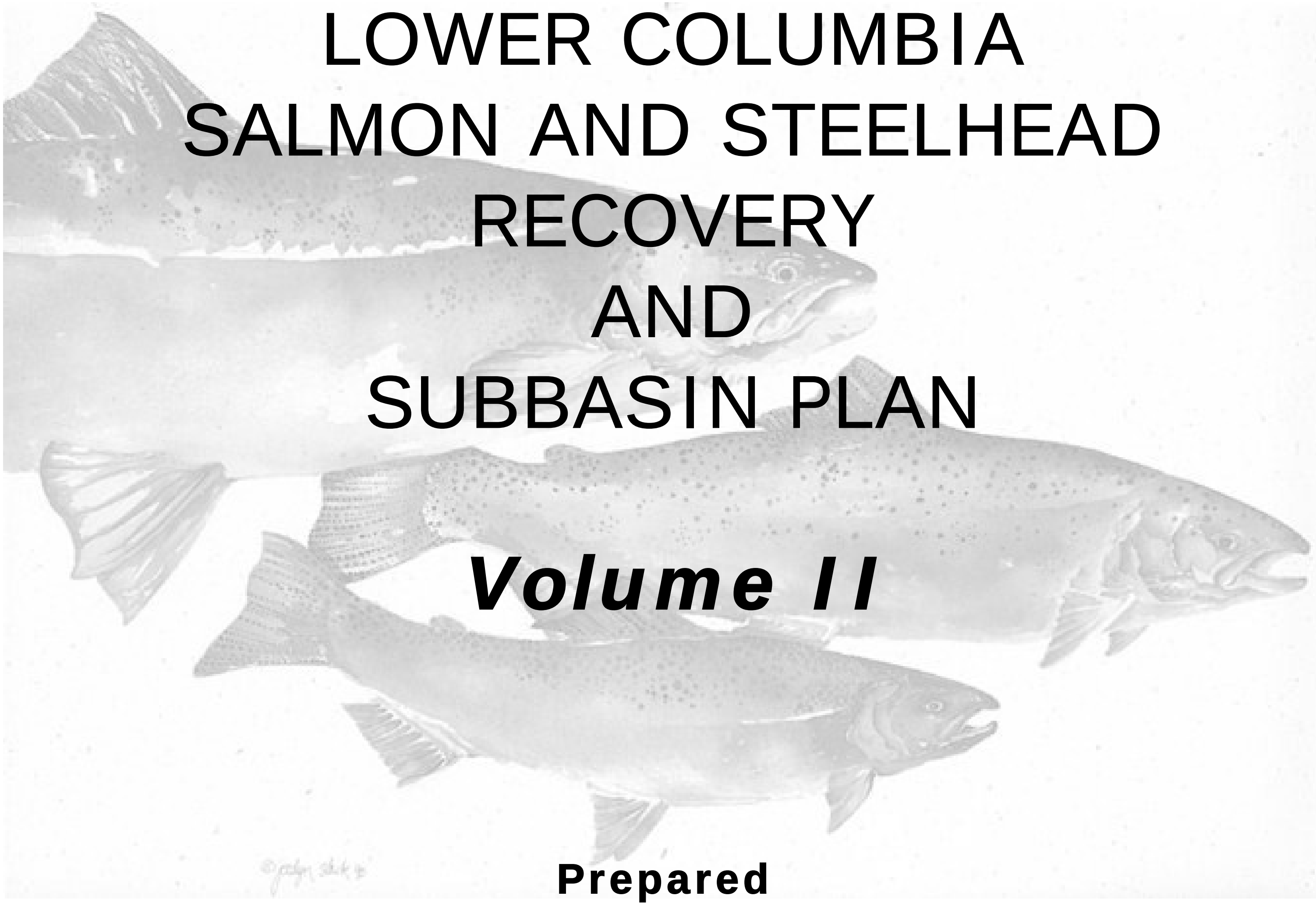

LOWER COLUMBIA SALMON AND STEELHEAD RECOVERY AND SUBBASIN PLAN

Volume II

Prepared
For
Northwest Power
And
Conservation Council

MAY 28, 2004
DRAFT

Prepared By:
Lower Columbia Fish Recovery Board

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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Robert Willis	US Army Corp of Engineers
Lee VanTussenbrook	Washington Department of Fish and Wildlife
	Yakama Nation

Consultants

SP Cramer and Associates
WA Department of Fish and Wildlife
Mobrand Biometrics
The Research Group
URS Corporation
Steward and Associates
Lower Columbia Estuary Partnership
Zenn and Associates
Parametrix
JD White Company

Lower Columbia Fish Recovery Board Staff

Jeff Breckel	Executive Director
Lorie Fundingsland	Program Assistant
Melody Tereski	Program Manager
Phil Trask	Plan Coordinator
Gary Wade	Habitat Coordinator

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Overview

This volume sets forth local actions for recovering salmon and steelhead and enhancing other fish and wildlife species within each subbasin addressed by this plan. The subbasin-specific strategies and measures supplement or refine the regional strategies and actions discussed in the Strategies and Measures chapter of Volume I. It should be noted that the lower Columbia River mainstem and estuary subbasin description follows a different format than all other subbasins for three primary reasons: 1) a lack of habitat data consistent with the other subbasins, 2) the unique role of the lower mainstem and estuary for all salmonid populations in the Columbia River basin, and 3) the joint planning and recovery effort with the State of Oregon.

This volume provides for each subbasin:

- An overview or summary of the subbasin description, the species of interest, biological objectives, limiting factors and threats, strategies and measures, programs, and implementation plans.
- Biological objectives and descriptions of salmonids, other fish, and wildlife species of interest in each basin. For salmon and steelhead the goals are taken from the Regional Recovery Scenario discussed in the Biological Objectives chapter of Volume I of the Management Plan. Biological goals for other fish and wildlife species are also described in the Biological Objectives chapter.
- Estimates of the relative contribution of various limiting factors to the decline in status of fish populations. For salmonids, this discussion includes both in-basin and out-of-basin threats and limiting factors.
- Proposed strategies and measures for addressing the threats and limiting factors and achieving subbasin biological goals. These include subbasin stream and watershed habitats, estuary and lower Columbia mainstem habitats, hydropower, harvest, hatcheries and ecological interactions. Salmonid strategies and measures supplement broader regional strategies and measures.
- An evaluation of existing federal, state, and local programs that play varying roles in implementing the strategies and measures.

This volume focuses on subbasin-specific actions that support regional recovery goals. Anadromous fish populations will benefit from local actions in the subbasin of origin as well as regional actions that affect out-of-subbasin factors. Strategies and actions that address harvest, hatcheries, Columbia River mainstem habitat, estuary habitat, and ecological interactions are primarily regional in nature and are covered extensively in Volume I of this plan. Subbasin chapters represent the relative significance of each factor category for each population to place in-basin and out-of-basin factors into perspective. Volume II concentrates on actions to be implemented within the confines of each subbasin. These include actions tailored for specific local threats and regional actions with subbasin components. Local habitat threats and actions are a particular emphasis in this subbasin volume. The intent is to tailor regional strategies for habitat protection and restoration to the specific features of each subbasin.

Habitat attributes and conditions in each subbasin are identified, described, and analyzed in the Technical Foundation. Within the estuary and mainstem, we currently lack the tools to relate physical processes and conditions to biological responses of focal species; thus, objectives and strategies for the estuary and mainstem subbasins have been developed based on the best available data and professional judgement. For other subbasins, stream and watershed processes were analyzed using the Ecosystem Diagnosis and Treatment (EDT) model and the Integrated Watershed Assessment (IWA) approach. The analytical results were integrated with the plan's biological objectives to prioritize subwatersheds, reaches, and habitat attributes for protection and/or restoration. Designation of priority areas is based on species, population recovery targets, fish distribution, critical life history stages, current habitat conditions, and the potential benefits in fish population performance that could be expected by protecting or restoring habitat. Habitat measures included in this plan address the most important limiting factors in the most critical areas for focal species within each subbasin. This plan also includes a description of the programs that are currently in place to address limiting factors. Where limiting factors are not being adequately addressed by current programs, the gaps are identified and opportunities for addressing the gaps are discussed.

The following sections summarize the components that are found in each of the subbasin chapters in this volume. For each subbasin component, descriptions are given as to the type of information that is presented, how the information ties in with other components, source and methods for deriving the information, and references to other Recovery Plan sections where more detailed information can be found.

Basin Overview

The basin overview provides a general orientation to the basin and also serves as a summary of other subbasin components. This section introduces the reader to the biophysical characteristics of the river basin with respect to factors that affect fish and wildlife species. The information is intended to set the stage for discussions of species, limiting factors, and threats that follow. Maps and statistics of land ownership and land-use patterns provide context for discussions of human impacts to habitat and habitat-forming processes, both within river corridors and across the landscape. Information on the magnitude and direction of human population growth is presented because of its use in estimating trends in habitat impacts and for identifying areas for habitat preservation measures. Also included in these sections is a general overview of the programs that are in place within the basin and how effective these programs are at addressing key limiting factors. Not only does the overview summarize information presented in other chapter components, but it also summarizes information contained in the subbasin chapters of the Technical Foundation Volume II. Interested readers are referred to those chapters for additional detail.

Species of Interest

The species of interest section provides brief summaries of the focal species that are found within the basin. These include anadromous salmonids as well as other species of interest. The section begins with a description of the biological objectives for salmon and steelhead. The objectives are followed by discussions of the individual populations, with reference to population abundance, productivity, life history characteristics, distribution, and hatchery influence. Much of this information is a summary of the Focal Fish Species sections found in the subbasin chapters of Volume II of the Technical Foundation. Interested readers are referred to those chapters for additional detail, including species distribution maps.

All Columbia Basin anadromous fish utilize the lower Columbia migration corridor and the estuary habitat as juveniles and adults. Historical abundance of wild salmon and steelhead has declined significantly, however the current abundance of juveniles migrating through the lower Columbia to the estuary remains significant as a result of Columbia Basin hatchery production. In 1990, the combined wild and hatchery juvenile salmon and steelhead produced in the Columbia Basin was estimated at about 350 million fish. The abundance of wild lower Columbia white sturgeon and eulachon has fluctuated over the past 100 years, but current abundance may be within the range of historical levels. Pacific lamprey abundance has declined similar to salmon. There are no hatchery programs for lower Columbia white sturgeon, eulachon, or lamprey.

Potentially Manageable Impacts

The potentially manageable impacts section provides a breakdown of the fish population impacts resulting from various human-induced mortality factors. These mortality factors include the 4-H's (hydropower, stream habitat, hatchery, and harvest) plus estuary and predation impacts (manageable). This information helps determine the relative level of recovery effort that is needed in each broad category of impact. The method for calculating the impact values can be found in the Technical Foundation Volume I, Chapter 5.

Limiting Factors, Threats, and Measures

Limiting factors, threats, and measures are identified with respect to stream habitat, estuary and Columbia mainstem habitat, hydropower, harvest, hatcheries, and ecological interactions. A description of each of these categories follows:

Hydropower Operations and Configuration

This section describes the influence of hydropower operations on salmon and steelhead populations. The primary hydropower-related impacts stem from flow regulation and passage obstructions. The subbasins most affected by hydropower operations are the Cowlitz and Lewis rivers, and the Wind River (Bonneville Dam and Pool effects). Other populations are affected by mainstem Columbia hydro operations and flow regimes which affect habitat in migration corridors and in the estuary. Many of the measures needed to address hydropower impacts in the Cowlitz and Lewis subbasins are being developed as part of facility re-licensing negotiations between dam owners and the Federal Energy Regulatory Commission (FERC). Regional hydropower measures are identified in the Strategies and Measures chapter in Volume I.

Harvest

The harvest section describes the level of impact due to harvest in commercial and recreational fisheries. Harvest of lower Columbia River populations occurs in the ocean, estuary, Columbia mainstem, and within subbasins. With the exception of fall chinook, harvest has a relatively minor impact on lower Columbia populations. Harvest measures were first identified at the regional level (Strategies and Measures chapter – Management Plan Volume I) and are applied to individual subbasins in the Management Plan Volume II subbasin chapters.

Hatcheries

The hatchery discussion gives a general overview of the hatcheries operating in the subbasin and the degree of impact to native fish populations. Hatcheries can adversely affect wild fish through reductions in fitness, direct competition, and disease introduction. Hatchery measures were first identified at the regional level (Strategies and Measures chapter – Management Plan Volume I) and are applied to individual subbasins in the Management Plan Volume II subbasin chapters.

Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Issues include competition and predation associated with introduced fish species, nutrient dynamics (i.e., carcasses), and invasive plant and animal species. Many of these issues apply uniformly to all of the subbasins in the region, especially when they refer to out-of-basin interactions. In most cases, this section simply references the Recovery Plan sections where the effects of ecological interactions are evaluated.

Habitat - Estuary and Lower Columbia Mainstem

This section briefly summarizes the primary habitat conditions in the estuary and lower Columbia mainstem that affect the populations originating within the subbasin. Conditions in the estuary and mainstem Columbia affect all lower Columbia salmon and steelhead populations similarly, with the primary differences being length of mainstem travel and estuary residence times. In most cases, this section simply gives reference to the Recovery Plan sections that contain more in-depth discussions of estuary and mainstem Columbia impacts and measures to address them.

Habitat - Subbasin Streams and Watersheds

Subbasin habitat limiting factors, threats, and measures are identified for the areas of greatest priority to focal species. This information was generated in three phases:

1) Identification of spatial priorities,
2) Identification of limiting factors and threats in priority areas, and
3) Identification of the type and location of recovery measures that will best address the limiting factors and threats.

The first phase involved the identification of spatial priorities at the reach and subwatershed (7^{th} field Hydrologic Unit Code) scale. Spatial priorities were first determined at the reach scale. Reach priorities reflect population importance as well as multi-species benefits. 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 the subbasin chapters of Volume II of the Technical Foundation for additional information on reach priorities for individual populations.

Within a subbasin, reach rankings for all of the modeled populations were combined, using population designations as a weighting factor. Population designations have been determined from the Preferred Alternative Scenario evaluation process, a first take on designating populations according to their contribution to meeting Endangered Species Act (ESA) recovery criteria. These population designations will continue to be refined throughout the course of recovery planning. The Preferred Alternative Scenario 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. See the Biological Objectives chapter in Volume I of this Management Plan for more information on population designations.

Reaches were placed into tiers according to the following rules:

Tier 1: all high priority reaches 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; and

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.

Spatial priorities were also identified at the subwatershed scale. Subwatershed-scale priorities were directly determined by reach-scale priorities. 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. Subwatersheds were ranked according to the following rules:

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.

Spatial priority maps display the spatial priorities at both the reach scale and the subwatershed scale. Reach scale priorities are most useful for identifying habitat recovery measures in channels, floodplains, and riparian areas. Subwatershed scale priorities are most useful for identifying landscape level recovery measures that are intended to address watershed processes. Subwatershed-scale priorities can be used in conjunction with the IWA (see subbasin chapters in the Technical Foundation) to identify watershed process restoration and preservation opportunities.

In the subbasin chapters of this volume, we sometimes refer to general *areas* of a river basin as opposed to individual reaches or subwatersheds. Areas (as opposed to individual reaches) are used as a basis for the discussions for a number of reasons. First, in most basins, high priority reaches tend to be clustered in certain locations within the basin. This reflects the occurrence of unique biophysical characteristics and land-use patterns in different portions of a basin. Second, many recovery measures will affect multiple reaches in a given area as opposed to only impacting individual reaches. Third, grouping reaches allows for us to manage for the uncertainty that is inherent in the technical assessments by scaling back from a very high resolution (individual reaches) to a slightly coarser resolution (groups of reaches). For instance, a short tier 4 reach (low priority) sandwiched between two tier 1 (high priority) reaches is likely affected by the same impacts to habitat as the surrounding reaches, despite its different designation. With reach groupings, this low priority reach would be considered together with its neighboring high priority reaches when limiting factors, threats, and measures are identified.

In most cases, only the areas with the lowest tier reaches (i.e., tier 1 or 2) were included as priority areas, since these represent the most important areas to emphasize for species recovery. Limiting factors and threats are specified for priority areas. Measures were also specified for priority areas, with reference given to individual high priority reaches in some cases. Tier 3, 4, and non-tiered reaches are considered secondary priority, except in cases where other information sources (i.e., sources other than those used to derive reach tiers) indicate significant impairment. Information on habitat conditions in areas of secondary priority can be found in the subbasin chapters in Volume II of the Technical Foundation.

A summary table is included in each subbasin chapter except for subbasins where EDT was not applied (Estuary Tributaries, Columbia Gorge Tributaries, and Little White Salmon). The summary table presents species-specific information within priority areas and also includes the watershed process impairment ratings. Its greatest utility has been to serve as a starting point for developing a scientifically-based list of habitat limiting factors and recovery measures within subbasins. The summary table provides a useful link between the assessments conducted as part of the Technical Foundation and the habitat measures identified in this Management Plan. The table does not represent any new information, but rather organizes information from the various existing assessments in a manner that emphasizes the most important habitat conditions in the most important places. Since it focuses predominantly on only the most important features affecting fish populations, it should be used in conjunction with the other subbasin information in order to develop a complete picture of subbasin conditions. Listed on the left side of the table are the subwatersheds and the reaches contained within them. The other columns identify reaches used by particular species, reach priorities by species, critical habitat factors by species, critical life stages by species, recovery emphasis by species, and watershed process conditions.

The second phase of the habitat evaluation involves identifying habitat limiting factors and threats. All of the potential limiting factors and threats occurring throughout the region were first identified in the Limiting Factors and Threats chapter of the Management Plan (Volume I). This list served as a pool from which to select the limiting factors and threats that apply at the subbasin level. These results are presented by priority area within each subbasin. Limiting factors for individual salmon and steelhead populations were obtained from a combination of sources, including the EDT habitat factor analysis, the IWA watershed process ratings, the barrier assessment (see Technical Foundation Volume II and appendices for these analyses), and air photo analysis. The EDT habitat factor analysis was used as a first cut for identifying limiting factors. Generally, only high or medium impact habitat factors (those represented by a large or medium sized dot in the EDT habitat factor analysis diagram) were used to infer key limiting factors. Riparian, flow, or sediment limiting factors were added according to the IWA impairment ratings. Habitat connectivity was included as a limiting factor if the barrier analysis suggested there was a passage issue, or if blockages to off-channel habitat (i.e., through hydromodifications) could be inferred from coarse-scale air photo analysis.

Habitat threats are the landscape conditions or land-use practices that are believed to be the primary contributors to the limiting factors. It is important to note that 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 in-stream 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. Threats were determined from a variety of sources including GIS data layers, Washington Conservation Commission Limiting Factors Analyses, air photo analysis, barrier analysis, personal knowledge of investigators, or known cause-effect relationships between stream conditions and land-uses.

The third phase of the habitat evaluation involves identifying habitat measures. All of the potential measures throughout the region were first identified in the Strategies and Measures chapter of the Management Plan (Volume I). This list served as a pool from which to select the measures that apply at the subbasin level. Habitat measures are the actions that are believed to offer the greatest potential to effectively address limiting factors and threats. Measures may refer to preservation or restoration actions and may include active or passive restoration. Measures may refer to stream corridor actions or to actions on hillslopes that are intended to address watershed process impairments. Measures may also reflect programmatic actions in addition to on-the-ground types of activities. Measures are specified for priority areas within a basin. In some cases, especially when the measure refers to a localized activity, the individual high priority reaches are also identified. The measures list includes the primary limiting factors and threats that would be addressed, the target species, the estimated time until habitat benefits would be realized, and a brief discussion. The list of species reflects the populations that are the primary focus of the measure, not simply the species that are present.

Programs

Each subbasin chapter includes a programs section that includes a description of the programs that are currently in place that will accomplish subbasin measures. Where measures are not being adequately addressed by current programs, the gaps and actions needed to address the gaps are identified. Additional information on programs can be found in Volume IV of the Technical Foundation.

1 Columbia Lower and Columbia Estuary Subbasins

Figure 1-1. Location of the Columbia River estuary and mainstem subbasin within the Lower Columbia River Basin.

1.1 Basin Overview

The Columbia River estuary has formed over geologic time by the forces of glaciation, volcanism, hydrology, and erosion and accretion of sediments. Circulation of sediments and nutrients throughout the estuary are driven by river hydrology and coastal oceanography. Sea levels have risen since the late Pleistocene period, which has submerged river channels and caused deposition of coarse and fine sands. An abundance of fish and wildlife species are known to occur in the Columbia Estuary and Columbia Lower Subbasins, either as year-round residents, seasonal residents, or migratory visitors.

The Columbia River estuary and lower mainstem span over two ecological provinces as defined by the Northwest Power and Conservation Council (NPCC): Columbia River Estuary (river mouth, including nearshore waters and Columbia River plume, to RM 34) and the Lower Columbia River (RM 34 to Bonneville Dam). The historical (circa 1880) total surface area of the Columbia River estuary has been estimated from 160-186 square miles, with extensive sand beds and variable river flow. The current estuary surface area has been estimated as 101,750 acres, which is equivalent to 159 square miles. The Willamette River is the largest tributary to the lower Columbia River. Major tributaries originating in the Cascades include the Sandy River in Oregon and the Washougal, Lewis, Kalama and Cowlitz rivers in Washington. Major Coast Range tributaries include the Elochoman and Grays rivers in Washington and the Lewis and Clark, Youngs, and Clatskanie rivers in Oregon. Numerous other minor tributaries drain small watersheds but do not have substantial influence on the Columbia River because of their small size.

In the Columbia River, tidal impacts in water level have been observed as far upstream as Bonneville Dam (RM 146) during low flow, reversal of river flow has been measured as far upstream as Oak Point (RM 53), and intrusion of salt water is typically to Harrington Point (RM 23) at the minimum regulated monthly flow, although at lower daily flows saltwater intrusion can extend past Pillar Rock (RM 28) (Neal 1972). The lowest river flows generally occur during September and October, when rainfall and snowmelt runoff are low. The highest flows occur from April to June, resulting from snowmelt runoff. High flows also occur between November and March, caused by heavy winter precipitation. The discharge at the mouth of the river ranges from 100,000 to 500,000 CFS, with an average of about 260,000 CFS. Historically, unregulated flows at the mouth ranged from 79,000 CFS to over 1 million CFS, with average flows about 273,000 CFS.

The climate conditions vary across the subbasins; in general, coastal areas receive more precipitation and experience cooler summer temperatures and warmer winter temperatures than inland areas. In the lower part of the subbasin, climate data has been collected in Astoria, Oregon, since 1953. Total average annual precipitation is 68 inches, ranging from 1.04 inches in July to 10.79 inches in December. January is the coldest month in Astoria with an average maximum temperature of 48.2°F and an average minimum temperature of 36.5°F; August is the warmest month with an average maximum temperature of 68.7°F and an average minimum temperature of 52.8°F. In the middle part of the subbasin, climate conditions have been recorded at St. Helens, Oregon, since 1976. Total average annual precipitation is 44 inches, ranging from 0.79 inches in July to 6.77 inches in December. January is the coldest month in St. Helens with an average maximum temperature of 46.9°F and an average minimum temperature of 33.5°F; August is the warmest month with an average maximum temperature of 82.7°F and an average minimum temperature of 55.6°F. In the upper part of the subbasin, climate conditions have been recorded at Bonneville Dam since 1948. Total average annual precipitation is 77 inches, ranging from 0.90 inches in July to 12.91 inches in December. January is the coldest month at Bonneville with an average maximum temperature of 42.4°F and an average minimum temperature of 32.7°F; August is the warmest month with an average maximum temperature of 78.7°F and an average minimum temperature of 56.4°F.

The region is rich with history characterized by extensive human use of the natural resources in the subbasins. As early as 1792, European explorers sailed across the Columbia River bar, beginning an era of exploration and European settlement. By the early 1800s, approximately 50,000 Native Americans inhabited villages scattered along the banks of the Columbia River; records indicate that people in the region harvested Pacific salmon as early as 9,000 years ago. Timber and fisheries became the driving forces behind European settlement of the region. Earliest accounts of European exploitation of salmon date around 1830; the salmon industry began to realize its full potential when the first cannery began operating in Eagle Cliff, WA, in 1867. Initially, Chinook salmon were the primary catch, but fisheries began harvesting other salmon by the late 1800s; catch of all species peaked at 47 million pounds in 1911.

Concomitant to the growth of the fishing industry, the timber industry was experiencing a boom. Timber industry practices included the removal of stream debris, temporary construction of splash dams to store timber, and log drives that flushed timber through the system as freshet flows blasted the splash dams. Although efficient and inexpensive, such practices destroyed instream and riparian habitat. Log drive practices were eliminated by 1914, but other logging practices (such as the lack of riparian buffers) continued to negatively affect fish and wildlife habitat, including that of salmonids.

Introductions of exotic fish species had substantial impacts on early fisheries. For example, American shad were introduced to San Francisco in 1871; by 1903, Columbia River fisherman reported that shad had become so numerous they were a nuisance. Other species (i.e., warm-water fish such as bluegill, crappie, and bass) were becoming increasingly abundant in the lower reaches of many Columbia River tributaries and slough habitats of the lower mainstem Columbia River; these sloughs are ideal habitats for these warmwater species.

By the late 1800s, a substantial amount of acreage in the subbasin had been cleared of trees, burned, and converted to agricultural land; much of this land conversion was occurring in the lower Columbia River floodplain and the interior valleys. Many of these floodplain areas remain in agricultural use today.

Since the late 1800s, the US Army Corps of Engineers has been responsible for maintaining navigation safety on the Columbia River. In 1878, Congress directed the Corps to maintain a 20-foot minimum channel depth, authorizing the Columbia River navigation channel project. Since that time, Congress has periodically increased the approved channel depth to the current level of 43 ft. To maintain channel depth, the Corps has performed periodic maintenance dredging, constructed jetties at the mouth of the river, and used pile dikes to assist in channel depth (the existing dike system consists of 256 dikes totaling 240,000 linear feet).

In the early 1930s, the Columbia River was slated for development of the next major federal hydropower project; Bonneville Dam began operation in the late 1930s, affecting salmonid access to spawning habitat above Bonneville Dam. With extensive hydroelectric development, the lower Columbia River was quickly viewed as a production zone for salmon. Mitigation for the loss of habitat caused by dams came in the Mitchell Act of 1948, which created a system of hatcheries on the Columbia River. Although some of the first hatcheries where generally unsuccessful, hatcheries were viewed as the solution to overfishing, habitat loss, and hydroelectric development.

The Columbia Estuary and Columbia Lower Subbasins will play a key role in the recovery of salmon and steelhead. The subbasins serve as critical juvenile rearing pathways for fall Chinook and chum salmon; the importance of the estuary and mainstem to other anadromous salmonids is not completely understood. Chum salmon and fall Chinook have recently been observed spawning in multiple mainstem locations between Vancouver, WA, and Bonneville Dam; these areas are thought to be important in the recovery of these species. The subbasins also serve as a migratory route for all anadromous adult salmonids in the Columbia River basin. In the Columbia River basin today, there are 12 salmonid ESUs listed as threatened or endangered under the Endangered Species Act (ESA), as well as other candidates for listing. The deterioration of habitat conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonids within the Columbia Basin. Other fish species of interest are sturgeon, Pacific Lamprey, and eulachon – these species are also expected to benefit from salmon protection and restoration measures. Wildlife species of interest in the subbasins are Columbian white-tailed deer, bald eagle, and sandhill crane; because of the federal or state listed status of these species, management plans have already been developed to address the protection and recovery needs of these species. As a result, these species will not be addressed further because the Lower Columbia Fish Recovery Board (LCFRB) supports the recommendations of the existing management plans.

Salmon and steelhead in the estuary and mainstem are affected by a variety of in-basin and out-of basin factors. Analysis has demonstrated that recovery cannot be achieved by addressing only one limiting factor. Recovery will require action to reduce or eliminate all manageable factors or threats. Key ecological interactions of concern include effects of nonnative species and predation by species affected by development including Caspian terns, northern pikeminnow, seals, and sea lions. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the Columbia Estuary and Columbia Lower Subbasins.

Human population in the Columbia Estuary and Columbia Lower Subbasins is expected to increase; a substantial part of this growth is a result of the expansion of the Vancouver metropolitan area. Development pressure is expected to increase along riparian and floodplain areas, having the potential to seriously degrade watershed processes and habitat conditions.

County land use regulations will provide moderate protection. All Washington counties not currently operating under the state Growth Management Act (GMA) must have the GMA in place by the end of 2005. Clark County, which is operating under the GMA, is pursuing an ESA Section 4(d) limit by developing additional protective measures. All Washington counties within the subbasins will need to adopt measures to protect watershed processes and habitat from degradation resulting from land use conversions. While improved land use regulation can make a significant contribution to habitat protection, it will not and, in all likelihood, cannot effectively prevent any further deterioration of habitat conditions. Seemingly minor unregulated activities such as application of fertilizers and pesticides and removal of riparian vegetation can cause incremental deterioration of habitat conditions. These impacts must be addressed through public information and outreach efforts that promote appropriate practices and landowner incentive programs.

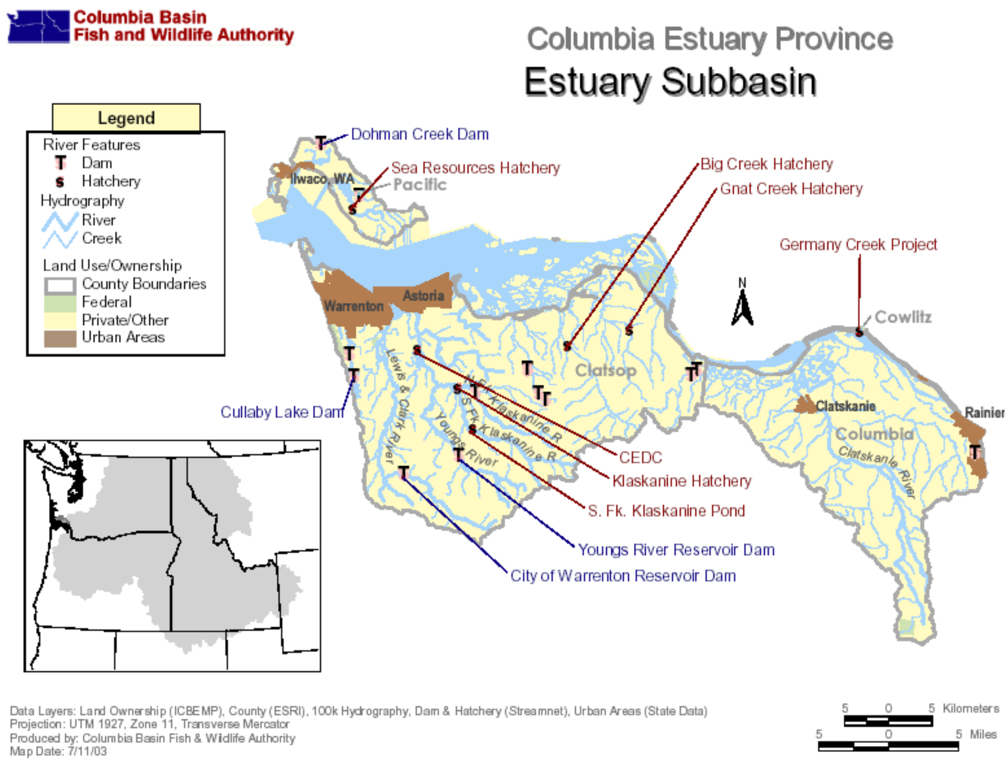


Figure 1-2. Boundaries of the Columbia Estuary Subbasin as defined by the Northwest Power and Conservation Council.

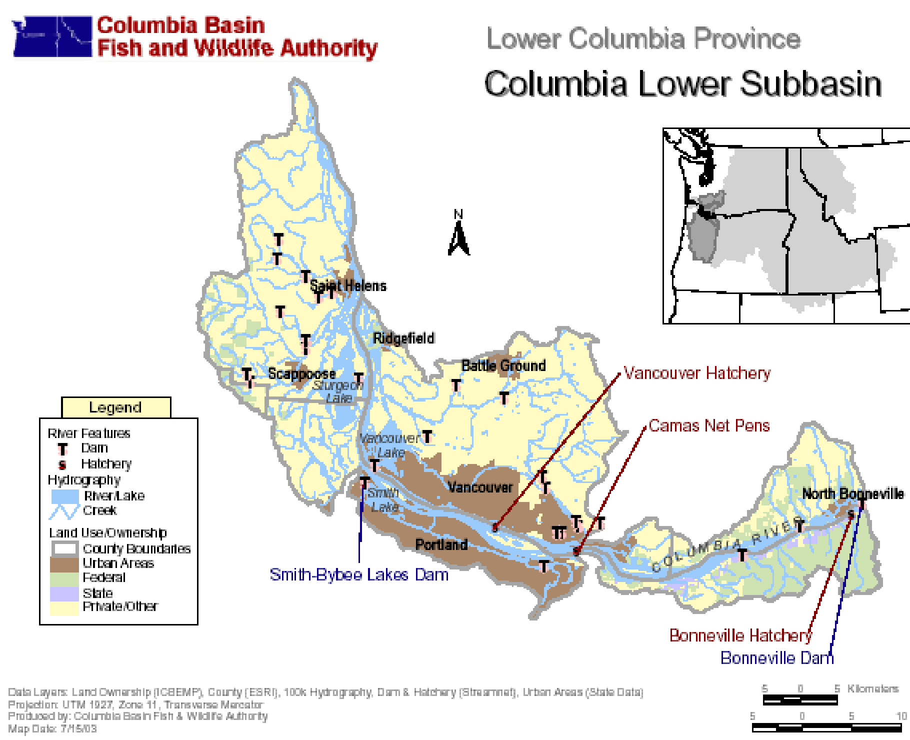


Figure 1-3. Boundaries of the Lower Columbia Subbasin as defined by the Northwest Power and Conservation Council.

1.2 Species of Interest

Focal salmonid species in the estuary and mainstem subbasins include fall Chinook, spring Chinook, winter steelhead, summer steelhead, chum, and coho. The health or viability of these populations is currently very low to moderate, as addressed in the following subbasin chapters. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Other species of interest in the estuary and mainstem subbasins include sturgeon, Pacific lamprey, and eulachon. Regional objectives for these species are described in Volume I, Chapter 6. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for these other species. Sturgeon, Pacific lamprey, and eulachon are expected to benefit from restoration of hydrologic conditions and sediment transport processes, as well as restrictions on non-native species.

All Columbia Basin anadromous fish utilize the lower Columbia migration corridor and the estuary habitat as departing juveniles and returning adults. Historical abundance has declined significantly, however the current abundance of juvenile salmon and steelhead migrating through the lower Columbia to the estuary remains significant as a result of Columbia Basin hatchery production. In 1990, the combined wild and hatchery juvenile salmon and steelhead produced in the Columbia Basin was estimated at about 350 million fish. Recent year returns of combined wild and hatchery salmon and steelhead, including adults and jacks, to the Columbia River ranges from 700,000 to 3 million fish.

The abundance of wild lower Columbia white sturgeon and eulachon (smelt) has fluctuated over the past century, but current abundance may be within the range of historical levels. There are no hatchery programs for lower Columbia white sturgeon or eulachon.

1.3 Potentially Manageable Impacts

Estuary and mainstem habitat conditions have contributed to reduced salmonid productivity, numbers, and population viability as fish rear or migrate through the subbasins. Based on an analysis of potentially manageable factors (harvest, hatcheries, subbasin and mainstem habitat, hydrosystem, and predation) of lower Columbia salmonid populations, degraded mainstem and estuary habitat conditions contribute to mortality as summarized in Table 1-1. The current mortality levels, as well as the estimated mortality level at population recovery levels, are presented. Thus, to contribute to recovery, the mainstem and estuary habitat mortality factor should be reduced from current to recovery goal levels. The difference between current estuary mortality and goals does not necessarily reflect the magnitude of improvement needed for each population to meet recovery goals. The estuary and mainstem mortality reductions are influenced by the relative proportion of mortalities associated with other limiting factors. For example, chum recovery is dominated by the need to improve freshwater habitat, which skews the reflected estuary recovery need to a smaller level in comparison. These results should not be interpreted to reflect a lack of importance in estuary and mainstem improvements for chum recovery.

Table 1-1. Estimated mainstem and estuary mortality factors, by species.

	Current		Recovery Goal	
Species	**Range**	**Average**	**Range**	**Average**
Tule Fall Chinook	0.29-0.38	0.33	0.16-0.36	0.27
Bright Fall Chinook	0.39	na	0.26	na
Spring Chinook	na	0.20	insufficient data	
Winter Steelhead	0.10-0.18	0.14	0.10-0.18	0.10
Summer Steelhead	0.04-0.59	0.16	0.04-0.59	0.16
Chum	0.28-0.59	0.46	0.23-0.58	0.42
Coho	insufficient data			

Mortality is based on preliminary analysis by the LCFRB based on comparison of EDT estimates of mainstem and estuary habitat effects on lower Columbia River salmonid populations, current population abundance estimates, and population abundance recovery goals.

1.4 Threats and Actions

Decades of human activity have significantly altered watershed processes and reduced both the quality and quantity of habitat needed to sustain viable populations of salmon and steelhead.

1.4.1 Limiting Factors

The limiting factors have been formulated based on known or suspected biological relationships in the estuary and mainstem ecosystem. We have provided a qualitative metric of the importance and certainty level of each limiting factor as described below.

In an attempt to rank limiting factors, a subjective evaluation was conducted based on what is known or suspected regarding the present status of each species in relation to historical conditions. Throughout this document, the qualitative terms of “High”, “Medium”, and “Low” have been used to provide a relative level of importance for the limiting factors identified for each species. It is important to note that, because of the subjective nature of this evaluation, no two scientists will likely qualify each limiting factor in precisely the same manner. The purpose of the evaluation is to identify the most important limiting factors for each species; thus, actions intended to improve those limiting factors are expected to have the greatest benefit for the species population. In the context of species-specific limiting factors, the qualitative terms are defined as:

- High – The factor currently limits population viability because of effects on mortality rates or productivity. The limiting factor is of primary importance in maintaining current levels of population abundance/productivity. Or the limiting factor must be addressed to promote recovery of the species.
- Medium – The factor currently effects population viability, but at present impact levels, may not be significantly reducing population abundance or productivity. The limiting factor does effect current levels of population abundance/productivity or recovery of the species, however, addressing this factor will have less impact on overall population viability than the high impact factors.

- Low – The factor exists, but unlikely effects population viability at present impact levels. The limiting factor should be recognized but will unlikely produce measurable effects on population viability until the high and medium limiting factors have improved.

The level of impact of each limiting factor is further qualified based on the current level of certainty in the impact designation. Thus, the qualitative terms of “High”, “Medium”, and “Low” are again used and, in the context of certainty, are defined as:

- High – Considerable research has been performed on the subject and has repeatedly produced similar results.
- Medium – Considerable research has been performed on the subject and results have been inconclusive or contradictory. Or, some research has been performed on the subject and preliminary results suggest a relationship exists.
- Low – Some research has been performed on the subject and preliminary results are inconclusive or contradictory. Or, little to no research has been performed on the subject and any relationships are assumed based on other related scientific data or relationships.

Table 1-2. Salmonid limiting factors by life stage.

Life Stage	Limiting Factors	Impact	Certainty	Species
Juvenile Rearing (within and out-of-subbasin populations)	**Sa.LF.1** Availability of preferred habitat (i.e., shallow water, low velocity, peripheral habitats). Ocean-type salmon are closely associated with peripheral habitats. There has been extensive loss of peripheral wetland and side channel habitat throughout the mainstem and estuary, as a result of water regulation, dike construction, and urban and agricultural development.	High	High	Fall Chinook, Chum
	Sa.LF.2 Microdetritus-based food web. The current microdetritus-based food web is expected to be less productive than the historical macrodetritus-based food web. Loss of wetland and side channel habitat identified above has reduced the local macrodetritus inputs from terrestrial and riparian habitats that supported the historical food web. Present detrital inputs to the food web are dominated by microdetritus from upriver sources and are controlled primarily by reservoir production and flow rates from Bonneville Dam. Further, the microdetritus-based food web is thought to be less available to chum salmon because it is pelagic in nature and may be focused on the spatially-confined estuary turbidity maximum region.	High	Medium	Fall/ Spring Chinook, Winter/ Summer Steelhead, Chum, Coho

	Sa.LF.3 Loss of habitat connectivity. Areas of adjacent habitat types distributed across the estuarine salinity gradient may be necessary to support annual migrations of juvenile salmonids. As juveniles grow, they move across a spectrum of salinities, depths, and water velocities. For ocean-type salmon that rear in the estuary for extended time periods, a broad range of habitat types in the proper proximities to one another may be critical to satisfy feeding and refuge requirements within each salinity zone.	High	High	Fall/ Spring Chinook, Winter/ Summer Steelhead, Chum, Coho
	Sa.LF.4 Predation mortality. Current sources of predation on salmonids are substantial, however, how current predation levels compare to those experienced historically is unknown. Primary predation sources include Caspian terns and northern pikeminnow; both have increased in abundance as a result of habitat change in the mainstem and estuary. Caspian tern predation is higher for larger emigrating salmonids (i.e., stream-type).	Medium	High	Fall/ Spring Chinook, Winter/ Summer Steelhead, Chum, Coho
	Sa.LF.5 Contaminant exposure. Contaminants have been documented throughout the lower mainstem and estuary. Contaminants are known to have detrimental effects on salmonids. Ocean-type juveniles are closely associated with peripheral, side channel habitats where contaminants commonly accumulate.	Medium	Medium	Fall/ Spring Chinook, Winter/ Summer Steelhead, Chum, Coho
	Sa.LF.6 Interaction with introduced species. Hundreds of species introductions, both intentional and unintentional, have occurred in the lower Columbia mainstem and estuary. Effects on salmonids are unknown but are expected to be negative.	High	Low	Fall/ Spring Chinook, Winter/ Summer Steelhead, Chum, Coho
	Sa.LF.7 Density dependence. Density dependent mechanisms in the lower mainstem, estuary, and plume may limit juvenile salmonid survival and productivity, however, the significance is unclear. NOAA Fisheries is currently conducting research intended to clarify this issue.	Medium	Low	Fall/ Spring Chinook, Winter/ Summer Steelhead, Chum, Coho
	Sa.LF.8 Fitness and timing of juvenile salmonids entering the subbasin. Juveniles entering the subbasin from upriver via barge releases or dam passage experience lower survival than historical mainstem emigration prior to hydrosystem development.	High	High	Fall/ Spring Chinook, Winter/ Summer Steelhead, Coho
Adult Migration (within and out-of-subbasin populations)	**Sa.LF.9** Dam passage. Bonneville Dam has blocked most upstream migration of chum salmon to historical spawning areas. Other salmonids experience mortality and delay associated with mainstem dam passage. For lower Columbia River mainstem dams, average per dam survival rate estimate for fall Chinook, spring Chinook, and steelhead was 94%, 89%, and 95%, respectively; these estimates include fallback and re-entry.	High	High	Fall/ Spring Chinook, Winter/ Summer Steelhead, Chum, Coho

	Sa.LF.10 Migration barriers/ lack of resting habitats. Elevated water temperature or high water flow may act as a temporary adult migration barrier. Additionally, high water flow likely reduces available resting habitat for migrating adults.	Low	High	Fall/ Spring Chinook, Winter/ Summer Steelhead, Chum, Coho
	Sa.LF.11 Predation losses. Marine mammals (pinnipeds) prey on adult salmon, but the significance is unclear.	Low	Medium	Fall/ Spring Chinook, Winter/ Summer Steelhead, Chum, Coho
Adult Spawning (within subbasin)	**Sa.LF.12** Availability of spawning habitat (i.e., accessibility/ quantity). Chum and fall Chinook salmon have been observed spawning in multiple lower mainstem locations between the I-205 Bridge and Bonneville Dam. These spawning aggregations represent an important component of current natural production. Water regulation at Bonneville Dam substantially effects water level in these mainstem spawning locations. Low flow may limit access to spawning areas while high flow may decrease the quality of these spawning locations (i.e., depth or velocity too high).	High	High	Fall Chinook, Chum
	Sa.LF.13 Decreased flows during spawning and incubation. Water regulation at Bonneville Dam substantially effects water flow in these mainstem spawning locations. Low flow may decrease the delivery of nutrients and dissolved oxygen to incubating eggs, thereby decreasing survival.	High	Medium	Fall Chinook, Chum
	Sa.LF.14 Dewatering of redds. Water regulation at Bonneville Dam substantially effects water level in these mainstem spawning locations. Flow reductions to the point of dewatering redds will result in substantial mortality of incubating eggs or pre-emergent alevins.	High	Medium	Fall Chinook, Chum

Table 1-3. Sturgeon, Pacific lamprey, and eulachon limiting factors by life stage. (Note: All factors apply to white sturgeon; only the adult abundance factors apply to green sturgeon.)

Life Stage	Limiting Factors	Impact	Certainty	Species
Egg Incubation	**OS.LF.1** Sedimentation of spawning substrates. Deposition of fine sediments in the preferred spawning habitats (i.e., deepwater, rocky substrates for sturgeon; i.e. coarse sands for eulachon) results in egg suffocation. Fine sediment sources include adjacent tributary subbasins as well as migration of sediments from mainstem deposits.	Medium	High	Sturgeon, Eulachon
	OS.LF.2 Egg hypoxia. Hypoxia may have disproportionate negative effects on sturgeon compared to other fish because of their limited capacity to osmoregulate at low dissolved oxygen concentrations. Dissolved oxygen levels may be low for any number of reasons. Delivery of oxygenated water is decreased through sedimentation.	Medium	High	Sturgeon, Eulachon
	OS.LF.3 Predation mortality. Demersal white sturgeon embryos are vulnerable to predation. Research on the upper Columbia indicated that 12% of naturally-spawned white sturgeon eggs were subject to predation, although the research suggests that predation was likely underestimated. Eulachon eggs have been documented as an important food item of juvenile sturgeon in the lower mainstem. Eulachon eggs comprised up to 25% of stomach contents for sturgeon $\leq$350mm; the percentage increased to 51% for sturgeon 351-724mm. If predation mortality is substantial, recruitment failure can result.	Medium	Medium	Sturgeon, Eulachon
	OS.LF.4 Direct dredging mortality. Although, white sturgeon prefer to spawn in rocky substrates with sufficient interstitial spaces, spawning has been observed in sands and fine sediments. Additionally, eggs broadcast among rocky substrates may disperse downstream and settle among sands or fine sediments. Dredging activities in areas where embryos are present results in direct mortality. Also, evidence suggests that dredging activity in the vicinity of eulachon spawning areas makes the substrate too unstable for egg incubation.	Medium	Low	Sturgeon, Eulachon
	OS.LF. Contaminant/parasite exposure. Contaminants have been documented throughout the lower mainstem and estuary. Contaminants are known to have detrimental effects on development and physiological processes.	Medium	Low	Sturgeon, Eulachon
Juvenile Rearing and Migration	**OS.LF.6** Flow alteration. Juvenile Pacific lamprey are poor swimmers and rely on flow to carry them toward the ocean. Flow alterations in the Columbia River basin (hydrosystem operations, water withdrawal) have decreased peak flows in the lower Columbia River mainstem, as well as created inundated habitats throughout the basin. Flow reductions may delay downstream migration, disrupting the synchrony of physiological development and downstream migration timing.	Medium	Medium	Pacific Lamprey

	OS.LF.7 Predation mortality. Juvenile white sturgeon losses to predation are probably low because of the protective scutes, benthic habitats, and fast growth. Juvenile lamprey and eulachon losses to predation are unknown and need to be evaluated. Predation could be substantial because juvenile lamprey and eulachon have poor swimming ability and emigrate at the mercy of river currents.	Medium	Low	Sturgeon, Pacific Lamprey, Eulachon
	OS.LF.8 Direct dredging mortality. White sturgeon, lamprey, and eulachon association with benthic habitats make them susceptible to suction dredging effects. There is speculation that dredging operations may attract white sturgeon, compounding potential losses. Dredging activities in areas where juveniles are present can result in direct mortality.	Medium	Low	Sturgeon, Pacific Lamprey, Eulachon
	OS.LF. Contaminant/parasite exposure. Contaminants have been documented throughout the lower mainstem and estuary. Contaminants are known to have detrimental effects on growth and physiological processes. Juvenile sturgeon, lamprey, and eulachon are closely associated with fine sediments where contaminants commonly accumulate.	Medium	Low	Sturgeon, Pacific Lamprey, Eulachon
	OS.LF.10 Interaction with introduced species. Hundreds of species introductions, both intentional and unintentional, have occurred in the lower Columbia mainstem and estuary. Effects on native species are unknown and may be offsetting. For example, shad have become an important food source for adult sturgeon while shad and gamefish may compete for food sources with juvenile sturgeon.	Medium	Low	Sturgeon, Pacific Lamprey, Eulachon
	OS.LF.11 Near ocean survival. Mortality upon ocean entry is unknown, but may be substantial.	High	Low	Eulachon
Adult Abundance	**OS.LF.12** Fishing mortality. At present, size restrictions in the sport fishery are allowing for sturgeon survival to older ages, thus maintaining adequate abundance of spawning adults. Historically, tribes harvested lamprey throughout the Columbia basin for food, ceremonial, medicinal, and trade purposes. Today, harvest is limited primarily to Willamette Falls and Sherars Falls (Deschutes River). Because of limitations on lamprey harvest (i.e., fishing effort, legal gear types, area closures, seasonal restrictions, diel restrictions), harvest may not be a major mortality factor. At present, eulachon fishery regulations, fishing effort, and harvest levels appear to be at sustainable levels. Fishery regulations, fishing effort, harvest levels, and population response needs to be monitored closely to ensure abundance is maintained.	Low	High	Sturgeon, Pacific Lamprey, Eulachon
	OS.LF.13 Interaction with introduced species. Hundreds of species introductions, both intentional and unintentional, have occurred in the lower Columbia mainstem and estuary. Effects on white sturgeon are unknown and may be offsetting. For example, shad have become an important food source for adult sturgeon while shad and gamefish may compete for food sources with juvenile sturgeon.	Medium	Low	Sturgeon, Pacific Lamprey, Eulachon

	OS.LF.14 Incidental mortality. Operations at Bonneville Dam, specifically dewatering of turbines, can strand white sturgeon and result in mortality. Significance of this mortality factor needs to be evaluated.	Low	Low	Sturgeon
	OS.LF.15 Predation losses. Because of their high caloric value, Pacific lamprey are an important food source for marine mammals (pinnipeds) and sturgeon (and potentially others) in the lower Columbia River. Eulachon are an important food item for many estuary and lower mainstem species. Large congregations of avian predators accompany eulachon runs into spawning areas. Pinnipeds prey on eulachon as they migrate through the estuary; pinnipeds may also follow eulachon runs to spawning areas. The significance of predation on lamprey and eulachon needs to be quantified.	Medium	Medium	Pacific Lamprey, Eulachon
	OS.LF.16 Dam passage/ migration barriers. Pacific lamprey and eulachon are often unable or unwilling to migrate through fish ladders. Thus, Bonneville Dam has limited upstream migration of Pacific lamprey and eulachon to historical upriver spawning areas; many tributary or other mainstem dams have also limited lamprey access. Optimal water temperature for eulachon upstream migration is about 40 °F; below this temperature, migration will be delayed.	High	High	Pacific Lamprey, Eulachon

1.4.2 Strategies

Because of our current level of understanding of the links between physical conditions and species' biological response in the estuary and lower mainstem ecosystem, we are limited in the degree of specificity that can reasonably be included in habitat strategies and measures. As a result, the strategies and measures presented in Volume I, Chapter 6, Regional Strategies and Measures, as well as Chapter 7, Research, Monitoring, and Evaluation, apply to the salmonid and other species physical objectives presented above. In particular, the sections pertaining to the estuary and lower mainstem, hydropower, ecological interactions, and research address most biological and physical objectives in the Columbia Estuary and Columbia Lower subbasins. Thus, to avoid repetition, those measures and strategies are not included here. In this section, we have presented only those strategies that differ from the regional strategies because of the unique characteristics of sturgeon, Pacific lamprey, and eulachon.

Because of the diversity of estuary and mainstem species of interest and their subsequent life history requirements, the potential for conflict exists among suggested strategies and measures among the focal species. If conflicts arise, planning and policy decisions will dictate which strategies and measures are implemented, based on species prioritization. However, the strategies and measures suggested within this management plan have been formulated to minimize conflict among species-specific strategies and measures. For example, lamprey and eulachon experience challenges with Columbia River mainstem migration and dam passage. Thus, strategies and measures promote lamprey and eulachon migration. However, because of the differential swimming capabilities between these two species and most salmonids, passage improvements for eulachon and lamprey are challenged by potential negative effects on salmonids.

1.4.2.1 Predators

S1. Evaluate the level of predation mortality during the embryo and juvenile life stages of sturgeon and eulachon to determine the extent of predation-related recruitment failure.

S2. Evaluate the level of predation mortality during the adult life stages of lamprey and eulachon to determine estuary and mainstem survival.

Explanation: In an unaltered natural system, predator and prey populations generally establish an equilibrium that does not pose a long-term threat to the viability of either. Where natural systems have been substantially altered by human activities or other disturbances, this equilibrium can be disturbed to the detriment of one species or another. Increased predation and risks are typically a symptom of some more pervasive cause. Predator-prey interactions are also complex and difficult to understand or manage. However, in selected cases it is possible to temporarily limit risks through management of predators or predation. Predator management need not rely on predator control; a variety of predator management alternatives exist.

1.4.2.2 Other Mortality Factors

S3. Avoid incidental mortality of embryos and juveniles during dredging operations.

Explanation: Developing embryos or juvenile sturgeon, eulachon, or lamprey may be present among sand or fine substrates throughout the lower Columbia River. Suction dredging in these areas results in direct mortality. Dredge operations should avoid areas of known embryo or juvenile presence.

S4. Manage Columbia River fisheries at sustainable levels, maintaining a viable population through adequate spawner abundance.

Explanation: Longevity, slow growth, and delayed maturation make sturgeon susceptible to fishery overexploitation. Columbia River sturgeon fisheries should continue to be managed in such a way as to ensure sufficient abundance of fish attaining older ages, thus maintaining adequate spawner abundance. Columbia River eulachon fisheries should continue to be managed in such a way as to ensure population viability while meeting the needs of commercial, tribal, and recreational fisheries. At present levels of fishing effort and fishery restrictions, current lamprey harvest is relatively low but should be monitored as fishery effort and restrictions change.

S5. Avoid incidental mortality as a result of Bonneville Dam operations.

Explanation: Dewatering of turbines at Bonneville Dam has been documented to strand white sturgeon, resulting in mortality. Operations at Bonneville, and elsewhere in the subbasins, need to be evaluated to minimize sturgeon mortality.

S6. Evaluate and improve passage conditions at mainstem and tributary dams, ensuring no negative effects on salmonid passage.

Explanation: Adult Pacific lamprey and eulachon have difficulty in dam passage and juveniles migrating downstream do not appear to benefit from juvenile salmonid passage systems. Bonneville Dam has blocked access to historical spawning and rearing areas. Potential improvements to lamprey or eulachon passage need to be evaluated for potential negative effects on salmonids.

1.4.3 Measures

As discussed in the Strategies Section 1.4.2, regional measures presented in Volume 1, Chapters 6 and 7 apply to the biological and physical objectives of salmonids in the Columbia Estuary and Lower Columbia subbasins and are not repeated here. In this section, we have presented only those measures that differ from the regional measures because of the unique characteristics of sturgeon, Pacific lamprey, and eulachon. The measures identified in this section represent a list of potential actions or categories of actions. Habitat actions vary substantially from location to location and more specific direction needed to develop implementation plans is necessary.

1.4.3.1 Habitat

M1. Maintain sturgeon and eulachon preferred spawning habitat in the estuary and tidal freshwater portion of the lower Columbia River.

Explanation: Spawning substrate used by white sturgeon varies considerably, although they appear to prefer deepwater, rocky habitats with sufficient interstitial spaces to provide adequate water flow and predator protection during embryonic development. Spawning substrate used by eulachon is characterized by coarse sand substrate. At present, there is limited information as to the available acreage of preferred spawning habitat or as to whether acreage of this habitat type is increasing or decreasing. Based on the recent productivity of the white sturgeon population, there is currently no indication that white sturgeon are spawning habitat limited. Because of our present lack of information regarding the lower Columbia sturgeon and eulachon, an inventory of spawning locations, habitat characteristics, and habitat availability would be beneficial.

M2. Allocate water within the annual water budget for the Columbia River Basin that simulates peak spring discharge.

Explanation: Flow affects from upstream dam construction and operation have significantly modified estuary and mainstem hydrologic conditions. Juvenile lamprey are poor swimmers and are at the mercy of currents to complete downstream migrations. Decreased spring flows in the lower Columbia River may have eliminated the synchrony between lamprey physiological development and emigration timing. Establishing flows in the Columbia River estuary and lower mainstem that emulate a more natural regime will help improve emigration conditions for juvenile Pacific lamprey.

1.4.3.2 Predators

M3. Identify predators of sturgeon, lamprey, and eulachon embryos and juveniles; reduce predation mortality.

Explanation: Predators of sturgeon embryos and juveniles in the lower Columbia River are unknown and need to be identified. Elsewhere in the Columbia River, substantial predation on sturgeon embryos has been observed. The potential for predation-related recruitment failure exists. Small white sturgeon (i.e. <725mm) are a substantial predator of eulachon eggs. Other predators of eulachon eggs and juveniles in the lower Columbia River are unknown and need to be identified. Predators of juvenile lamprey in the lower Columbia River are unknown and need to be identified. Juvenile lamprey and eulachon have poor swimming ability and are expected to be highly susceptible to predation.

1.4.3.3 Other Mortality Factors

M4. Evaluate and mitigate Bonneville Dam operations that result in direct sturgeon mortality.

Explanation: Dewatering of turbines at Bonneville Dam can result in direct sturgeon mortality through stranding. The degree and significance of this mortality factor needs to be identified. Measures to mitigate impacts resulting from these activities should be identified and implemented.

M5. Modify passage structures at dams to improve juvenile and adult passage efficiency for Pacific lamprey and eulachon.

Explanation: Pacific lamprey and eulachon access to historical spawning and rearing habitats has been limited because of their inability to navigate fish ladders designed for salmonid passage. Additionally, juvenile lamprey do not appear to benefit from juvenile salmonid passage systems. Passage modifications need to proceed with caution; negative effects on salmonid passage need to be prevented.

M6. Closely monitor Columbia River fisheries harvest levels to maintain sturgeon, lamprey, and eulachon abundance.

Explanation: Current fishery regulations, particularly size limits, have allowed sturgeon to survive to older ages, thereby maintaining the spawning portion of the population. Harvest levels and fishery regulations should be closely monitored to ensure that adequate spawning adult abundance is maintained. Current lamprey fishery restrictions and level of effort maintain harvest at relatively low levels. Harvest levels and fishery regulations should be closely monitored to insure that lamprey population viability is maintained. Current eulachon fishery regulations and harvest effort have maintained harvest at sustainable levels. Harvest levels and fishery regulations should be closely monitored to insure that population viability is maintained.

1.4.4 Physical Objectives and Actions

In an attempt to rank physical objectives, a subjective evaluation was conducted based on what is known or suspected regarding the present status of each species and the level to which the physical objective would address an important limiting factor. Throughout this document, the qualitative terms of “High”, “Medium”, and “Low” have been used to provide a relative benefit of each identified physical objective. It is important to note that, because of the subjective nature of this evaluation, no two scientists will likely qualify each physical objective in precisely the same manner. The purpose of the evaluation is to identify those physical objectives that address the most important limiting factors for each species; thus, achieving these physical objectives are expected to have the greatest benefit for the species population. In the context of species-specific physical objectives, these terms are defined as:

- High – The physical objective addresses a limiting factor that currently limits population viability because of effects on mortality rates or productivity. Achieving the physical objective is of primary importance in maintaining current levels of population abundance/productivity or in promoting recovery of the species.
- Medium – The physical objective addresses a limiting factor that currently effects population viability, but at present impact levels, may not be significantly reducing population abundance or productivity. Achieving this physical objective will have less impact on overall population viability than the high benefit objectives.
- Low – The physical objective addresses a limiting factor that exists, but unlikely effects population viability at present impact levels. Achieving the physical objective will unlikely produce measurable effects on population viability until the high and medium benefit physical objectives are implemented.

The physical objectives benefit level is further qualified based on the current level of certainty that the objective will address a limiting factors. The qualitative terms of “High”, “Medium”, and “Low” are defined similarly to the certainty terms applied to the limiting factors.

Table 1-4. Salmonid desired environmental conditions.

Life Stage	Physical Objective	Difficulty	Benefit/Certainty
Juvenile Rearing (all juveniles in the Columbia River Basin)	**Sa.PO.1** Protect existing rearing habitat to ensure no further net degradation. *Hypothesis Statement:* If current rearing habitat is protected, then juvenile rearing capacity and productivity in the lower mainstem, estuary, and plume can be maintained. *Justification:* Protection and maintenance of existing rearing habitat will provide a base level of juvenile salmonid production and diversity. Further, protection of existing habitat is often more cost effective than restoration of former habitat.	Medium	High/High
	Sa.PO.2 Increase shallow water peripheral and side channel habitats toward historic levels. *Hypothesis Statement:* If shallow water habitat is increased, then juvenile rearing capacity in the estuary and mainstem will increase. *Justification:* Rearing ocean-type juvenile salmon are closely associated with shallow water habitats in the estuary and lower mainstem.	High	High/High
	Sa.PO.3 Restore connectivity between river and floodplain, tidally influenced reaches of tributaries, as well as in-river habitats. *Hypothesis Statement:* If connectivity with the floodplain is restored, then juvenile salmon productivity in the estuary and mainstem will increase. *Justification:* Connectivity with the floodplain will restore macrodetrital inputs and alter the current food web. A macrodetritus-based food web will increase productivity and support greater life history diversity.	High	High/High
	Sa.PO.4 Reduce predation mortality on emigrating juveniles. *Hypothesis Statement:* If predation on juveniles is reduced, then juvenile survival in the lower mainstem, estuary, and plume will increase. *Justification:* Predation on juvenile salmonids in the lower Columbia River and estuary has increased as a result of increased predator populations, such as northern pikeminnow or Caspian terns.	High	Medium/Medium
	Sa.PO.5 Reduce contaminant exposure of emigrating juveniles. *Hypothesis Statement:* If contaminant exposure is reduced, then juvenile survival in the lower mainstem, estuary, and plume will increase. *Justification:* Contaminants have been shown to have detrimental effects on juvenile salmonids, such as decreased immune function, disrupted physiological processes, and generally reduced fitness. Numerous contaminants have been detected throughout the lower Columbia River and estuary at concentrations known to have detrimental effects on aquatic organisms. Ocean-type salmon may be particularly susceptible to contaminant exposure because they are closely associated with peripheral, shallow water habitats where contaminants are known to accumulate.	High	Medium/Medium

	Sa.PO.6 Document the interaction between emigrating juvenile salmonids and introduced species; minimize negative interactions. *Hypothesis Statement:* If introduced species continue to thrive, then juvenile salmonid survival in the lower mainstem, estuary, and plume will be negatively affected. *Justification:* Introduced species, both purposeful and unintentional, have altered the lower mainstem, estuary, and plume ecosystem. Effects on native species are generally unknown, may be significant, and need to be quantified.	High	High/Low
	Sa.PO.7 Develop an understanding of emigrating juvenile salmonid life history diversity and habitat use in the lower mainstem, estuary, and plume. *Hypothesis Statement:* If our understanding of salmonid integration with the ecosystem increases, then management and recovery actions will proceed with greater certainty. *Justification:* Our current understanding of life history diversity and salmonid interaction with the lower mainstem, estuary, and plume ecosystem is limited; ongoing research continues to increase our knowledge and reduce uncertainty.	High	High/Medium
Adult Migration (all adults in the Columbia River Basin)	**Sa.PO.8** Maintain favorable water flow and temperature throughout migration period. *Hypothesis Statement:* If extreme water flows or temperatures exist during migration, then spawning may be delayed or averted. *Justification:* Extreme (i.e., both high and low) water flow and temperature can serve as a migration barrier that generally results in one of three outcomes: delayed arrival to spawning grounds, spawning activity in less than desirable locations, or no spawning. Each of these scenarios often results in decreased juvenile fitness or productivity.	Medium	Medium/High
	Sa.PO.9 Reduce predation mortality on migrating adults. *Hypothesis Statement:* If predation on adults is reduced, then survival in the estuary and mainstem will increase. *Justification:* Marine mammal predation on adult salmonids in the lower Columbia River and estuary has been observed. Predation mortality may be significant and needs to be quantified.	High	Low/High
Adult Spawning (adult spawners in estuary and lower mainstem)	**Sa.PO.10** Protect existing spawning habitat to ensure no further net degradation. *Hypothesis Statement:* If current spawning habitat is protected, then adult spawning capacity and productivity in the estuary and mainstem can be maintained. *Justification:* Protection and maintenance of existing spawning habitat will provide a base level of chum and fall Chinook salmon production. Further, protection of existing habitat is often more cost effective than restoration of former habitat.	Medium	High/High

	Sa.PO.11 Maintain favorable water flow and temperature throughout mainstem spawning period. *Hypothesis Statement:* If extreme water flows or temperatures exist during spawning, then chum and fall Chinook may not have access to current spawning areas. *Justification:* Extreme (i.e., both high and low) water flow and temperature can serve as a migration barrier and prevent access to current spawning areas. Further, extreme flow and temperature may decrease the quality of existing spawning habitat.	Medium	High/High
	Sa.PO.12 Maintain favorable water flow and temperature throughout mainstem incubation period. *Hypothesis Statement:* If extreme water flows or temperatures exist during incubation, then egg mortality will be unacceptably high. *Justification:* Extreme (i.e., both high and low) water flow and temperature can decrease egg to fry survival. High flow can cause bed scour and subsequent egg loss. Low flow reduces nutrient and oxygen transport to developing eggs; extreme low flow can result in redd dewatering. High temperature can increase egg mortality. Low temperature delays emergence and subsequent emigration. Each of these scenarios often results in decreased juvenile fitness.	Medium	High/High

Table 1-5. Sturgeon, Pacific lamprey, and eulachon desired environmental conditions.

Life Stage	Physical Objective	Difficulty	Benefit/ Certainty	Species
Egg Incubation	**OS.PO.** Protect existing spawning habitat to ensure no future net degradation. *Hypothesis Statement:* If current spawning habitat is protected, then productivity and population recruitment in the estuary and mainstem can be maintained. *Justification:* Sturgeon: Protection and maintenance of existing deepwater, rocky substrate spawning habitat will maintain the current level of embryo survival and population productivity. Sedimentation and dissolved oxygen delivery are two important concerns with developing embryos; concerns are minimized in rocky substrates. Eulachon: Protection and maintenance of existing stable coarse sand substrate spawning habitat will maintain the current level of population productivity. Dredging in the vicinity of eulachon spawning areas can make the substrate too unstable for successful egg incubation.	Medium	High/High	Sturgeon, Eulachon
	OS.PO.2 Reduce predation mortality on developing embryos. *Hypothesis Statement:* If predation on embryos is reduced, then embryo survival in the estuary and mainstem will increase. *Justification:* Sturgeon: Predation on white sturgeon embryos has been observed at about 12% in the upper Columbia River; current levels of predation in the lower Columbia is unknown and needs to be quantified. Eulachon: Predation on eulachon eggs by white sturgeon can be substantial; other predators may exist. Eulachon eggs comprised 51% of stomach samples from sturgeon 351-724mm in the Skamania area.	Medium	Medium/ Medium	Sturgeon, Eulachon
	OS.PO. Reduce contaminant exposure. *Hypothesis Statement:* If contaminant exposure is reduced, then embryo survival in the estuary and mainstem will increase. *Justification:* Contaminants have been shown to have detrimental effects, such as delayed development or disrupted physiological processes. Numerous contaminants have been detected throughout the lower Columbia River and estuary at concentrations known to have detrimental effects on aquatic organisms.	High	Medium/ Low	Sturgeon, Eulachon

	OS.PO.4 Avoid direct dredging mortality. *Hypothesis Statement:* If suction dredging activities occur in the presence of embryos, then direct mortality will result. *Justification:* White sturgeon or eulachon embryos may be present among sand and fine sediments as a result of deposition and dispersal mechanisms. Suction dredging of these sands and fine sediments results in entrainment and mortality. Dredge operations should avoid known areas of developing embryos.	Low	Medium/ Low	Sturgeon, Eulachon
	OS.PO.5 Develop an understanding of spawning habitat characteristics in the lower mainstem and estuary. *Hypothesis Statement:* If our understanding of spawning habitat increases, then management actions will proceed with greater certainty. *Justification:* Our current understanding of known spawning sites and specific spawning habitat characteristics in the lower mainstem and estuary ecosystem is limited; research is needed to increase our knowledge and reduce uncertainty.	High	High/Low	Sturgeon, Eulachon
Juvenile Rearing/ Migration	**OS.PO.6** Restore spring peak flows in lower Columbia River. *Hypothesis Statement:* If peak flows are restored, then juvenile lamprey physiological development and downstream migration timing will remain synchronized. *Justification:* Restoration and maintenance of historical peak flows will provide a consistent mechanism for juvenile lamprey downstream migration.	High	Medium/ Medium	Pacific Lamprey
	OS.PO.7 Reduce predation mortality. *Hypothesis Statement:* If predation mortality is reduced, then juvenile survival in the lower mainstem, estuary, and plume will increase. *Justification:* Juvenile eulachon have poor swimming capability. Predation on emigrating juvenile eulachon may be substantial and needs to be quantified.	High	High/Low	Eulachon
	OS.PO.8 Reduce contaminant exposure. *Hypothesis Statement:* If contaminant exposure is reduced, then juvenile survival in the estuary and mainstem will increase. *Justification:* Contaminants have been shown to have detrimental effects, such as reduced growth or disrupted physiological processes. Numerous contaminants have been detected throughout the lower Columbia River and estuary at concentrations known to have detrimental effects on aquatic organisms.	High	Medium/ Low	Sturgeon, Pacific Lamprey, Eulachon

	OS.PO.9 Avoid direct dredging mortality. *Hypothesis Statement:* If suction dredging activities occur in the presence of juveniles, then direct mortality will result. *Justification:* Juveniles are closely associated with sand and fine sediments. Suction dredging of these sands and fine sediments results in entrainment and mortality. Dredge operations should avoid known areas of juveniles.	Low	Medium/ Low	Sturgeon, Pacific Lamprey, Eulachon
	OS.PO.10 Document the interaction between juveniles and introduced species; minimize negative interactions. *Hypothesis Statement:* If introduced species continue to thrive, then juvenile survival in the estuary and mainstem may be negatively affected. *Justification:* Introduced species, both purposeful and unintentional, have altered the lower mainstem, estuary, and plume ecosystem. Effects on native species are generally unknown, may be significant, and need to be quantified.	High	Medium/ Low	Sturgeon, Pacific Lamprey, Eulachon
	OS.PO.11 Develop an understanding of juvenile habitat use in the lower mainstem, estuary, and plume. *Hypothesis Statement:* If our understanding of sturgeon, Pacific lamprey, and eulachon integration with the ecosystem increases, then management actions will proceed with greater certainty. *Justification:* Our current understanding of species interaction with the lower mainstem, estuary, and plume ecosystem is limited; research is needed to increase our knowledge and reduce uncertainty.	High	High/Low	Sturgeon, Pacific Lamprey, Eulachon
Adult Abundance	**OS.PO.12** Improve migration conditions and dam passage. *Hypothesis Statement:* If dam passage conditions are improved, then populations will benefit basin-wide. *Justification:* Adult Pacific lamprey and eulachon navigate hydrosystem dams with poor efficiency; thus, access to historical spawning and rearing areas has been limited. Eulachon preferred migration water temperature is 40 °F; cooler temperatures will delay migration.	High	High/High	Pacific Lamprey, Eulachon

	OS.PO.13 Avoid incidental mortality at Bonneville Dam. *Hypothesis Statement:* If Bonneville Dam operations are properly managed, then sturgeon incidental mortality can be minimized. *Justification:* Turbine dewatering operations at Bonneville Dam have been observed to strand sturgeon and result in mortality. This, and other operations at Bonneville and elsewhere in the subbasins, needs to be monitored to determine the significance to the lower Columbia sturgeon population.	Medium	Low/Low	Sturgeon
	OS.PO.14 Reduce predation mortality. *Hypothesis Statement:* If predation mortality is reduced, then adult survival in the estuary and mainstem will increase. *Justification:* Marine mammals and sturgeon prey on adult lamprey in the lower Columbia River and estuary. Other predators may exist. Eulachon are an important food item for many estuary and mainstem species. Large congregations of avian predators have been observed in eulachon spawning areas and pinnepeds may follow eulachon runs in the mainstem.	High	Medium/ High	Pacific, Lamprey, Eulachon
	OS.PO.15 Protect population from overexploitation. *Hypothesis Statement:* If current fisheries are properly managed, then adult abundance in the estuary and mainstem can be maintained. *Justification:* Sturgeon: Longevity, slow growth, and delayed maturation make sturgeon susceptible to fishery overexploitation. Fishery restrictions (such as size limits) and constant population monitoring can help maintain the current level of spawner abundance. Lamprey: At present levels of fishing effort and fishery restrictions, lamprey harvest is relatively low and unlikely a major limiting factor. Eulachon: Fishery regulations and constant population monitoring can help maintain sustainable harvest levels.	Medium	High/High	Sturgeon, Pacific Lamprey, Eulachon
	OS.PO.16 Document the interaction between sturgeon, Pacific lamprey, and eulachon and introduced species; minimize negative interactions. *Hypothesis Statement:* If introduced species continue to thrive, then native species survival in the estuary and mainstem may be negatively affected. *Justification:* Introduced species, both purposeful and unintentional, have altered the lower mainstem, estuary, and plume ecosystem. Effects on native species are generally unknown, may be significant, and need to be quantified.	High	High/Low	Sturgeon, Pacific Lamprey, Eulachon

	OS.PO.17 Develop an understanding of habitat use in the lower mainstem, estuary, and plume. *Hypothesis Statement:* If our understanding of sturgeon, Pacific lamprey, and eulachon integration with the ecosystem increases, then management actions will proceed with greater certainty. *Justification:* Our current understanding of species interaction with the lower mainstem, estuary, and plume ecosystem is limited; research is needed to increase our knowledge and reduce uncertainty.	High	High/Low	Sturgeon, Pacific Lamprey, Eulachon

1.5 Program Gap and Sufficiency Analysis

The lower Columbia River mainstem and estuary incorporates the mainstem from Bonneville Dam (RM 146) to the mouth of the river; the estuary surface area is estimated at about 160 square miles. The subbasins span two ecological provinces as defined by the NPCC: the Columbia River Estuary (mouth to RM 34) and the Lower Columbia River (RM 34 to Bonneville Dam). There are multiple major tributaries to the lower mainstem and estuary in both Washington and Oregon; each Washington tributary is defined as a subbasin by NPCC and has been addressed separately in this Management Plan. Land ownership and jurisdictional authority are varied throughout the lower mainstem and estuary. The lower mainstem and estuary is inherently linked to the various lower Columbia tributaries, as well as the mainstem and tributaries above Bonneville Dam. Thus, programs discussed in the subsequent tributary subbasin chapters have general applicability to the mainstem and estuary subbasin. To avoid repetition, those tributary subbasin programs have not been included here; only those programs with specific applicability to the mainstem river corridor or estuary ecosystem have been identified.

Protection Programs

Protection programs in the mainstem and estuary subbasins are implemented by citizen volunteer groups, non-profit organizations, local counties, State of Washington departments, and federal agencies/corporations. Protection programs in this analysis include those programs that protect habitat conditions or watershed functions through regulatory measures, through the outright purchase or lease of property rights, or by applying standards to new development that protects resources by avoiding damaging impacts. Protection programs may also address ecological interactions, such as programs that seek to reestablish historical predator-prey relationships. Major programs implementing protection measures are identified below.

- *Columbia Land Trust:* Columbia Land Trust works exclusively with willing landowners to find ways to conserve the natural values of the land and water. Landowners donate the development rights or full ownership of their land to the Columbia Land Trust. The Land Trust in turn manages the land under a stewardship plan. The Columbia Land Trust also identifies priority conservation lands to purchase, using financial contributions from private donors.
- *The Lower Columbia River Estuary Partnership:* LCREP is a two-state, public-private initiative that works to protect and restore the lower Columbia River estuary with habitat improvements and education/information programs. LCREP produced a Comprehensive Conservation and Management Plan in 1999 that provides a vision for the estuary and

ensures that ongoing efforts remain consistent with this vision. Through collaboration, convening, and coordination, LCREP integrates 28 cities, nine counties, and the states of Oregon and Washington. LCREP supports a wide range of volunteer, education, protection, and restoration projects that seek to improve habitat and land use, heighten education, information, and coordination, and reduce pollutants in the estuary.

- ✓ *LCREP Habitat Monitoring Program*: The program involves "status monitoring" as outlined in the US Army Corps of Engineers (USACE)/Bonneville Power Administration (BPA) Research, Monitoring, and Evaluation (RME) Plan. Status monitoring is the "measurement of environmental characteristics over an extended period of time to determine status or trends in some aspect of environmental quality." The LCREP's Columbia River Estuary (CRE) Habitat Monitoring Program is consistent with the RME Plan and, in fact, the CRE may be treated as a pilot monitoring subbasin. The funding from BPA covers a three-year program with annual funding increments. The intent of the funding is to develop and establish a habitat monitoring program that can be initiated in year two, and sustained in year three and after. The three parts with their associated goals are as follows: 1. Population/Habitat Status Monitoring – monitoring for trends in the status of juvenile salmon and conditions in the habitats they use, 2. Ecosystem Status Monitoring – habitat classification using remote sensing, and 3. Invasive Species Monitoring – monitoring abundance and distribution of non-indigenous plants and animals.

- o *Columbia River Estuary Study Taskforce*: CREST is a council of local governments serving as a forum for collaboration and regional planning that provides technical assistance to local governments and implements restoration and protection of the Columbia River estuary from river mile 0 to 46. The program provides resource protection, restoration, and management for anadromous and resident fish. CREST assists local jurisdictions with permitting issues, zoning ordinances, comprehensive plan and shoreline master plan amendments, estuarine impact analysis, and wetland, dredging, and water quality issues.
- o *NOAA Fisheries Habitat Conservation Program*: NOAA Fisheries is responsible for habitat conservation through application of ESA Sections 4, 7, and 10. NOAA Fisheries regulates water quality, quantity, habitat, and wetlands for the management of anadromous fish. Conserving the habitat of ESA listed Pacific salmon is the Habitat Conservation Division's largest program area.
- o *USACE*: The USACE has regulatory protection authority over waters of the U.S. under the Rivers and Harbors Act and the Clean Water Act.
  - ✓ The USACE presides over permitting, mitigation, and enforcement of waters of the U.S. primarily in matters pertaining to Section 404 of the Clean Water Act and Sections 10 and 13 of the Rivers and Harbors Act. The Corps evaluates permit applications and enforcement work including wetlands and other special aquatic sites. Section 10 of the Rivers and Harbors Act requires authorization for the construction of any structure in or over any navigable water of the United States. This law applies to any dredging or disposal of dredged materials, excavation, filling, rechannelization, or any other modification of navigable water of the United States, and applies to all structures.
  - ✓ Section 404 of the Clean Water Act regulates the discharge of dredged or fill material into all waters of the United States, including wetlands, both adjacent and isolated. Discharges of fill material generally include, without limitation: placement of fill that is necessary for the construction of any structure or impoundment requiring rock, sand, dirt, or other material for its construction; site-development fills for recreational, industrial,

commercial, residential, and other uses; causeways or road fills; dams and dikes; artificial islands; property protection or reclamation devices such as riprap, groins, seawalls, breakwaters, and revetments; beach nourishment; levees; fill for intake and outfall pipes and subaqueous utility lines; fill associated with the creation of ponds; and any other work involving the discharge of fill or dredged material.

- *BPA Environment, Fish, and Wildlife Program*: BPA is responsible for protecting, mitigating, and enhancing fish and wildlife affected by the development and operation of hydroelectric dams in the Columbia River Basin. Through the guidance of the NPCC, BPA funds projects which protect and enhance salmon and other fish and wildlife populations impacted by regional hydroelectric development and operations.
- *State of Washington:* Numerous department within the State of Washington have protection program responsibilities.
  - ✓ Department of Fish and Wildlife (WDFW) manages land for fish, wildlife, and recreation needs. The Department is mandated to preserve, protect, and perpetuate fish and wildlife and their habitat. A goal of WDFW is to encourage and assist local governments in adopting policies and regulations to protect fish and wildlife habitat. The Priority Habitats and Species Program is the principal means by which WDFW provides important fish, wildlife, and habitat information to local governments, state and federal agencies, private landowners and consultants, and tribal biologists for land use planning purposes. The Department also provides a partnership-based information system that characterizes freshwater and estuary habitat conditions and distribution of salmonid stocks in Washington.
  - ✓ WDFW, in collaboration with Oregon Department of Fish and Wildlife (ODFW), is also responsible for fisheries management, and sets annual harvest regulations for salmon, sturgeon, eulachon, and lamprey in the estuary and lower Columbia mainstem.
  - ✓ Department of Natural Resources public lands are managed under the guidelines of a Habitat Conservation Plan. The Habitat Conservation Plan has protection mechanisms for riparian buffers.
  - ✓ *Washington State Department of Agriculture (WSDA) Water Quality Protection Program*: The goal of this program is to work together with the agricultural community and regulators to protect water resources. The program addresses a variety of surface and ground water issues that involve fertilizers and pesticides. The WSDA is also evaluating current pesticide use practices in conjunction with pesticide residue data in surface waters that provide habitat for ESA- listed species.
- *Local Governments:* Numerous programs are in place to assist urban or industrial development at the city or county level to proceed while minimizing negative environmental impacts.
  - ✓ The State *Growth Management Act (GMA)* requires cities and counties to plan for growth and development through a comprehensive, coordinated, and proactive land use planning approach.
  - ✓ *Critical Area Ordinances*: As part of the GMA, cities and counties are required to adopt policies and regulations that protect critical areas, such as fish and wildlife habitat conservation areas, wetlands, frequently flooded areas, aquifer recharge areas, geologically hazardous areas.
  - ✓ *Shoreline Management Act (SMA)*: The SMA governs proposed land uses within 200 ft. of shoreline areas and their associated wetlands and/or 100-year floodplain, including shorelines along saltwater, streams >20cfs, and lakes >20 acres.

- ✓ *State Environmental Policy Act (SEPA)*: SEPA aims to maintain and improve environmental quality through requiring government agencies to properly consider environmental matters during decision making, including the identification and evaluation of probable impacts to all elements of the built and natural environment.

- o *Northern Pikeminnow Management Program:* The goal of the program is to manage annual pikeminnow predation on juvenile salmonids. The program pays rewards to anglers for harvesting pikeminnow over a prescribed size, thus providing an incentive to remove the large, predaceous pikeminnow from the population.
- o *Caspian Tern Management Programs*: Numerous programs/activities have recently occurred that address Caspian tern management in the Columbia River estuary.
  - ✓ *Caspian Tern Working Group*: Task force dedicated to establishing the needs of the Columbia River Caspian tern breeding population while minimizing negative effects on ESA-listed species.
  - ✓ *Caspian Tern Environmental Impact Statement (EIS)*: The USFWS, USACE, and NOAA Fisheries are jointly preparing the EIS; the purpose is to explore options to reduce the level of tern predation on Columbia River salmonids while insuring the protection and conservation of Caspian terns in the Pacific Coast/Western region (California, Oregon, Washington, Idaho, and Nevada).
  - ✓ *Caspian Tern Relocation Project*: The goal of the project was to relocate terns to another location in the estuary where tern predation on juvenile salmonids would be reduced but the viability of the tern population would be maintained.
- o *Pacific Flyway Council, Dusky Canada Goose Management*
  - ✓ A management plan for the Dusky Canada goose was developed by United States Fish and Wildlife (USFWS), ODFW, WDFW, Oregon State University (OSU), and Pacific Flyway representatives. This group developed harvest, nest survey, management and research tasks with the goal of improving the declining dusky population. If these tasks are funded, then the population of dusky geese will reach a level where special protection is not needed. Funding has been limited recently and many projects are not being implemented as planned.
  - ✓ *Agricultural Depredation Control Plan*: This plan is a list of strategies and tasks to reduce the agricultural depredation committed by geese on private property. The plan was developed by WDFW, ODFW, USFWS, APHIS-WS, OSU, and the Oregon and Washington Farm Bureaus. The funding for this plan is inconsistent and recent reductions have caused landowners to potentially suffer more crop damage. Assistance from agencies to landowners has also declined by lack of funding.
  - ✓ *Agricultural Waterfowl Incentive Program*: The program is designed to enhance waterfowl habitat by providing seeds, tubers, graze, and invertebrates. In 1998, 49 landowners participated to create 38,949 ac (15,769 ha) of waterfowl habitat, a 75% increase from the proceeding year. Enrolled landowners were predominantly rice producers in the northern Central Valley, with only one elsewhere. Much of this flooding is in addition to the 60,021 ac (24,300 ha) already being flooded before the program was initiated.

Restoration Programs

Restoration programs in the mainstem and estuary subbasins are implemented by citizen volunteer groups, non-profit organizations, local counties, State of Washington departments, and federal agencies/corporations. Many protection programs outlined above also have restoration components; these programs are not repeated here. Major programs implementing restoration measures include:

- *LCREP:* The purpose of LCREP has been described above under the 'Protection Programs' section.
  - ✓ *LCREP Habitat Restoration Program*: An effort to develop an ecosystem based approach to protecting existing habitat and restoring altered habitat has been initiated by the Estuary Partnership in association with the CREST. The outcome of this project will be a coordinated, ecosystem based habitat restoration program focused on increasing the survival of juvenile salmonids and monitoring habitat project success over time. The specific objectives of this project are to: (1) establish a habitat restoration program for the lower Columbia River and estuary (Bonneville Dam to mouth of river), and (2) develop monitoring and evaluation protocols for the lower river and estuarine habitats.
- *NOAA Fisheries.*
  - ✓ *Federal Columbia River Power System (FCRPS) and Channel Deepening Biological Opinions*: Numerous restoration actions have been identified through the BiOps; USACE, BPA, and the Bureau of Reclamation are responsible for implementing these restoration actions.
  - ✓ *Evaluating Cumulative Ecosystem Response To Restoration Projects in the Columbia River Estuary*: The goal of this study is to develop standardized techniques and protocols that will facilitate evaluation of the performance of salmon habitat restoration actions and support the decision-making process for said actions in the CRE aimed at increasing population levels of listed Columbia Basin salmonids. The management implications of this research are two-fold. It will provide techniques to: 1) obtain data to compare project results in order to support decisions regarding what projects to pursue for restoration of the ecosystem, and 2) to evaluate the ecological performance of the collective habitat restoration effort in the CRE and its effects on listed salmonids. The objectives of this study are to: 1) develop standard monitoring protocols and methods to prioritize monitoring activities that can be applied to CRE habitat restoration activities for listed salmonids; 2) develop the empirical basis for a cumulative assessment methodology, together with a set of metrics and a model depicting the cumulative effects of CRE restoration projects on key major ecosystem functions supporting listed salmonids; 3) design and implement field evaluations of the cumulative effects of restoration projects using standard methods, and sensors or remotely operated technologies, to measure the effects on listed salmonids through ecosystem response; and 4) develop an adaptive management system including data management and dissemination to support decisions by the Corps of Engineers and others regarding CRE habitat restoration activities intended to increase population levels of listed salmon.
- *USACE*: Under Section 206 of the Water Resources Development Act of 1996, the USACE has the authority to carry out an aquatic ecosystem restoration and protection project if the project will improve the quality of the environment, is in the public interest, and is cost-effective. Significant provisions of Section 206 include a cost-sharing requirement and an annual funding cap for programs nation-wide. A minimum of 35% of a project's costs must be contributed from non-federal sources and a maximum of $25 million dollars annually may be dedicated to projects nation-wide. Restoration and protection projects funded under Section 206 need not be tied to a hydrologic project.
- *USFWS Environmental Contaminants Program*: The program applies to all watersheds within the Columbia River Basin. The Environmental Contaminants Program conducts

studies that help to reveal the health of terrestrial and aquatic ecosystems. Wildlife and fish populations are assessed for the health of their habitats, populations and individual organisms. The purpose is to identify and prevent the harmful effects of contaminants on fish and wildlife, and to restore resources degraded by contamination. The Service provides technical assistance on a variety of issues including: pesticide use, mining, agriculture, industrial discharges, forestry practices, range management, urbanization, wastewater treatment system discharges, and non-point source discharges, crop production for waterfowl, and control of fish diseases at hatcheries.

- *USFWS Partners for Fish and Wildlife Program*: The program is the USFWS's primary mechanism for delivering voluntary on-the-ground habitat improvement projects on private lands for the benefit of federal trust species. The purpose of the program is to promote watershed based restoration of wetland, riparian, prairie, and other habitats essential to fish and wildlife resources. Restoration projects are intended to provide direct benefit to fish and wildlife resources. The program provides technical and financial assistance to landowners to help meet the habitat needs of federal trust species on private lands.

Gap Analysis

Protection-related Programs: The lower mainstem and estuary subbasins have protections through federal, state, and local regulatory authority. These protection programs can direct local subbasin actions, however, this remains only a portion of the protection challenges for the lower mainstem and estuary because all upstream activities and protection programs affect conditions in the lower mainstem and estuary.

Restoration-related Programs: Over a long period of time, improvements to the lower mainstem and estuary are possible, primarily through restoration action of LCREP and via the NOAA Fisheries BiOps. To the degree possible, programs should focus on restoring floodplain function and connectivity with the mainstem, as well as restoring off- and side-channel habitats.'

Table 1-6. Programmatic Actions to Address Gaps

Action No.	Lead Agency	Proposed Action
EST/M.1	Counties	Adequately protect riparian areas, wetlands, wetland buffers, and wetland function. Activities on the landscape must protect wetlands and the vegetation surrounding them to avoid disturbing soils, vegetation, and local hydrology. Utilize mitigation, where necessary, to offset unavoidable damage.
EST/M.2	Counties	Adequately protect historical stream meander patterns and channel migration zones and avoid hardening stream banks and shorelines.
EST/M.3	Counties	Remove or modify tide gates to restore floodplain connectivity with mainstem and floodplain function.
EST/M.4	Counties	Apply land use code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application.
EST/M.5	Columbia Land Trust, LCREP, WDFW, USFWS, USACE, BPA, Counties	Obtain wetland, riparian, off-channel, and floodplain habitats to restore connectivity between river and floodplain as well as floodplain function.
EST/M.6	USACE, BPA	Monitor/manage Bonneville Dam releases to evaluate effects on watershed functions, mainstem spawning habitats, and peripheral rearing habitats over time to evaluate hydrologic impacts.
EST/M.7	LCFRB, WDFW, NOAA, USFWS, USACE, BPA, SRFB, LCREP	Increase available funding for projects that implement measures and addresses underlying threats.
EST/M.8	Counties, LCREP	Utilize a combination of public outreach/education, incentives, and authority to positively influence landowner behaviors toward land stewardship in practices not covered by land use regulations.
EST/M.9	LCFRB, WDFW, Counties	Build institutional capacity for agencies and organizations to undertake additional protection and restoration projects (e.g., noxious weed control).
EST/M.10	LCFRB, WDFW, NOAA, USFWS, USACE, BPA, SRFB, LCREP, Counties	Address threats proactively by building agreement on priorities among the various program implementers.

2 Columbia River Estuary Tributaries

Figure 2-1. Location of the Columbia River estuary tributaries basin within the Lower Columbia River Basin

2.1 Basin Overview

The Estuary tributaries basin includes the Chinook River, Wallacut River, and other small streams that flow into the estuary between the communities of Chinook and Knappton, just west of Grays Bay. The basin is part of WRIA 24.

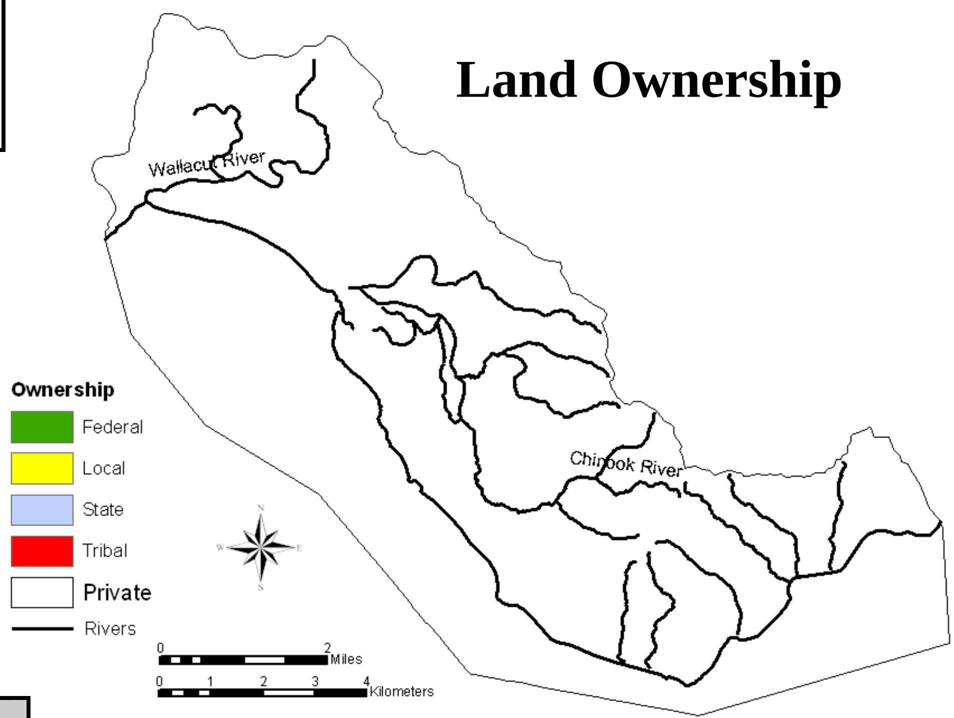
The Estuary tributaries basin will play a key role in the recovery of salmon and steelhead. The basin has historically supported populations of fall Chinook, chum, and coho. Today, Chinook and chum are listed as threatened under the ESA. Coho salmon are a candidate for listing. Other fish species of interest are Pacific lamprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

Estuary tributary salmon and steelhead are affected by a variety of in-basin and out-of basin factors including stream, estuary, and ocean habitat conditions; harvest; hatcheries, and ecological relationships with other species. Analysis has demonstrated that recovery cannot be achieved by addressing only one limiting factor. Recovery will require action to reduce or eliminate all manageable factors or threats. The deterioration of habitat conditions in the Columbia River estuary and plume affect all anadromous salmonids within the Columbia Basin. Direct harvest of listed salmon and steelhead is prohibited but sport and commercial fisheries focusing on hatchery fish and other healthy wild populations, primarily in the mainstem Columbia and ocean, incidentally affect ESA-listed Estuary tributary fish. Key ecological interactions of concern include effects of nonnative species; nutrient inputs from salmon carcasses; and predation by species affected by development including Caspian terns, northern pikeminnow, seals, and sea lions. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the Estuary tributary subbasin.

Private land ownership dominates the watershed, which is only 4% publicly owned. Residential and commercial uses increase at the west end of the watershed, spreading east from the tourist communities of Long Beach and Seaview, WA to the town of Ilwaco, WA. Lower elevation areas provide space for agriculture, and the higher elevation areas support a small amount of timber harvesting. Much of the estuary habitat at the mouth of the rivers has been converted to agricultural uses, with significant diking and filling of off-channel habitats. Fishing, timber, agriculture, and tourism provide the economic base for area residents. The area is sparsely populated, and the fishing port of Ilwaco and the small rural communities of Chinook and Megler are the only population centers on the Washington side. Astoria, OR is the largest population center in the area.

The majority of productive habitat for anadromous fish is found in the Chinook and Wallacut rivers. Limited amounts of habitat are also found in the lower reaches of other small streams. Tidegates, floodplain filling, and channel straightening have had detrimental impacts to stream and estuarine habitats in the Chinook and Wallacut rivers.

Land Ownership	
Private	100%
Federal	0%
State	0%
Other public	0%



Vegetation Composition	
Late Seral	1%
Mid Seral	11%
Early Seral	20%
Other Forest	54%
Non Forest	13%

2.2 Species of Interest

Focal salmonid species in the Estuary tributary watersheds include fall Chinook, chum, and coho. The current health or viability of the focal population (when included with Grays populations) is low for coho and between low and medium for chum and fall Chinook. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Recovery goals call for improving the Grays/Chinook coho and fall Chinook populations to a high viability level, providing a 95 percent probability of persistence over 100 years and the Grays/Chinook chum population to above high viability level, providing grater than 95 percent probability of persistence over 100 years.

Other species of interest in the estuary tributaries include coastal cutthroat trout and Pacific lamprey. Regional objectives for these species are described in Volume I, Chapter 6. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for these other species. Cutthroat will benefit from improvements in stream habitat conditions for salmonids. Lamprey are expected to benefit from habitat improvements in the estuary, Columbia River, and mainstem, and in the Chinook River subbasin, although specific spawning and rearing habitat requirements for lamprey are not well known.

Table 2-1. Current viability status of estuary tributary populations and the biological objective status that is necessary to meet the recovery criteria for the Coast strata and the lower Columbia ESU.

	ESA	Hatchery	Current		Objective	
Species	Status	Component	Viability	Numbers	Viability	Numbers
Fall Chinook	Threatened	Yes	Low+	100-300	High	1,400-1,400
Chum	Threatened	Yes	Low+	500-10,000	High+	4,300-7,800
Coho	Candidate	Yes	Low+	unknown	High	unknown

Fall Chinook– The historical Grays/Chinook adult population is estimated from 1,500-10,000 fish. The majority of fish returned to the Grays River. Current natural spawning returns to the Grays River range from 100-300 fish. There is little fall Chinook natural production in Chinook River or other estuary tributaries. Spawning in the Chinook River occurs primarily in the lower 5 miles of the mainstem, downstream of the Sea Resources Hatchery. Fall Chinook spawn primarily in October. Juvenile rearing occurs near and downstream of the spawning areas. Juveniles emerge in early spring and migrate to the Columbia in spring and summer of their first year.

Chum– The historical Grays/Chinook adult population is estimated from 8,000-14,000 fish. Current returns range from 500-10,000 fish, with the vast majority in Grays River. In the Chinook River, natural spawning occurs in the lower 5 miles of the mainstem. Most fish are produced from Sea Resources Hatchery, which is using Grays River stock chum to supplement Chinook River chum natural production. Natural production also occurs in smaller estuary tributaries, most notably Jim Crow and Crooked creeks. Peak spawning occurs in late November-early December. Juveniles emerge in the early spring and migrate to the Columbia after a short rearing period.

Coho– The historical Grays River/Chinook adult population is estimated from 5,000-40,000 fish, with the returns late stock which spawn from late November to March. Current returns are unknown but assumed be low. Natural spawning in the Chinook basin occurs primarily in the lower reaches downstream of the hatchery. Spawning also occurs in vicinity streams, including Crooked, Hitchcock, and Jim Crow creeks. Juvenile rearing occurs upstream and downstream of spawning areas. Juveniles rear for a full year in these basins basin before migrating as yearlings in the spring.

Coastal Cutthroat– Coastal cutthroat abundance in the estuary tributaries has not been quantified but the population is considered depressed. Cutthroat trout are present throughout these. Both anadromous and resident forms of cutthroat trout are present in the estuary tributaries. Anadromous cutthroat enter their stream of origin from late July-mid April and spawn from January through April. Most juveniles rear 2-3 years before migrating from their natal stream.

Pacific lamprey– Information on lamprey abundance is limited and does not exist for the estuary tributary populations. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have also declined in the estuary tributaries. 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 seven years before migrating to the ocean.

2.3 Limiting Factors, Threats and Measures

2.3.1 Hydropower Operation and Configuration

There are no hydro-electric dams in the Esutary Tributary Basin. However, Estuary Tributary species are affected by mainstem Columbia hydro operations and flow regimes which affect habitat in migration corridors and in the estuary. Mainstem hydro factors and threats are addressed by regional strategies and measures identified in Volume I.

2.3.2 Harvest

Most harvest of wild estuary tributary salmon and steelhead occurs incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. This mortality is very low for chum, but is more significant for fall Chinook. Estuary tributary fall Chinook are harvested in ocean and Columbia River commercial sport fisheries Harvest is controlled by an ESA harvest limit associated with Coweeman natural fall Chinook. In-basin sport fisheries are closed to the retention of Chinook. No harvest of chum occurs in ocean fisheries, there are no Columbia River commercial fisheries for chum, and sport fishing is closed to chum. Some chum can be impacted incidental to fisheries directed at coho and winter steelhead. Harvest of estuary coho occurs in the ocean commercial and recreational fisheries off the Washington and Oregon coasts and Columbia River. Wild coho impacts are limited by fishery management to retain marked hatchery fish and release unmarked wild fish. 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 marked hatchery steelhead and commercial fisheries cannot retain hatchery or wild steelhead.

Measures 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. The regional measures 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 Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest measures that have significant application to the estuary subbasin populations are summarized in the following table:

Table 2-2. Regional harvest measures from Volume I, Chapter 7 with specific implementation actions in the Estuary Tributary Subbasins.

Measure	Description	Comments
F.M18	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	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.M19	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	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.M24	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	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.

2.3.3 Hatcheries

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

The Sea Resources Hatchery (since 1895) is operated by the non-profit Sea Resources Watershed Learning Center. The hatchery produces smaller numbers of chum, fall Chinook, and coho. Since 1996, the goal of the hatchery programs is to restore naturally reproducing populations of salmon in the Chinook River in conjunction with habitat restoration projects. The Deep River net pens (located in Deep River upstream of the river mouth at Grays Bay), acclimate and release coho and spring Chinook for Select Area harvest in Grays Bay and lower Deep River. The main threats associated with the Deep River programs are potential domestication of natural produced coho if non harvested adults stray to adjacent streams, and possible ecological interactions between hatchery released juveniles and natural produced juvenile salmon. There is no known natural salmon or steelhead production in the Deep River basin.

Table 2-3. Estuary Tributary Hatchery Production.

Hatchery	Release Location	Spring Chinook	Fall Chinook	Coho	Chum
Grays River	Deep River			200,000	
Cowlitz Salmon or Lewis Salmon	Deep River	200,000			
Sea Resources	Chinook River		107,500	52,000	147,500

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 estuary subbasin 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 (HGMP) for public review and consideration by NOAA Fisheries (details in programs Technical Foundation, Volume IV). Regional hatchery measures identified in Volume I, Chapter 7 with potential applications at facilities within the estuary subbasins are summarized in Table 7.

Table 2-4. Regional hatchery measures from Volume I, Chapter 7 with potential implementation actions in the estuary Subbasins.

Measure	Description	Comments
H.M32,40	Juvenile release strategies to minimize interactions with naturally spawning fish	Release strategies are aimed at reducing or avoiding interactions with wild chum, fall Chinook, and coho by release timing and release location strategies.
H.M23, 41	Mark hatchery produced coho and spring Chinook	Marking Deep River hatchery releases enables selective fisheries to retain hatchery fish and release wild fish and accountability of any stray hatchery fish in other basins
H.M 5,24,36	Hatchery programs utilized for supplementation and enhancement of wild chum and coho populations	The Grays Hatchery is currently used for supplementation and risk management of the Grays River chum population and Sea Resources Hatchery for enhancement of Chinook River chum, coho, and fall Chinook. Programs would be further developed to integrate hatchery and natural programs.
H,M8	Adaptively manage hatchery programs to further protect and enhance natural populations and improve operational efficiencies.	Appropriate research, monitoring, and evaluation programs along with guidance from regional hatchery evaluations will be utilized to improve the survival and contribution of hatchery fish, reduce impacts to natural fish, and increase benefits to natural fish.
H.M2,6	Evaluate Grays River and Sea Resources hatcheries facility operations.	Both facilities would be evaluated in the BRAP process for potential hazards associated with barriers to fish passage, adequacy of screens, and water quality.

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

2.3.4 Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Estuary tributary salmon are affected throughout their lifecycle by ecological interactions with non native species, food web components, and predators. Interactions are similar for Estuary tributary populations to those of most other subbasin salmonid populations. Ecological interactions are addressed by regional strategies and measures identified in Volume I.

2.3.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. 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 are similar for Estuary tributary populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook than coho. Estuary and mainstem effects on Columbia Estuary tributary salmon populations are addressed by regional strategies and measures identified in Volume I and the Estuary Subbasin sections of Volume II.

2.3.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity 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 Estuary Tributaries basin have the greatest impact on the health and viability of salmon and steelhead relative to the other limiting factors and threats discussed in this chapter.

Due to the small amount of available habitat, the Estuary Tributary populations have not been analyzed using the EDT model and reaches have not been prioritized using the methods employed for other subbasins. Limiting factors, threats, and measures have been derived through consultation with other information sources, including the WRIA 25 Limiting Factors Analysis (Wade 2001), Sea Resources Hatchery's Chinook Watershed Restoration Plan (www.searesources.org), and aerial photograph interpretation. A summary of the primary habitat limiting factors and threats are presented in Table 2-5. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 2-2. Habitat measures and related information are presented in Table 2-6.

The most important habitats for salmonids in the Chinook River are located in the lower 4 miles, where most of the available spawning habitat is located. The lower 2.5 miles, within tidal influence, was historically a broad lowland marsh with many interconnected backwater habitats and was a very productive site for juvenile rearing. This estuarine habitat was not only important for Chinook River populations, but for other Columbia River populations as well. This segment now consists of a single thread channel confined by dikes with agricultural uses in the historical floodplain. A tidegate at the highway crossing near the mouth affects tidal hydrologic processes in the lower river and can limit fish passage under certain conditions. Overall, significant backwater habitats have been lost, food production processes have been disrupted, and predation from introduced species has increased. Efforts are currently underway to restore portions of the lower river and address problems with the tidegate, potentially removing it altogether.

The areas with the greatest potential production for anadromous salmonids in the Estuary Tributaries basin are the following:

- Chinook River – between tidal influence (RM 2.5) and Sea Resources Hatchery (RM 4)
- Wallacut River and other small Columbia River tributaries

While reach level habitat conditions often result from local factors, they are also affected or shaped by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input, and large woody debris recruitment are often affected by or result from upstream conditions and degraded watershed processes. Access to key reaches may also be affected by barriers that occur downstream of a reach. Accordingly, restoration of a priority reach may require action outside the targeted reach. The IWA analysis was used to identify potential upstream watershed areas that could influence reach level habitat attributes.

The mainstem Chinook between tidal influence (RM 2.5) and the Sea Resources Hatchery (RM 4) currently contains habitats that are important for Chinook River salmon populations. Potential production in this reach is limited by riparian degradation, loss of floodplain function, loss of backwater habitats, and sedimentation of stream channels. Adjacent agricultural uses have resulted in channels confined by dikes and under-vegetated riparian areas. Sedimentation originates from upper basin sediment delivery and local agriculture/grazing practices.

The Wallacut River is affected by many of the same attributes as the Chinook River. The estuarine portion of the lower Wallacut River has been channelized and diked to create crop and pasture lands. Fish passage is currently limited at certain times by tidegates. Other potentially productive small tributaries to the Columbia River are located between the communities of Chinook and Megler. Some of these streams have fish passage issues associated with culverts under Highways 401 and 101.

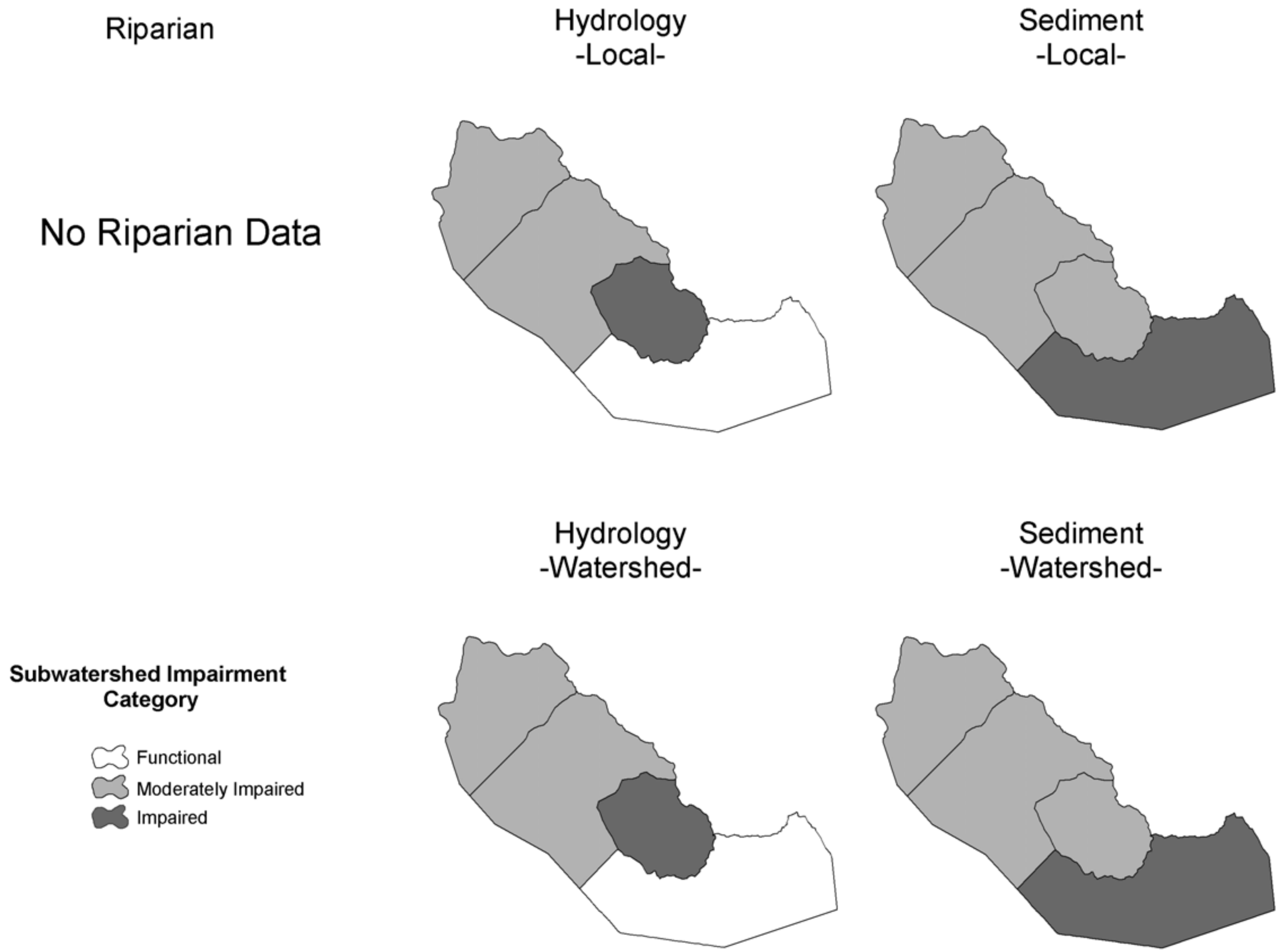


Figure 2-2. IWA subwatershed impairment ratings by category for the Estuary Tributaries Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 2-5. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the Chinook River (CH) and the Wallacut River plus other small tributaries (WA). Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors			Threats		
	CH	WA		CH	WA
Habitat connectivity			***Agriculture / grazing***		
Blockages to off-channel habitats	✓	✓	Clearing of vegetation	✓	✓
Blockages to stream habitats due to structures	✓	✓	Riparian grazing	✓	✓
Habitat diversity			Floodplain filling	✓	✓
Lack of stable instream woody debris	✓	✓	***Rural development***		
Altered habitat unit composition	✓	✓	Clearing of vegetation	✓	✓
Loss of off-channel or side-channel habitats	✓	✓	Floodplain filling	✓	✓
Channel stability			Roads – riparian/floodplain impacts	✓	✓
Bed and bank erosion	✓	✓	***Forest practices***		
Riparian function			Timber harvests: sediment supply impacts	✓	✓
Reduced stream canopy cover	✓	✓	Timber harvests: impacts to runoff	✓	✓
Reduced bank/soil stability	✓	✓	Riparian harvests	✓	✓
Exotic and/or noxious species	✓	✓	Forest roads: impacts to sediment supply	✓	✓
Reduced wood recruitment	✓	✓	Forest roads: impacts to runoff	✓	✓
Floodplain function			Forest roads: riparian/floodplain impacts	✓	✓
Altered nutrient exchange processes	✓	✓	***Channel manipulations***		
Reduced flood flow dampening	✓	✓	Bank hardening	✓	✓
Restricted channel migration	✓	✓	Channel straightening	✓	✓
Disrupted hyporheic processes	✓	✓	Artificial confinement	✓	✓
Stream flow			Passage obstruction (tidegates, culverts)	✓	✓
Altered magnitude, duration, or rate of change	✓	✓			
Water quality					
Altered stream temperature regime	✓	✓			
Substrate and sediment					
Embedded substrates	✓	✓			
Excessive fine sediment	✓	✓			

Table 2-6. Habitat measures in priority areas, with reference to limiting factors addressed, threats addressed, target species, and estimated time until benefits would be realized (time). Areas of known priority are listed under the location column for some measures (i.e., stream corridor measures). Reaches not included in the table are considered secondary priority.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
1. Protect and restore floodplain function and channel migration processes ***A. Set back, breach, or remove artificial channel confinement structures***					
Chinook River ***Wallacut River and other small tributaries***	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes	• Floodplain filling • Channel straightening • Artificial confinement	• All species	2-15 years	High potential benefit due to improvements in many limiting factors. This passive restoration approach can allow channel to restore naturally once confinement structures are removed. There are challenges with implementation due to existing infrastructure already in place, private property, potential flood risk to property, large expense, and no regulatory mechanisms in place for this type of restoration.
2. Protect and restore off-channel and side-channel habitats ***A. Restore historical off-channel and side-channel habitats where they have been eliminated*** ***B. Provide access to blocked off-channel habitats*** ***C. Create new off-channel or side-channel habitats (i.e., spawning channels)***					
Chinook River ***Wallacut River and other small tributaries***	• Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats • Altered habitat unit composition	• Artificial confinement • Channel straightening • Floodplain filling	• Chum • Coho • Winter steelhead	2-15 years	Good potential benefit especially for chum, which have lost a significant portion of historically available off-channel habitat for spawning. Potential benefit is limited by moderate probability of success with creation of new habitats. There are challenges with implementation due to existing infrastructure already in place, private property, and large expense. No regulatory mechanisms in place for this type of restoration
3. Protect and restore riparian function ***A. Reforest riparian zones*** ***B. Allow for the passive restoration of riparian vegetation*** ***C. Livestock exclusion fencing*** ***D. Invasive species eradication*** ***E. Hardwood-to-conifer conversion***					
Chinook River ***Wallacut River and other small tributaries***	• Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream	• Timber harvest – riparian harvests • Riparian grazing • Clearing of vegetation due to rural residential and agricultural	• All species	20-100 years	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. Riparian protections on forest lands are provided for under current harvest policy. Riparian restoration projects are relatively inexpensive and are often supported by landowners. The

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
	woody debris • Exotic and/or noxious species	uses			specified stream reaches are the highest priority for riparian measures, however, riparian restoration and preservation should occur throughout the basin since riparian conditions affect downstream reaches.
4. Protect and restore fish access to channel habitats ***A. Chinook River*** ***B. Wallacut River*** ***C. Other small streams***					
Chinook River Tidegate at mouth of Chinook River Freshwater Creek (City of Chinook water supply) ***Wallacut River*** Tidegates ***Small streams between Chinook and Megler*** Culverts under Hwys 401 & 101	• Blockages to channel habitat	• Passage obstruction	• All species	Immediate	Good potential benefit, especially because tidegate removal will also help to restore natural hydrologic fluctuations. There are efforts currently underway to remove the tidegate at the mouth of the Chinook River and to upgrade culverts under Highways 401 and 101 that may be restricting passage to several small streams.
5. Protect and restore natural sediment supply processes ***A. Address forest road related sources*** ***B. Address timber harvest related sources*** ***C. Address agricultural sources***					
Entire basin	• Excessive fine sediment • Embedded substrates	• Timber harvest – impacts to sediment supply • Forest roads – impacts to sediment supply • Agricultural practices – impacts to sediment supply	• All species	5-50 years	High potential benefit due to sediment effects on egg incubation and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs and forest land HCPs. There are challenges with implementation on agricultural lands due to few sediment-focused regulatory requirements for agricultural lands. Use IWA impairment ratings to identify restoration and preservation opportunities.
6. Protect and restore runoff processes ***A. Address forest road impacts*** ***B. Address timber harvest impacts***					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Timber harvest – impacts to runoff • Forest roads – impacts to runoff	• All species	5-50 years	High potential benefit due to flow effects on habitat formation, redd scour, and early rearing. Improvements are expected on timber lands due to requirements under the new Forest Practices Rules (FPRs) and forest land HCPs. Use IWA impairment ratings to identify restoration and preservation opportunities.
7. Protect and restore instream flows ***A. Water rights closures*** ***B. Purchase or lease existing water rights*** ***C. Relinquishment of existing unused water rights*** ***D. Enforce water withdrawal regulations*** ***E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Water withdrawals	• All species	Immediate	Instream flow management strategies for the Estuary Tributaries basin have been identified as part of Watershed Planning for WRIA 25 (LCFRB 2004). One of the major withdrawals in the basin is the City of Chinook's water supply from Freshwater Creek (Chinook River tributary).
8. Protect and restore instream habitat complexity ***A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting*** ***B. Structurally modify stream channels to create suitable habitat types***					
Chinook River ***Wallacut River and other small tributaries***	• Lack of stable instream woody debris • Altered habitat unit composition	• None (symptom-focused restoration strategy)	• All species	2-10 years	Moderate potential benefit due to the high chance of failure. Failure is probable if habitat-forming processes are not also addressed. These projects are relatively expensive for the benefits accrued. There is a moderate likelihood of implementation given the lack of hardship imposed on landowners and the current level of acceptance of these type of projects.
9. Protect and restore water quality ***A. Restore the natural stream temperature regime***					
Entire basin	• Altered stream temperature regime	• Riparian harvests • Riparian grazing	• All species	1-50 years	Primary emphasis for restoration should be placed on stream segments that are listed on the 2004 303(d) list.
10. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
A. Plan growth and development to avoid sensitive areas (e.g., wetlands, riparian zones, floodplains, unstable geology) ***B. Encourage the use of low-impact development methods and materials*** ***C. Apply mitigation measures to off-set potential impacts***					
Entire basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	The focus should be on management of land-use conversion and continued development in sensitive areas (e.g., wetlands, stream corridors, unstable slopes). Many critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary mechanisms need to be put in place to restore currently degraded habitats.
11. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection ***A. Purchase properties outright through fee acquisition and manage for resource protection*** ***B. Purchase easements to protect critical areas and to limit potentially harmful uses*** ***C. Lease properties or rights to protect resources for a limited period***					
Entire basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit where other protection measures such as incentives and regulation do not provide adequate protection These programs are under-funded and have low landowner participation.

Program Gap Analysis

The Estuary Tributaries Basin (~41 sq mi) is located in Pacific County. The Basin can be characterized as predominantly forested, with agricultural uses occurring in the Wallacut and Chinook River valleys.

- No federal land ownership in the Estuary Tributaries Basin.
- Approximately 2 square miles of state-owned land (Washington State Parks) is located within in the watersheds of the estuary tributaries.
- Approximately 39 square miles are in private ownership; a high percentage of the private ownership is in small- and industrial forest use.
- The watersheds of the estuary tributaries are located in Pacific County.

Protection Programs

Federal and state regulatory agencies, Pacific County, regional agencies, nonprofit organizations and landowners implement protection programs in the Estuary Tributaries Basin. Protection programs in this analysis include those programs that protect habitat conditions or watershed functions through regulatory measures, acquisition of sensitive habitats or protective easements, incentives, or by applying standards to new development that protects resources by avoiding damaging impacts. Major programs implementing protection measures in the watersheds of the estuary tributaries are identified below.

Federal Programs

➢ ***U.S. Army Corps of Engineers***

- Regulatory Programs: The Corps of Engineers administers the Section 10 (Rivers and Harbor Act) and Section 404 (Clean Water Act) permit processes. Section 10 requires approval of any activity in, above, or below a navigable river, which affects course, location, condition, or capacity of navigable waters. Section 404 requires prior approval of dredging, filling, grading, clearing, and bank hardening. In waters used by listed fish species, the permits are subject to ESA Section 7 consultation with NOAA Fisheries to ensure that any approved action is adequately protective of the fish; [M.1A; M.2A; M.2B; M.4A; M.8A; M.8B]

State Programs

➢ ***Department of Natural Resources***

- State Forest Land HCP:

  State forest lands are managed under the provisions of a Habitat Conservation Plan (HCP). The Habitat Conservation Plan protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. [Relates to M.3, M.5, M.6, and M.9]

- State Forest Practices:

Riparian areas and watershed functions on small- and industrial forest lands are protected under the State of Washington Forest Practices Rules, including the Forest and Fish Module. These rules provide for riparian buffers, harvest restrictions, sensitive area protections, and protective standards for new road construction. [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B]

- ***Washington Department of Fish and Wildlife***

  - Washington State Hydraulic Code

    The Washington State Hydraulic Code is administered through the Washington Department of Fish and Wildlife. The purpose of this program is to protect stream conditions and habitat. The regulations apply to such activities as stream bank protection, instream construction, culvert installation, channel changes or realignments, debris removal, and water diversion facilities. Those proposing such actions must obtain a Hydraulic Project Approval (HPA) permit; [M.1A; M.2A; M.2B; M.4A; M.8A; M.8B]

  - Habitat Program: The Department provides advice to local governments and landowners interested in measures to protect habitat values on their property.

- ***Washington Departments of Ecology and the Department of Fish and Wildlife***

  - Water Resources Program/Water Rights: Department of Ecology, in consultation with the Department of Fish and Wildlife, has administrative closed selected areas within the watersheds of the estuary tributaries to surface and groundwater withdraws (where groundwater is in continuity with surface water) to protect fish. Existing administrative closures by the Department of Ecology protect surface waters from further withdrawals. Formal rule-making would strengthen the closures. The extent of unauthorized surface water withdrawals is unknown, but could exacerbate summer low flows. [M.7A; M.7B; M.7C; M.7D]

- ***Salmon Recovery Funding Board (SRFB)/Lower Columbia Fish Recovery Board***

  - Washington Salmon Recovery Act: The SRFB and the LCFRB jointly administer a grant program that allocates federal Pacific Salmon Recovery Funds and State funds for habitat protection and restoration projects by state and local agencies, nonprofit organizations, and landowners. To date the SRFB has provided $775,000 in grants to protect and restore the Chinook watershed.

Local Government Programs

- ***Pacific County***

  - Land Use:

  Lands within Pacific County have multiple zoning overlays. Predominant zones include rural, agriculture, industrial, transitional forest and conservation. In addition, the County has a critical areas ordinance for protecting sensitive areas; [M.10A; M.10B; M.10C]

- Fisheries Habitat Regulations:
  - ✓ Pacific County's policy is to protect habitat conservation areas and adopts the DNR's Official Water Type Maps.
  - ✓ *Standard Stream Setback Width Requirements*:
    Type 1: 100'
    Type 2: 100'
    Type 3: 100'
    Type 4: 50'
    Type 5: 25'
  - ✓ Prohibited activities within stream setbacks include removal of more than 30% of stream bank tree canopy within any ten years, land filling or grading, and land clearing or vegetation removal that results in exposure of bare earth.

➢ ***Pacific County Conservation District and NRCS*** offers technical advice, and incentive programs to assist interested landowners in the protection of watershed processes and habitat. (e.g., CREP). [M.3B; M.3C; M.3D; M.4B; M.5C; M.8A; M.8B; M.8C; M.9A; M.11C]

Community Programs

➢ ***Sea Resources*** is a nonprofit organization is committed to the restoration and protection of the Chinook River watershed. It leads a broad partnership of federal and state agencies and other organizations that has acquired, through outright purchase and donation, approximately 1100 acres in the lower Chinook River; [M.11A; M.11B]

Restoration Programs

Restoration programs in the Estuary Tributaries Basin are implemented by a variety of agencies, organizations, and private interests. Major programs implementing protection measures are identified below:

Federal Programs

➢ ***U.S. Army Corps of Engineers***

- Chinook River Restoration: The Corps of Engineers is active partner in the Chinook River restoration efforts lead by Sea Resources. The Corps provides technical, engineering and design services and funding.

- Lower Columbia Ecosystem Restoration General Investigation: Oregon and Washington have entered into a cooperative agreement with the Corps of Engineers to conduct a study providing a comprehensive engineering and environmental background for restoration actions. The study will serve as a tool for furthering the recovery of ESA listed salmonids and as well as habitat conditions for many non-listed species. The extent to which tributaries will be included in the study will be determined during phase 1 of the study. The study could result in a collaborative cost-share restoration effort.

State Programs

- ***Washington Department of Natural Resources***

  - State Forest Land HCP:

    State forest lands are managed under the provisions of a Habitat Conservation Plan (HCP). The Habitat Conservation Plan protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. [Relates to M.3, M.5, M.6, and M.9]

  - State Forest Practice Rules: Large Industrial forests within the watersheds of the estuary tributaries are governed by Forest and Fish regulations and have rigid schedules for maintaining and improving roads and removing barriers. Industrial landowners have 15 years to bring roads and barriers into compliance with regulations. Small private forest owners are governed by Forest and Fish regulations; however their road and barrier maintenance and improvement programs are tied to state funding. In the State 2003-05 Biennial Budget, 2 million dollars was allocated statewide to support small private forest owners. [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8A; M.8C; M.9A]

- ***Washington Department of Fish and Wildlife***

  - Habitat Program: WDFW is an active participant in efforts lead by Sea Resources to protect and restore estuarine wetlands in the lower Chinook watershed.

- ***Washington Department of Transportation***

  - Barrier Removal: WSDOT is a partner with Sea Resources and the U.S. Army Corp of Engineers in the design and replacement of the I-101 Astoria Bridge.

- ***Salmon Recovery Funding Board/Lower Columbia Fish Recovery Board:***

  - Washington Salmon Recovery Act (RCW 77.85): The SRFB and the LCFRB jointly administer a grant program that allocates federal Pacific Salmon Recovery Funds and State funds for habitat protection and restoration projects by state and local agencies, nonprofit organizations, and landowners. To date the SRFB has provided $775,000 in grants to protect and restore the Chinook watershed.

Local Government Programs

- ***Pacific County***

  - Passage Restoration:

    The County's Public Works Program has conducted an assessment of county culverts through the SSHEAR database and is working to replaces and/or upgrades barriers associated with county roads.

  - Wildlife Habitat Regulations:

    Fish and wildlife habitat conservation areas include areas with which endangered, threatened, and sensitive species have a primary association, such as commercial and recreational shellfish beds, kelp and eelgrass beds, and waters of the state. Mitigation actions must address restoration, rehabilitation, and alternatives according to specific requirements.

- ***Pacific Conservation District and NRCS*** work directly with agriculture interests in the Estuary Tributaries through farm planning, and activities associated with the Conservation Reserve Enhancement Program; [M.3A; M.3B; M.3C; M.4A; M.5C, M.8B; M.8C; M.9A]

- ***Pacific County Noxious Weed Control Board***

  - The Board has three primary programs that address weed control in the Estuary Tributaries Basin; [M.3D]
    - ✓ Public education to prevent the spread of noxious weeds;
    - ✓ Survey of the County to assess emerging issues; and
    - ✓ Enforcement of noxious weed control

Regional Programs

- ***Columbia River Estuary Study Task Force (CREST)***

CREST is a council of local governments (counties, cities, ports) in the lower Columbia and estuary. It provides technical planning assistance and environmental analyses, conducts public education efforts, and implements habitat protection and restoration actions in the lower 46 miles of the Columbia River. Columbia River Estuary Regional Management Plan developed by CREST provides an inventory of the physical, biological, and cultural characteristics in the estuary. CREST is a partner in restoration efforts in the Chinook and Wallicut watersheds.

- ***Lower Columbia River Estuary Partnership***

Established pursuant to the National Estuary Program, the Lower Columbia River Estuary Partnership leads a collaborative effort by federal, state, tribal, and local interests to improve ecosystem conditions in the lower river and estuary.

- Water Quality Monitoring
  LCREP administers a water quality monitoring program staffed by its staff and supported by local volunteers.

- Habitat Restoration
  LCREP provides guidance and allocates federal funding to implement habitat restoration activities in the estuary. The program has been active in Chinook River protection and restoration efforts.

Community Programs

- ***Sea Resources***

  - Chinook River Watershed Restoration Management Plan
    In collaboration with Ducks Unlimited, Columbia Land Trust, the Lower Columbia Fish Recovery Board and other state and federal agencies, Sea Resources is restoring estuarine

and riparian habitats in the Chinook River. This is the largest estuarine renovation project in the Columbia River Estuary; [M.1A; M.2A; M.2B; M.2C; M.3A; M.3B; M.4A; M.9A]

Gap Analysis

Forest-related Programs: In the watersheds of the estuary tributaries, forestry programs have a substantial role in protecting and restoring watershed functions and habitat conditions at levels supporting recovery goals. Forests cover a high percentage of the basin. Certainty of forestry-related protection and restoration is relatively high because programs are being implemented and, for the most part, fully funded. Program areas of concern include state funding for small commercial forest landowners and the continued potential for hydrologic impacts caused by past harvest practices. Monitoring of watershed processes and habitat conditions will be required to confirm the effectiveness of these measures.

Protection-related Programs: Lands in the watersheds of the estuary tributaries have protections through Pacific County's land use regulations, as well as the regulatory authorities of the Corps of Engineers and the state Department of Fish and Wildlife. Acquisition programs by Sea Resources and Columbia Land Trust have effectively acquired lands for additional restoration and subsequent protection. As in all lower Columbia subbasins, there are very limited regulatory mechanisms for agricultural practices relative to protection of riparian areas and hydrologic processes.

Restoration-related Programs: Over a long period of time, improvements to the estuary tributaries will occur as a result of improved forest management practices that are already in place. Increased emphasis should be placed on restoring floodplain function and channel migration, as well as restoring off- and side-channel habitats.

Table 2-7. Program Actions to Address Gaps

Action #	Lead Agency	Proposed Action
EST TRIB.1	Pacific County	Develop and implement controls to adequately protect riparian areas to maintain currently functional and restored habitat around rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Require mitigation, where necessary, to offset unavoidable damage to habitat conditions in riparian management areas
EST TRIB.2	Pacific County	Development and implement controls to protect historic stream meander patterns and channel migration zones and avoid hardening stream banks and shorelines
EST TRIB.3	Pacific County	Development and implement controls and development standards to adequately protect wetlands, wetland buffers, and wetland function.
EST TRIB.4	Pacific County	Develop and implement controls to address erosion and sediment run-off during (and after) construction to prevent sediment and pollutant discharge to streams, wetlands and other water bodies
EST TRIB.5	Pacific County	Apply land use and resource protection code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
EST TRIB.6	State of Washington	Provide state funding for small forest owners in the Estuary Tributaries Basin to a level sufficient to achieve the road and barrier improvements of Forest and Fish on a schedule parallel to private industrial forest owners
EST TRIB.7	Forest Managers LCFRB, and DFW	Identify and sequence early action forest-wide restoration projects that analysis indicates could provide significant benefits. In these cases, it may be appropriate to identify outside funding to initiate these early actions
EST TRIB.8	LCFRB, USFS, WDNR. WSDOT, Counties, private property owners.	Develop and implement a coordinated and strategic barrier removal program based on watershed fish priorities and ensuring an effective and efficient sequencing of barrier removal work.
EST TRIB.9	Pacific County	Utilize a combination of public outreach/education and, incentives, and to promote (1) stewardship practices for protecting habitat and water quality and (2) landowner support of and participation in habitat restoration efforts.
EST TRIB.10	State of Washington (DOE, DFW)	Close the Estuary Tributaries Basin to further surface water withdrawals, including groundwater in connectivity with surface waters; curtail unauthorized withdrawals
EST TRIB.11	LCFRB, WDFW, Pacific County, Pacific CD, LCFEG	Build capacity (e.g. technical and administrative skills, personnel and fiscal resources) needed to allow agencies and organizations to undertake protection and restoration projects, including noxious weed control in a reasonable period time.
EST TRIB.12	SRFB, BPA, NOAA, USFWS, DOE, ACOE	Increase available funding for projects that implement measures and address underlying threats
EST TRIB.13	State of Washington (Dept of Agriculture, and Department of Ecology)	Develop and implement agricultural practices and regulations to protect riparian conditions and water quality
EST TRIB.14	Pacific Conservation District	Expand landowner incentive (e.g. CREP) and education plans to promote further habitat protection and restoration.
EST TRIB.15	LCFRB, Pacific CD, Pacific County,	Address threats proactively by building agreement on priorities among the various program implementers
EST TRIB.16	FEMA	Update floodplain maps using Best Available Science

3 Grays River Subbasin

Figure 3-1. Location of the Grays River Subbasin within the Lower Columbia River Basin.

3.1 Basin Overview

The Grays River Subbasin comprises approximately 124 square miles, in Wahkiakum and Pacific counties. The river enters the Columbia at RM 21, near the town of Oneida, Washington. Tidal influence extends upriver for 6 miles. Principal tributaries include Hull Creek, and the East, West, North and South Forks. The subbasin is part of WRIA 25.

The Grays Subbasin will play a key role in the recovery of salmon and steelhead. The subbasin has historically supported populations of fall Chinook, winter steelhead, chum, and coho. Today, Chinook, steelhead and chum are listed as threatened under the ESA. Coho salmon are a candidate for listing. Other fish species of interest are Pacific lamprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

Grays salmon and steelhead are affected by a variety of in-basin and out-of basin factors including stream, Columbia River mainstem, estuary, and ocean habitat conditions; harvest; hatcheries; and ecological relationships with other species. Analysis has demonstrated that recovery cannot be achieved by addressing only one limiting factor. Recovery will require action to reduce or eliminate all manageable factors or threats. The deterioration of habitat conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonids within the Columbia Basin. There is no direct harvest of listed salmon and steelhead but sport and commercial fisheries focusing on hatchery fish and other healthy wild populations, primarily in the mainstem Columbia and ocean, incidentally affect ESA-listed Grays fish. Grays River and Sea Resources hatcheries operate within the basin with the potential to both adversely affect wild salmon and steelhead populations and to assist in recovery efforts. Key ecological interactions of concern include effects of nonnative species; nutrient inputs from salmon carcasses; and predation by species affected by development including Caspian terns, northern pikeminnow, seals, and sea lions. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the Grays Subbasin.

Approximately 95% of the Grays Subbasin is forested and commercial timber companies own 73% of the land. State ownership comprises the bulk of the remaining lands. Much of the basin has been impacted by timber harvest and is primarily composed of young forest stands. Approximately 500 acres of the lower Grays River has been acquired by the Columbia Land Trust for protection of natural resources.

Although the majority of the basin is commercial forest land, there is also substantial agricultural development in the lower mainstem river valley and along the lower reaches of mainstem tributaries. Forest harvest and agricultural development have left the subbasin with nearly 70% of vegetation in young forest or non-forested conditions. A major impact on native fish populations is the reduction in backwater habitats in the lower river within tidal influence, which is associated with agricultural development near the mouth. These changes have sharply reduced the habitats available to chum.

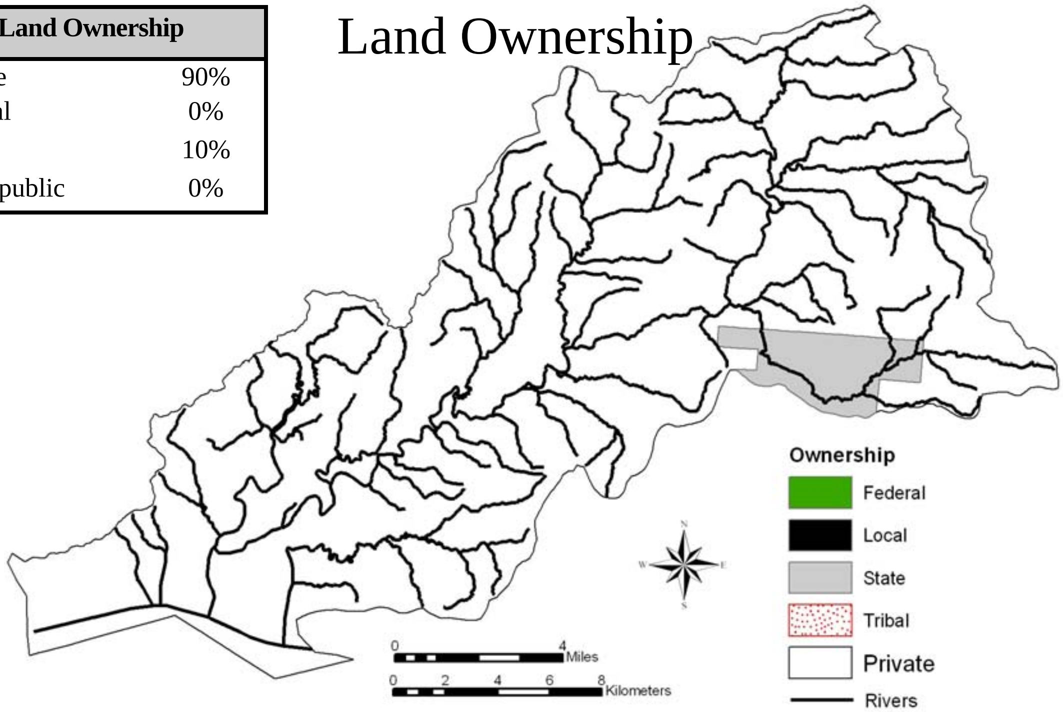
Several general areas of importance can be identified from the Grays assessments. First, forest harvest and related road building on steep, unstable slopes have contributed to increased sedimentation of stream channels and elevated risk of peak flow increases. These conditions affect nearly all of the key habitats for fish populations in the subbasin, especially the critical mainstem spawning and rearing reaches. Furthermore, the potential for continued degradation is high due to the dominance of private timber land in the subbasin. New forest practices regulations regarding timber harvest on steep slopes will likely allow for some degree of passive restoration of impaired sediment delivery processes over time.

A second area of importance is the severe channelization (and subsequent loss of backwater habitats) and riparian degradation that has negatively affected conditions for chum, coho, fall Chinook, and to some degree winter steelhead, in the lower mainstem. Channelization and riparian degradation are mostly related to extensive agricultural development. The spawning reaches Grays 1G tidal and Grays 2 are particularly important for preservation and restoration measures that would provide benefits to multiple species.

The only population centers in the basin are the unincorporated towns of Grays River, Rosburg, and Chinook. Projected population change from 2000-2020 for unincorporated areas in WRIA 25 is 37% (LCFRB 2001). Population growth will result in the 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 critical habitats and the conditions that create and support them.

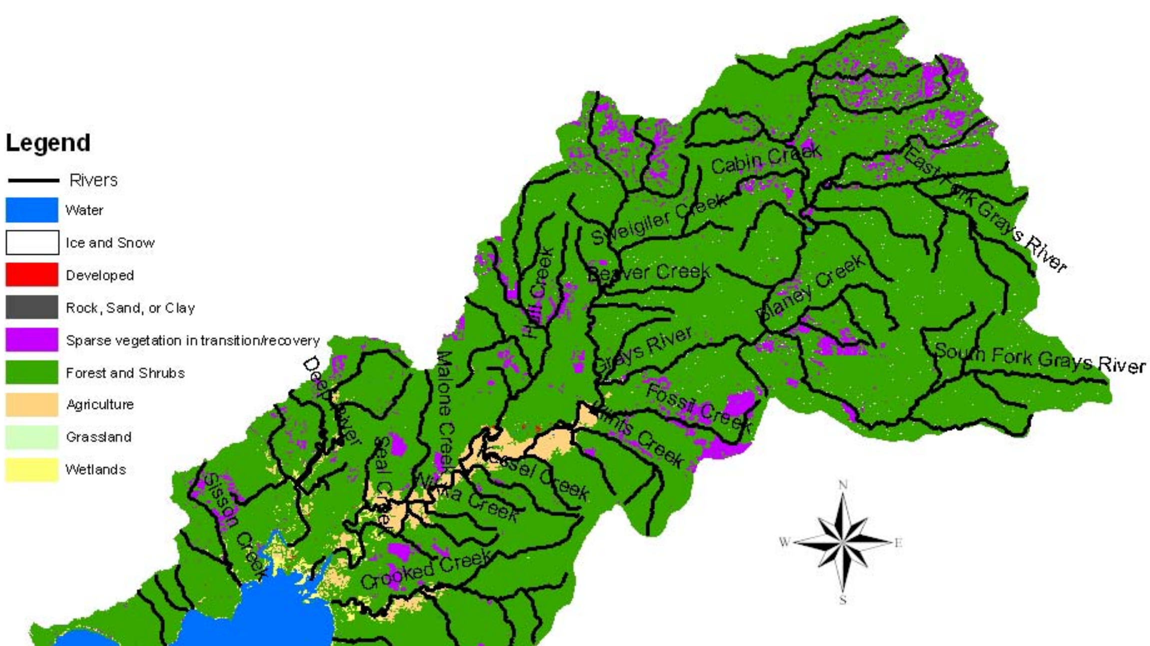
Land Ownership	
Private	90%
Federal	0%
State	10%
Other public	0%

Land Ownership



Vegetation Composition	
Late Seral	1%
Mid Seral	30%
Early Seral	14%
Other Forest	43%
Non Forest	4%

Land Use / Cover



3.2 Species of Interest

Focal salmonid species in the Grays River and Chinook River watersheds include fall Chinook, winter steelhead, chum and coho. The current health or viability of the focal populations ranges from low for coho to low-medium for chum, fall Chinook, and winter steelhead. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Recovery goals call for restoring all four populations to a high or very high viability level. This level will provide for a 95% or better probability of population survival over 100 years.

Other species of interest in the Grays/Chinook area include coastal cutthroat trout and Pacific lamprey. Regional objectives for these species are described in Volume I, Chapter 6. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for these other species. Cutthroat will benefit from improvements in stream habitat conditions for salmonids. Lamprey are also expected to benefit from habitat improvements in the estuary, Columbia River mainstem, and Grays subbasin although specific spawning and rearing habitat requirements of lamprey are not well known.

Table 3-1. Current viability status of Grays/Chinook 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	No	Low+	100-300	High	1,400-1,400
Winter steelhead	Threatened	Yes	Low+	400-600	High	600-2,300
Chum	Threatened	Yes	Low+	500-10,000	High+	4,300-7,800
Coho	Candidate	Yes	Low	unknown	High	unknown

<u>Fall Chinook</u> – The historical Grays/Chinook adult population is estimated from 1,500-10,000 fish. The majority of fish returned to the Grays River. Current natural spawning returns to the Grays River range from 100-300 fish. Spawning in the Grays occurs primarily in the mainstem Grays between tidewater and the West Fork, and in the West Fork downstream of the Grays River Hatchery. Juvenile rearing occurs near and downstream of the spawning areas. Juveniles emerge in early spring and migrate to the Columbia in spring and summer of their first year.

<u>Winter Steelhead</u> – The historical Grays River adult population is estimated to be about 4,500 fish. Current natural spawning returns range from 400-600. Interaction with Chambers Creek/Beaver Creek stock hatchery steelhead is likely lower due to different spawn timing. Spawning occurs in the mainstem, East, West, and South Forks of the Grays River, and in Mitchell Creek. 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 to the Columbia River.

<u>Coho</u> – The historical Grays River/Chinook adult population is estimated from 5,000-40,000 fish, with the returns being late stock which spawn from late November to March. Current returns are unknown but assumed be low. A number of hatchery produced fish spawn naturally. Natural spawning occurs primarily in upper mainstem, South Fork, West Fork, Crazy Johnson Creek, and Hull Creek. Spawning also occurs in vicinity streams, including Crooked, Hitchcock, and Jim Crow creeks. Juvenile rearing occurs upstream and downstream of spawning

areas. Juveniles rear for a full year in these basins basin before migrating as yearlings in the spring.

Chum – The historical Grays/Chinook adult population is estimated from 8,000-14,000 fish. Current returns range from 500-10,000 fish. Spawning in the Grays River occurs in the lower mainstem (RM 9.5-13), the lower 1.4 miles of the West Fork, the lower 0.5 miles of Crazy Johnson Creek, and in Gorley Creek. The current returns to the Grays River are predominately from natural production except for a minor contribution from a small enhancement hatchery program at Grays River Hatchery. In the Chinook River, natural spawning occurs in the lower 5 miles of the mainstem. Most fish are produced from Sea Resources Hatchery, which is using Grays River stock chum to supplement natural production. Peak spawning occurs in late November-early December. Juveniles emerge in the early spring and migrate to the Columbia after a short rearing period.

Coastal Cutthroat – Coastal cutthroat abundance in the Grays/Chinook area has not been quantified but the population is considered depressed. Cutthroat trout are present throughout the basin. Both anadromous and resident forms of cutthroat trout are present in the basin. Anadromous cutthroat enter the Grays from late July-mid April and spawn from January through April. Most juveniles rear 2-3 years before migrating from their natal stream.

Pacific lamprey – Information on lamprey abundance is limited and does not exist for the Grays/Chinook population. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have also declined in the Grays and Chinook rivers. 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.

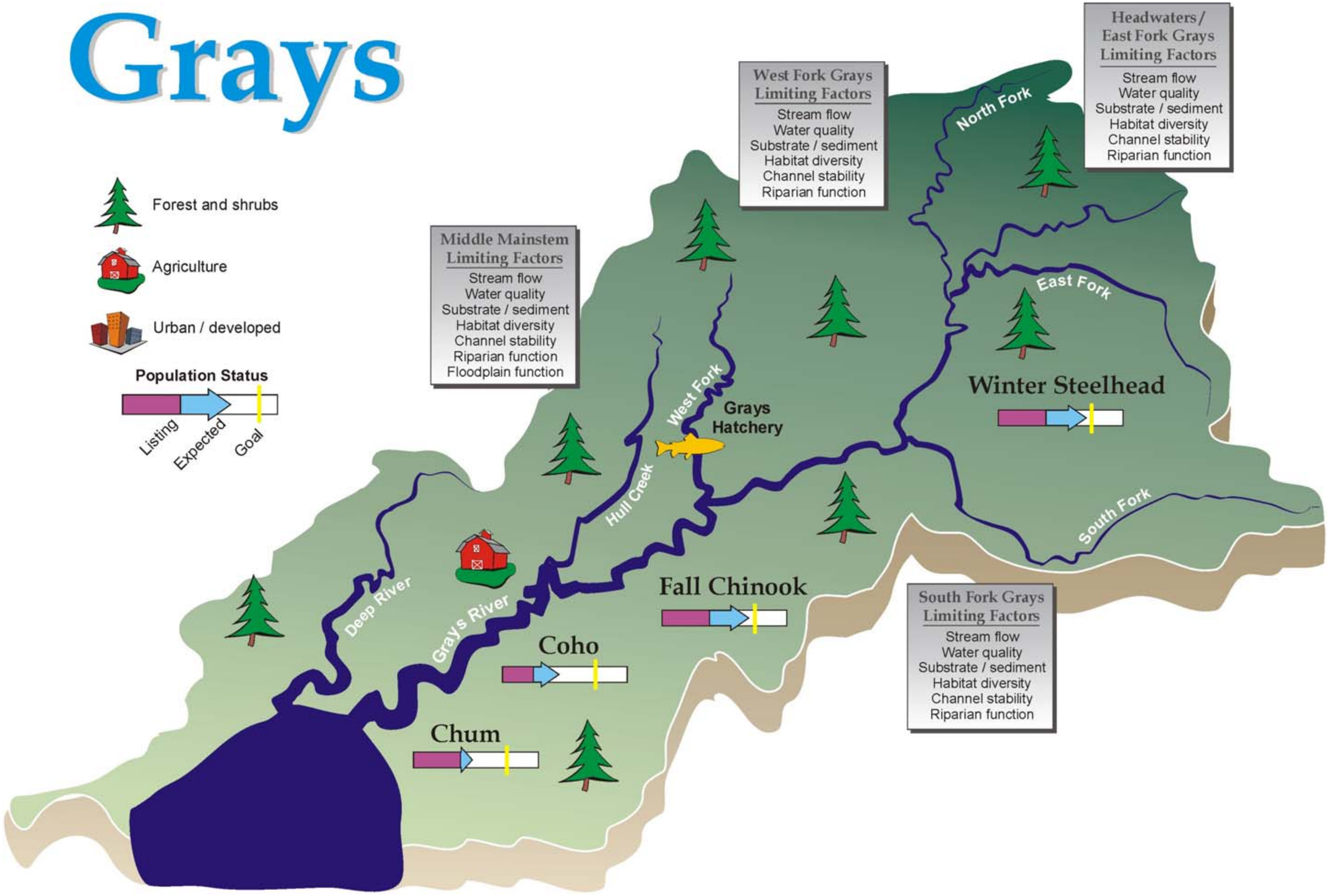


Figure 3-2. Summary of habitat limiting factors, population status, expected population improvement trend with existing programs, and biological objectives depicted for the Grays Subbasin.

3.3 Potentially Manageable Impacts

Stream habitat, estuary/mainstem habitat, harvest, hatchery and predation effects have all contributed to reduced salmonid productivity, numbers, and population viability in the Grays Subbasin. The pie charts below represent the relative order of magnitude of quantifiable effects for each of these factors for each focal species. The preferred recovery scenario targets an equivalent reduction in each impact factor in proportion to the magnitude of the effect. Population-specific targets are discussed in further detail in Volume I, Chapter 6.

- Loss of tributary habitat quality and quantity accounts for the largest relative impact on all species. Loss of estuary habitat quality and quantity is also relatively important for all species, but less so for coho.
- Harvest has a sizeable effect on fall Chinook, but is relatively minor for chum and winter steelhead; harvest impact on coho is intermediate.
- Hatchery impacts are substantial for coho, moderate for fall Chinook, and relatively low for chum and winter steelhead.
- Predation impacts are moderate for all species.
- Hydrosystem access and passage impacts appear to be relatively minor for all species.

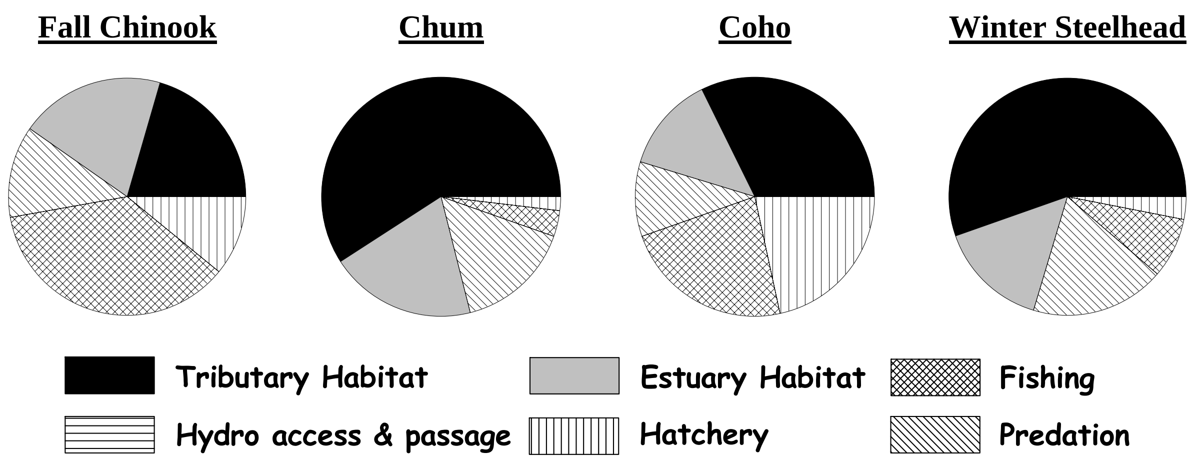


Figure 3-3. Relative contribution of potentially manageable impacts for Grays populations.

3.4 Limiting Factors, Threats, and Measures

3.4.1 Hydropower Operation and Configuration

There are no hydro-electric dams in the Grays River Basin. However, Grays species are affected by mainstem Columbia hydro operations and flow regimes which affect habitat in migration corridors and in the estuary. Mainstem hydro factors and threats are addressed by regional strategies and measures identified in Volume I.

3.4.2 Harvest

Most harvest of wild Grays River salmon and steelhead occurs incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. This mortality is very low for chum and steelhead, but is more significant for fall Chinook. Grays River fall Chinook are harvested in ocean and Columbia River commercial sport fisheries Harvest is controlled by an ESA harvest limit associated with Coweeman natural fall Chinook. In-basin sport fisheries are closed to the retention of Chinook. No harvest of chum occurs in ocean fisheries, there is no directed Columbia River or Grays basin chum fisheries and retention of chum is prohibited in Columbia River and Grays/Chinook River sport fisheries. Chum are impacted incidental to fisheries directed at coho and winter steelhead. Harvest of Grays 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 Grays basin. Wild coho impacts are limited by fishery management to retain marked hatchery fish and release unmarked wild fish. 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.

Measures 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. The regional measures 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 Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest measures with significant application to the Grays Subbasin populations are summarized in the following table:

Table 3-2. Regional harvest measures from Volume I, Chapter 7 with significant application actions to the Grays Subbasin populations.

Measure	Description	Comments
F.M13	Develop a regional mass marking program for tule fall Chinook	Retention of salmon is prohibited in Grays River sport fisheries, however marking of other hatchery tule Chinook would provide regional selective fishing options.
F.M17	Monitor chum handle rate in winter steelhead and late coho tributary sport fisheries.	State agencies would include chum incidental handle assessments as part of their annual tributary sport fishery sampling plan.
F.M18	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	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.M19	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	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.M24	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	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.

3.4.3 Hatcheries

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

Grays River Hatchery (since 1961) produces coho, spring Chinook, and steelhead for harvest opportunity and chum for natural population enhancement. The coho program includes releases into the Grays River as well as transfers to Deep River net pens. The spring Chinook are imported to Grays River Hatchery as eggs for incubation and rearing prior to transfer to the Deep River net pens. Winter steelhead are transferred from the Elcohoman Hatchery to Grays River Hatchery as eggs and released into the Grays River as smolts. The Elochoman Hatchery steelhead are a composite stock and are genetically different from the naturally-produced steelhead in the Grays River. The main threats from hatchery steelhead are 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 threats of the hatchery coho program are ecological interactions between natural juvenile salmon and hatchery coho in the Grays River and potential domestication of natural coho. The Deep River programs result in fish for harvest returning to Deep River, with negligible threats to natural populations

The Sea Resources Hatchery (since 1895) is operated by the non-profit Sea Resources Watershed Learning Center. It produces smaller numbers of chum, fall Chinook, and coho.

Since 1996, the goal of the hatchery programs is to restore naturally reproducing populations of salmon in the Chinook River in conjunction with habitat restoration projects.

Table 3-3. Grays/Chinook subbasin hatchery production.

Hatchery	Release Location	Fall Chinook	Spring Chinook	Chum	Coho	Winter Steelhead
Grays River	Grays River			300,000	150,000	40,000
	Deep River		200,000		400,000	
Sea Resources	Chinook River	107,500		147,500	52,000	

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 Grays/Chinook 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 Technical Foundation, Volume IV). Regional hatchery measures identified in Volume I, Chapter 7 with potential applications at facilities within the Grays/Chinook subbasin are summarized in Table 3-4.

Table 3-4. Regional hatchery measures from Volume I, Chapter 7 with potential implementation actions in the Grays/Chinook Subbasin.

Measure	Description	Comments
H.M32,40	Juvenile release strategies to minimize interactions with naturally spawning fish.	Release strategies are aimed at reducing or avoiding interactions with wild steelhead, fall Chinook, coho by release timing and release location strategies.
H.M34,41	Mark hatchery steelhead and coho with an adipose fin-clip for identification and selective harvest.	Marking hatchery fish allows for identification of hatchery fish in the natural spawning grounds and at collection facilities which enables accurate accounting of wild fish. Marking also enables selective fisheries to retain hatchery fish and release wild fish.
H.M24,36	Hatchery programs utilized for supplementation and enhancement of wild chum and coho populations.	The Grays Hatchery is currently used for supplementation and risk management of the Grays River chum population and Sea Resources Hatchery for enhancement of Chinook River chum, coho, and fall Chinook. Grays River Hatchery could be considered for a natural coho supplementation program.
H.M8	Adaptively manage hatchery programs to further protect and enhance natural populations and improve operational efficiencies.	Appropriate research, monitoring, and evaluation programs along with guidance from regional hatchery evaluations will be utilized to improve the survival and contribution of hatchery fish, reduce impacts to natural fish, and increase benefits to natural fish.
H.M2,6	Evaluate Grays River and Sea Resources Hatcheries facility operations.	Both facilities would be evaluated in the BRAP process for potential hazards associated with barriers to fish passage, adequacy of screens, and water quality.

3.4.4 Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Grays salmon and steelhead are affected throughout their lifecycle by ecological interactions with non native species, food web components, and predators. Interactions are similar for Grays populations to those of most other subbasin salmonid populations. Ecological Interactions are addressed by regional strategies and measures identified inVolume I.

3.4.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. 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 are similar for Grays populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook than steelhead and coho. Estuary and mainstem effects on Grays salmon and steelhead populations are addressed by regional strategies and measures identified in Volume I and the Columbia Mainstem and Estuary Subbasin sections of Volume II.

3.4.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity 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 Grays River subbasin have the greatest impact on the health and viability of salmon and steelhead relative to the other limiting factors and threats discussed in this chapter.

Subwatersheds, reaches, and habitat attributes have been prioritized for protection and/or restoration based on the plan’s biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Priority areas for habitat preservation and restoration are identified in Figure 3-4. A summary of the primary habitat limiting factors and threats are presented in Table 3-6. Habitat measures and related information are presented in Table 3-7. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 3-5. Reach- and subwatershed-scale limiting factors generated from the technical assessment are included in Table 3-5. Details on species-specific spatial priorities and limiting factors at the subbasin level may be found in Volume II of the Technical Foundation. A description of the methodology used to generate composite (multi-species) reach and subwatershed priorities can be found in the introduction to this volume of the recovery plan.

The areas with the greatest current or potential contribution to focal salmonid population health and productivity are listed below. Tier 1 and 2 reaches within these priority areas are included in the list. The habitat limiting factors, threats, and measures included in this chapter focus primarily on the priority areas and the Tier 1 and 2 reaches within them. Tier 3, 4, and non-tiered reaches are considered secondary priority, but in many cases, these lower priority areas will also require restoration and preservation actions in order to achieve recovery objectives. Watershed process measures generally focus on the entire basin as opposed to being limited only to high priority areas because conditions in high priority areas are often influenced by cumulative watershed effects. High priority areas and reaches in the Grays Subbasin include the following:

- Middle mainstem & tributaries – Grays 1F-3; Thadbar Cr lower; King Cr lower; Klints Cr lower; Fossil Cr lower; Gorley Cr 1; Crazy Johnson Cr
- Headwaters & East Fork Grays – Grays 3B-4C; Grays LF; Grays RF; Beaver Cr; EF Grays 1, 3-4, 6
- South Fork Grays – SF Grays 1-3; Blaney Cr 1

- West Fork Grays – WF Grays 1-4

The following paragraphs provide a brief overview of each of these priority areas, including species most affected, land-use threats, and the general type of measures that will be necessary for recovery. Additional detail can be found in the tables and figures that follow.

While reach level habitat conditions often result from local factors, they are also affected or shaped by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input, and large woody debris recruitment are often affected by or result from upstream conditions and degraded watershed processes. Access to key reaches may also be affected by barriers that occur downstream of a reach. Accordingly, restoration of a priority reach may require action outside the targeted reach. The IWA analysis was used to identify potential upstream watershed areas that could influence reach level habitat attributes. EDT was used to allow a relative comparison of reaches and habitat attributes within a reach.

Chum, coho, and fall Chinook are most impacted by conditions within the middle mainstem and the lower portion of middle mainstem tributaries (i.e., Fossil Creek, Crazy Johnson Channel). Agricultural uses dominate the riparian areas and floodplains of these reaches, with forestry activities as the primary use on the surrounding hillslopes. The channel has been altered significantly due to past splash-damming, channel straightening, streambank hardening, and more recent flood control activities. Effective recovery measures in these areas will entail restoring riparian areas, re-connecting floodplains, and addressing sites where mass wasting has contributed to large sediment loads and turbidity problems.

The mainstem headwaters, EF Grays River, SF Grays River, and WF Grays River primarily support winter steelhead spawning and rearing. These reaches have been impacted most by recent and historical forest practices (including splash dam logging), which have disrupted riparian function, hydrology, and sediment supply processes. Effective recovery measures will involve the passive restoration of mature riparian and hillslope forests as well as the restoration of sediment supply conditions through addressing the basin-wide road network and mass wasting sites in the stream corridor.

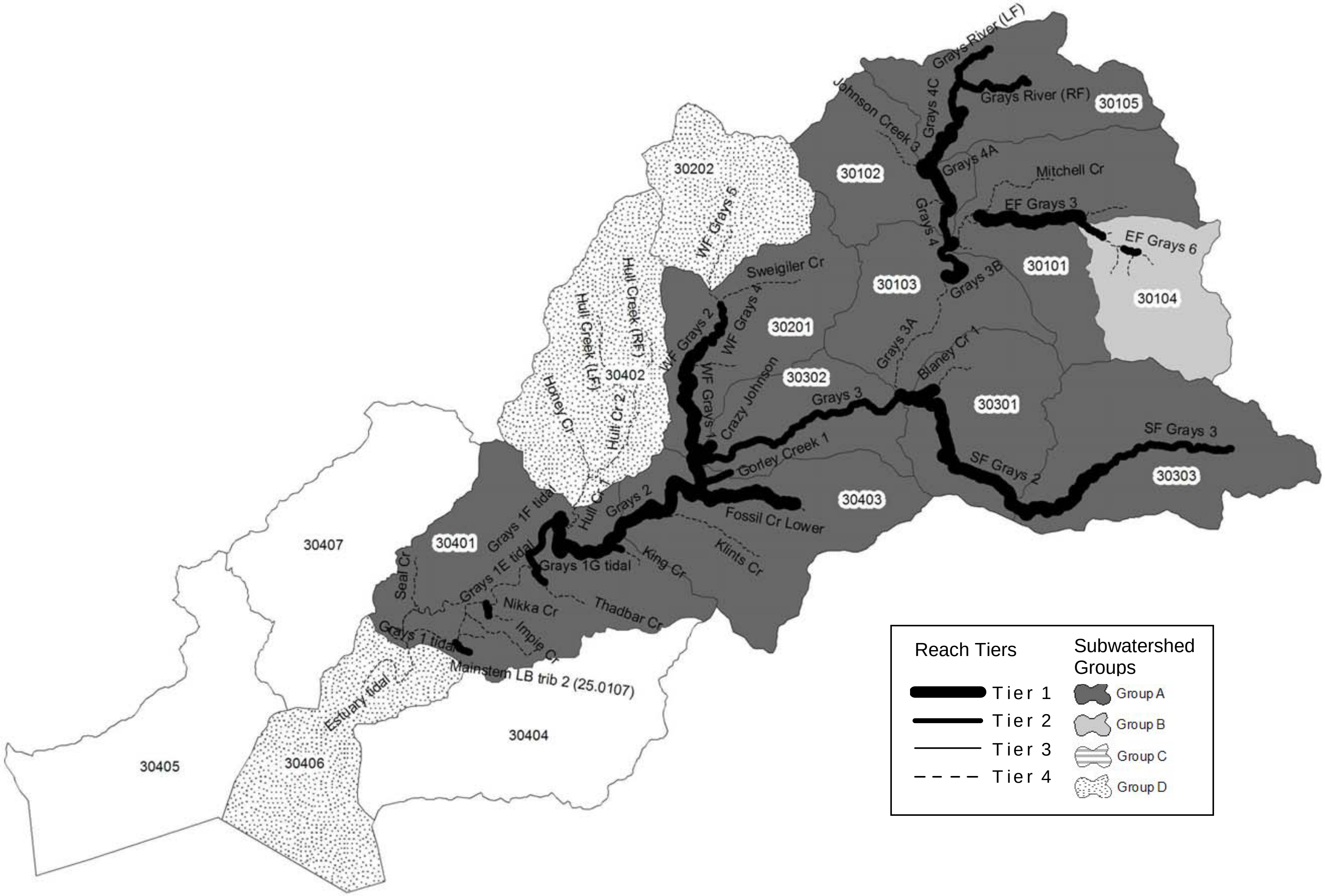


Figure 3-4. Reach tiers and subwatershed groups in the Grays Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities at the reach 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.

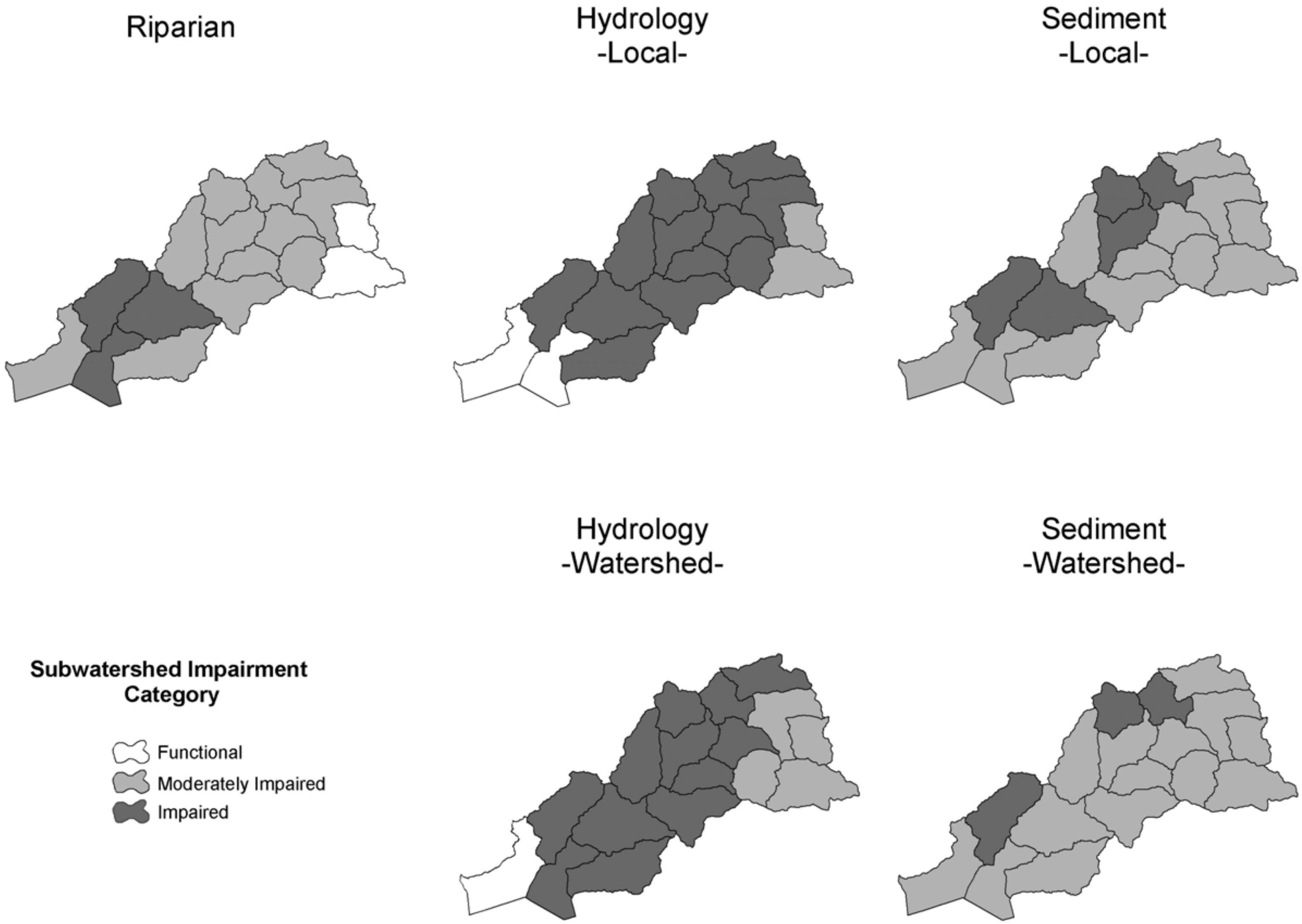


Figure 3-5. IWA subwatershed impairment ratings by category for the Grays Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 3-5. 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-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) Hydrology	Watershed processes (local) Sediment	Watershed processes (local) Riparian	Watershed processes (watershed) Hydrology	Watershed processes (watershed) Sediment
A	30403	Grays 2B Grays 2A Fossil Cr Lower Klints Cr Lower Gorley Creek 1 Gorley Creek 2 Fossil Cr Klints Cr	ChF	none				I	M	M	I	M
			Chum	Grays 2B Fossil Cr Lower Klints Cr Lower	Spawning Egg incubation Fry colonization Adult holding Adult migrant	habitat diversity sediment	PR					
			StW	Grays 2B	Egg incubation Summer rearing	none	PR					
			Coho	Grays 2B Grays 2A	Egg incubation Fry colonization Summer rearing	channel stability temperature sediment key habitat quantity	R					
	30401	Grays 2 Grays 1G tidal Grays 1F tidal King Cr Lower Nikka Cr Lower Thadbar Cr Lower Mainstem LB trib 1 (25.0105) Grays 1 tidal Grays 1B tidal Grays 1C tidal Grays 1D tidal Grays 1E tidal Hull Cr 1 Impie Cr Lower Seal Slough 1 Impie Cr King Cr Malone Cr Malone Cr Lower Nikka Cr Seal Slough 2 Thadbar Cr Mainstem LB trib 2 (25.0107) Seal Cr	ChF	Grays 2	Spawning Egg incubation Fry colonization Adult holding	sediment	P	I	I	I	I	M
			Chum	Grays 2	Egg incubation Fry colonization Adult holding	none	PR					
			StW	none								
			Coho	Grays 2 Grays 1G tidal	Egg incubation Summer rearing Winter rearing Adult holding	channel stability temperature predation sediment key habitat quantity	R					
	30302	Grays 2C Grays 2D Crazy Johnson Grays 3	ChF	none				I	M	M	I	M
			Chum	Grays 2C Grays 2D Crazy Johnson	Spawning Egg incubation Fry colonization Adult holding	habitat diversity sediment	PR					
			StW	none								
			Coho	Grays 2C	Egg incubation Summer rearing Winter rearing	channel stability temperature sediment key habitat quantity	R					
	30301	Blaney Cr 1 Blaney Cr 2 SF Grays 1 SF Grays 2	StW	Blaney Cr 1 SF Grays 1 SF Grays 2	Spawning Egg incubation Fry colonization Summer rearing Winter rearing Adult holding		R	I	M	M	M	M
	30201	WF Grays 1 Lower WF Grays 1 WF Grays 2 WF Grays 3 WF Grays 4 Shannon Cr Sweigiler Cr	ChF	none				I	I	M	I	M
			Chum	WF Grays 1 Lower	Spawning Egg incubation Fry colonization Adult holding	habitat diversity key habitat quantity	PR					
			StW	WF Grays 1 Lower WF Grays 1 WF Grays 2 WF Grays 3	Egg incubation Fry colonization Summer rearing Winter rearing	habitat diversity temperature flow sediment pathogens	PR					
			Coho	none								
	30105	Beaver Cr Grays 4B Grays 4C Grays River (LF) Grays River (RF)	StW	Beaver Cr Grays 4B	Egg incubation Fry colonization Summer rearing Winter rearing	habitat diversity flow sediment key habitat quantity	R	I	M	M	I	M
			Coho	none								
	30103	Grays 3B Grays 3C Grays 3A	StW	Grays 3B	Egg incubation Summer rearing	habitat diversity temperature flow sediment	R	I	M	M	I	M
	30102	Grays 4A Grays 4 Cabin Creek Johnson Creek 1 Johnson Creek 2 Johnson Creek 3	StW	Grays 4A	Egg incubation Summer rearing Winter rearing	habitat diversity sediment	R	I	I	M	I	I

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	30101	EF Grays 1 EF Grays 3 EF Grays 4 EF Grays 2 EF LB Trib 1 (not listed) EF RB trib 1 (not listed) Mitchell Cr	StW	EF Grays 1 EF Grays 3	Egg incubation Fry colonization Summer rearing Winter rearing	flow sediment	PR	I	M	M	M	M
A	30303	SF Grays 2 SF Grays 3	StW	SF Grays 2	Spawning Egg incubation Fry colonization Summer rearing Winter rearing Adult holding	sediment key habitat quantity	R	M	M	F	M	M
B	30104	EF Grays 6 EF Grays 5 EF Grays 7 EF LB Trib 2 (not listed) EF LB Trib 3 (not listed) EF RB trib 2 (not listed)	StW	none				M	M	F	M	M
D	30402	Hull Cr 2 Honey Cr Honey Cr Lower Hull Creek (LF) Hull Creek (RF)	Chum StW Coho	none none none				I	M	M	I	M
D	30202	WF Grays 5	StW	none				I	I	M	I	I
D	30406	Estuary tidal	All	none				F	M	I	I	M

Table 3-6. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the middle mainstem & tributaries (MM), headwaters/EF Grays (HW), South Fork Grays (SF), and West Fork Grays (WF). Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors	MM	HW	SF	WF
Habitat connectivity				
Blockages to off-channel habitats	✓			
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	✓			
Stream flow				
Altered magnitude, duration, or rate of change	✓	✓	✓	✓
Water quality				
Altered stream temperature regime	✓	✓	✓	✓
Excessive turbidity	✓		✓	✓
Bacteria	✓			
Substrate and sediment				
Excessive fine sediment	✓	✓	✓	✓
Embedded substrates	✓	✓	✓	✓

Threats	MM	HW	SF	WF
Agriculture / grazing				
Clearing of vegetation	✓			
Riparian grazing	✓			
Floodplain filling	✓			
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	✓			
Dredge and fill activities	✓			

Table 3-7. Habitat measures in priority areas, with reference to limiting factors addressed, threats addressed, target species, and estimated time until benefits would be realized (time). Tier 1 and 2 reaches, or other areas of known priority, are listed under the location column for some measures (i.e., stream corridor measures). Reaches not included in the table (Tiers 3, 4, and non-tiered reaches) are considered secondary priority.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
1. Protect and restore floodplain function and channel migration processes					
A. Set back, breach, or remove artificial channel confinement structures					
Middle mainstem + tribs Grays 1F-2D; Thadbar lower; King lower; Klints lower; Fossil lower	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes • Channel incision	• Floodplain filling • Channel straightening • Artificial confinement	• chum • Coho • Fall Chinook	2-15 years	Great potential benefit due to improvements in many limiting factors. This passive restoration approach can allow channels to restore naturally once confinement structures are removed. There are challenges with implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense.
2. Protect and restore off-channel and side-channel habitats					
A. Restore historical off-channel and side-channel habitats where they have been eliminated					
B. Provide access to blocked off-channel habitats					
C. Create new off-channel or side-channel habitats (i.e., spawning channels)					
Middle mainstem + tribs Grays 1F-2D; Thadbar lower; King lower; Klints lower; Fossil lower	• Blockages to off-channel habitats • Loss of off-channel and/or side-channel habitat • Altered habitat unit composition	• Floodplain filling • Channel straightening • Artificial confinement	• Chum • Coho	2-15 years	Good potential benefit especially for chum, which have lost a significant portion of historically available off-channel habitat for spawning. There has already been good success with this type of restoration in the Grays Basin (Gorley Creek, Crazy Johnson Creek). There are challenges with further implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense.
3. Protect and restore riparian function					
A. Reforest riparian zones					
B. Allow for the passive restoration of riparian vegetation					
C. Livestock exclusion fencing					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
D. Invasive species eradication ***E. Hardwood-to-conifer conversion***					
Middle mainstem + tribs Grays 1F-2D; Thadbar lower; King lower; Klints lower; Fossil lower ***Headwaters/EF Grays*** Grays 3B-4C, LF, RF; Beaver Cr; EF Grays 1, 3-4, 6 ***SF Grays*** SF Grays 1-3; Blaney 1 ***WF Grays*** WF Grays 1-4	• Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or noxious species	• Timber harvest – riparian harvests • Riparian grazing • Clearing of vegetation due to residential development and agriculture	• All species	20-100 years	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. Riparian protections on forest lands are provided for under current harvest policy. Riparian restoration projects are relatively inexpensive and are often supported by landowners. Whereas the specified stream reaches are the highest priority for riparian measures, riparian restoration and preservation should occur throughout the basin since riparian conditions affect downstream reaches. Use IWA riparian ratings to help identify restoration and preservation opportunities.
4. Protect and restore streambank stability ***A. Restore eroding streambanks*** ***B. Restore mass wasting (landslides, debris flows) within river corridors***					
Middle mainstem + tribs Grays 2C-2D; King lower; Klints lower; Fossil lower ***Headwaters mainstem*** Grays 4B-4C ***West Fork Grays*** WF Grays 1-4 ***South Fork Grays*** SF Grays 1-2 ***South Fork Grays*** SF Grays	• Reduced bank/soil stability • Excessive fine sediment • Excessive turbidity • Embedded substrates	• Artificial confinement • Clearing of vegetation • Roads – riparian / floodplain impacts • Riparian grazing • Timber harvest – riparian harvests	• All species	5-50 years	There are several areas of bank instability on the mainstem, including primarily the Gorley Spring area. Mass wasting sites (debris flows, landslides) create turbidity problems on middle mainstem tributaries, mainstem headwaters, WF, and SF reaches. Bio-engineered approaches that rely on structural as well as vegetative measures are the most appropriate restoration measures. These projects have a high risk of failure if causative factors are not adequately addressed.
5. Protect and restore natural sediment supply processes ***A. Address forest road related sources*** ***B. Address timber harvest related sources*** ***C. Address agricultural sources***					
Entire basin	• Excessive fine sediment	• Timber harvest –	• All species	5-50 years	High potential benefit due to sediment effects on egg incubation and early rearing.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
	• Excessive turbidity • Embedded substrates	impacts to sediment supply • Forest roads – impacts to sediment supply • Agricultural practices – impacts to sediment supply			Improvements are expected on timber lands due to requirements under the new FPRs and forest land HCPs. There are challenges with implementation on agricultural lands due to few sediment-focused regulatory requirements for agricultural lands. Use IWA impairment ratings to identify restoration and preservation opportunities.
6. Protect and restore runoff processes ***A. Address forest road impacts*** ***B. Address timber harvest impacts*** ***C. Limit additional watershed imperviousness***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Timber harvest – impacts to runoff • Forest roads – impacts to runoff	• All species	5-50 years	High potential benefit due to flow effects on habitat formation, redd scour, and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs and forest land HCPs. Use IWA impairment ratings to identify restoration and preservation opportunities.
7. Protect and restore instream flows ***A. Water rights closures*** ***B. Purchase or lease existing water rights*** ***C. Relinquishment of existing unused water rights*** ***D. Enforce water withdrawal regulations*** ***E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Water withdrawals	• All species	1-5 years	Instream flow management strategies for the Grays basin have been identified as part of Watershed Planning for WRIA 25 (LCFRB 2004). Strategies include water rights closures, setting of minimum flows, and drought management policies.
8. Protect and restore water quality ***A. Restore the natural stream temperature regime*** ***B. Reduce fecal coliform bacteria levels*** ***C. Reduce turbidity sources***					
Entire basin	• Altered stream temperature regime	• Riparian harvests • Timber harvests –	• All species	1-50 years	Primary emphasis for restoration should be placed on stream segments that are on the

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
	• Bacteria • Excessive turbidity	sediment supply impacts • Forest roads – sediment supply impacts • Clearing of vegetation for agricultural uses • Riparian grazing			2004 303(d) list.
9. Protect and restore instream habitat complexity ***A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting*** ***B. Structurally modify stream channels to create suitable habitat types***					
Middle mainstem + tribs Grays 1F-2D; Thadbar lower; King lower; Klints lower; Fossil lower ***Headwaters/EF Grays*** Grays 3B-4C, LF, RF; Beaver Cr; EF Grays 1, 3-4, 6 ***SF Grays*** SF Grays 1-3; Blaney 1 ***WF Grays*** WF Grays 1-4	• Lack of stable instream woody debris • Altered habitat unit composition	• None (symptom-focused restoration strategy)	• Coho • Winter steelhead	2-10 years	Moderate potential benefit due to the high chance of failure. Failure is probable if habitat-forming processes are not also addressed. These projects are relatively expensive for the benefits accrued. Moderate to high likelihood of implementation given the lack of hardship imposed on landowners and the current level of acceptance of these type of projects.
10. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development ***A. Plan growth and development to avoid sensitive areas (e.g., wetlands, riparian zones, floodplains, unstable geology)*** ***B. Encourage the use of low-impact development methods and materials*** ***C. Apply mitigation measures to off-set potential impacts***					
Entire basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	The focus should be on management of land-use conversion and managing continued development in sensitive areas (e.g., wetlands, stream corridors, unstable slopes). Many critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary

Location	Limiting Factors Addressed Threats Addressed	Target Species	Time	Discussion
				mechanisms need to be put in place to restore currently degraded habitats.
11. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection ***A. Purchase properties outright through fee acquisition and manage for resource protection*** ***B. Purchase easements to protect critical areas and to limit potentially harmful uses*** ***C. Lease properties or rights to protect resources for a limited period***				
Entire basin	***Preservation Measure*** – addresses many potential limiting factors and threats	• All species	5-50 years	Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit. These programs are under-funded and have low landowner participation. In the lower, estuarine portion of the basin, the Columbia Land Trust has purchased approximately 500 acres and intends to restore estuarine habitats where feasible.

3.5 Program Gap Analysis

The Grays Basin (~124 sq mi) is located in Pacific and Wahkiakum Counties. The Basin can be characterized as predominantly forested, with agricultural uses occurring in the lower mainstem river valley and the lower reaches of mainstem tributaries.

- There is no federal land ownership in the Grays River Basin.
- The Washington Department of Natural Resources public lands comprise approximately 12 square miles.
- Approximately 91 square miles of the Grays River Basin are owned and managed by commercial timber companies.
- Much of the Grays River headwaters, including the West Fork and upper Grays River mainstem are in Pacific County.
- The lower mainstem river valley and much of the South Fork Grays are located in Wahkiakum.

Protection Programs

Protection programs in the Grays River Basin are implemented by private forest owners under the state forest practice rules, Pacific and Wahkiakum Counties, the Grays River Habitat Enhancement District, the Department of Natural Resources, and nonprofit organizations, such as the Columbia Land Trust. Protection programs in this analysis include those programs that protect habitat conditions or watershed functions through regulatory measures, through the acquisition of sensitive habitats or protective easements, incentives, or by applying standards to new development that protects resources by avoiding damaging impacts. Major programs implementing protection measures are identified below.

Federal Protection Programs

- ***U.S. Army Corps of Engineers***

  - Regulatory Program: The Corps administers the Section 10 (Rivers and Harbor Act) and Section 404 (Clean Water Act) permit processes. Section 10 requires approval of any activity in, above, or below a navigable river, which affects course, location, condition, or capacity of navigable waters. Section 404 requires prior approval of dredging, filling, grading, clearing, and bank hardening. In waters used by listed fish species, the permits are subject to ESA Section 7 consultation with NOAA Fisheries to ensure that any approved action is adequately protective of the fish; [M.1A; M.2A; M.2B; M.4A; M.9A; M.9B]

State Protection Programs

- ***Department of Natural Resources***

  - State Forest Land HCP:

    State forestlands are managed under the provisions of a Habitat Conservation Plan (HCP). The Habitat Conservation Plan protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8A; M.8C]

- State Forest Practices:

  Riparian zones and harvest restrictions represent significant protections under the State of Washington Forest Practices Rules, including the Forest and Fish Module. These rules also establish standards for new road construction addressing management of runoff, sediment, and slope failure. [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8A; M.8C]

➢ ***Washington Department of Fish and Wildlife***

- Washington State Hydraulic Code

  The Washington State Hydraulic Code is administered through the Washington Department of Fish and Wildlife. The purpose of this program is to protect stream conditions and habitat. The regulations apply to such activities as stream bank protection, instream construction, culvert installation, channel changes or realignments, debris removal, and water diversion facilities. Those proposing such actions must obtain a Hydraulic Project Approval (HPA) permit. [M.1A; M.2A; M.2B; M.4A; M.9A; M.9B]

- Habitat Program: The Department provides advice to local governments and landowners interested in measures to protect habitat values on their property. [M.1A; M.2A; M.2B; M.3A; M.4A; M.4B; M.6C; M.8A; M.8C; M.9A; M.9B; M.10A; M.10B; M.10C]

➢ ***Washington Department of Ecology***

- Water Resources Program/Water Rights: Department of Ecology, in consultation with the Department of Fish and Wildlife, has administrative closed selected areas within the Grays Basin to further surface and groundwater withdraws (where groundwater is in continuity with surface water). Existing administrative closures by the Department of Ecology protect surface waters from further withdrawals. Formal rule making would strengthen the closures. The extent of unauthorized surface water withdrawals is unknown, but could exacerbate summer low flows on smaller tributaries. [M.7A; M.7B; M.7C; M.7D]

- Water Resources Program/Watershed Planning: In cooperation with the Lower Columbia Fish Recovery Board, other state and federal agencies, tribes, local governments, and citizens, the Department funds and participates in a state authorized watershed planning process for Water Resource Inventory Area (WRIA) 25 pursuant to RCW 90.82. The goal of the plan is to ensure adequate water for people and fish. The planning process is dealing with water quantity and quality, stream flows and fish habitat. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.7A; M.7B; M.7C; M.7D]

➢ ***Department of Transportation***

- Road Maintenance Program

WSDOT has an ESA Section 4(d) Road Maintenance Program. The Maintenance Program uses trained crews to primarily manage roadside vegetation, litter control, and maintenance of safety rest areas associated with SR 4. [M.10A]

- ***Salmon Recovery Funding Board (SRFB)/ Lower Columbia Fish Recovery Board (LCFRB)***

  - Washington Salmon Recovery Act (RCW 77.85): The SRFB and the LCFRB jointly administer a grant program that allocates federal Pacific Salmon Recovery Funds and State funds for habitat protection and restoration projects by state and local agencies, nonprofit organizations, and landowners. To date the SRFB has granted $2.26 million for acquisition and restoration efforts in the Grays. [M.1A; M.2A; M.2B; M.3A; M.4A; M.4B; M.8A; M.8B; M.8C; M.9A; M.9B; M.11A; M.11B]

- ***Conservation Commission/ Wahkiakum Conservation Districts*** provides technical assistance and incentives (e.g., Conservation Reserve and Enhancement Program) to encourage agricultural landowners to protect riparian areas and stream habitat. The Wahkiakum Conservation District has been actively involved in the Grays watershed. These programs could help address measure M.3A; M.3C; M.4A; M.5C; M.8A; M.8C; M.9A; M.9B]

Local Government Programs

- ***Pacific County***

  - Lands within Pacific County in the Grays River Basin are zoned 'Commercial Forestry District; While the number of acres are relatively large, the only land use within Pacific county portion of the Grays River is commercial forestry and it is regulated primarily under Washington State Forest Practices Rules; [M.10A; M.10B; M.10C]

- ***Wahkiakum County***

  - Comprehensive Planning and Land Use Zoning: M.10A; M.10B; M.10C]
    - The County has adopted a comprehensive plan and zoning. The County land use program is subject to the Washington Growth Management Act (GMA), except for the requirement to adopt a Critical Areas Ordinance.
    - The County Critical Areas Ordinance provides for stream buffers from 25 to 200 feet depending on stream type and intensity of use. Wetland buffers also vary from 25 to 200 feet.
    - The County has adopted a Shoreline Master Program to regulate development.

Community Programs

- ***Columbia Land Trust*** is a nonprofit organization whose mission is to preserve and restore unique landscapes, natural areas, and sensitive habitats. It has acquired approximately 500 acres in the lower, estuarine portion of the basin and continues to acquire additional lands in the lower reaches of Deep River and the Grays River for subsequent restoration activities. [M.11A; M.11B]

Restoration Programs

Restoration programs in the Grays River Basin are implemented by a variety of agencies, organizations, and private interests. Major programs implementing protection measures are identified below:

Federal Restoration Programs

➢ ***U.S. Army Corps of Engineers***

- Ecosystem Restoration: The Corps entered into a Section 1135 ecosystem restoration agreement for the Grays River with the Washington Department of Fish And Wildlife, Wahkiakum County, the Grays River Habitat Enhancement District, the Lower Columbia Fish Recovery Board, the Columbia Land Trust and other interested parties. The project is on hold due to a Corps funding rescission. [M.1A; M.2A; M.2B; M.3A; M.4A; M.8A; M.8C]

State Restoration Programs

➢ ***Department of Natural Resources*:**

- State Forest Land Habitat Conservation Plan (HCP): The Department manages state forest lands pursuant to a Habitat Conservation Plan (HCP). The HCP road maintenance and restoration objectives require barrier upgrades and road abandonment and/or other improvements. [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8A; M.8C]

- State Forest Practices Act:
    - ✓ Industrial forests within the Grays Basin are governed by Forest and Fish regulations and have rigid schedules for maintaining and improving roads and removing barriers. Industrial landowners have 15 years to bring roads and barriers into compliance with regulations [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8A; M.8C]
    - ✓ Small private forest owners are governed by Forest and Fish regulations; however their road and barrier maintenance and improvement programs are tied to state funding. In the State 2003-05 Biennial Budget, 2 million dollars was allocated statewide to support small private forest owners [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8A; M.8C]

➢ ***Department of Fish and Wildlife***

- Habitat Program: The Department provides advice to local governments and landowners interested in measures to restoring watershed processes and stream habitat. [M.1A; M.2A; M.2B; M.3A; M.4A; M.4B; M.6C; M.8A; M.8C; M.9A; M.9B; M.10A; M.10B; M.10C]

- ***Department of Ecology***

  - Water Quality Program: The Grays and West Fork have been listed on the WA State 303(d) list for temperature. [M.8A; M.8B; M.8C]
  - Water Resources Program/Watershed Planning:
    The planning process for WRIA 25 is dealing with water quantity and quality, stream flows and fish habitat. Potential restoration efforts address improving summer low flows through conservation and acquisition of water rights. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.7A; M.7B; M.7C; M.7D; M.8A; M.8B; M.8C; M.10A]

- ***Salmon Recovery Funding Board (SRFB)/ Lower Columbia Fish Recovery Board***

  - Washington Salmon Recovery Act (RCW 77.85): As noted under preservation programs above, the SRFB and the LCFRB jointly administer a grant program that allocates federal Pacific Salmon Recovery Funds and State funds for habitat protection and restoration projects by state and local agencies, nonprofit organizations, and landowners. To date the SRFB has granted $2.26 million for acquisition and restoration efforts in the Grays River to restore wetlands, remove dikes and preserve old growth in Deep and Grays Rivers and Brook Slough. [M.1A; M.2A; M.3A; M.4.A; M.4B; M.8A; M.8C; M.9A; M.9B

- ***Conservation Commission/ Wahkiakum Conservation District*** provides technical assistance (e.g., farm plans) and incentives (e.g., Conservation Reserve and Enhancement Program) to encourage agricultural landowners to restore riparian areas and stream habitat. The Wahkiakum Conservation District has been active in the Grays basin. These programs could help address measures M.1A; M.2A; M.2B; M.3A; M.4A; M.5C; M.8A; M.8C; M.9A; M.9B]

Local Government Restoration Programs

- ***Wahkiakum County***

  - Public Works Program: The County maintains an active and ongoing program of identifying and replacing culverts that are a barrier to fish passage.
  - County Noxious Weed Control Board: The Board has three primary programs that address weed control in the Mill/Abernathy/Germany Basin; [M.3D]
    - ✓ Public education to prevent the spread of noxious weeds;
    - ✓ Survey of the County to assess emerging issues; and
    - ✓ Enforcement of noxious weed control

- **Grays River Habitat Enhancement District:**
  This mission of special purpose district is to enhance fish habitat and provide flood protection in the lower Grays basin. The District is supported landowner assessments and grants. They are currently conducting an assessment of the Grays and have applied for SRFB and NFWF funding for restoration projects. [M.11A; M.11B]

- [M.1A; M.2A; M.2B; M.3A; M.4A; M.4B]

Community Programs

- ***Lower Columbia Fish Enhancement Group*** is one of many nonprofit enhancement groups authorized by state law. The group focuses on restoration projects and has participated in projects in the Mill, Germany, and Abernathy watersheds. M.3A; M.4A; M.8A; M.8C]

- ***Columbia Land Trust*** is a nonprofit organization whose mission is to preserve and restore unique landscapes, natural areas, and sensitive habitats. It is pursuing several projects in the Mill, Germany, and Abernathy watersheds. [M.11A; M.11B; M.11C]

- ***Lower Columbia River Estuary Partnership*** provides guidance and funding to implement habitat restoration activities in the estuary [M.1A; M.2A; M.2B]

- ***Ducks Unlimited*** in collaboration with Columbia Land Trust, the Lower Columbia Fish Recovery Board and other agencies, Ducks Unlimited is restoring wetlands and riparian habitats in the Grays and Deep River watersheds; [M.1A; M.2A; M.2B; M.2C; M.3A; M.3B; M.4A; M.9A]

Gap Analysis

Forest-related Programs: Ninety-five percent of the Grays River Basin is in forest use. Accordingly, forestry programs play a substantial role in protecting and restoring watershed functions and habitat conditions at levels supporting recovery goals. Certainty of forestry-related protection and restoration programs is relatively high because programs are being implemented and, for the most part, fully funded. Program areas of concern include state funding for small commercial forest landowners and the continued potential for hydrologic impacts caused by past harvest practices. Monitoring of watershed processes and habitat conditions will be required to confirm the effectiveness of these measures.

Protection-related Programs: Lands in the Grays River Basin have protections through Pacific and Wahkiakum County's regulatory authority. Pacific County's lands within the Grays Basin are zoned Commercial Forestry. Wahkiakum County's land use programs are significantly more important fro protection of watershed processes and habitat due to the number of land uses in the basin. Wahkiakum County's Critical Areas Ordinances and Shoreline Master Plan should be improved by updating for Best Available Science and recent habitat studies. Other areas of concern include limited protections for habitat and watershed processes on agricultural lands within the Grays River Basin.

Restoration-related Programs: Over a long period of time, improvements to the mid- and lower Grays River will occur as a result of improved forest management practices that are already in place. To the degree possible, programs should focus on restoring floodplain function and channel migration, as well as restoring off- and side-channel habitats.

Table 3-8. Programmatic Actions to Address Gaps

Action #	Lead Agency	Proposed Action
GRAYS.1	Wahkiakum County, Pacific County	Adequately protect riparian areas well enough to attain or maintain Properly Functioning Conditions around all rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Utilize mitigation, where necessary, to offset unavoidable damage to Properly Functioning Conditions in riparian management areas
GRAYS.2	Wahkiakum County, Pacific County	Adequately protect wetlands, wetland buffers, and wetland function. Activities on the landscape must protect wetlands and the vegetation surrounding them to avoid disturbing soils, vegetation, and local hydrology
GRAYS.3	Wahkiakum County	Adequately protect historical stream meander patterns and channel migration zones and avoid hardening stream banks and shorelines
GRAYS.4	Wahkiakum County, Pacific County	Apply land use code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
GRAYS.5	State of Washington	Provide state funding for small forest owners in the Grays Basin to a level sufficient to achieve the road and barrier improvements of Forest and Fish on a schedule parallel to private industrial forest owners
GRAYS.6	Forest Managers LCFRB, and DFW	Identify early action forest-wide restoration projects that analysis indicates could provide significant benefits. In these cases, it may be appropriate to identify outside funding to initiate these early actions
GRAYS.7	Commercial Forest Owners, DNR	Monitor watershed functions and habitat conditions over time to evaluate hydrologic impacts
GRAYS.8	LCFRB, DOE, DFW, NOAA, USFWS, ACOE, BPA	Increase available funding for projects that implement measures and addresses underlying threats
GRAYS.9	Wahkiakum County, Wahkiakum CD, Grays Habitat Group	Utilize a combination of public outreach/education, incentives, and authority to positively influence landowner behaviors toward land stewardship in practices not covered by land use regulations
GRAYS.10	WRIA 25/26 PU, DOE, DFW	Close the Grays River to further surface water withdrawals, including groundwater in connectivity with surface waters
GRAYS.11	LCFRB, Wahkiakum County, DFW	Build institutional capacity for agencies and organizations to undertake additional protection and restoration projects (e.g., noxious weed control)
GRAYS.12	SRFB, Fish and Wildlife Foundation	Increase available funding for projects that implement measures and addresses underlying threats
GRAYS.13	LCFRB, Wahkiakum County, Commercial Foresters, Grays Habitat Group	Address threats proactively by building agreement on priorities among the various program implementers
GRAYS.14	FEMA	Update floodplain maps based on Best Available Science

4 Elochoman Subbasin – Elochoman & Skamokawa

Figure 4-1. Location of the Elochoman & Skamokawa basins within the Lower Columbia River Basin.

4.1 Basin Overview

The Elochoman and Skamokawa basins comprise approximately 73 square miles, primarily in Wahkiakum County. The Elochoman enters the Columbia River near the town of Cathlamet at RM 38. The Skamokawa enters the Columbia approximately 5 miles west of the Elochoman. Major tributaries to the Elochoman include Beaver Creek and the West Fork Elochoman. Principal tributaries to the Skamokawa include the West Fork and Wilson Creek. The subbasin is part of WRIA 25.

The Elochoman and Skamokawa basins will play a key role in the recovery of salmon and steelhead. The basin has historically supported populations of fall Chinook, winter steelhead, chum, and coho. Today, Chinook, steelhead and chum are listed as threatened under the ESA. Coho salmon are a candidate for listing. Other fish species of interest are Pacific lamprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

Elochoman and Skamokawa salmon and steelhead are affected by a variety of in-basin and out-of basin factors including stream, Columbia River mainstem, estuary, and ocean habitat conditions; harvest; hatcheries, and ecological relationships with other species. Analysis has demonstrated that recovery cannot be achieved by addressing only one limiting factor. Recovery will require action to reduce or eliminate all manageable factors or threats. The deterioration of habitat conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonids within the Columbia Basin. Direct harvest of listed salmon and steelhead is prohibited but sport and commercial fisheries focusing on hatchery fish and other healthy wild populations, primarily in the mainstem Columbia and ocean, incidentally affect ESA-listed Elochoman and Skamokawa fish. Elochoman Hatchery operates within the basin with the potential to both adversely affect wild salmon and steelhead populations and to assist in recovery efforts. Key ecological interactions of concern include effects of nonnative species; nutrient inputs from salmon carcasses; and predation by species affected by development including Caspian terns, northern pikeminnow, seals, and sea lions. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the Elochoman and Skamokawa Subbasin.

The Elochoman / Skamokawa basin is almost entirely comprised of private and state owned lands, the bulk of which is commercial timber land. Considerable logging occurred in the past without regard for riparian and instream habitat, resulting in sedimentation of salmonid spawning and rearing habitat (WDF 1990). Nearly 0% of the forest cover is in late-seral stages, however, as the forest matures, watershed conditions are recovering.

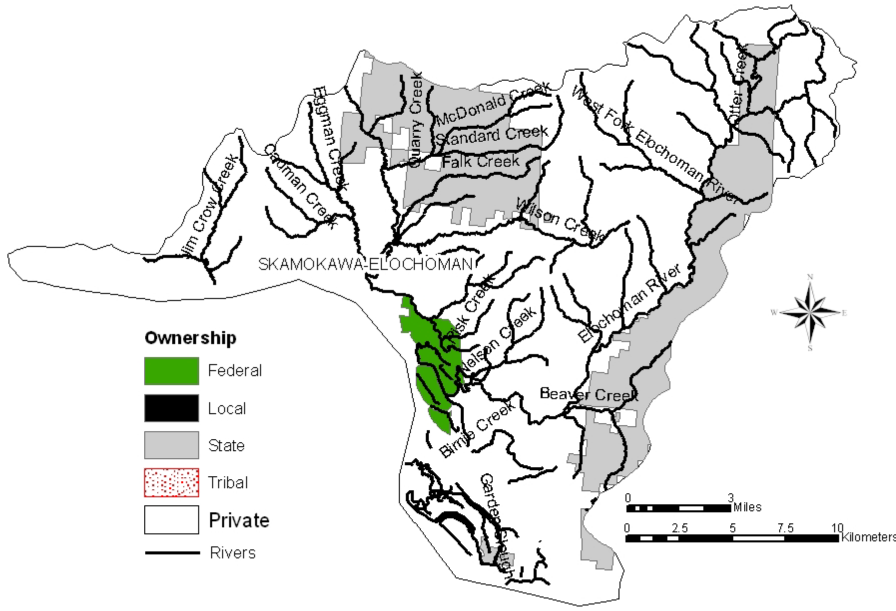
A broad agricultural valley extends up the mainstem Skamokawa, West Fork Skamokawa, and Wilson Creek. There are considerable agricultural impacts to fish habitat in these areas, which suffer from non-forested riparian zones and disconnected floodplains. Chum, fall Chinook, and coho utilize these lower valley reaches and are therefore heavily impacted by agricultural land-uses. The upper reaches of the mainstem and all major tributaries are impacted most heavily by forest harvest and the forest road network. Winter steelhead and coho occupy upper basin reaches, and are therefore affected most by forest practices.

A similar land-use pattern can be found in the Elochoman basin, with the exception being that the agricultural valley is found primarily only along the mainstem. The species effects are also similar, with agricultural uses having the greatest impact on chum and fall Chinook and forest practices having the greatest effect on winter steelhead and coho.

The projected population change from 2000 to 2020 for unincorporated areas in WRIA 25 is 37% (LCFRB 2001). Current and expected growth will occur predominantly in the broad agricultural valleys along the major stream courses, resulting in land-use conversion from agricultural to residential uses. This pattern is already apparent in many areas. It will be important for land-use planning and critical areas policy to provide adequate protection of habitat and habitat-forming processes in sensitive areas.

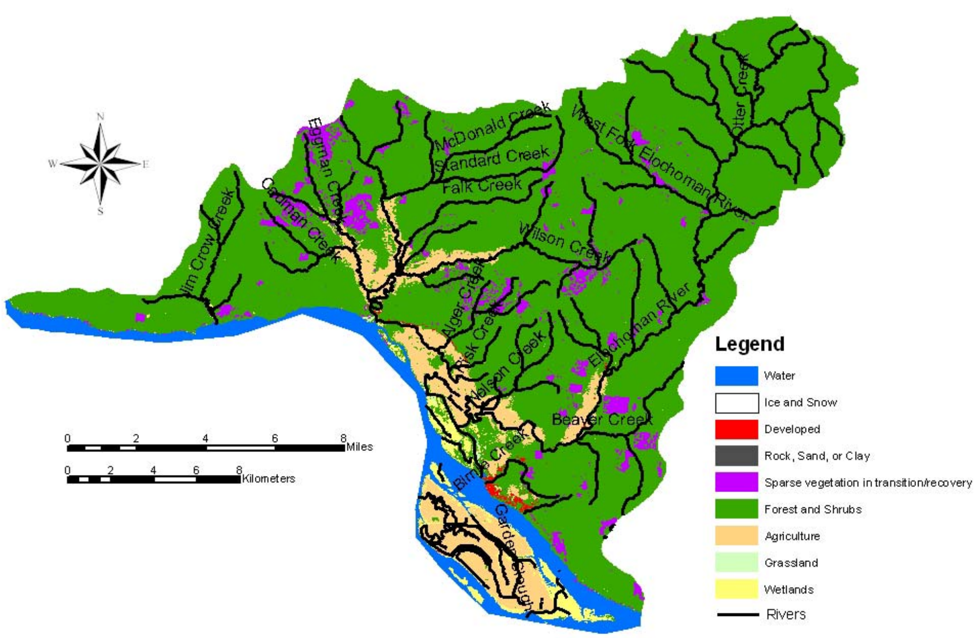
Land Ownership	
Private	77%
State	21%
Federal	2%

Land Ownership



Vegetation Composition	
Late Seral	0%
Mid Seral	26%
Early Seral	10%
Other Forest	45%
Non Forest	13%

Land Use / Cover



4.2 Species of Interest

Focal salmonid species in the Elochoman and Skamokawa watersheds include fall Chinook, winter steelhead, chum and coho. The current health or viability of the focal populations ranges from very low for chum and coho to low-medium for fall Chinook and winter steelhead. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Recovery goals call for restoring fall Chinook, chum and coho to a high or very high viability level. This level will provide for a 95% or better probability a population survival over 100 years. Winter steelhead recovery goals call for restoration to medium levels which will provide for a 75-95% probability of survival over 100 years.

Other species of interest in the Elochoman/Skamokawa area include coastal cutthroat trout and Pacific lamprey. Regional objectives for these species are described in Volume I, Chapter 6. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for these other species. Cutthroat will benefit from improvements in stream habitat conditions for salmonids. Lamprey are also expected to benefit from habitat improvements in the estuary, Columbia River mainstem, and Elochoman and Skamokawa subbasin although specific spawning and rearing habitat requirements of lamprey are not well known.

Table 4-1.Current viability status of Elochoman/Skamokawa 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+	100-2,300	High+	1,400-4,500
Winter Steelhead	Threatened	Yes	Low+	200-700	Medium	600-1,000
Chum	Threatened	No	Low	<200	High+	1,100-8,200
Coho	Candidate	Yes	Low	Unknown	High	unknown

Fall Chinook – The historical Elochoman/Skamokawa adult population is estimated from 5,000-10,000 fish. The vast majority of fish returned to the Elochoman River. Current natural spawning returns range from 100-2,300 in the Elochoman River and 50-500 in Skamokawa Creek. The majority of current returns are hatchery origin fish. Spawning occurs in the lower Elochoman from above tidewater (RM 4 to the Elochoman Hatchery (RM 9). Spawning occurs in Skamokawa Creek from Wilson Creek upstream to Standard and McDonald creeks (4.5 miles). Juvenile rearing occurs near and downstream of the spawning areas. Juveniles emerge in early spring and migrate to the Columbia in spring and summer of their first year.

Winter Steelhead – The historical Elochoman/Skamokawa adult population is estimated to be about 1,400 fish. Current natural spawning returns range from 100-400 in the Elochoman River and 100-300 in Skamokawa Creek. Interaction with Chambers Creek/Beaver Creek stock hatchery steelhead is likely lower due to different spawn timing. Spawning in the Elochoman occurs in the mainstem, West, North, and East Forks, as well as Otter, Rock, Clear, Beaver, and Duck creeks. Spawning in Skamokawa Creek occurs throughout the mainstem, Wilson, Left Fork, Quartz, McDonald, and Standard creeks, as well as several smaller tributaries. 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 to the Columbia River.

Coho – The historical Elochoman/Skamokawa adult population is estimated from 15,000-40,000 fish, with the returns being late stock which spawn from late November to March. Current returns are unknown but assumed to be low. A number of hatchery produced fish spawn naturally. Natural spawning occurs in most areas of the Elochoman Basin accessible to coho, principally in the upper watershed, in particular the West Fork Elochoman. Duck Creek is an important spawning area in the lower river. In Skamokawa Creek, important spawning areas include the mainstem, and Wilson, Left Fork, Quartz, Standard, and McDonald creeks. Juvenile rearing occurs upstream and downstream of spawning areas. Juveniles rear for a full year in these basins basin before migrating as yearlings in the spring.

Chum – The historical Elochoman/Skamokawa adult population is estimated from 15,000-50,000 fish. Current returns are about 200 fish or less. Recent year counts have been higher in Skamokawa Creek than in the Elochoman River. Natural spawning primarily occurs in the lower maintem Elochoman between tidewater and the Elochoman Hatchery and in Skamakowa Creek between tidewater and Standard and McDonald creeks. Jim Crow Creek, which flows directly into the Columbia downstream of Skamokawa Creek, is also an important chum spawning area. Peak spawning occurs in December. Juveniles emerge in the early spring and migrate to the Columbia after a short rearing period.

Coastal Cutthroat – Coastal cutthroat abundance in Elochoman/Skamokawa has not been quantified but the population is considered depressed. Cutthroat trout are present throughout the basin. Both anadromous and resident forms of cutthroat trout are present in the basin. Anadromous cutthroat enter the Elochoman River and Skamokawa Creek from August to mid April and spawn from January through April. Most juveniles rear 2-3 years before migrating from their natal stream.

Pacific lamprey – Information on lamprey abundance is limited and does not exist for the Elochoman/Skamokawa population. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have also declined in the Elochoman River and Skamokawa Creek. 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 seven years before migrating to the ocean.

Figure 4-2. Summary of habitat limiting factors, popoulation status, expected population improvement trend with existing programs and biological objectives depicted for the Elochoman and Skamokawa basins.

4.3 Potentially Manageable Impacts

Stream habitat, estuary/mainstem habitat, harvest, hatchery and predation effects have all contributed to reduced salmonid productivity, numbers, and population viability in the Elochoman and Skamokawa subbasin. The pie charts below represent the relative order of magnitude of quantifiable effects for each of these factors for each focal species. The preferred recovery scenario targets an equivalent reduction in each impact factor in proportion to the magnitude of the effect. Population-specific targets are discussed in further detail in Volume I, Chapter 6.

- Loss of tributary habitat quality and quantity is an important impact for all species, particularly for chum but less so for fall Chinook. Loss of estuary habitat quality and quantity is also important, accounting for relative impacts of about 20% for chum and fall Chinook, 15% for winter steelhead, and 10% for coho.
- Harvest accounts for the largest relative impact on fall Chinook, but is a minor factor for other species.
- Hatchery impacts are substantial for coho and fall Chinook and moderately important to coho, but of lesser importance for winter steelhead and chum.
- Predation impacts are moderate for winter steelhead and chum, but are relatively low for coho and fall Chinook.
- Hydrosystem access and passage impacts appear to be relatively minor for all species.

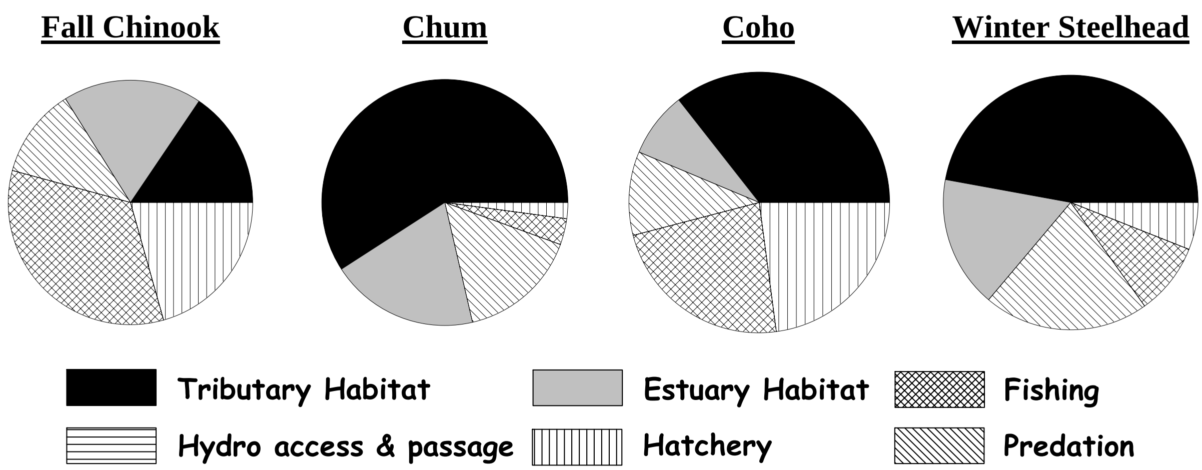


Figure 4-3. Relative contribution of potentially manageable impacts for Elochoman and Skamokawa populations.

4.4 Limiting Factors, Threats, and Measures

4.4.1 Hydropower Operation and Configuration

There are no hydro-electric dams in the Elochoman and Skamokawa subbasins. However, Elochoman and Skamokawa species are affected by mainstem Columbia hydro operations and flow regimes which affect habitat in migration corridors and in the estuary. Mainstem hydro factors and threats are addressed by regional strategies and measures identified in Volume I.

4.4.2 Harvest

Most harvest of wild Elochoman and Skamokawa salmon and steelhead occurs incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. This mortality is very low for chum and steelhead, but is more significant for fall Chinook. Elochoman fall Chinook are harvested in ocean and Columbia River commercial sport fisheries as well as in-basin sport fisheries. Harvest is controlled by an ESA harvest limit associated with Coweeman natural fall Chinook. No harvest of chum occurs in ocean fisheries, there is no directed Columbia River or Elochoman Basin chum fisheries and retention of chum is prohibited in Columbia River and Elochoman basin sport fisheries. Some chum can be impacted by fisheries directed at coho and winter steelhead. Harvest of Elochoman 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 Elcohoman basin. Wild coho impacts are limited by fishery management to retain marked hatchery fish and release unmarked wild fish. 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.

Measures 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. The regional measures 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 Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest measures with significant application to Elochoman/Skamokawa Subbasin populations are summarized in the following table:

Table 4-2. Regional harvest measures from Volume I, Chapter 7 with significant application to the Elochoman/Skamokawa Subbasin populations

Measure	Description	Comments
F.M17	Monitor chum handle rate in winter steelhead and late coho tributary sport fisheries.	State agencies would include chum incidental handle assessments as part of their annual tributary sport fishery sampling plan.
F.M13	Develop a mass marking plan for hatchery tule Chinook for tributary harvest management and for naturally-spawning escapement monitoring.	Provides the opportunity to implement selective tributary sport fishing regulations in the Elochoman 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.M18	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	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.M19	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	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.

Measure	Description	Comments
F.M24	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	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.

4.4.3 Hatcheries

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

The Elochoman Hatchery (since 1954) produces winter and summer steelhead, fall Chinook, and coho for harvest opportunity. The winter steelhead program includes both a composite stock from Beaver Creek Hatchery and a local stock program. The summer steelhead are Skamania stock. The Elcohoman Hatchery also provides coho for net pen rearing and harvest in Steamboat Slough and winter steelhead for release into the Coweeman River. There are no hatchery fish released into Skamokawa Creek. 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 threats from the Elochoman Hatchery salmon programs are domestication of natural fall Chinook and coho and potential ecological interactions between hatchery and natural juvenile salmon.

The Beaver Creek Hatchery (since 1957) historically reared early-run winter steelhead for distribution to several lower Columbia basins. The hatchery was closed in 1999.

Table 4-3.Elochoman Hatchery Production.

Hatchery	Release Location	Fall Chinook	Early Coho	Late Coho	Local Winter Steelhead	Winter Steelhead	Summer Steelhead
Elochoman	Elochoman	2,000,000	418,000	512,000	30,000	60,000	30,000
	Coweeman					20,000	
	Steamboat Slough		200,000				

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 Elochoman Subbasin 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 Technical Foundation, Volume IV). Regional hatchery measures identified in Volume I, Chapter 7 with potential applications at facilities within the Elochoman Subbasin are summarized in Table 4-4.

Table 4-4. Regional hatchery measures from Volume I, Chapter 7 with potential implementation actions in the Elochoman Subbasin.

Measure	Description	Comments
H.M5,13,38	Integrated hatchery and wild program for fall Chinook. Evaluate potential for integration of a late stock coho program.	Assures fitness of the natural produced fish which will improve population productivity. Integrated programs would be developed specific to the Elochoman populations in the BRAP procedure.
H.M14	Use only local brood stock in the fall Chinook hatchery program.	This measure will preclude transfer of outside basin stock into the Elochoman Hatchery program. This will enable a hatchery and wild integrated program to be developed with fall Chinook that are ecologically adapted to the Elochoman Basin
H.M15,32,40	Juvenile release strategies to minimize interactions with naturally spawning fish.	Release strategies are aimed at reducing or avoiding interactions with wild steelhead, fall Chinook, coho by release timing and release location strategies.
H.M17,34,41	Mark hatchery steelhead, coho, fall Chinook with an adipose fin-clip for identification and selective harvest	Marking hatchery fish allows for identification of hatchery fish in the natural spawning grounds and at collection facilities which enables accurate accounting of wild fish. Marking also enables selective fisheries to retain hatchery fish and release wild fish.
H.M24,36	Hatchery program utilized for supplementation and enhancement of wild coho and chum populations.	Supplementation programs for Elochoman natural coho could be developed with appropriate brood stock in the Elochoman Hatchery. Beaver Creek Hatchery could be considered for a coastal area chum enhancement program.
H.M8	Adaptively manage hatchery programs to further protect and enhance natural populations and improve operational efficiencies.	Appropriate research, monitoring, and evaluation programs along with guidance from regional hatchery evaluations will be utilized to improve the survival and contribution of hatchery fish, reduce impacts to natural fish, and increase benefits to natural fish.
H.M2,6	Evaluate Elochoman Hatchery facility operations.	The facility would be evaluated in the BRAP process for potential hazards associated with barriers to fish passage, adequacy of screens, and water quality.

4.4.4 Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Elochoman and Skamokawa salmon and steelhead are affected throughout their lifecycle by ecological interactions with non - native species, food web components, and predators. Interactions are similar for Elochoman and Skamokawa populations to those of most other subbasin salmonid populations. These interactions are described in further detail in Volume I, Chapter 6. Ecological Interactions are addressed by regional strategies and measures identified inVolume I, Chapter 7.

4.4.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. 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 are similar for Skamokawa and Elochoman populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook than steelhead and coho.

Estuary and mainstem effects on Skamokawa and Elochoman salmon and steelhead populations are addressed by regional strategies and measures identified in Volume I and the Columbia Mainstem and Estuary Subbasin sections of Volume II.

4.4.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity 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 Elochoman/Skamokawa Basin have the greatest impact on the health and viability of salmon and steelhead relative to the other limiting factors and threats discussed in this chapter.

Subwatersheds, reaches, and habitat attributes have been prioritized for protection and/or restoration based on the plan's biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Priority areas for habitat preservation and restoration are identified in Figure 4-4. A summary of the primary habitat limiting factors and threats are presented in Table 4-6. Habitat measures and related information are presented in Table 4-7. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 4-5. Reach- and subwatershed-scale limiting factors generated from the technical assessment are included in Table 4-5. Details on species-specific spatial priorities and limiting factors at the subbasin level may be found in Volume II of the Technical Foundation. A description of the methodology used to generate composite (multi-species) reach and subwatershed priorities can be found in the introduction to this volume of the recovery plan.

The areas with the greatest current or potential contribution to focal salmonid population health and productivity are listed below. Tier 1 and 2 reaches within these priority areas are included in the list. The habitat limiting factors, threats, and measures included in this chapter focus primarily on the priority areas and the tier 1 and 2 reaches within them. Tier 3, 4, and non-tiered reaches are considered secondary priority, but in many cases, these lower priority areas will also require restoration and preservation actions in order to achieve recovery objectives. Watershed process measures generally focus on the entire basin as opposed to being limited only to high priority areas because conditions in high priority areas are often influenced by cumulative watershed effects. High priority areas and reaches in the Elochoman/Skamokawa Basin include the following:

- Upper Skamokawa & tributaries – Skamokawa 4-8; LF Skamokawa 2; McDonald 1,3; Falk 1-2
- Wilson Creek – Wilson 1-4
- Lower Elochoman & tributaries – Elochoman 3-7; Clear Creek 1-3; Duck 1-6
- Upper Elochoman & tributaries – Elochoman 8-14; WF Elochoman 1-2; NF Elochoman 1; EF Elochoman 1

The following paragraphs provide a brief overview of each of these priority areas, including species most affected, land-use threats, and the general type of measures that will be necessary for recovery. Additional detail can be found in the tables and figures that follow.

While reach level habitat conditions often result from local factors, they are also affected or shaped by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input and large woody debris recruitment are often affected by or result from upstream conditions and degraded watershed processes. Access to key reaches may also be affected by barriers that occur downstream of a reach. Accordingly, restoration of a priority reach may require action outside the targeted reach. The IWA analysis was used to identify potential upstream watershed areas that could influence reach level habitat attributes. EDT was used to allow a relative comparison of reaches and habitat attributes within a reach.

The upper Skamokawa and tributaries provide potentially productive habitat for all species. Wilson Creek primarily supports winter steelhead and coho. These reaches are heavily impacted by agriculture and rural residential development. Effective recovery measures will include riparian reforestation, cattle exclusion fencing, and floodplain re-connection.

The lower Elochoman and the lower reaches of mainstem tributaries have been impacted by agriculture and rural residential development. Effective recovery measures will involve riparian and floodplain restoration. Winter steelhead make the greatest use of upper Elochoman reaches. These reaches are predominantly impacted by forest practices occurring in the upper basin. Effective recovery of these reaches will involve basin-wide recovery of runoff and sediment supply function.

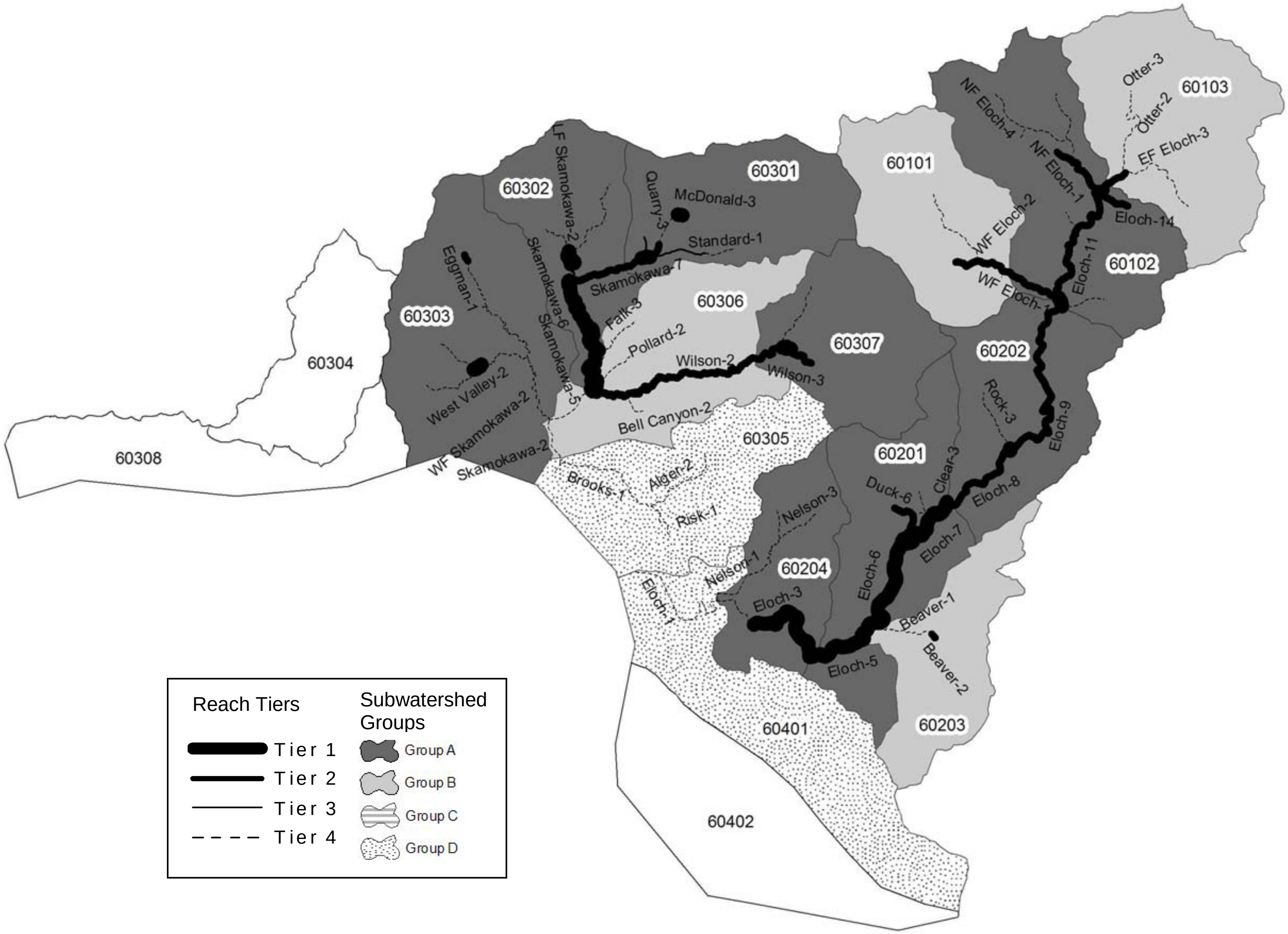


Figure 4-4. Reach tiers and subwatershed groups in the Elochoman/Skamokawa Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities 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.

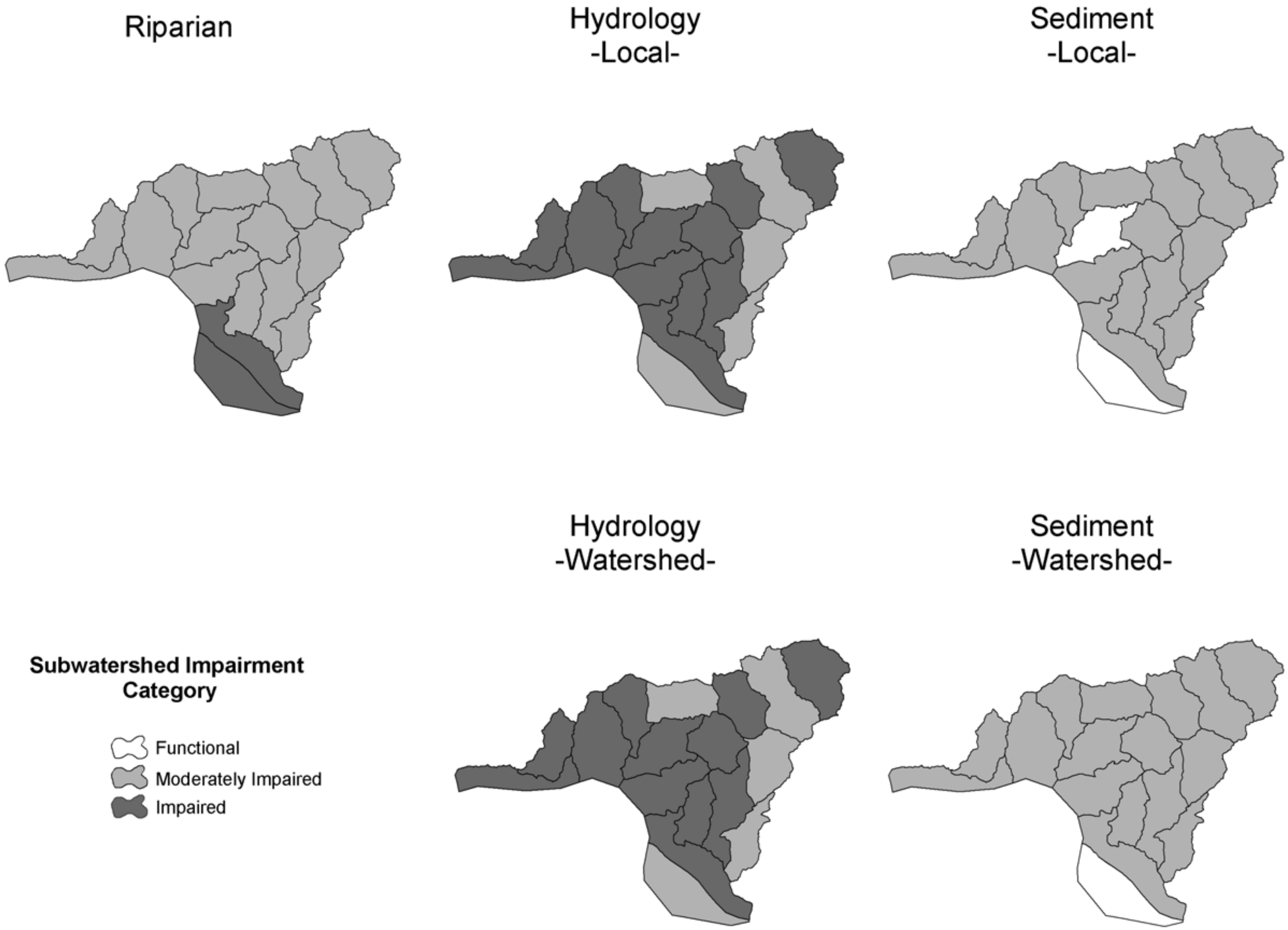


Figure 4-5. IWA subwatershed impairment ratings by category for the Elochoman/Skamokawa Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 4-5. 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.

Skamokawa

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) Hydrology	Watershed processes (local) Sediment	Watershed processes (local) Riparian	Watershed processes (watershed) Hydrology	Watershed processes (watershed) Sediment
A	60307	Trib1233686463037 Wilson-3 Wilson-4	Coho	Wilson-3	egg incubation fry colonization summer rearing	habitat diversity sediment food key habitat quantity	PR	I	M	M	I	M
			StW	Wilson-3 Wilson-4	egg incubation fry colonization summer rearing winter rearing adult holding	habitat diversity flow sediment key habitat quantity	PR					
	60303	Cadman-1 Cadman-2 Cadman-3 Eggman-1 Eggman-2 West Valley-1 West Valley-2 West Valley-3 WF Skamokawa-1 WF Skamokawa-2 WF Skamokawa-3 WF Skamokawa-4 WF Skamokawa-5	Coho	West Valley-2	spawning egg incubation summer rearing winter rearing	habitat diversity sediment	PR	I	M	M	I	M
			StW	none								
	60302	LF Skamokawa-1 LF Skamokawa-2 LF Skamokawa-3 LF Skamokawa-4 Skamokawa-5 Skamokawa-6 Skamokawa-7 Trib1234547463284-1 Trib1234547463284-2	ChF	Skamokawa-5	egg incubation fry colonization adult holding	sediment	P	I	M	M	I	M
			Chum	Skamokawa-6 Skamokawa-5	spawning egg incubation adult holding	habitat diversity sediment	P					
			Coho	Skamokawa-6 LF Skamokawa-2 Skamokawa-5	egg incubation fry colonization summer rearing winter rearing	habitat diversity temperature sediment food	PR					
			StW	Skamokawa-7	egg incubation summer rearing	temperature sediment	PR					
	60301	McDonald-1 McDonald-2 McDonald-3 Quarry-1 Skamokawa-8 Standard-1 Standard-2	ChF	Skamokawa-8	spawning egg incubation fry colonization adult holding	channel stability sediment	P	M	M	M	M	M
			Coho	McDonald-3	spawning egg incubation fry colonization summer rearing winter rearing adult holding	habitat diversity sediment key habitat quantity	P					
			StW	Skamokawa-8 McDonald-1	egg incubation fry colonization summer rearing	habitat diversity temperature flow sediment food key habitat quantity	PR					
B	60306	Bell Canyon-1 Falk-1 Falk-2 Falk-3 Pollard-1 Skamokawa-2 Skamokawa-3 Skamokawa-4 Wilson-1 Wilson-2	All	none				I	F	M	I	M
D	60305	Alger-1 Alger-2 Brooks-1 Brooks-2 Skamokawa-1	All	none				I	M	M	I	M

Elochoman

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): Hydrology	Watershed processes (local): Sediment	Watershed processes (local): Riparian	Watershed processes (watershed): Hydrology	Watershed processes (watershed): Sediment
A	60202	Eloch-5 Eloch-6 Rock-1 Rock-3	ChF	Eloch-6	egg incubation fry colonization adult holding	sediment	PR	M	M	M	M	M
			Chum	none								
			Coho	Eloch-5 Eloch-6 Rock-1	spawning fry colonization egg incubation summer rearing winter rearing adult holding	habitat diversity temperature sediment key habitat quantity	PR					
			StW	Rock-1	spawning egg incubation fry colonization adult holding	habitat diversity sediment	P					
	60201	Clear-1 Clear-3 Duck-1 Duck-3 Duck-4 Duck-6 Eloch-2 Eloch-4 Trib1233126462580	ChF	Eloch-4	spawning egg incubation fry colonization	sediment	PR	I	M	M	I	M
			Chum	Eloch-4	spawning egg incubation adult holding	sediment	PR					
			Coho	Clear-1 Clear-3 Duck-1 Eloch-4	spawning fry colonization egg incubation summer rearing juvenile (age-0) migrant winter rearing adult holding		PR					
			StW	Clear-1 Clear-3	egg incubation fry colonization adult holding	sediment	P					
	60102	Eloch-10 Eloch-11 Eloch-12 Eloch-13 Eloch-14 Eloch-7 Eloch-8 Eloch-9 NF Eloch-1 NF Eloch-2 NF Eloch-3 NF Eloch-4 Trib1232509463400 Trib1232540463591 Trib1232562463641 Trib1232567463186 Trib1232728463673 WF Eloch-1	ChF	Eloch-10 Eloch-7	spawning egg incubation fry colonization adult holding	channel stability habitat diversity sediment	PR	M	M	M	M	M
			Coho	Eloch-10 Eloch-13	egg incubation fry colonization summer rearing winter rearing		R					
			StW	Eloch-10 Eloch-11 Eloch-13 Eloch-8 WF Eloch-1	egg incubation fry colonization summer rearing winter rearing	habitat diversity flow sediment	PR					
	60204	Eloch-2 Eloch-3 Longtrain-1 Nelson-1 Nelson-2 Nelson-3 Trib1233695462430-1	ChF	none				I	M	M	I	M
			Chum	Eloch-3	spawning egg incubation adult holding	sediment	PR					
			Coho	none								
			StW	none								
B	60203	Beaver-1 Beaver-2	Coho	none				M	M	M	M	M
			StW	Beaver-2	spawning egg incubation fry colonization summer rearing	habitat diversity sediment	R					
	60101	Trib1232792463272 Trib1232902463299 Trib1233036463388-1 WF Eloch-2 WF Eloch-3	Coho	none				I	M	M	I	M
			StW	WF Eloch-2	egg incubation fry colonization summer rearing winter rearing	habitat diversity flow sediment	R					
	60103	EF Eloch-1 EF Eloch-2 Otter-1 Otter-2 Trib1232156463572	Coho	none				I	M	M	I	M
			StW	none								
D	60401	Eloch-1	All	none				I	M	I	I	M

Table 4-6. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the upper Skamokawa and tributaries (US), Wilson Creek (WC), lower Elochoman and tributaries (LE), and the upper Elochoman and tributaries (UE). Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors	US	WC	LE	UE
Habitat connectivity				
Blockages to channel habitats			✓	
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	✓	✓	✓	
Stream flow				
Altered magnitude, duration, or rate of change	✓	✓	✓	✓
Water quality				
Altered stream temperature regime	✓	✓	✓	
Excessive turbidity	✓	✓		
Bacteria	✓	✓	✓	
Substrate and sediment				
Lack of adequate spawning substrate				
Excessive fine sediment	✓	✓	✓	✓
Embedded substrates	✓	✓	✓	✓

Threats	US	WC	LE	UE
Agriculture / grazing				
Clearing of vegetation	✓	✓	✓	
Riparian grazing	✓	✓	✓	
Floodplain filling	✓	✓	✓	
Rural development				
Clearing of vegetation	✓	✓	✓	
Floodplain filling	✓	✓	✓	
Roads – riparian/floodplain impacts	✓	✓	✓	
Increased watershed imperviousness	✓	✓	✓	
Leaking septic systems	✓	✓	✓	
Forest practices				
Timber harvests –sediment supply impacts	✓	✓	✓	✓
Timber harvests – impacts to runoff	✓	✓	✓	✓
Riparian harvests			✓	✓
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	✓	✓	✓	

Table 4-7. Habitat measures in priority areas, with reference to limiting factors addressed, threats addressed, target species, and estimated time until benefits would be realized (time). Tier 1 and 2 reaches, or other areas of known priority, are listed under the location column for some measures (i.e., stream corridor measures). Reaches not included in the table (Tier 3, 4, and non-tiered reaches) are considered secondary priority.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
1. Protect and restore floodplain function and channel migration processes					
A. Set back, breach, or remove artificial channel confinement structures					
Upper Skamokawa & tributaries Skamokawa 4-8; LF Skamokawa 2; Falk 1-2 ***Wilson Creek*** Wilson 1-4 ***Lower Elochoman & tributaries*** Elochoman 3-7; Duck 1-6; Clear Cr 1-3	• Loss of off-channel and/or side channel habitats • Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes	• Floodplain filling • Channel straightening • Artificial confinement	• All species	2-15 years	Great potential benefit due to improvements in many limiting factors. This passive restoration approach can allow channels to restore naturally once confinement structures are removed. There are challenges with implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense.
2. Protect and restore off-channel and side-channel habitats					
A. Restore historical off-channel and side-channel habitats where they have been eliminated					
B. Provide access to blocked off-channel habitats					
C. Create new off-channel or side-channel habitats (i.e. spawning channels)					
Upper Skamokawa & tributaries Skamokawa 4-8; LF Skamokawa 2; Falk 1-2 ***Wilson Creek*** Wilson 1-4 ***Lower Elochoman & tributaries*** Elochoman 3-7; Duck 1-6; Clear Cr 1-3	• Loss of off-channel and/or side-channel habitat • Altered habitat unit composition	• Floodplain filling • Channel straightening • Artificial confinement	• Chum • Coho	2-15 years	Good potential benefit especially for chum, which have lost a significant portion of historically available off-channel habitat for spawning. Potential benefit is limited by moderate probability of success with creation of new habitats. There are challenges with implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense.
3. Protect and restore riparian function					
A. Reforest riparian zones					
B. Allow for the passive restoration of riparian vegetation					
C. Livestock exclusion fencing					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
D. Invasive species eradication ***E. Hardwood-to-conifer conversion***					
Upper Skamokawa & tributaries Skamokawa 4-8; LF Skamokawa 2; Falk 1-2; McDonald 1,3 ***Wilson Creek*** Wilson 1-4 ***Lower Elochoman & tributaries*** Elochoman 3-7; Duck 1-6; Clear Cr 1-3 ***Upper Elochoman & tributaries*** Elochoman 8-14; WF Eloch 1-2; NF Eloch 1; EF Eloch 1	• Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or noxious species	• Timber harvest – riparian harvests • Riparian grazing • Clearing of vegetation due to rural development & agriculture	• All species	20-100 years	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. Riparian protections on forest lands are provided for under current harvest policy. Riparian restoration projects are relatively inexpensive and are often supported by landowners. Whereas the specified stream reaches are the highest priority for riparian measures, riparian restoration and preservation should occur throughout the basin since riparian conditions affect downstream reaches. Use IWA riparian ratings to help identify restoration and preservation opportunities.
4. Protect and restore streambank stability ***A. Restore eroding streambanks***					
Upper Skamokawa & tributaries Skamokawa 4-8; LF Skamokawa 2; Falk 1-2 ***Wilson Creek*** Wilson 1-4	• Reduced bank/soil stability • Excessive fine sediment • Excessive turbidity • Embedded substrates	• Artificial confinement • Clearing of vegetation (ag) • Roads – riparian / floodplain impacts • Riparian grazing	• All species	5-50 years	Most areas of bank instability are located in the agricultural middle valley of the Skamokawa and Wilson Creeks. Bio-engineered approaches that rely on structural as well as vegetative measures are the most appropriate. These projects have a high risk of failure if causative factors are not adequately addressed.
5. Protect and restore natural sediment supply processes ***A. Address forest road related sources*** ***B. Address timber harvest related sources*** ***C. Address agricultural sources***					
Entire basin	• Excessive fine sediment • Excessive turbidity • Embedded substrates	• Timber harvest – impacts to sediment supply • Forest roads – impacts to sediment supply	• All species	5-50 years	High potential benefit due to sediment effects on egg incubation and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs and forest land HCPs. There are challenges with implementation on agricultural lands due to few

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
		• Agricultural practices – impacts to sediment supply			sediment-focused regulatory requirements for agricultural lands. Use IWA impairment ratings to identify restoration and preservation opportunities.
6. Protect and restore runoff processes ***A. Address forest road impacts*** ***B. Address timber harvest impacts*** ***C. Limit additional watershed imperviousness***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Timber harvest – impacts to runoff • Forest roads – impacts to runoff • Increased impervious surfaces • Clearing of vegetation	• All species	5-50 years	High potential benefit due to flow effects on habitat formation, redd scour, and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs and forest land HCPs. There are challenges associated with addressing runoff issues on developed lands due to continued increase in watershed imperviousness related to development and lack of adequate mitigation. Use IWA impairment ratings to identify restoration and preservation opportunities.
7. Protect and restore instream flows ***A. Water rights closures*** ***B. Purchase or lease existing water rights*** ***C. Relinquishment of existing unused water rights*** ***D. Enforce water withdrawal regulations*** ***E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Water withdrawals	• All species	1-5 years	Instream flow management strategies for the Elochoman/Skamokawa Basin have been identified as part of Watershed Planning for WRIA 25 (LCFRB 2004).
8. Protect and restore water quality ***A. Restore the natural stream temperature regime*** ***B. Reduce fecal coliform bacteria levels***					
Entire basin	• Altered stream temperature regime • Bacteria	• Riparian harvests • Riparian grazing • Leaking septic systems	• All species	1-50 years	Primary emphasis for restoration should be placed on stream segments that are listed on the 2004 303(d) list.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
9. Protect and restore instream habitat complexity ***A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting*** ***B. Structurally modify stream channels to create suitable habitat types***					
Upper Skamokawa & tributaries Skamokawa 4-8; LF Skamokawa 2; Falk 1-2; McDonald 1,3 ***Wilson Creek*** Wilson 1-4 ***Lower Elochoman & tributaries*** Elochoman 3-7; Duck 1-6; Clear Cr 1-3 ***Upper Elochoman & tributaries*** Elochoman 8-14; WF Eloch 1-2; NF Eloch 1; EF Eloch 1	• Lack of stable instream woody debris • Altered habitat unit composition	• None (symptom-focused restoration strategy)	• Coho • Winter steelhead	2-10 years	Moderate potential benefit due to the high chance of failure. Failure is probable if habitat-forming processes are not also addressed. These projects are relatively expensive for the benefits accrued. Moderate to high likelihood of implementation given the lack of hardship imposed on landowners and the current level of acceptance of these type of projects.
10. Protect and restore fish access to channel habitats ***A. Beaver Creek Hatchery blockage*** ***B. Culvert barriers on various small tributaries***					
Lower Elochoman Beaver Creek ***Various small tribs***	• Blockages to channel habitats	• Dams, culverts, in-stream structures	• Coho • Winter steelhead	immediate	As many as 10 miles of potentially accessible habitat are blocked by culverts or other barriers (approximately eight barriers total). The blocked habitat is believed to be marginal in most cases. The water intake dam for the hatchery on Beaver Creek is believed to be a partial barrier. Passage restoration projects should focus on cases where it can be demonstrated that there is good potential benefit and reasonable project costs.
11. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development ***A. Plan growth and development to avoid sensitive areas (e.g. wetlands, riparian zones, floodplains, unstable geology)*** ***B. Encourage the use of low-impact development methods and materials*** ***C. Apply mitigation measures to off-set potential impacts***					
Entire basin	***Preservation Measure*** – addresses many potential		• All species	5-50 years	The focus should be on management of land-

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
	limiting factors and threats				use conversion and managing continued development in sensitive areas (e.g., wetlands, stream corridors, unstable slopes). Critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary mechanisms need to be put in place to restore currently degraded habitats.
12. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection ***A. Purchase properties outright through fee acquisition and manage for resource protection*** ***B. Purchase easements to protect critical areas and to limit potentially harmful uses*** ***C. Lease properties or rights to protect resources for a limited period***					
Entire basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit. These programs are under-funded and have low landowner participation.

4.5 Program Gap Analysis

The Elochoman-Skamokawa Subbasin (~73 sq mi) is located primarily in Wahkiakum County; however, the uppermost headwaters of the Elochoman are in Pacific and Cowlitz County. The Elochoman-Skamokawa Basins can be characterized as nearly exclusively forested, with agricultural land uses occurring in the broad mainstem river valleys of the lower Skamokawa and Elochoman basins.

- Approximately 41 square miles of the Elochoman-Skamokawa Basin are owned and managed by large industrial timber companies; a small fraction of those acres are small-commercial forest lands;
- There is only minor federal land ownership in the Elochoman-Skamokawa Basin; the Julia Butler Hansen Refuge (1.46 sq mi) is managed by the US Fish and Wildlife Service;
- Washington Department of Natural Resources manages approximately 15 square miles of forestlands in the Elochoman-Skamokawa Basins;
- Functionally, all of the Elochoman-Skamokawa Basins are located in Wahkiakum County;

Protection Programs

Protection programs in the Elochoman-Skamokawa Basin are implemented by private forest owners pursuant to the state forest practice rules, Wahkiakum County land use regulations, the Department of Natural Resources HCP and other regulatory agencies. Protection programs in this analysis include those programs that protect habitat conditions or watershed functions through management policies and programs, regulatory measures, incentives, and acquisition of sensitive habitats or protective easements. Major programs implementing protection measures are identified below.

Federal Programs

- ***U.S. Army Corps of Engineers***

  - Administers the Section 10 (Rivers and Harbor Act) and Section 404 (Clean Water Act) permit processes. Section 10 requires approval of any activity in, above, or below a navigable river, which affects course, location, condition, or capacity of navigable waters. Section 404 requires prior approval of dredging, filling, grading, clearing, and bank hardening. In waters used by listed fish species, the permits are subject to ESA Section 7 consultation with NOAA Fisheries to ensure that any approved action is adequately protective of the fish; [M.1A; M.2A; M.2B; M.4A; M.9A; M.9B]

State Programs

- ***Department of Natural Resources***

  - State Forest Land HCP:

    State forestlands are managed under the provisions of a Habitat Conservation Plan (HCP). The Habitat Conservation Plan protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. [M.3A; M.3B; M.4A; M.5A; M.5B; M.6A; M.6B; M.8A]

  - State Forest Practices:

Riparian zones and harvest restrictions represent significant protections under the State of Washington Forest Practices Rules, including the Forest and Fish Module. These rules also establish standards for new road construction that manage stormwater, sedimentation and slope failure potential. [M.3A; M.3B; M.4A; M.5A; M.5B; M.6A; M.6B; M.8A]

- ***Washington Department of Fish and Wildlife***

  - Washington State Hydraulic Code

    The Washington State Hydraulic Code is administered through the Washington Department of Fish and Wildlife. The purpose of this program is to protect stream conditions and habitat. The regulations apply to such activities as stream bank protection, instream construction, culvert installation, channel changes or realignments, debris removal, and water diversion facilities. Those proposing such actions must obtain a Hydraulic Project Approval (HPA) permit; [M.1A; M.2A; M.2B; M.4A; M.9A; M.9B]

  - Habitat Program
    The Department provides advice to local governments and landowners interested in measures to protect habitat values on their property. [M.1A; M.2A; M.2B; M.2C; M.3A; M.4A; M.8A; M.8B; M.9A; M.9B; M.10A; M.10B; M.11A; M.11B; M.11C]

- ***Washington Department of Ecology***

  - Water Resources Program/Water Rights: Department of Ecology, in consultation with the Department of Fish and Wildlife, has administrative closed selected areas within the lower Cowlitz basin to further surface and groundwater withdraws (where groundwater is in continuity with surface water). Existing administrative closures by the Department of Ecology protect surface waters from further withdrawals. Formal rule-making would strengthen the closures. The extent of unauthorized surface water withdrawals is unknown, but could exacerbate summer low flows on smaller tributaries. [M.7A; M.7B; M.7C; M.7D]

  - Water Resources Program/Watershed Planning: In cooperation with the Lower Columbia Fish Recovery Board, other state and federal agencies, tribes, local governments, and citizens, the Department funds and participates in a state authorized watershed planning process for Water Resource Inventory Area (WRIA) 26 pursuant to RCW 90.82. The goal of the plan is to ensure adequate water for people and fish. The planning process is dealing with water quantity and quality, stream flows and fish habitat. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.7A; M.7B; M.7C; M.7D; M.7E; M.8A; M.8B]

- ***Washington Department of Transportation***

  - Road Maintenance Program

  WSDOT has an ESA Section 4(d) Road Maintenance Program. The Maintenance Program uses trained crews to primarily manage roadside vegetation, litter control, and maintenance of safety rest areas. [M.5C; M.8C]

- ***Conservation Commission/ Wahkiakum Conservation District*** provides technical assistance and incentives (e.g., Conservation Reserve and Enhancement Program) to encourage agricultural landowners to protect riparian areas and stream habitat. The Wahkiakum Conservation District has been actively involved in the Elochoman and Skamokawa watersheds. These programs could help address measure M.3A; M.3C; M.4A; M.5C; M.8A; M.8B; M.9A; M.9B]

Local Government Programs

- ***Wahkiakum County***

  - <u>Comprehensive Planning and Land Use Zoning:</u> [M.11A; M.11B; M.11C]
    - ✓ The County has adopted a comprehensive plan and zoning. The County land use program is subject to the Washington Growth Management Act (GMA), except for the requirement to adopt a Critical Areas Ordinance.
    - ✓ The County Critical Areas Ordinance provides for stream buffers from 25 to 200 feet depending on stream type and intensity of use. Wetland buffers also vary from 25 to 200 feet.
    - ✓ The County has adopted a Shoreline Master Program to regulate development.

  - <u>Public Works Program</u>: The County is proceeding with the replacement or repair of blocking culverts on County roads. [M.10B]

Community Programs

- No active programs.

<u>Restoration Programs</u>

Restoration programs in the Elochoman-Skamokawa Basin are implemented by a variety of agencies, organizations, and private interests. Major programs implementing protection measures are identified below:

Federal Programs

- No active programs

State Programs

- ***Washington Department of Natural Resources***

  - <u>State Forest Land Habitat Conservation Plan (HCP)</u>: The Department manages state forest lands pursuant to a Habitat Conservation Plan (HCP). The HCP road maintenance and restoration objectives require barrier upgrades and road abandonment and/or other improvements. This program addresses measures M.3A; M.3B; M.5A, M.5B; M.6A; M.6B; M.8A; and M.10B.

  - <u>State Forest Practices Act</u>:
    - ✓ Industrial forests within the lower NF Lewis Basin are governed by Forest and Fish regulations and have rigid schedules for maintaining and improving roads

and removing barriers. Industrial landowners have 15 years to bring roads and barriers into compliance with regulations.

- ✓ Small private forest owners are governed by Forest and Fish regulations; however their road and barrier maintenance and improvement programs are tied to state funding. In the State 2003-05 Biennial Budget, 2 million dollars was allocated statewide to support small private forest owners. [M.3A; M.3B; M.5A, M.5B; M.6A; M.6B; M.8A; and M.10B].

➢ ***Washington Department of Fish and Wildlife***

- Habitat Program: The Department provides advice to local governments and landowners interested in measures to restoring watershed processes and stream habitat. [M.1A; M.2A; M.2B; M.2C; M.3A; M.4A; M.8A; M.8B; M.9A; M.9B; M.10A; M.10B; M.11A; M.11B; M.11C]

➢ ***Washington Department of Ecology***

- Water Quality Program: Ecology has listed both the Elochoman and Skamokawa on the state's impaired water bodies 303(d) list**.** [M.8A; M.8B]
- Water Resources Program/Watershed Planning:
  The planning process for WRIA 26 is dealing with water quantity and quality, stream flows and fish habitat. Potential restoration efforts address improving summer low flows through conservation and acquisition of water rights. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.7A; M.7B; M.7C; M.7D; M.7E; M.8A; M.8B]

➢ ***Washington Department of Transportation***

- Barrier Removal Program:
  WSDOT is working to improve blockages associated with SR-4. [M.5D; M.8C; M.10A]

➢ ***Conservation Commission/ Wahkiakum Conservation District*** provides technical assistance (e.g., farm plans) and incentives (e.g., Conservation Reserve and Enhancement Program) to encourage agricultural landowners to restore riparian areas and stream habitat. Both Conservation Districts have undertaken restoration projects in the Elochoman and Skamokawa watersheds. [M.3A; M.3C; M.4A; M.5C; M.8A; M.8B; M.9A; M.9B].

Local Government Programs

➢ ***Wahkiakum County***

- Public Works Program replaces and/or upgrades barriers associated with roads. [M.10B]

➢ ***Wahkiakum County Noxious Weed Control Board***

- The Board has three primary programs that address weed control in the Elochoman--Skamokawa Basin; [M.3D]
  - ✓ Public education to prevent the spread of noxious weeds;

- ✓ Survey of the County to assess emerging issues; and
- ✓ Enforcement of noxious weed control

Community Restoration Programs

- ➢ ***Lower Columbia Fish Enhancement Group*** is one of many nonprofit enhancement groups authorized by state law. The group focuses on restoration projects and has participated in projects in the Elochoman and Skamokawa watersheds. [M.3A; M.4A; M.8A; M.9A; M.9B; M.10B]

- ➢ ***Columbia Land Trust*** is a nonprofit organization whose mission is to preserve and restore unique landscapes, natural areas, and sensitive habitats. The organization has been involved in restoration projects in the Elochoman and Skamokawa watersheds. [M.12A; M.12B; M.12C]

Analysis

***Forest-related Programs*:** Forestlands comprise 75 percent of the Elochoman-Skamokawa Basin. Accordingly, forestry programs play a substantial role in protecting and restoring watershed functions and habitat conditions at levels supporting recovery goals. Certainty of forestry-related protection and restoration programs is relatively high because programs are being implemented and, for the most part, fully funded. Program areas of concern include the continued potential for hydrologic impacts caused by past harvest practices. Monitoring of watershed processes and habitat conditions will be required to confirm the effectiveness of these measures.

Protection-related Programs: Watershed processes and stream habitat in the Elochoman-Skamokawa Basin have limited protection through Wahkiakum County's land use regulations. Pacific and Cowlitz County land use regulations make a limited contribution to the protection of watershed processes and stream habitat in the Basin, since they apply to only a small area of the basin. Effective county land use programs are important, especially in the rural residential and agricultural areas in the Skamokawa (the broad agricultural valley extending up the mainstem, West Fork and Wilson tributaries); and the Elochoman (areas extending up the mainstem). Wahkiakum County's Critical Areas Ordinances could be improved by updating for Best Available Science and buffer improvements to the Shoreline Master Program. Other areas of concern include limited agricultural protections within the Elochoman-Skamokawa Basin.

Restoration-related Programs: Over a long period of time, improvements to the Elochoman-Skamokawa will occur as a result of improved forest management practices that are already in place. To the degree possible, restoration programs should focus on restoring floodplain function and channel migration, as well as restoring off- and side-channel habitats. Program areas of concern include the overall level of effort in terms of restoration activities. Attention to the Department of Fish and Wildlife's Beaver Creek Hatchery should be directed toward providing access to upstream habitats. \

Table 4-8. Program Actions to Address Gaps

Action #	Lead Agency	Proposed Action
ELOCH.1	Wahkiakum County	Develop and implement controls to adequately protect riparian areas to maintain currently functional and restored habitat around rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Require mitigation, where necessary, to offset unavoidable damage to habitat conditions in riparian management areas
ELOCH.2	Wahkiakum County	Development and implement controls to protect historic stream meander patterns and channel migration zones and avoid hardening stream banks and shorelines
ELOCH.3	Wahkiakum County	Development and implement controls and development standards to adequately protect wetlands, wetland buffers, and wetland function.
ELOCH.4	Wahkiakum County	Develop and implement controls to address erosion and sediment run-off during (and after) construction to prevent sediment and pollutant discharge to streams, wetlands and other water bodies
ELOCH.5	Wahkiakum County	Apply land use and resource protection code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
ELOCH.6	Forest Managers LCFRB, and DFW	Identify and sequence early action forest-wide restoration projects that analysis indicates could provide significant benefits. In these cases, it may be appropriate to identify outside funding to initiate these early actions
ELOCH.7	LCFRB, USFS, WDNR. WSDOT, Counties, private property owners.	Develop and implement a coordinated and strategic barrier removal program based on watershed fish priorities and ensuring an effective and efficient sequencing of barrier removal work.
ELOCH.8	Wahkiakum County	Utilize a combination of public outreach/education and, incentives, and to promote (1) stewardship practices for protecting habitat and water quality and (2) landowner support of and participation in habitat restoration efforts.
ELOCH.9	State of Washington (DOE, DFW)	Close the Elochoman-Skamokawa Basin to further surface water withdrawals, including groundwater in connectivity with surface waters; curtail unauthorized withdrawals
ELOCH.10	LCFRB, WDFW, Wahkiakum County, Wahkiakum CD, LCFEG	Build capacity (e.g. technical and administrative skills, personnel and fiscal resources) needed to allow agencies and organizations to undertake protection and restoration projects, including noxious weed control in a reasonable period time.
ELOCH.11	SRFB, BPA, NOAA, USFWS, DOE, ACOE	Increase available funding for projects that implement measures and address underlying threats
ELOCH.12	State of Washington (Dept of Agriculture, and Department of Ecology)	Develop and implement agricultural practices and regulations to protect riparian conditions and water quality
ELOCH.13	Wahkiakum Conservation District	Expand landowner incentive (e.g. CREP) and education plans to promote further habitat protection and restoration.
ELOCH.14	LCFRB, Wahkiakum CD, Wahkiakum County,	Address threats proactively by building agreement on priorities among the various program implementers
ELOCH.15	DFW	Improve fish passage at the Beaver Creek Hatchery
ELOCH.16	FEMA	Update floodplain maps using Best Available Science

5 Elochoman Subbasin – Mill, Abernathy, & Germany

Figure 5-1. Location of the Mill, Abernathy, and Germany basins within the Lower Columbia River Basin.

5.1 Basin Overview

The Mill, Abernathy, and Germany basins comprise approximately 152 square miles, primarily in Cowlitz County with the remainder in Wahkiakum County. The basins are part of WRIA 25.

The Mill, Abernathy, and Germany basins will play a key role in the recovery of salmon and steelhead. The basins historically supported populations of fall Chinook, winter steelhead, chum, and coho. Today, Chinook, steelhead and chum are listed as threatened under the ESA. Coho salmon are a candidate for listing. Other fish species of interest are Pacific lamprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

Mill, Abernathy, and Germany salmon and steelhead are affected by a variety of in-basin and out-of basin factors including stream, Columbia River mainstem, estuary, and ocean habitat conditions; harvest; hatcheries; and ecological relationships with other species. Analysis has demonstrated that recovery cannot be achieved by addressing only one limiting factor. Recovery will require action to reduce or eliminate all manageable factors or threats. The deterioration of habitat conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonids within the Columbia Basin. Direct harvest of listed salmon and steelhead is prohibited but sport and commercial fisheries focusing on hatchery fish and other healthy wild populations, primarily in the mainstem Columbia and ocean, incidentally affect ESA-listed Mill, Abernathy, and Germany fish. Key ecological interactions of concern include effects of nonnative species; nutrient inputs from salmon carcasses; and predation by species affected by development including Caspian terns, northern pikeminnow, seals, and sea lions. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the Mill, Abernathy and Germany subbasins.

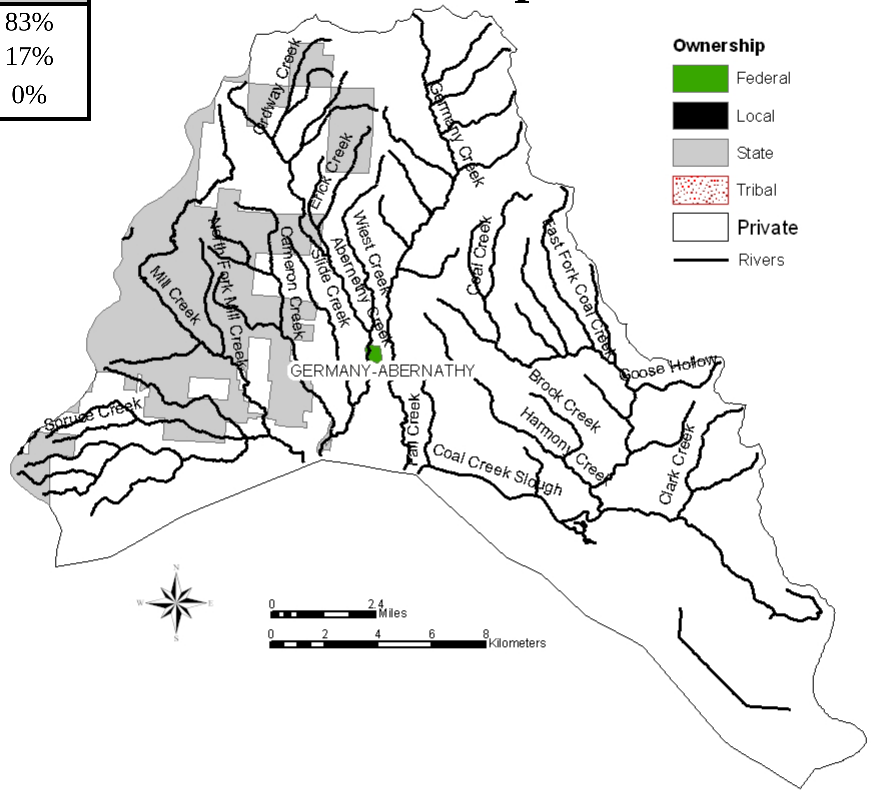
The Mill/Abernathy/Germany Basin is almost entirely comprised of private and state owned lands, the bulk of which is commercial timber land. Considerable logging occurred in the past without regard for riparian and instream habitat, resulting in sedimentation of salmonid spawning and rearing habitat (WDF 1990). Essentially none of the forest cover is in late-seral stages, however, as the forest matures, watershed conditions are recovering. The impacts of forest practices on riparian areas and sediment supply have most affected winter steelhead and coho spawning and rearing habitat in the middle and upper basin reaches.

Agricultural valleys extend up the mainstems of Abernathy and Germany creeks. The reaches within these broad valleys provide potentially productive habitat for all species, especially for chum and fall Chinook, which make heavy use of lower mainstem reaches. Channel confinement and riparian degradation are the limiting factors with the greatest impacts in these areas. There is not extensive agricultural use in the Mill Creek basin, however, rural residential development has been increasing in the lower basin over the last decade, which poses potential threats to fish habitat, primarily for fall Chinook and chum that make the most use of lower basin reaches.

The projected population change from 2000 to 2020 for unincorporated areas in WRIA 25 is 37% (LCFRB 2001). Current and expected growth will occur predominantly in the agricultural valleys along the major stream courses, resulting in land-use conversion from agricultural to residential uses. This pattern is already apparent in many areas. It will be important for land-use planning and critical areas policy to provide adequate protection of habitat and habitat-forming processes in sensitive areas.

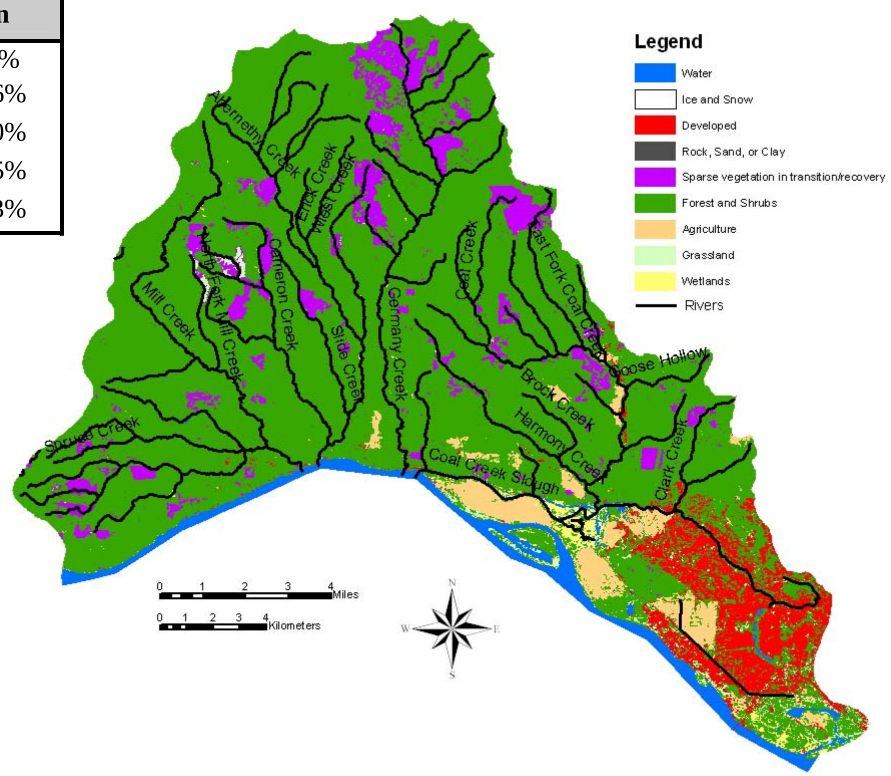
Land Ownership	
Private	83%
State	17%
Federal	0%

Land Ownership



Vegetation Composition	
Late Seral	0%
Mid Seral	26%
Early Seral	10%
Other Forest	45%
Non Forest	13%

Land Use / Cover



5.2 Species of Interest

Focal salmonid species in Mill, Abernathy, and Germany creeks include fall Chinook, winter steelhead, chum and coho. The current health or viability of the focal populations ranges from very low for chum to low-medium for winter steelhead. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). The recovery goals call for restoring winter steelhead and chum to a high viability level, providing a 95% or better probability of population survival over 100 years. Fall Chinook and coho restoration goals of medium levels provide for a 75-94% probability of population survival over 100 years.

Other species of interest in these creeks include coastal cutthroat trout and Pacific lamprey. Regional objectives for these species are described in Volume I, Chapter 6. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for these other species. Cutthroat will benefit from improvements in stream habitat conditions for salmonids. Lamprey are also expected to benefit from habitat improvements in the estuary, Columbia River mainstem, and the Mill, Abernathy, and Germany Subbasin although specific spawning and rearing habitat requirements of lamprey are not well known.

Table 5-1. Current viability status of Mill, Abernathy, and Germany 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	No	Low	300-4,000	Medium	2,000-3,200
Winter steelhead	Threatened	Yes	Low+	50-500	High	600-1,500
Chum	Threatened	No	Very Low	50-100	High	1,100-3,000
Coho	Candidate	Yes	Low	unknown	Medium	unknown

Fall Chinook – The historical combined adult population in Mill, Abernathy, and Germany creeks is estimated from 5,000-7,500 fish. There is some question as to the historical significance of fall Chinook in these basins compared to other species. Current returns range from 300-4,000. The Abernathy fall Chinook hatchery program was discontinued, with the final adult hatchery returns in 1997. Spawning is concentrated in the lower 2 miles of Mill Creek, and the lower 3 miles of Abernathy and Germany creeks. 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.

Winter Steelhead – The historical combined adult population in Mill, Abernathy, and Germany creeks is estimated at 2,000 fish. Current natural spawning returns to Abernathy and Germany creeks range from 50-500. Spawning in Mill Creek occurs in the mainstem, North Fork and unnamed tributaries. Spawning in Abernathy Creek occurs in the mainstem, Slide Creek, and Cameron Creek. Spawning in Germany Creek occurs in the mainstem, Loper Creek, and John Creek. 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 creeks.

Chum- The historical combined adult population in Mill, Abernathy, and Germany creeks is estimated from 6,500-40,000 fish. Current natural spawning returns are 50-100. Spawning occurs in the lower reaches of Mill, Abernathy, and Germany creeks, with recent year spawning primarily concentrated in Abernathy and Germany creeks. Hatchery releases were discontinued in Germany Creek in 1983 and in Abernathy Creek in 1991. Juveniles emerge in the early spring and migrate to the Columbia with little rearing time in these creeks.

Coho – The historical combined adult population in Mill, Abernathy, and Germany creeks is estimated from 10,000-30,000 fish. The historical population is late stock which spawns from late November-March. Current returns are unknown but assumed be low. Natural spawning is presumed to occur in most areas accessible to coho in Mill, Abernathy, and Germany creeks, and also in nearby Coal Creek. Juvenile rearing occurs upstream and downstream of spawning areas. Juveniles rear for a full year in these creeks before migrating as yearlings in the spring.

Coastal Cutthroat – Anadromous and resident forms of cutthroat trout are present in Mill, Abernathy, and Germany creeks. Anadromous cutthroat counts at Abernathy trap have been very low at fewer than 15 fish since 1991. Anadromous cutthroat enter these creeks from August-April and spawn from January to April. Most juveniles rear 2-3 years before migrating from their natal stream.

Pacific lamprey – Information on lamprey abundance is limited and does not exist for Mill, Abernathy, and Germany populations. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have also declined in these creeks. 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 these creeks. Juveniles rear in freshwater up to seven years before migrating to the ocean.

Figure 5-2. Summary of habitat limiting factors, population status, expected population improvement trend with existing programs, and biological objectives depicted for the Mill, Abernathy, and Germany basins.

5.3 Potentially Manageable Impacts

Stream habitat, estuary/mainstem habitat, harvest, hatchery and predation effects have all contributed to reduced salmonid productivity, numbers, and population viability in the Mill, Abernaty and Germany Subbasin. The pie charts below represent the relative order of magnitude of quantifiable effects for each of these factors for each focal species. The preferred recovery scenario targets an equivalent reduction in each impact factor in proportion to the magnitude of the effect. Population-specific targets are discussed in further detail in Volume I, Chapter 6.

- Loss of tributary habitat quality and quantity is an important impact for all species, particularly for chum but less so for fall Chinook. Loss of estuary habitat quality and quantity is also important, accounting for relative impacts of about 20% for chum, fall Chinook and winter steelhead, and 10% for coho.
- Harvest accounts for the largest relative impact on fall Chinook and is moderately important to coho, but is a relatively minor factor for other species.
- Hatchery impacts are substantial for coho and fall Chinook, but of lesser importance for winter steelhead and chum.
- Predation impacts are moderate for winter steelhead and chum, but are relatively low for coho and fall Chinook.
- Hydrosystem access and passage impacts appear to be relatively minor for all species.

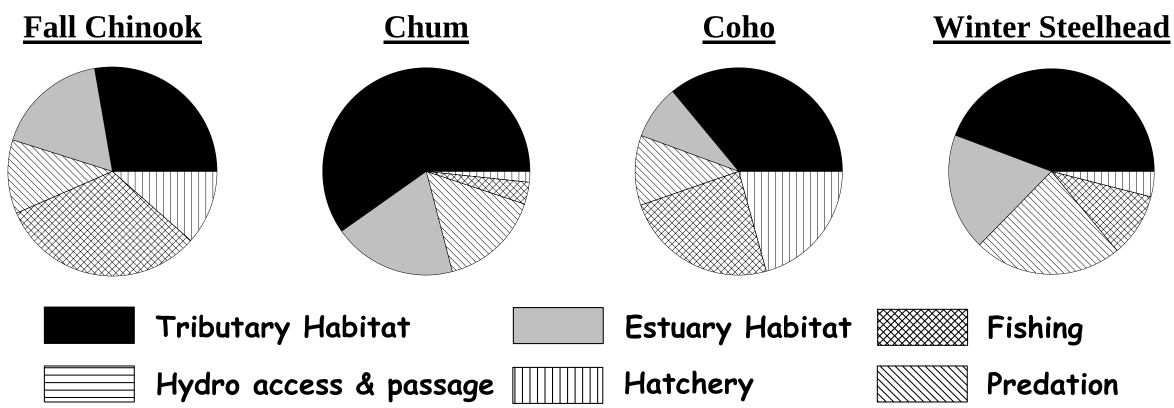


Figure 5-3. Relative contribution of potentially manageable impacts for Mill, Germany, and Abernathy populations.

5.4 Limiting Factors, Threats, and Measures

5.4.1 Hydropower Operation and Configuration

There are no hydro-electric dams in the any of the Mill, Germany, or Abernathy basins. However, species in these basins are affected by mainstem Columbia hydro operations and flow regimes which affect habitat in migration corridors and in the estuary. Mainstem hydro factors and threats are addressed by regional strategies and measures identified in Volume I.

5.4.2 Harvest

Most harvest of wild Mill, Abernathy, and Germany creek salmon and steelhead occurs incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. This mortality is very low for chum and steelhead, but is more significant for fall Chinook. Mill, Abernathy, and Gremany fall Chinook are harvested in ocean and Columbia River commercial sport fisheries as well as in-basin sport fisheries. Harvest is controlled by an ESA harvest limit associated with Coweeman natural fall Chinook.. No harvest of chum occurs in ocean fisheries, there is no directed Columbia River or tributary chum fisheries and retention of chum is prohibited in Columbia River sport fisheries. Chum can be impacted incidental to fisheries directed at coho and winter steelhead. Harvest of coho occurs in the ocean commercial and recreational fisheries off the Washington and Oregon coasts and Columbia River. There are no salmon sport fisheries in Mill, Abernathy, or Germany creeks. Wild coho impacts are limited by fishery management to retain marked hatchery fish and release unmarked wild fish. Incidental mortality of steelhead occurs in freshwater commercial fisheries directed at Chinook and coho and freshwater sport fisheries directed at hatchery steelhead. All recreational fisheries are managed to selectively harvest fin-marked hatchery steelhead and commercial fisheries cannot retain hatchery or wild steelhead.

Measures 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. The regional measures 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 Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest measures with significant application to Mill, Abernathy, and Germanay Subbasin populations are summarized in the following table:

Table 5-2. Regional harvest measures from Volume I, Chapter 7 with significant application to Mill, Abernathy, and Germany Subbasin populations.

Measure	Description	Comments
F.M17	Monitor chum handle rate in winter steelhead sport fisheries.	State agencies would include chum incidental handle assessments as part of their annual tributary sport fishery sampling plan. If winter steelhead fisheries continue in these basins.
F.M18	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	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.M19	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	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.M24	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	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.

5.4.3 Hatcheries

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

There are no production hatcheries operating in Mill, Abernathy, or Germany creek subbasins. Abernathy National Fish Hatchery currently operates as a fishery research facility. Small numbers of hatchery winter steelhead have been planted into Abernathy and Germany creeks since 1961 for harvest opportunity. There is currently no hatchery steelhead scheduled for release into these streams. 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.

Regional hatchery strategies and measures are focused on evaluating and reducing biological risks and reducing the risks to natural populations. Any future artificial production programs within Mill, Abernathy, or Germany creek basins 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 Technical Foundation, Volume IV). Regional hatchery measures identified in Volume I, Chapter 7 with potential applications to hatchery programs within the Mill, Germany, and Abernathy creek subbasins are summarized in Table 5-3.

Table 5-3. Regional hatchery measures from Volume I, Chapter 7 with potential implementation actions in the Mill, Abernathy, and Germany creek subbasins.

Measure	Description	Comments
H.M32.	Juvenile release strategies to minimize interactions with naturally-spawning fish.	Release strategies are aimed at reducing or avoiding interactions with wild steelhead, fall Chinook, coho by release timing and release location strategies.
H.M34	Mark hatchery steelhead with an adipose fin-clip for identification and selective harvest.	Marking hatchery fish allows for identification of hatchery fish in the natural spawning grounds and at collection facilities which enables accurate accounting of wild fish. Marking also enables selective fisheries to retain hatchery fish and release wild fish.
H.M26,34	Hatchery program utilized for supplementation and enhancement of wild chum and coho populations.	Enhancement programs for natural chum and coho could be considered with appropriate brood stock at Abernathy Hatchery.
H.M8	Adaptively manage hatchery programs to further protect and enhance natural populations and improve operational efficiencies.	Abernathy Hatchery could be utilized for research, monitoring, and evaluation programs to provide information for regional application.

5.4.4 Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Mill, Germany and Abernathy salmon and steelhead are affected throughout their lifecycle by ecological interactions with non native species, food web components, and predators. Interactions are similar for Mill, Germany, and Abernathy populations to those of most other subbasin salmonid populations. Ecological Interactions are addressed by regional strategies and measures identified in Volume I.

5.4.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. 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 are similar for Mill, Germany, and Abernathy populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook than steelhead and coho. Estuary and mainstem effects on Mill, Germany, and Abernathy salmon and steelhead populations are addressed by regional strategies and measures identified in Volume I and the Columbia Mainstem and Estuary Subbasin sections of Volume II.

5.4.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity 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 Mill/Abernathy/Germany Basin have the greatest impact on the health and viability of salmon and steelhead relative to the other limiting factors and threats discussed in this chapter.

Subwatersheds, reaches, and habitat attributes have been prioritized for protection and/or restoration based on the plan's biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Priority areas for habitat preservation and restoration are identified in Figure 5-4. A summary of the primary habitat limiting factors and threats are presented in Table 5-5. Habitat measures and related information are presented in Table 5-6. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 5-5. Reach- and subwatershed-scale limiting factors generated from the technical assessment are included in Table 5-4. Details on species-specific spatial priorities and limiting factors at the subbasin level may be found in Volume II of the Technical Foundation. A description of the methodology used to generate composite (multi-species) reach and subwatershed priorities can be found in the introduction to this volume of the recovery plan.

The areas with the greatest current or potential contribution to focal salmonid population health and productivity are listed below. Tier 1 and 2 reaches within these priority areas are included in the list. The habitat limiting factors, threats, and measures included in this chapter focus primarily on the priority areas and the Tier 1 and 2 reaches within them. Tier 3, 4, and non-tiered reaches are considered secondary priority, but in many cases, these lower priority areas will also require restoration and preservation actions in order to achieve recovery objectives. Watershed process measures generally focus on the entire basin as opposed to being limited only to high priority areas because conditions in high priority areas are often influenced by cumulative watershed effects. High priority areas and reaches in the Mill/Abernathy/Germany Basin include the following:

- Lower Mill Creek & tributaries – Mill 1-5; SF Mill 1; Spruce 1-2; NF Mill 1-2
- Mainstem Abernathy Creek & tributaries – Abernathy 1-11; Cameron 1; Erick 2; Midway 5
- Mainstem Germany Creek – Germany 1-8, 10, 12-15

The following paragraphs provide a brief overview of each of these priority areas, including species most affected, land-use threats, and the general type of measures that will be necessary for recovery. Additional detail can be found in the tables and figures that follow.

While reach level habitat conditions often result from local factors, they are also affected or shaped by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input and large woody debris recruitment are often affected by or result from upstream conditions and degraded watershed processes. Access to key reaches may also be affected by barriers that occur downstream of a reach. Accordingly, restoration of a priority reach may require action outside the targeted reach. The IWA analysis was used to identify potential upstream watershed areas that could influence reach level habitat attributes. EDT was used to allow a relative comparison of reaches and habitat attributes within a reach.

The reaches with the most current and potential production in the Mill Creek basin are in the lower mainstem (below the SF confluence and just upstream of the NF confluence), in lower SF Mill Creek, and in NF Mill Creek. The Mill Creek basin is nearly entirely forest land, with scattered rural residential development along the lower mainstem and lower SF Mill Creek. The primary impacts are related to basin-wide forest practices and recovery measures should therefore focus primarily on forestry related impacts.

The most productive reaches in Abernathy Creek are located in the lowest 3-4 miles of the mainstem and in the tributaries Erick and Midway creeks. These reaches suffer from basin-wide forest practices and from localized riparian and floodplain impacts related to agriculture and rural residential development. Successful restoration of habitat will involve riparian forest recovery, floodplain re-connection, and restoration of functional runoff and sediment supply processes from the entire basin.

The lower and middle mainstem Germany reaches (Germany 1-8) are used by all salmonid populations. These reaches are impacted by basin-wide forest practices and by local agriculture and rural residential development. The upper Germany Creek reaches (Germany 10-15) are utilized most by winter steelhead. These reaches are impacted most by upper basin forest harvest and road conditions. Germany Creek reaches will require stream corridor (riparian areas and floodplains) restoration as well as basin-wide recovery of functional runoff and sediment supply processes.

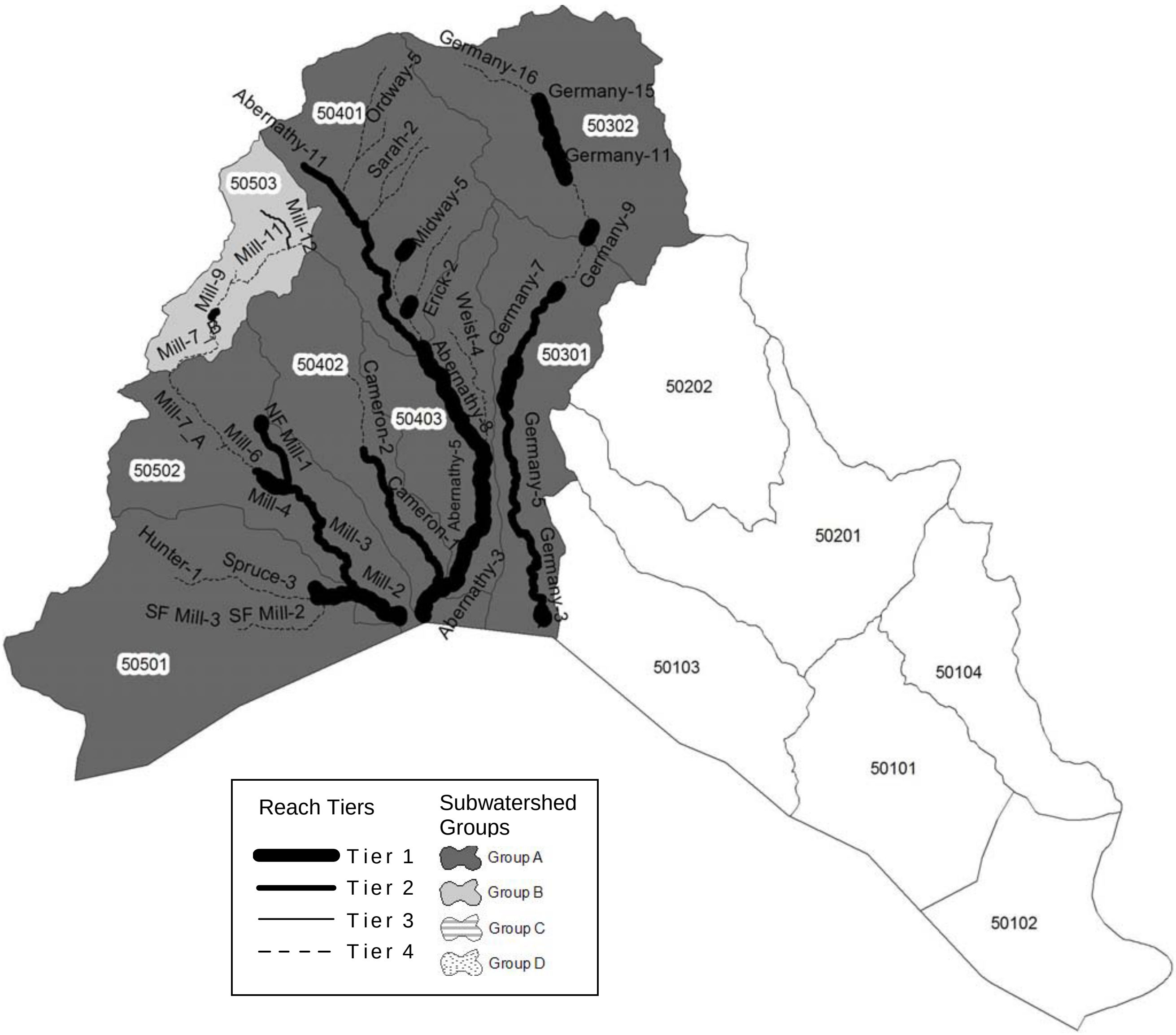


Figure 5-4. Reach tiers and subwatershed groups in the Mill/Abernathy/Germany Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities 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.

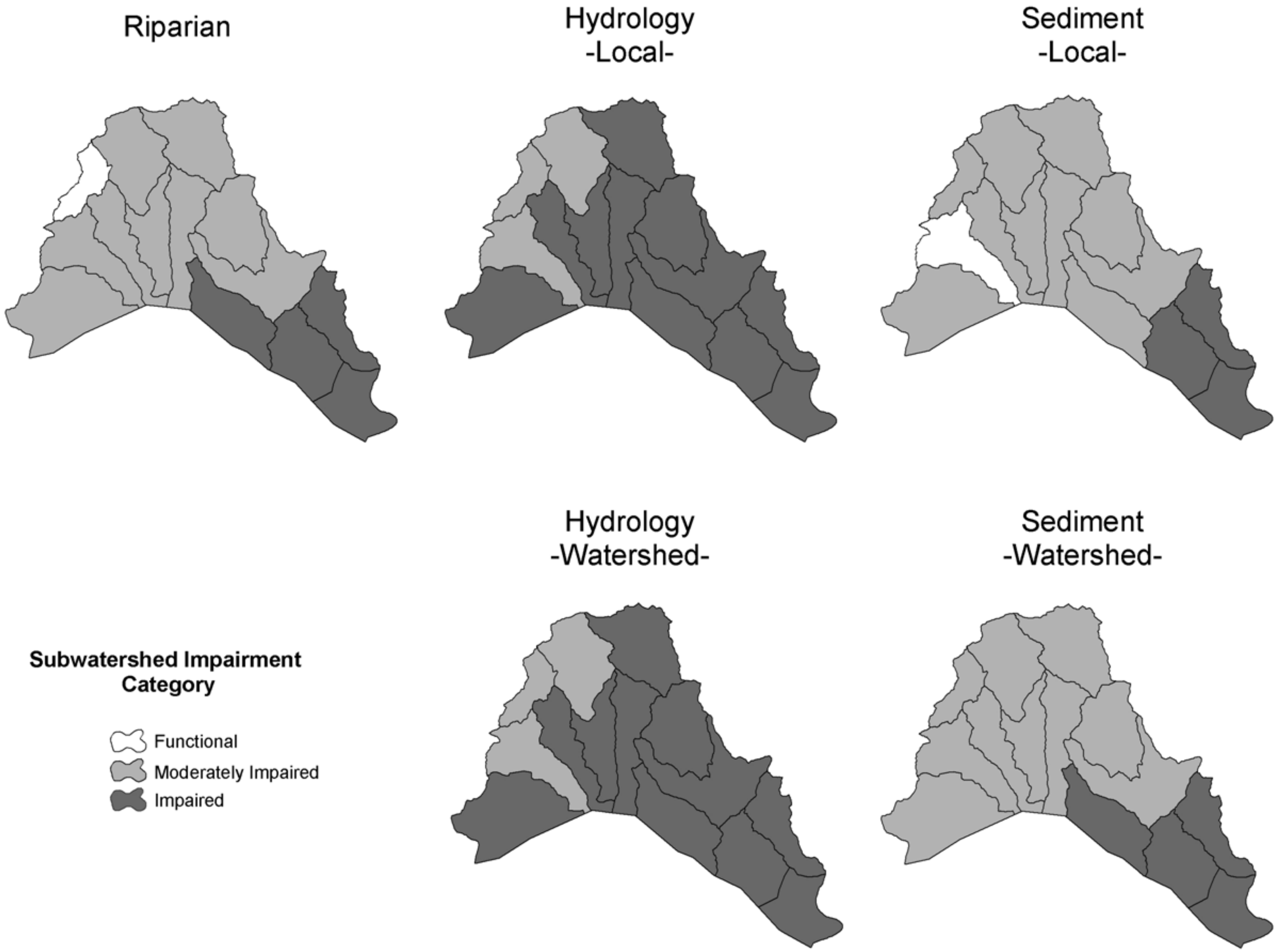


Figure 5-5. IWA subwatershed impairment ratings by category for the Mill/Abernathy/Germany Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 5-4. 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.

Mill

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) Hydrology	Watershed processes (local) Sediment	Watershed processes (local) Riparian	Watershed processes (watershed) Hydrology	Watershed processes (watershed) Sediment
A	50501	Spruce-1 Spruce-2 Spruce-3 SF Mill-1 SF Mill-2 Trib1231995461938-1	StW	Spruce-1 Spruce-2 Trib1231995461938-1 SF Mill-1	spawning egg incubation fry colonization summer rearing winter rearing adult holding	channel stability habitat diversity temperature flow sediment	PR	I	M	M	I	M
			Chum	SF Mill-1	spawning egg incubation fry colonization adult holding	habitat diversity sediment	PR					
			Coho	Spruce-1 Spruce-2 Trib1231995461938-1 SF Mill-1	spawning egg incubation fry colonization summer rearing juvenile (age-0) migrant winter rearing adult holding	channel stability habitat diversity flow sediment food key habitat quantity	PR					
	50502	Mill-1 Mill-2 Mill-3 Mill-4 Mill-5 Mill-6 Mill-7 NF Mill-1 NF Mill-2 Trib1232393462311-1	StW	Mill-2 Mill-4 NF Mill-2	spawning egg incubation fry colonization summer rearing winter rearing adult holding	none	PR	M	F	M	M	M
			Chum	none								
			ChF	Mill-2	spawning egg incubation fry colonization adult holding	habitat diversity sediment	PR					
			Coho	Mill-2 Mill-4 Mill-5 NF Mill-2	spawning egg incubation fry colonization summer rearing juvenile (age-0) migrant winter rearing adult holding	habitat diversity	PR					
B	50503	Mill-7 Mill-8 Mill-9 Mill-10 Mill-11 Mill-12 Mill-13 Trib1232392462718-1 Trib1232190462807-1	Coho	Mill-8	egg incubation summer rearing winter rearing	none	PR	M	M	F	M	M

Abernathy

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): Hydrology	Watershed processes (local): Sediment	Watershed processes (local): Riparian	Watershed processes (watershed): Hydrology	Watershed processes (watershed): Sediment
A	50403	Abernathy-3 Abernathy-4 Abernathy-5 Abernathy-6 Abernathy-7 Abernathy-8 Trib1231566462579-1 Trib1231566462579-2 Weist-1 Weist-2 Weist-3	StW	Abernathy-4 Abernathy-5 Abernathy-7 Abernathy-8	egg incubation fry colonization summer rearing winter rearing	habitat diversity temperature sediment	PR	I	M	M	I	M
			Chum	Abernathy-3	spawning egg incubation fry colonization adult holding	habitat diversity sediment key habitat quantity	PR					
			ChF	none								
			Coho	Abernathy-5 Abernathy-7	egg incubation summer rearing winter rearing	channel stability habitat diversity flow sediment	PR					
	50402	Abernathy-1 Abernathy-2 Cameron-1 Cameron-2	StW	Abernathy-1 Abernathy-2	egg incubation summer rearing	channel stability habitat diversity temperature predation flow sediment	PR	I	M	M	M	M
			Chum	Abernathy-1 Abernathy-2	spawning egg incubation adult holding	habitat diversity sediment	PR					
			ChF	Abernathy-1 Abernathy-2	spawning egg incubation fry colonization adult holding	habitat diversity sediment	PR					
			Coho	Abernathy-2	egg incubation summer rearing winter rearing	channel stability habitat diversity temperature flow sediment	PR					
	50401	Abernathy-9 Abernathy-10 Abernathy-11 Erick-1 Erick-2 Erick-3 Midway-1 Midway-2 Midway-3 Midway-4 Midway-5 Ordway-1 Ordway-2 Ordway-3 Ordway-4 Ordway-5 Sarah-1 Sarah-2 Sarah-3	StW	Erick-2 Midway-5	egg incubation fry colonization summer rearing winter rearing	sediment	PR	M	M	M	M	M
			Coho	none								

Germany

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	50302	Germany-10 Germany-11 Germany-12 Germany-13 Germany-14 Germany-15 Germany-16 Trib-1231107462883 Trib-1231123462853 Trib-1231127463253 Trib-1231209463005 Trib-1231264463102 Trib-1231282461874-1 Trib-1231282461874-2 Trib-1231287463265 Trib-1231292463165-1 Trib-1231292463165-2	StW	Germany-10 Germany-12 Germany-13 Germany-14 Germany-15	egg incubation summer rearing winter rearing	habitat diversity flow sediment	PR	I	M	M	I	M
			Coho	none								
	50301	Germany-1 Germany-2 Germany-3 Germany-4 Germany-5 Germany-6 Germany-7 Germany-8 Germany-9 Trib-1231221462726 Trib-1231231462714 Trib-1231363462545-1 Trib-1231363462545-2 Trib-1231363462545-3	StW	Germany-2 Germany-6 Germany-8 Trib-1231363462545-1	spawning egg incubation fry colonization summer rearing	habitat diversity temperature sediment	PR	I	M	M	I	M
			Chum	Germany-2	spawning egg incubation adult holding	habitat diversity sediment	PR					
			ChF	Germany-2 Germany-3	egg incubation fry colonization adult holding	habitat diversity sediment	PR					
			Coho	Germany-2 Germany-3 Germany-8 Trib-1231363462545-1	spawning egg incubation fry colonization summer rearing juvenile (age-0) migrant winter rearing adult holding	habitat diversity temperature sediment	PR					

Table 5-5. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the lower Mill Creek & tributaries (MI), mainstem Abernathy & tributaries (AB), and mainstem Germany & tributaries (GE). Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors	MI	AB	GE
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)	✓	✓	
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	✓	✓	✓
Substrate and sediment			
Excessive fine sediment	✓	✓	✓
Embedded substrates	✓	✓	✓

Threats	MI	AB	GE
Agriculture / grazing			
Clearing of vegetation		✓	✓
Riparian grazing		✓	✓
Floodplain filling		✓	✓
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	✓	✓	✓
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	✓	✓	✓

Table 5-6. Habitat measures in priority areas, with reference to limiting factors addressed, threats addressed, target species, and estimated time until benefits would be realized (time). Tier 1 and 2 reaches, or other areas of known priority, are listed under the location column for some measures (i.e., stream corridor measures). Reaches not included in the table (Tier 3, 4, and non-tiered reaches) are considered secondary priority.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
1. Protect and restore floodplain function and channel migration processes ***A. Set back, breach, or remove artificial channel confinement structures***					
Mill Creek Mill 1-2; SF Mill 1 ***Abernathy Creek*** Abernathy 1-8 ***Germany Creek*** Germany 4-6	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes • Channel down-cutting (incision)	• Floodplain filling • Channel straightening • Artificial confinement	• All species	2-15 years	Great potential benefit due to improvements in many limiting factors. This passive restoration approach can allow channels to restore naturally once confinement structures are removed. There are challenges with implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense.
2. Protect and restore off-channel and side-channel habitats ***A. Restore historical off-channel and side-channel habitats where they have been eliminated*** ***B. Create new off-channel or side-channel habitats (i.e. spawning channels)***					
Mill Creek Mill 1-2; SF Mill 1 ***Abernathy Creek*** Abernathy 1-8 ***Germany Creek*** Germany 4-6	• Loss of off-channel and/or side-channel habitat • Altered habitat unit composition	• Floodplain filling • Channel straightening • Artificial confinement	• All species	2-15 years	Good potential benefit especially for chum, which have lost a significant portion of historically available off-channel habitat for spawning. Potential benefit is limited by moderate probability of success with creation of new habitats. There are challenges with implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense.
3. Protect and restore riparian function ***A. Reforest riparian zones*** ***B. Allow for the passive restoration of riparian vegetation*** ***C. Livestock exclusion fencing*** ***D. Invasive species eradication*** ***E. Hardwood-to-conifer conversion***					
Mill Creek	• Reduced stream canopy	• Timber harvest –	• All species	20-100	High potential benefit due to the many limiting

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
Mill 1-5; SF Mill 1; Spruce 1-2; NF Mill 1-2 ***Abernathy Creek*** Abernathy 1-11; Cameron 1; Erick 2; Midway 5 ***Germany Creek*** Germany 1-8, 10, 12-15	cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or noxious species	riparian harvests • Riparian grazing • Clearing of vegetation due to rural development and agriculture		years	factors that are addressed. Riparian impairment is related to most land-uses and is a concern throughout the basin. Riparian protections on forest lands are provided for under current harvest policy. Riparian restoration projects are relatively inexpensive and are often supported by landowners. Whereas the specified stream reaches are the highest priority for riparian measures, riparian restoration and preservation should occur throughout the basin since riparian conditions affect downstream reaches. Use IWA riparian ratings to help identify restoration and preservation opportunities.
4. Protect and restore streambank stability ***A. Restore eroding streambanks***					
Mill Creek Mill 1-2; SF Mill 1 ***Abernathy Creek*** Abernathy 1-8 ***Germany Creek*** Germany 4-6	• Reduced bank/soil stability • Excessive fine sediment • Excessive turbidity • Embedded substrates	• Artificial confinement • Clearing of vegetation • Roads – riparian/floodplain impacts • Riparian grazing	• All species	5-50 years	Most areas of bank instability are located in the lower portion of the basins where agricultural, residential, and recreation impacts have created localized areas of bank erosion. Bio-engineered approaches that rely on structural as well as vegetative measures are the most appropriate means of restoration. These projects have a high risk of failure if causative factors are not adequately addressed.
5. Protect and restore natural sediment supply processes ***A. Address forest road related sources*** ***B. Address timber harvest related sources*** ***C. Address agricultural sources***					
Entire basin	• Excessive fine sediment • Excessive turbidity • Embedded substrates	• Timber harvest – impacts to sediment supply • Forest roads – impacts to sediment supply • Agricultural practices – impacts to sediment supply	• All species	5-50 years	High potential benefit due to sediment effects on egg incubation and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs and forest land HCPs. There are challenges with implementation on agricultural lands due to few sediment-focused regulatory requirements for agricultural lands. Use IWA impairment ratings to identify restoration and preservation opportunities.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
6. Protect and restore runoff processes ***A. Address forest road impacts*** ***B. Address timber harvest impacts*** ***C. Limit additional watershed imperviousness***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Timber harvest – impacts to runoff • Forest roads – impacts to runoff • Clearing of vegetation (associated with agriculture and residential uses)	• All species	5-50 years	High potential benefit due to flow effects on habitat formation, redd scour, and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs and forest land HCPs. There are challenges associated with addressing runoff issues on developed lands due to continued increase in watershed imperviousness related to development and lack of adequate mitigation. Use IWA impairment ratings to identify restoration and preservation opportunities.
7. Protect and restore instream flows ***A. Water rights closures*** ***B. Purchase or lease existing water rights*** ***C. Relinquishment of existing unused water rights*** ***D. Enforce water withdrawal regulations*** ***E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Water withdrawals	• All species	1-5 years	Instream flow management strategies for the Mill/Abernathy/Germany basin have been identified as part of Watershed Planning for WRIA 25 (LCFRB 2004). Strategies include water rights closures, setting of minimum flows, and drought management policies.
8. Protect and restore water quality ***A. Restore the natural stream temperature regime***					
Entire basin	• Altered stream temperature regime	• Riparian harvests • Riparian grazing	• All species	1-50 years	Primary emphasis for restoration should be placed on stream segments that are listed on the 2004 303(d) list.
9. Protect and restore instream habitat complexity ***A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting*** ***B. Structurally modify stream channels to create suitable habitat types***					
Mill Creek	• Lack of stable instream	• None (symptom-	• Cho	2-10 years	Moderate potential benefit due to the high

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
Mill 1-5; SF Mill 1; Spruce 1-2; NF Mill 1-2 ***Abernathy Creek*** Abernathy 1-11; Cameron 1; Erick 2; Midway 5 ***Germany Creek*** Germany 1-8, 10, 12-15	woody debris • Altered habitat unit composition	focused restoration strategy)	• Wnter steelhead		chance of failure. Failure is probable if habitat-forming processes are not also addressed. These projects are relatively expensive for the benefits accrued. Moderate to high likelihood of implementation given the lack of hardship imposed on landowners and the current level of acceptance of these type of projects.
10. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development ***A. Plan growth and development to avoid sensitive areas (e.g.,wetlands, riparian zones, floodplains, unstable geology)*** ***B. Encourage the use of low-impact development methods and materials*** ***C. Apply mitigation measures to off-set potential impacts***					
Entire basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	The focus should be on management of land-use conversion and managing continued development in sensitive areas (e.g.,wetlands, stream corridors, unstable slopes). Critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary mechanisms need to be put in place to restore currently degraded habitats.
11. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection ***A. Purchase properties outright through fee acquisition and manage for resource protection*** ***B. Purchase easements to protect critical areas and to limit potentially harmful uses*** ***C. Lease properties or rights to protect resources for a limited period***					
Entire basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit. These programs are under-funded and have low landowner participation.

Program Gap Analysis

The Mill/Abernathy/Germany Basin (~152 sq mi) is located primarily in Cowlitz County; however, the middle and upper reaches of Mill Creek are in Wahkiakum County. The Mill/Abernathy/Germany Basin can be characterized as significantly forested with some rural residential. Agriculture occurs in the mainstem valleys of Abernathy and Germany Creeks, but not in Mill Creek.

- Large private industrial forestland comprising about 60 square miles is the largest land use.
- Department of Natural Resources forestlands encompass about 26 square miles.
- Small forestlands acreage is estimated to be 12 square miles.
- The eastern third of the basin has growing commercial, rural residential and suburban land uses that are heavily influenced by proximity to the Longview/Kelso urban center;

Protection Programs

Private industrial forest owners, the Department of Natural Resources, Cowlitz and Wahkiakum Counties, and other regulatory agencies implement protection programs in the Mill/Abernathy/Germany Basin. Protection programs in this analysis include those programs that protect habitat conditions or watershed functions through management policies and programs, regulatory measures, and acquisition of sensitive habitat or protective easements, and incentives. Major programs implementing protection measures are identified below.

Federal Programs

- ***U.S. Army Corps of Engineers***

  - Administers the Section 10 (Rivers and Harbor Act) and Section 404 (Clean Water Act) permit processes. Section 10 requires approval of any activity in, above, or below a navigable river, which affects course, location, condition, or capacity of navigable waters. Section 404 requires prior approval of dredging, filling, grading, clearing, and bank hardening. In waters used by listed fish species, the permits are subject to ESA Section 7 consultation with NOAA Fisheries to ensure that any approved action is adequately protective of the fish; [M.1A; M.2A; M.2B; M.4A; M.9A; M.9B]

State Programs

- ***Department of Natural Resources***

  - State Forest Land HCP:

    State forestlands are managed under the provisions of a Habitat Conservation Plan (HCP). The Habitat Conservation Plan protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8A]

  - State Forest Practices:

    Riparian zones and harvest restrictions represent significant protections under the State of Washington Forest Practices Rules, including the Forest and Fish Module. These rules also establish standards for new road construction addressing management of runoff, sediment, and slope failure. [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8A]

- ***Washington Department of Fish and Wildlife***

  - Washington State Hydraulic Code

    The Washington State Hydraulic Code is administered through the Washington Department of Fish and Wildlife. The purpose of this program is to protect stream conditions and habitat. The regulations apply to such activities as stream bank protection, instream construction, culvert installation, channel changes or realignments, debris removal, and water diversion facilities. Those proposing such actions must obtain a Hydraulic Project Approval (HPA) permit. [M.1A; M.2A; M.2B; M.4A; M.9A; M.9B]

  - Habitat Program: The Department provides advice to local governments and landowners interested in measures to protect habitat values on their property. [M.1A; M.2A; M.2B; M.3A; M.4A; M.7A; M.7B; M.7C; M.8A; M.9A; M.9B; M.10A; M.10B; M.10C]

- ***Washington Department of Ecology***

  - Water Resources Program/Water Rights: Department of Ecology, in consultation with the Department of Fish and Wildlife, has administrative closed selected areas within the lower Cowlitz basin to further surface and groundwater withdraws (where groundwater is in continuity with surface water). Existing administrative closures by the Department of Ecology protect surface waters from further withdrawals. Formal rule making would strengthen the closures. The extent of unauthorized surface water withdrawals is unknown, but could exacerbate summer low flows on smaller tributaries. [M.7A; M.7B; M.7C; M.7D]

  - Water Resources Program/Watershed Planning: In cooperation with the Lower Columbia Fish Recovery Board, other state and federal agencies, tribes, local governments, and citizens, the Department funds and participates in a state authorized watershed planning process for Water Resource Inventory Area (WRIA) 26 pursuant to RCW 90.82. The goal of the plan is to ensure adequate water for people and fish. The planning process is dealing with water quantity and quality, stream flows and fish habitat. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.6C; M.7A; M.7B; M.7C; M.7D; M.7E; M.8A]

- ***Conservation Commission/ Cowlitz- Wahkiakum Conservation Districts*** provide technical assistance and incentives (e.g., Conservation Reserve and Enhancement Program) to encourage agricultural landowners to protect riparian areas and stream habitat. The Cowlitz Conservation District has been actively involved in these watersheds. These programs could help address measure M.3A; M.3C; M.4A; M.5C; M.8A; M.9A; M.9B]

- ***Washington Department of Community Trade and Economic Development*** provided funding for the purchase of riparian easements. In 1999 Cowlitz County received $1,000,000 grant for the purchase of easements along the lower reaches of Abernathy Creek. [M.11B]

Local Government Programs

- ***Cowlitz County***

  - Land Use:
    - ✓ The comprehensive plan that applies to the non-federal lands but contains no significant policies for the protection of watershed processes and stream habitat.
    - ✓ Zoning along State Highway 503 provides for one dwelling per 2 acres and one dwelling per 5 acres along non-county roads.
    - ✓ Cowlitz County has not adopted protective stream buffers.
    - ✓ Wetland buffers vary from 25' to 200' and are based upon soil type and wildlife utilization.
    - ✓ The County has not developed comprehensive ordinances for the protection of watershed processes or stream habitat conditions. [M.10A; M.10B; M.10C]
  - Road Maintenance

    The County has not developed or implemented a road maintenance program to protect habitat. [M.8A]

  - Land Acquisition: The County acquired easements along the lower reaches of Abernathy Creek for protection and restoration of riparian habitat using a $1 million grant from the Washington Department of Community Trade and Economic Development. The acquisition benefited ESA listed salmonids as well as fish research conducted at the U.S. Fish and Wildlife Service Abernathy Fish Technology Center. [M.11B]

- ***Wahkiakum County***

  - Comprehensive Planning and Land Use Zoning:
    - ✓ The County has adopted a comprehensive plan and zoning. The County land use program is subject to the Washington Growth Management Act (GMA), except for the requirement to adopt a Critical Areas Ordinance.
    - ✓ The County Critical Areas Ordinance provides for stream buffers from 25 to 200 feet depending on stream type and intensity of use. Wetland buffers also vary from 25 to 200 feet.
    - ✓ The County has adopted a Shoreline Master Program to regulate development. [M.10A; M.10B; M.10C]

Restoration Programs

Restoration programs in the Mill/Abernathy/Germany Basin are implemented by a variety of agencies, organizations, and private interests. Major programs implementing protection measures are identified below:

Federal Programs

No active programs.

State Restoration Programs

- ***Department of Natural Resources***

- State Forest Land Habitat Conservation Plan (HCP): The Department manages state forest lands pursuant to a Habitat Conservation Plan (HCP). The HCP road maintenance and restoration objectives require barrier upgrades and road abandonment and/or other improvements. [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8A]

- State Forest Practices Act:
  - Industrial forests within the lower NF Lewis Basin are governed by Forest and Fish regulations and have rigid schedules for maintaining and improving roads and removing barriers. Industrial landowners have 15 years to bring roads and barriers into compliance with regulations [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8A]
  - Small private forest owners are governed by Forest and Fish regulations; however their road and barrier maintenance and improvement programs are tied to state funding. In the State 2003-05 Biennial Budget, 2 million dollars was allocated statewide to support small private forest owners [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8B].

➢ ***Washington Department of Fish and Wildlife***

- Habitat Program: The Department provides advice to local governments and landowners interested in measures to restoring watershed processes and stream habitat. [M.1A; M.2A; M.2B; M.3A; M.4A; M.7A; M.7B; M.7C; M.8A; M.9A; M.9B; M.10A; M.10B; M.10C]

➢ ***Washington Department of Ecology***

- Water Quality Program: Abernathy and Germany Creeks are both listed on the WA State 303(d) listing for temperature impairment. [M.8A]
- Water Resources Program/Watershed Planning:
  The planning process for WRIA 25 is dealing with water quantity and quality, stream flows and fish habitat. Potential restoration efforts address improving summer low flows through conservation and acquisition of water rights. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.6C; M.7A; M.7B; M.7C; M.7D; M.7E; M.8A]

➢ ***Department of Transportation***

- Road Maintenance Program

WSDOT has an ESA Section 4(d) Road Maintenance Program. The Maintenance Program uses trained crews to primarily manage roadside vegetation, litter control, and maintenance of safety rest areas associated with SR 4. [M.10A]

- Barrier Replacement Program
  In partnership with the County and conservation districts, WSDOT has provided over $230,000 in funding for county culvert assessment, design and engineering.

➢ ***Salmon Recovery Funding Board (SRFB)/ Lower Columbia Fish Recovery Board (LCFRB)***

- Washington Salmon Recovery Act (RCW 77.85): The SRFB and the LCFRB jointly administer a grant program that allocates federal Pacific Salmon Recovery Funds and State funds for habitat protection and restoration projects by state and local agencies, nonprofit organizations, and landowners. To date the SRFB has provided $240,000 for restoration activities in Abernathy Creek. [M.1A; M.2A; M.2B; M.3A; M.4A; M.8A]

➢ ***Conservation Commission/ Cowlitz-Wahkiakum Conservation Districts*** provides technical assistance (e.g., farm plans) and incentives (e.g., Conservation Reserve and Enhancement Program) to encourage agricultural landowners to restore riparian areas and stream habitat. The Cowlitz Conservation District has been active in the Mill, Germany, and Abernathy watersheds. These programs could help address measures M.3C, M.4A; M.5C; M.8A.

Local Government Restoration Programs

➢ ***Wahkiakum County***

- Public Works Program: The County maintains an active and ongoing program of identifying and replacing culverts that are a barrier to fish passage.

- County Noxious Weed Control Board: The Board has three primary programs that address weed control in the Mill/Abernathy/Germany Basin; [M.3D]
  - Public education to prevent the spread of noxious weeds;
  - Survey of the County to assess emerging issues; and
  - Enforcement of noxious weed control

Community Restoration Programs

➢ ***Lower Columbia Fish Enhancement Group*** is one of many nonprofit enhancement groups authorized by state law. The group focuses on restoration projects and has participated in projects in the Mill, Germany, and Abernathy watersheds. [M.3A; M.4A; M.8A]

➢ ***Columbia Land Trust*** is a nonprofit organization whose mission is to preserve and restore unique landscapes, natural areas, and sensitive habitats. It is pursuing several projects in the Mill, Germany, and Abernathy watersheds. [M.11A; M.11B; M.11C]

Gap Analysis

***Forest-related Programs*:** The Mill/Abernathy/Germany Basin is about 65 percent forestland. Accordingly, forestry programs have a substantial role in protecting and restoring watershed functions and habitat conditions at levels supporting recovery goals. Certainty of forestry-related protection and restoration programs is relatively high because programs are being implemented and, for the most part, fully funded. Program areas of concern include the continued potential for hydrologic impacts caused by past harvest practices. Monitoring of watershed processes and habitat conditions will be required to confirm the effectiveness of these measures.

Protection-related Programs: Lands in the Mill/Abernathy/Germany Basin have limited protection through Cowlitz County's regulatory authority. Wahkiakum County's land use regulations apply to only the middle and upper reaches of Mill Creek, an area largely protected by state forest practices rules. Cowlitz County land use programs lack effective provisions that commonly are used to direct growth away from sensitive habitat, preserve watershed processes, protect streams and wetlands, and manage stormwater. In addition, as in all lower Columbia subbasins, there are very limited protection mechanisms for agricultural practices relative to the protection riparian areas and hydrologic conditions.

Restoration-related Programs: Over a long period of time, improvements to the Mill/Abernathy/Germany Basin will occur as a result of improved forest management practices that are already in place. To the degree possible, restoration programs should focus on restoring floodplain function and channel migration, as well as restoring off- and side-channel habitats. Program areas of concern include the overall level of effort in terms of restoration activities to adequately address threats.

Table 5-7. Program Actions to Address Gaps

Action #	Lead Agency	Proposed Action
MAG.1	Cowlitz County	Develop and implement controls to adequately protect riparian areas to maintain currently functional and restored habitat around rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Require mitigation, where necessary, to offset unavoidable damage to habitat conditions in riparian management areas
MAG.2	Cowlitz County	Development and implement controls to protect historic stream meander patterns and channel migration zones and avoid hardening stream banks and shorelines
MAG.3	Cowlitz County	Development and implement controls and development standards to adequately protect wetlands, wetland buffers, and wetland function.
MAG.4	Cowlitz County	Develop and implement controls to address erosion and sediment run-off during (and after) construction to prevent sediment and pollutant discharge to streams, wetlands and other water bodies
MAG.5	Cowlitz County	Apply land use and resource protection code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
MAG.6	Forest Managers LCFRB, and DFW	Identify and sequence early action forest-wide restoration projects that analysis indicates could provide significant benefits. In these cases, it may be appropriate to identify outside funding to initiate these early actions
MAG.7	LCFRB, USFS, WDNR. WSDOT, Counties, private property owners.	Develop and implement a coordinated and strategic barrier removal program based on watershed fish priorities and ensuring an effective and efficient sequencing of barrier removal work.
MAG.8	Cowlitz County	Utilize a combination of public outreach/education and, incentives, and to promote (1) stewardship practices for protecting habitat and water quality and (2) landowner support of and participation in habitat restoration efforts.
MAG.9	State of Washington (DOE, DFW)	Close the Mill/Abernathy/Germany Basin to further surface water withdrawals, including groundwater in connectivity with surface waters; curtail unauthorized withdrawals
MAG.10	LCFRB, WDFW, Cowlitz County, Cowlitz CD, LCFEG	Build capacity (e.g. technical and administrative skills, personnel and fiscal resources) needed to allow agencies and organizations to undertake protection and restoration projects, including noxious weed control in a reasonable period time.
MAG.11	SRFB, BPA, NOAA, USFWS, DOE, ACOE	Increase available funding for projects that implement measures and address underlying threats
MAG.13	State of Washington (Dept of Agriculture, and Department of Ecology)	Develop and implement agricultural practices and regulations to protect riparian conditions and water quality
MAG.14	Cowlitz Conservation District	Expand landowner incentive (e.g. CREP) and education plans to promote further habitat protection and restoration.
MAG.15	LCFRB, Cowlitz CD, Cowlitz County,	Address threats proactively by building agreement on priorities among the various program implementers
MAG.16	FEMA	Update floodplain maps using Best Available Science

6 Cowlitz Subbasin - Lower Cowlitz

Figure 6-1. Location of the Lwer Cowlitz River Basin within the Lower Columbia River Basin.

6.1 Basin Overview

The lower Cowlitz River Bsin comprises approximately 440 square miles in Cowlitz and Lewis counties, The Cowlitz river enters the Columbia at RM 68, approximately 3.5 miles southeast of Longview, Washington. Principal tributaries include the Coweeman and Toutle riverssubbasin is part of WRIA 26.

The lower Cowlitz basin will play a key role in the recovery of salmon and steelhead. The basin has historically supported populations of fall Chinook, winter steelhead, chum, and coho. Today, Chinook, steelhead and chum are listed as threatened under the ESA. Coho salmon are a candidate for listing. Other fish species of interest are Pacific lmprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

Lower Cowlitz salmon and steelhead are affected by a variety of in-basin and out-of basin factors including stream, Columbia River mainstem, estuary, and ocean habitat conditions; harvest; hatcheries;and ecological relationships with other species. Analysis has demonstrated that recovery cannot be achieved by addressing only one limiting factor. Recovery will require action to reduce or eliminate all manageable factors or threats. The deterioration of habitat conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonids within the Columbia Basin. Direct harvest of listed salmon and steelhead is prohibited but sport and commercial fisheries focusing on hatchery fish and other healthy wild populations, primarily in the mainstem Columbia and ocean, incidentally affect ESA-listed lower Cowlitz fish. Cowlitz

Salmon and Cowlitz Trout hatcheries operate within the basin with the potential to both adversely affect wild salmon and steelhead populations and to assist in recovery efforts. Key ecological interactions of concern include effects of nonnative species; nutrient inputs from salmon carcasses; and predation by species affected by development including Caspian terns, northern pikeminnow, seals, and sea lions. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the lower Cowlitz Subbasin.

The lower Cowlitz basin is nearly entirely privately owned (94%); much of it by large industrial timber land owners. Forestry is the dominant land use. Commercial forestland makes up over 80% of the basin. The river valleys are mostly in agricultural or residential uses.

The middle mainstem reaches below Mayfield Dam represent important spawning and rearing areas for several species. Below the Barrier Dam, the river flows south through a broad valley. Degraded riparian and floodplain function in these reaches is primarily a result of intensive agricultural 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.

Conditions in the lower mainstem limit the productivity of all species. These reaches have experienced intensive diking, agricultural development, urbanization, Mt. St. Helens sediments, and placement of dredge spoils. Restoring these conditions would provide great benefits, especially to fall Chinook and chum; however, feasibility issues may limit the potential for improvement.

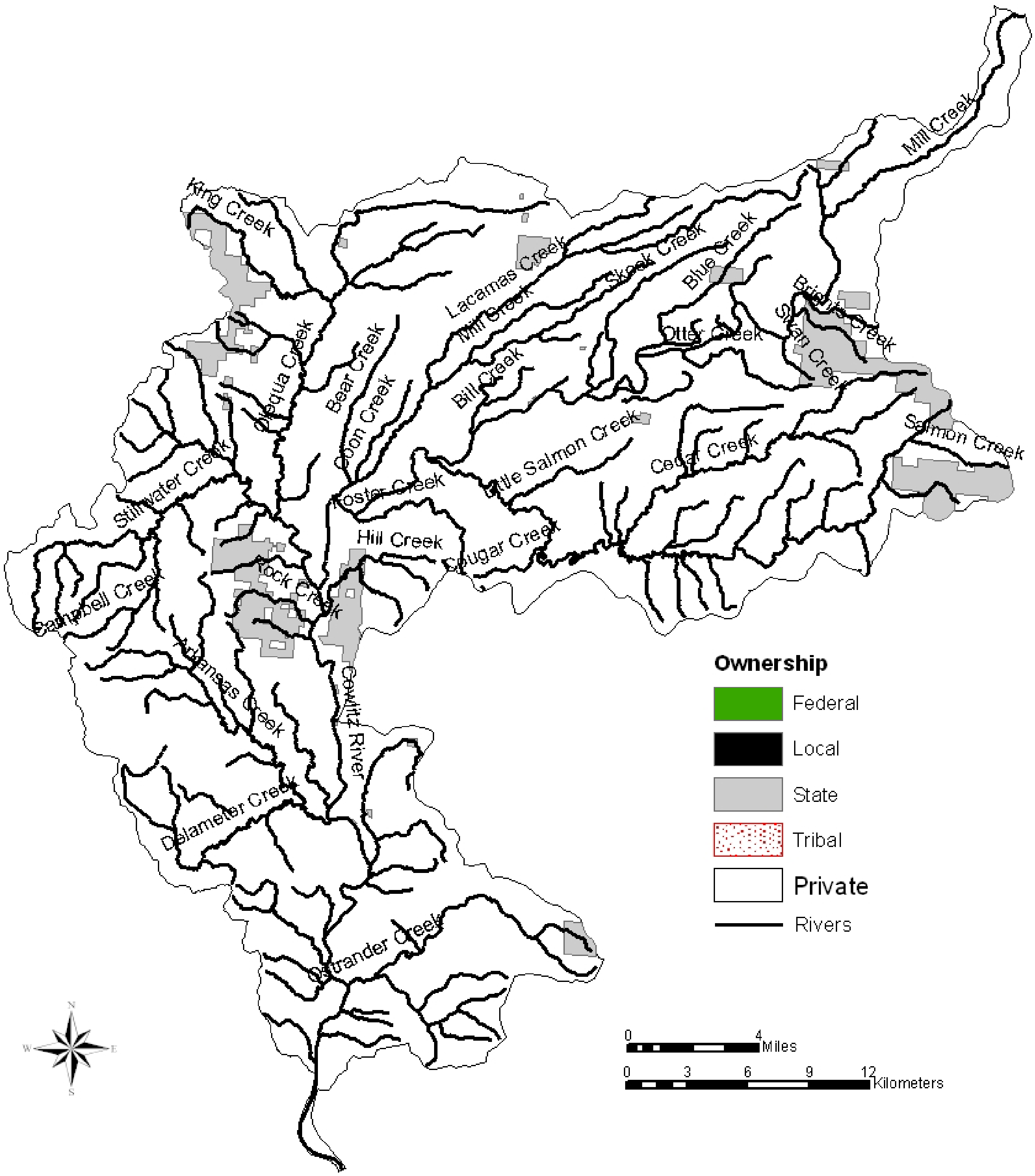
Flow regulation has decreased the risk of high temperatures, sedimentation, and flow extremes; however, stranding of steelhead redds, lack of spawning gravel replenishment, lack of habitat forming flows, and lack of large woody debris transported from upstream are potential problems.

Tributary systems to the middle mainstem provide important habitats for winter steelhead, coho, and resident species, but many of these suffer from degraded habitat conditions. Reaches in Salmon Creek, in particular, are severely limiting for steelhead. This basin has experienced intensive forest harvest in the upper basin and agriculture and grazing impacts along the lower river. Steelhead production is also severely limited in lower reaches of Ostrander, Leckler, and other smaller tributaries to the mainstem.

Population centers in the basin 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). 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.

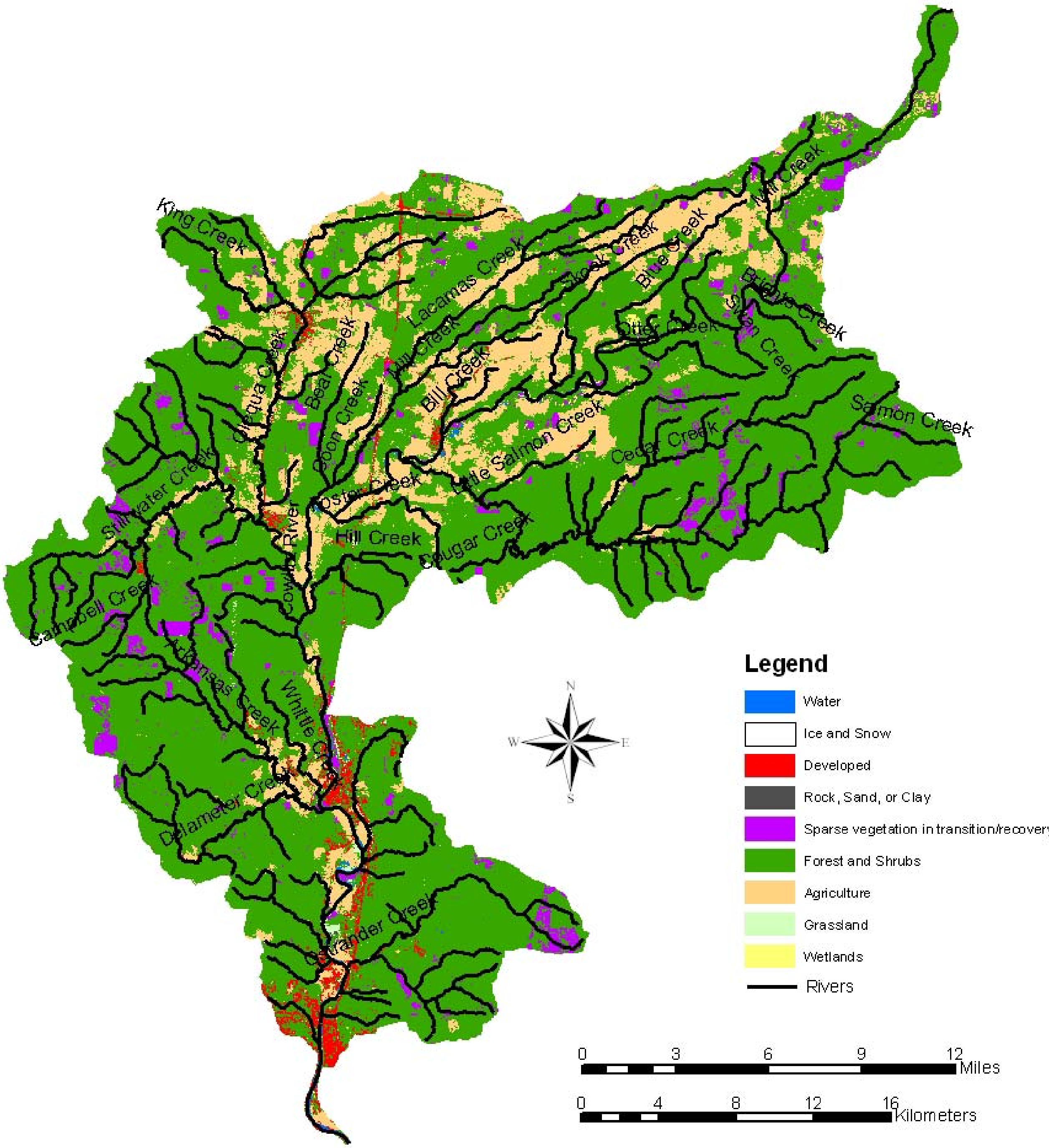
Land Ownership	
Private	94%
State	6%
Federal	0%
Other public	0%

Land Ownership



Vegetation Composition	
Late Seral	0%
Mid Seral	23%
Early Seral	8%
Other Forest	49%
Non Forest	20%

Land Use / Cover



6.2 Species of Interest

Focal salmonid species in the lower Cowlitz include fall Chinook, winter steelhead, chum and coho. The health or viability of these populations is currently low to medium for fall Chinook, low for winter steelhead and coho, and very low for chum. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Recovery goals call for restoring fall Chinook, winter steelhead and chum to a medium level. This level will provide for a 75-94%probability of population survival over 100 years. Coho goals for recovery are high providing a 95% or better probability of persistence over 100 years.

Other species of interest in the lower Cowlitz include coastal cutthroat trout and Pacific lamprey. Regional objectives for these species are described in Volume I, Chapter 6. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for these other species. Cutthroat will benefit from improvements in stream habitat conditions for salmonids. 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 of lamprey are not well known.

Table 6-1.Current viability status of lower 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	Low+	1,000-13,000	Medium	3,900-33,200
Winter steelhead	Threatened	Yes	Low	unknown	Medium	600-1,500
Chum	Threatened	No	Very Low	<150	Medium	1,100-135,700
Coho	Candidate	Yes	Low	unknown	High	unknown

<u>*Fall Chinook*</u> – 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.

<u>*Winter Steelhead*</u> – 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

<u>*Coho*</u> – 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.

Chum – 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,

Coastal Cutthroat – 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.

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. 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 lower Cowlitz. Juveniles rear in freshwater up to seven years before migrating to the ocean.

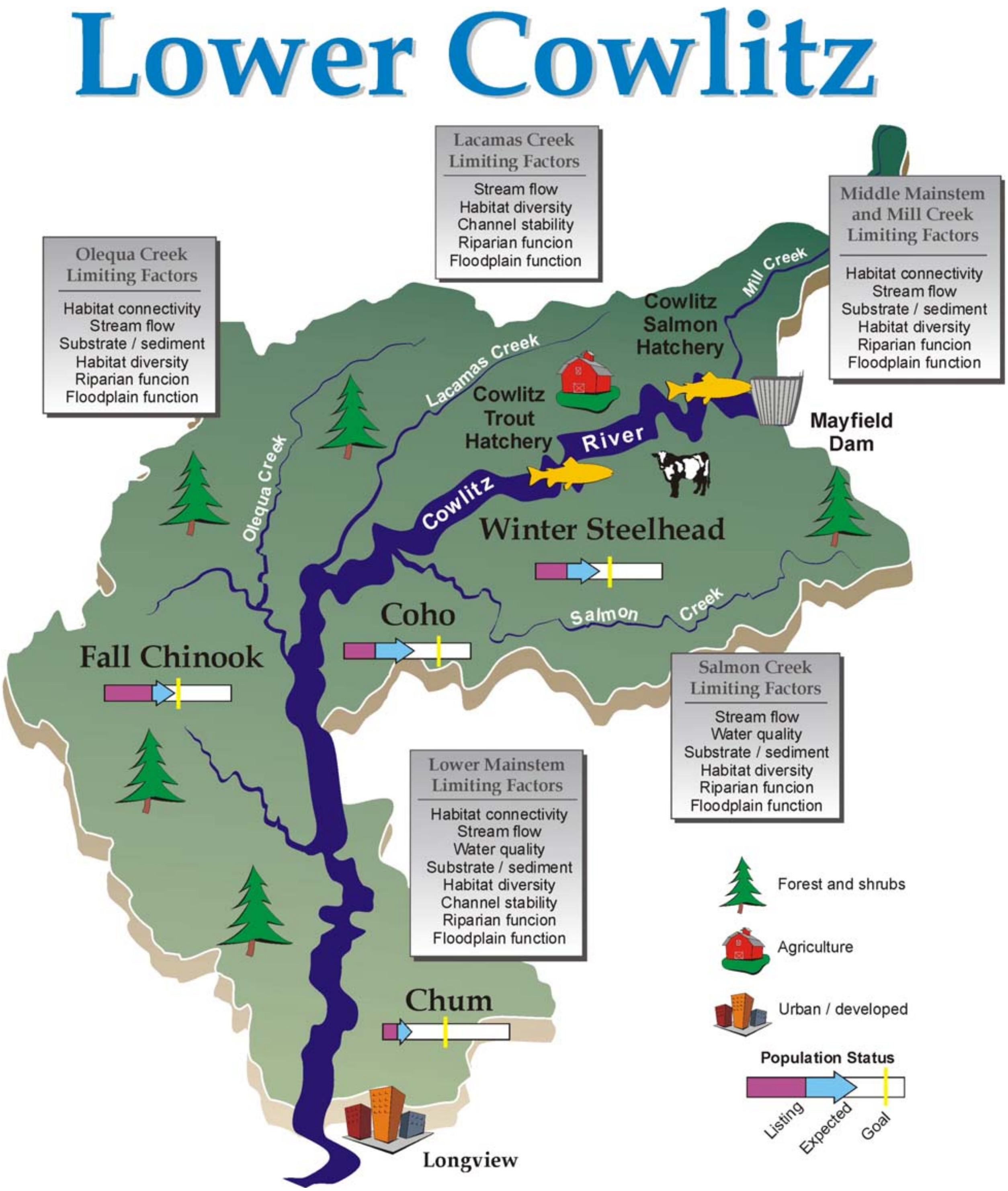


Figure 6-2. Summary of habitat limiting factors, population status, expected population improvement trend with existing programs,and biological objectives depicted for the lower Cowlitz Basin.

6.3 Potentially Manageable Impacts

Stream habitat, estuary/mainstem habitat, harvest, hatchery,and predation effects have all contributed to reduced salmonid productivity, numbers, and population viability in the lower Cowlitz subbasin. The pie charts below represent the relative order of magnitude of quantifiable effects for each of these factors for each focal species. The preferred recovery scenario targets an equivalent reduction in each impact factor in proportion to the magnitude of the effect. Population-specific targets are discussed in further detail in Volume I, Chapter 6.

- Loss of tributary habitat has significant impacts on fall Chinook, chum, winter steelhead and coho in the lower Cowlitz.
- Loss of estuary habitat is moderately important for fall Chinook and chum, but is not of great importance for spring Chinook, winter steelhead or coho.
- Harvest has moderately high impacts for fall Chinook and coho, but has minor impacts on winter steelhead and chum.
- Hatchery impacts are moderately important to all four populations.
- Predation is of moderate to minor importance for each of the lower Cowlitz populations.

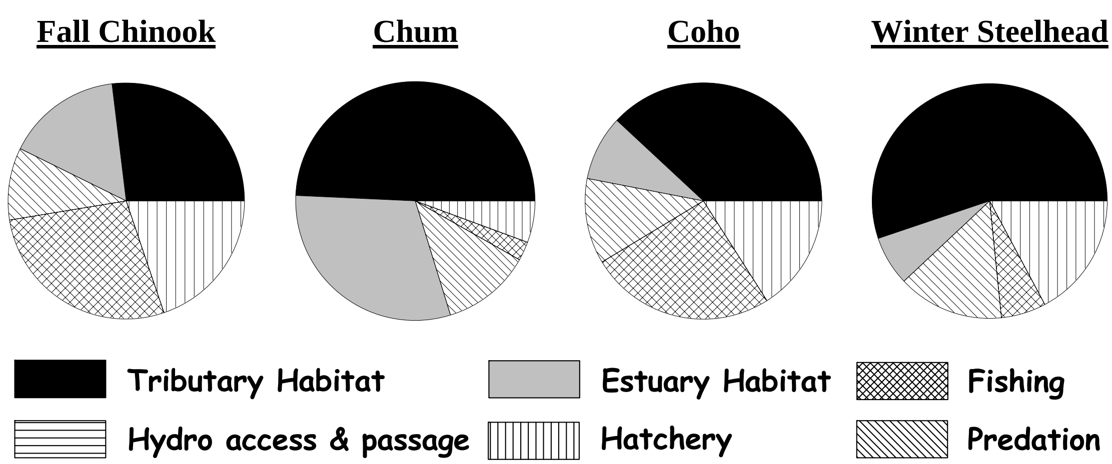


Figure 6-3. Relative contribution of potentially manageable impacts for lower Cowlitz populations.

6.4 Limiting Factors, Threats, and Measures

6.4.1 Hydropower Operation and Configuration

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. The quantity and quality of fall Chinook habitat in the lower Cowlitz 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 Cowlitz species in migration corridors and in the estuary. Key regional strategies affecting lower Cowlitz populations are included in the following table.

Table 6-2. Regional hydro measures 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 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 consider flow regimes, including minimum flow and ramping rates, which enhance the lower river habitat for fall Chinook.

6.4.2 Harvest

Most harvest of wild Cowlitz salmon and steelhead is incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. This mortality is very low for chum and steelhead, but is more significant for fall Chinook. Cowlitz fall Chinook are harvested in ocean and Columbia River commercial and sport fisheries as well as in-basin sport fisheries. Harvest is controlled by an ESA harvest limit associated with Coweeman natural fall Chinook. No harvest of chum occurs in ocean fisheries, there are no directed Columbia River or Cowlitz basin fisheries and retention of chum is prohibited in Columbia River and Cowlitz River sport fisheries. Chum are impacted incidental to fisheries directed at coho and winter steelhead. Harvest of 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 Cowlitz Basin. Wild coho impacts are limited by fishery management to retain fin-marked hatchery fish and release unmarked wild fish. 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 marked hatchery steelhead and commercial fisheries cannot retain hatchery or wild steelhead.

Measures 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. The regional measures 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 Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest measures with significant application to lower Cowlitz subbasin populations are summarized in the following table:

Table 6-3. Regional harvest measures from Volume I, Chapter 7 with significant applicationto lower Cowlitz Subbasin populations.

Measure	Description	Comments
F.M17	Monitor chum handle rate in winter steelhead and late coho tributary sport fisheries.	State agencies would include chum incidental handle assessments as part of their annual tributary sport fishery sampling plan.
F.M13	Consider developing a mass marking plan for hatchery tule Chinook for tributary harvest management and for naturally-spawning escapement monitoring.	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.M18	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	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.M19	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	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.M24	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	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.

6.4.3 Hatcheries

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

There are two hatcheries operating in the lower Cowlitz. The Cowlitz Salmon Hatchery (since 1967) produces fall Chinook, spring Chinook, and coho for harvest opportunity and is used for reintroduction of spring Chinook, coho, and winter steelhead to the upper Cowlitz basins. The harvest program also includes transfer of spring Chinook and coho to the Deep River net pens. The Cowlitz Salmon Hatchery also supplies spring Chinook and coho to the Friends Of The Cowlitz (FOC) organization for rearing and release into the lower Cowlitz. The salmon programs were derived from local Cowlitz stock with negligible transfers from outside the basin. The main hatchery salmon threats are domestication of lower Cowlitz natural fall Chinook and coho and potential ecological interactions between hatchery and natural juvenile salmon. The Cowlitz Trout Hatchery (since 1967) produces early-timed winter steelhead for harvest, late-timed winter steelhead for upper Cowlitz and Tilton basin reintroduction and for harvest, summer steelhead for harvest, and sea-run cutthroat for harvest. The Cowlitz Trout Hatchery supplies sea-run cutthroat trout and summer steelhead to FOC for rearing and release into the lower Cowlitz The early winter steelhead are a composite Elochoman, Chambers Creek, and Cowlitz stock, and the summer steelhead are Skamania stock. 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 6-4. 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	

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 Technical Foundation Volume IV). Regional hatchery measures identified in Volume I, Chapter 7 with potential applications at facilities within the Cowlitz subbasin are summarized in Table 6-5.

Table 6-5. Regional hatchery measures from Chapter 6 with potential implementation actions in the Cowlitz Subbasin.

Measure	Description	Comments
H.M2,5,13,	Integrated hatchery and wild program for fall Chinook. Evaluate potential for integration of a late stock coho program.	Assures fitness of the natural produced fish which will improve population productivity. Integrated programs would be developed specific to the Cowlitz populations in the BRAP procedure.
H.M14	Use only local brood stock in the fall Chinook hatchery program.	This measure will preclude transfer of outside basin stock into the Cowlitz hatchery program. This will enable a hatchery and wild integrated program to contiue with fall Chinook ecologically adapted to the Cowlitz Basin
H.M15, 22,32, 40	Juvenile release strategies to minimize interactions with naturally spawning fish.	Release strategies are aimed at reducing or avoiding interactions with wild steelhead, fall Chinook, coho by release timing and release location strategies.
H.M32,41,17	Mark hatchery steelhead, coho, and perhaps fall Chinook with an adipose fin-clip for identification and selective harvest.	Marking hatchery fish allows for identification of hatchery fish in the natural spawning grounds and at collection facilities which enables accurate accounting of wild fish. Marking also enables selective fisheries to retain hatchery fish and release wild fish.
H.M24, 36	Hatchery program utilized for supplementation and enhancement of lower Cowlitz chum and coho populations	The Cowlitz hatchery complex is used for reintroduction in the upper basin. This program could be considered for expansion to include enhancement of chum and coho populations in the lower Cowlitz.
H.M8	Adaptively manage hatchery programs to further protect and enhance natural populations and improve operational efficiencies.	Appropriate research, monitoring, and evaluation programs along with guidance from regional hatchery evaluations will be utilized to improve the survival and contribution of hatchery fish, reduce impacts to natural fish, and increase benefits to natural fish.
H.M2,6	Evaluate the Cowlitz Salmon and Trout Hatcheries facility operations.	Both facilities would be evaluated in the BRAP process for potential hazards associated with barriers to fish passage and adequacy of screens.
H.M19, 29, 37	Hatcheries utilized for reintroduction of coho, spring Chinook, and winter steelhead into the upper Cowlitz basin.	Hatchery facilities and operations to accommodate the reintroduction effort including rearing; collection, transport, marking, sorting, brood stock development, and M&E.

6.4.4 Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Lower Cowlitz salmon and steelhead are affected throughout their lifecycle by ecological interactions with non-native species, food web components, and predators. Interactions are similar for lower Cowlitz populations to those of most other subbasin salmonid populations. Ecological Interactions are addressed by regional strategies and measures identified in Volume I.

6.4.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. 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 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 than spring Chinook, steelhead, and coho. Estuary and mainstem effects on lower Cowlitz salmon and steelhead populations are addressed by regional strategies and measures identified in Volume I and the Columbia Mainstem and Estuary Subbasin sections of Volume II.

6.4.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity 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 River basin have the greatest impact on the health and viability of salmon and steelhead relative to the other limiting factors and threats discussed in this chapter.

Subwatersheds, reaches, and habitat attributes have been prioritized for protection and/or restoration based on the plan's biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Priority areas for habitat preservation and restoration are identified in Figure 6-4. A summary of the primary habitat limiting factors and threats are presented in Table 6-7. Habitat measures and related information are presented in Table 6-8. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 6-5. Reach- and subwatershed-scale limiting factors generated from the technical assessment are included in Table 6-6. Details on species-specific spatial priorities and limiting factors at the subbasin level may be found in Volume II of the Technical Foundation. A description of the methodology used to generate composite (multi-species) reach and subwatershed priorities can be found in the introduction to this volume of the recovery plan.

The areas with the greatest current or potential contribution to focal salmonid population health and productivity are listed below. Tier 1 and 2 reaches within these priority areas are included in the list. The habitat limiting factors, threats, and measures included in this chapter focus primarily on the priority areas and the Tier 1 and 2 reaches within them. Tier 3, 4, and non-tiered reaches are considered secondary priority, but in many cases, these lower priority areas will also require restoration and preservation actions in order to achieve recovery objectives. Watershed process measures generally focus on the entire basin as opposed to being limited only to high priority areas because conditions in high priority areas are often influenced by cumulative watershed effects. High priority areas and reaches in the lower Cowlitz basin include the following:

- Lower mainstem & tributaries – Lower Cowlitz 1-2; Salmon Cr 1-5; Delameter 1-2; Ostrander 1
- Middle mainstem & Mill Creek – Mid Cowlitz 5B-6; Mill Creek
- Olequa Creek & tributaries – Olequa 1-7; Stillwater 1-5
- Lacamas Creek – Lacamas 1-2, 4-7
- Salmon Creek & tributaries – upper Salmon Creek 1-3; Cedar Creek

The following paragraphs provide a brief overview of each of these priority areas, including species most affected, land-use threats, and the general type of measures that will be necessary for recovery. Additional detail can be found in the tables and figures that follow.

While reach level habitat conditions often result from local factors, they are also affected or shaped by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input and large woody debris recruitment are often affected by or result from upstream conditions and degraded watershed processes. Access to key reaches may also be affected by barriers that occur downstream of a reach. Accordingly, restoration of a priority reach may require action outside the targeted reach. The IWA analysis was used to identify potential upstream watershed areas that could influence reach level habitat attributes. EDT was used to allow a relative comparison of reaches and habitat attributes within a reach.

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.

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.

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 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 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.

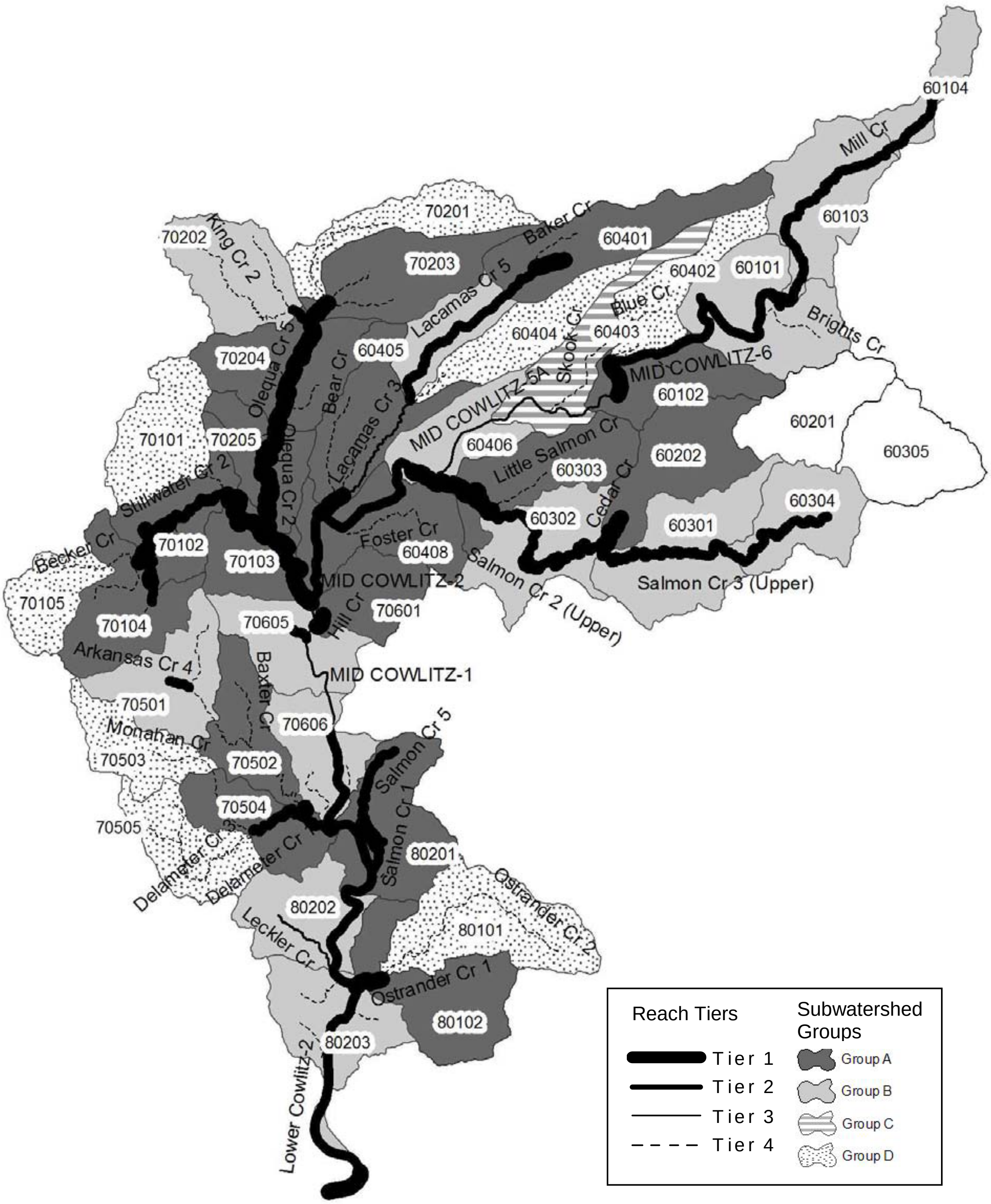


Figure 6-4. Reach tiers and subwatershed groups in the Lower Cowlitz Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities at 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.

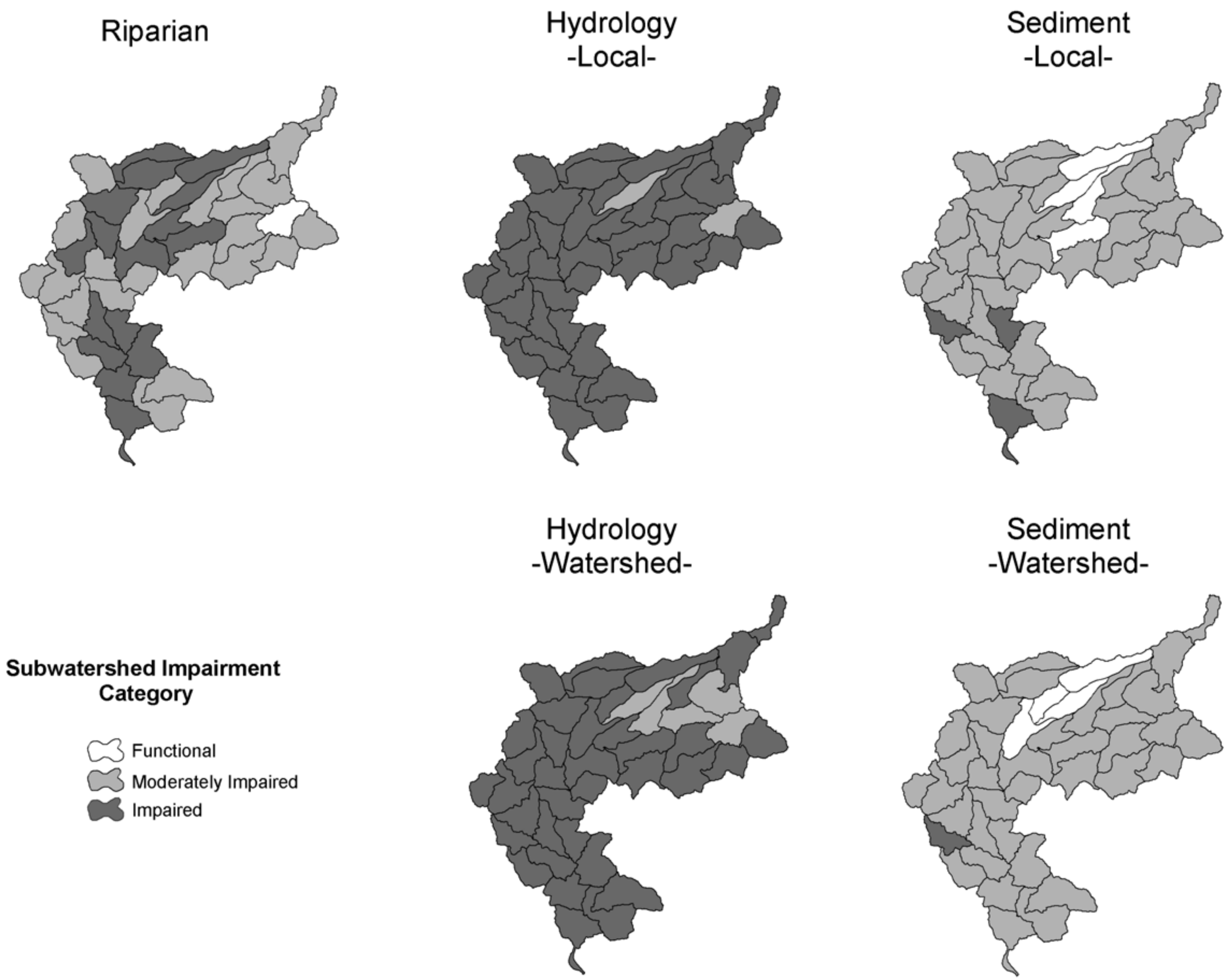


Figure 6-5. IWA subwatershed impairment ratings by category for the Lower Cowlitz Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 6-6. 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-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	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): Hydrology	Watershed processes (local): Sediment	Watershed processes (local): Riparian	Watershed processes (watershed): Hydrology	Watershed processes (watershed): 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) Hydrology	Watershed processes (local) Sediment	Watershed processes (local) Riparian	Watershed processes (watershed) Hydrology	Watershed processes (watershed) 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								

Table 6-7. 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-channel /side-channel habitat	✓	✓	✓		
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	✓				

Table 6-8. Habitat measures in priority areas, with reference to limiting factors addressed, threats addressed, target species, and estimated time until benefits would be realized (time). Tier 1 and 2 reaches, or other areas of known priority, are listed under the location column for some measures (i.e., stream corridor measures). Reaches not included in the table (Tier 3, 4, and non-tiered reaches) are considered secondary priority.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
1. Protect and restore floodplain function and channel migration processes ***A. Set back, breach, or remove artificial channel confinement structures***					
Lower mainstem + tribs Lower Cowlitz 1-2, Salmon Cr 1-5, Delameter 1-2, Ostrander Cr 1 ***Middle mainstem + Mill*** Mid Cowlitz 5B-6, Mill ***Olequa Creek + tribs*** Olequa 1-7,Stillwater 1-5 ***Lacamas Creek*** Lacamas 1-2, 4-7 ***Salmon Cr (Upper) +tribs*** Salmon Cr 1-3, Cedar Cr	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes	• Floodplain filling • Channel straightening • Artificial confinement	• Coho • Chum • Winter steelhead	2-15 years	Great potential benefit due to improvements in many limiting factors. This passive restoration approach can allow channels to restore naturally once confinement structures are removed. There are challenges with implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense.
2. Protect and restore off-channel and side-channel habitats ***A. Restore historical off-channel and side-channel habitats where they have been eliminated*** ***B. Provide access to blocked off-channel habitats*** ***C. Create new off-channel or side-channel habitats (i.e. spawning channels)***					
Lower mainstem + tribs Lower Cowlitz 1-2, Salmon Cr 1-5, Delameter 1-2, Ostrander Cr 1 ***Middle mainstem + Mill*** Mid Cowlitz 5B-6, Mill ***Olequa Creek + tribs*** Olequa 1-7,Stillwater 1-5 ***Lacamas Creek*** Lacamas 1-2, 4-7 ***Salmon Cr (Upper) +tribs*** Salmon Cr 1-3, Cedar Cr	• Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats • Altered habitat unit composition	• Floodplain filling • Channel straightening • Artificial confinement	• Coho • Chum • Winter steelhead	2-15 years	Good potential benefit especially for chum, which have lost a significant portion of historically available off-channel habitat for spawning. Potential benefit is limited by moderate probability of success with creation of new habitats. There are challenges with implementation on private lands due to existing infrastructure already in place, potential flood risk to property, and large expense. Opportunities exist in areas of public ownership in these reaches.
3. Protect and restore riparian function					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
A. Reforest riparian zones ***B. Allow for the passive restoration of riparian vegetation*** ***C. Livestock exclusion fencing*** ***D. Invasive species eradication*** ***E. Hardwood-to-conifer conversion***					
Lower mainstem + tribs Lower Cowlitz 1-2, Salmon Cr 1-5, Delameter 1-2, Ostrander Cr 1 ***Middle mainstem + Mill*** Mid Cowlitz 5B-6, Mill ***Olequa Creek + tribs*** Olequa 1-7,Stillwater 1-5 ***Lacamas Creek*** Lacamas 1-2, 4-7 ***Salmon Cr (Upper) +tribs*** Salmon Cr 1-3, Cedar Cr	• Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or noxious species	• Timber harvest – riparian harvests • Riparian grazing • Clearing of vegetation due to urban/rural/suburban development and agriculture	• All species	20-100 years	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. Riparian protections on forest lands are provided for under current harvest policy. Riparian restoration projects are relatively inexpensive and are often supported by landowners. Whereas the specified stream reaches are the highest priority for riparian measures, riparian restoration and preservation should occur throughout the basin since riparian conditions affect downstream reaches. Use IWA riparian ratings to help identify restoration and preservation opportunities.
4. Protect and restore natural sediment supply processes ***A. Address forest road related sources*** ***B. Address timber harvest related sources*** ***C. Address agricultural sources*** ***D. Address developed land sources***					
Entire basin	• Excessive fine sediment • Embedded substrates	• Timber harvest – impacts to sediment supply • Forest roads – impacts to sediment supply • Agricultural practices – impacts to sediment supply	• All species	5-50 years	High potential benefit due to sediment effects on egg incubation and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. There are challenges with implementation on agricultural lands due to few sediment-focused regulatory requirements for agricultural lands. Use IWA impairment ratings to identify restoration and preservation opportunities.
5. Protect and restore runoff processes					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
A. Address forest road impacts ***B. Address timber harvest impacts*** ***C. Limit additional watershed imperviousness*** ***D. Manage stormwater runoff***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Timber harvest – impacts to runoff • Forest roads – impacts to runoff • Increased impervious surfaces • Increased drainage network (road ditches, storm drains) • Clearing of vegetation	• All species	5-50 years	High potential benefit due to flow effects on habitat formation, redd scour, and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. There are challenges with addressing runoff conditions on developed lands due to continued increase in watershed imperviousness related to development and lack of adequate mitigation. Use IWA impairment ratings to identify restoration and preservation opportunities.
6. Protect and restore instream flows ***A. Water rights closures*** ***B. Purchase or lease existing water rights*** ***C. Relinquishment of existing unused water rights*** ***D. Enforce water withdrawal regulations*** ***E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Water withdrawals	• All species	1-5 years	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.
7. Manage regulated stream flows to provide for critical components of the natural flow regime ***A. Provide adequate flows for specific life stage requirements (i.e,. migration, summer rearing)*** ***B. Address geomorphic effects of hydro-regulation (channel-forming flows, sediment transport)***					
All mainstem Cowlitz reaches	• Alterations to the temporal pattern of stream flow • Altered stream temperature regime	• Hydropower operations – flow manipulation • Hydropower	• All species	1-5 years	Large potential benefit due to flow regulation and dam effects on habitat formation, stream temperatures, and fish movements. Adequate flow protections are being negotiated as part

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
	• Disrupted sediment transport processes (hydro)	operations – changes to sediment transport • Hydropower operations – changes to stream temperature			of Hydro re-licensing efforts conducted by Tacoma Power in consultation with the Federal Energy Regulatory Commission (FERC) and various stakeholders.
8. Protect and restore water quality ***A. Restore the natural stream temperature regime*** ***B. Reduce fecal coliform bacteria levels*** ***C. Reduce delivery of chemical contaminants to streams***					
Entire basin	• Altered stream temperature regime • Bacteria • Chemical contaminants	• Riparian harvests • Riparian grazing • Leaking septic systems • Application of pesticides, herbicides, and fertilizers	• All species	1-50 years	Primary emphasis for restoration should be placed on stream segments that are listed on the 2004 303(d) list.
9. Protect and restore instream habitat complexity ***A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting*** ***B. Structurally modify stream channels to create suitable habitat types***					
Lower mainstem + tribs Lower Cowlitz 1-2, Salmon Cr 1-5, Delameter 1-2, Ostrander Cr 1 ***Middle mainstem + Mill*** Mid Cowlitz 5B-6, Mill ***Olequa Creek + tribs*** Olequa 1-7,Stillwater 1-5 ***Lacamas Creek*** Lacamas 1-2, 4-7 ***Salmon Cr (Upper) +tribs*** Salmon Cr 1-3, Cedar Cr	• Lack of stable instream woody debris • Altered habitat unit composition	• None (symptom-focused restoration strategy)	• Coho • Winter steelhead	2-10 years	Moderate potential benefit due to the high chance of failure. Failure is probable if habitat-forming processes are not also addressed. These projects are relatively expensive for the benefits accrued. Moderate to high likelihood of implementation given the lack of hardship imposed on landowners and the current level of acceptance of these type of projects.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
10. Protect and restore fish access to channel habitats ***A. Culverts, dams, and other barriers on Cowlitz tributaries***					
Mill Creek ***Blue Creek*** ***Skook Creek*** ***Foster Creek*** ***Salmon Creek (lower)*** ***Leckler Creek*** ***Other small tribs***	• Blockages to channel habitats	• Dams, culverts, in-stream structures	• Coho • Winter steelhead	Immediate	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.
11. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development ***A. Plan growth and development to avoid sensitive areas (e.g. wetlands, riparian zones, floodplains, unstable geology)*** ***B. Encourage the use of low-impact development methods and materials*** ***C. Apply mitigation measures to off-set potential impacts***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	The basin is growing rapidly. The focus should be on management of land-use conversion and managing continued development in sensitive areas (e.g. wetlands, stream corridors, unstable slopes). Many critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary mechanisms need to be put in place to restore currently degraded habitats.
12. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection ***A. Purchase properties outright through fee acquisition and manage for resource protection*** ***B. Purchase easements to protect critical areas and to limit potentially harmful uses*** ***C. Lease properties or rights to protect resources for a limited period***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit. These programs are under-funded and have low landowner participation.

6.5 Program Gap Analysis

The Cowlitz Basin (~440 sq mi) is located in Cowlitz and Lewis County:

- No federal land ownership in the lower Cowlitz Basin.
- Large private industrial forest lands (~228 sq miles) are the largest land use.
- Small private commercial forest lands (~124 sq mi) are found throughout the lower Cowlitz Basin.
- Department of Natural Resources forest lands (~26 sq mi) are relatively small land use.
- The upper two-thirds of the lower Cowlitz basin is located in Lewis County.
- The lower third of the lower Cowlitz basin is in Cowlitz County.
- Cities in the lower Cowlitz Basin include Toledo, Winlock, Vader, Kelso, and Longview.
- Significant population growth is expected by the year 2020.

Protection Programs

Protection of watershed process and habitat in the lower Cowlitz Basin is provided primarily through local land use controls, the state forest practices rules, Department of Natural Resources HCP. Protection programs include those programs that protect habitat conditions or watershed functions through management policies and programs, regulatory measures, and acquisition of sensitive habitats or protective easements.

Federal Programs

- ***U.S. Army Corps of Engineers***
  - Regulatory Programs: U.S. Army Corps of Engineers administers the Section 10 (Rivers and Harbor Act) and Section 404 (Clean Water Act) permit processes. Section 10 requires approval of any activity in, above, or below a navigable river, which affects course, location, condition, or capacity of navigable waters. Section 404 requires prior approval of dredging, filling, grading, clearing, and bank hardening. In waters used by listed fish species, the permits are subject to ESA Section 7 consultation with NOAA Fisheries to ensure that any approved action is adequately protective of the ESA listed fish. [M.1A; M.2A; M.2B; M.2C; M.9A; M.9B]

- ***Federal Energy Regulatory Commission (FERC)***
  - Licensing of Hydroelectric Projects: Tacoma and Lewis County PUD operate hydroelectric facilities on the upper Cowlitz pursuant to FERC licenses. The licenses prescribe protection measures to be implemented by the utilities over the term of the licenses. A licensing settlement agreement between Tacoma Power and federal and state agencies, Lewis County, the Yakama Indian Nation and various non-governmental organizations (NGOs) prescribes additional measures for the Tacoma Power Cowlitz Hydro Project (Barrier, Mayfield and Mossyrock Dams and associated reservoirs). The license and settlement provide modest funding for the acquisition of sensitive habitats in the lower Cowlitz basin. They provide for flow regimes protective of spawning and rearing salmonids in the lower Cowlitz. [M.7A; M.7B; M.12A]

State Programs

- ***Washington Department of Natural Resources***

  - State Forest Land HCP:
    State forest lands are managed under the provisions of a Habitat Conservation Plan (HCP). The Habitat Conservation Plan has protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. [M.3A; M.3B; M.4A; M.4B; M.5A; M.5B]
  - State Forest Practices:
    Riparian areas and watershed functions on small- and industrial forest lands are protected under the State of Washington Forest Practices Rules, including the Forest and Fish Module. These rules provide for riparian buffers, harvest restrictions, sensitive area protections, and protective standards for new road construction. These activities address measures [M.3A; M.3B; M.4A; M.4B; M.5A; M.5B]

- ***Department of Fish and Wildlife***

  - Hydraulics Project Approval (HPA): The Department administers the state Hydraulic Code. The purpose of this program is to protect stream conditions and habitat. The regulations apply to such activities as streambank protection, instream construction, culvert installation, channel changes or realignments, debris removal, and water diversion facilities. Those proposing such actions must obtain a Hydraulic Project Approval (HPA) permit. [M.1A; M.2A; M.2B; M.2C; M.9A; M.9B]

  - Habitat Program: The Department provides advice to local governments and landowners interested in measures to protect habitat values on their property. [M.1A; M.2A; M.2B; M.2C; M.4D; M.5C; M.5D; M.7A; M.7B; M.8A; M.8B; M.8C; M.9A; M.9B; M.10A; M.11A; M.11B; M.11C; M.12A; M.12B]

- ***Washington Department of Ecology***

  - Water Resources Program/Water Rights: Department of Ecology, in consultation with the Department of Fish and Wildlife, has administrative closed selected areas within the lower Cowlitz basin to further surface and groundwater withdraws (where groundwater is in continuity with surface water). Existing administrative closures by the Department of Ecology protect surface waters from further withdrawals. Formal rule-making would strengthen the closures. The extent of unauthorized surface water withdrawals is unknown, but could exacerbate summer low flows on smaller tributaries. [M.6A; M.6B; M.6C; M.6D; M.6E]

  - Water Resources Program/Watershed Planning: In cooperation with the Lower Columbia Fish Recovery Board, other state and federal agencies, tribes, local governments, and citizens, the Department funds and participates in a state authorized watershed planning process for Water Resource Inventory Area (WRIA) 26 pursuant to RCW 90.82. The goal of the plan is to ensure adequate water for people and fish. The planning process is dealing with water quantity and quality, stream flows and fish habitat. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.6A; M.6B; M.6C; M.6D; M.7A; M.7B; M.8A; M.8B; M.8C; M.11A]

➢ ***Department of Transportation***

- Barrier Removal Program:
  WSDOT is working to improve blockages associated with I-5. [M.5B; M.8C; M.10A]

- Road Maintenance Program

WSDOT has an ESA Section 4(d) Road Maintenance Program. The Maintenance Program uses trained crews to primarily manage roadside vegetation, litter control, and maintenance of safety rest areas. [M.5B; M.8C; M.10A]

➢ ***Conservation Commission/ Lewis Conservation District/ Cowlitz Conservation District*** The Conservation Districts provide technical assistance and incentives (e.g. Conservation Reserve and Enhancement Program) to encourage agricultural landowners to protect riparian areas and stream habitat. The Cowlitz Conservation District has been actively involved in the lower Cowlitz basin within Cowlitz County. [M.3A; M.3C; M.4C; M.8A; M.8B; M.8C]

Local Government Protection Programs

➢ ***Lewis County*** [M.11A; M.11B; M.11C]

- Comprehensive Planning and Land Use Zoning: Lewis County comprehensive planning and zoning are subject to the requirements of the Washington Growth Management Act (GMA). Zoning is mixed throughout the upper Cowlitz, but significant agricultural zoning (R-20) exists within the valley floor. Some lands are zoned for rural residential uses.
- Critical Areas Ordinance: The County critical areas ordinance includes protections for fish and wildlife habitat. Stream buffers vary from 25 to 100 feet depending on DNR water typing and whether urban or rural uses are involved. Wetland buffers vary from 50 to 100 feet depending on type and the intensity of use involved. Existing agricultural practices are exempt.
- Road Maintenance: The County has not adopted road maintenance standards that are protective of fish habitat. [M.5C; M.5D; M.8C; M.10A]

➢ ***Cowlitz County***

- Land Use: [M.11A; M.11B; M.11C]
  - ✓ The comprehensive plan that applies to the non-federal lands, but contains no significant policies for the protection of watershed processes and stream habitat.
  - ✓ Zoning along State Highway 503 provides for one dwelling per 2 acres and one dwelling per 5 acres along non-county roads.
  - ✓ Cowlitz County has not adopted protective stream buffers.
  - ✓ Wetland buffers vary from 25’ to 200’ and are based upon soil type and wildlife utilization.
  - ✓ The County has not developed comprehensive ordinances for the protection of watershed processes or stream habitat conditions.
- Road Maintenance

  The County has not developed or implemented a road maintenance program to protect habitat. [M.5C; M.5D; M.8C; M.10A]

Community Protection Programs

- ***Davis Creek Community Group:*** provides watershed stewardship and restoration activities in Davis Creek. To date they have provide $4,500 in private donations for riparian restoration. [M.3A; M.3D]

Restoration Programs

Restoration programs in the lower Cowlitz Basin are implemented by a variety of agencies, organizations, and private interests. Major programs implementing protection measures are identified below:

Federal Restoration Programs

- ***Federal Energy Regulatory Commission (FERC)***
  - Licensing of Hydroelectric Projects: Tacoma and Lewis County PUD operate hydroelectric facilities on the upper Cowlitz pursuant to FERC licenses. The licenses prescribe protection measures to be implemented by the utilities over the term of the licenses. A licensing settlement agreement between Tacoma Power and federal and state agencies, Lewis County, the Yakama Indian Nation and various non-governmental organizations (NGOs) prescribes additional measures for the Tacoma Power Cowlitz Hydro Project (Barrier, Mayfield and Mossyrock Dams and associated reservoirs). Required restoration activities include augmentation of spawning gravel large woody debris and restoration of sensitive habitat in the lower Cowlitz Basin. [M.7A; M.7B; M.8A; M.8C; M.9A; M.9B; M.12A]

State Restoration Programs

- ***Washington Department of Natural Resources***
  - State Forest Land Habitat Conservation Plan (HCP): The Department manages state forest lands pursuant to a Habitat Conservation Plan (HCP). The HCP road maintenance and restoration objectives require barrier upgrades and road abandonment and/or other improvements. [M.3A; M.3B; M.4A; M.4B; M.5A; M.5B; M.8A; M.8C]
  - State Forest Practices Act:
    - ✓ Industrial forests within the lower NF Lewis Basin are governed by Forest and Fish regulations and have rigid schedules for maintaining and improving roads and removing barriers. Industrial landowners have 15 years to bring roads and barriers into compliance with regulations. [M.3A; M.3B; M.4A; M.4B; M.5A; M.5B; M.8A; M.8C]
    - ✓ Small private forest owners are governed by Forest and Fish regulations; however their road and barrier maintenance and improvement programs are tied to state funding. In the State 2003-05 Biennial Budget, 2 million dollars was allocated statewide to support small private forest owners. [M.3A; M.3B; M.4A; M.4B; M.5A; M.5B; M.8A; M.8C]

- ***Washington Department of Fish and Wildlife***

  - Habitat Program: The Department provides advice to local governments and landowners interested in measures to restoring watershed processes and stream habitat. [M.1A; M.2A; M.2B; M.2C; M.4D; M.5C; M.5D; M.7A; M.7B; M.8A; M.8B; M.8C; M.9A; M.9B; M.10A; M.11A; M.11B; M.11C; M.12A; M.12B]

- ***Washington Department of Ecology***

  - Water Quality Program:
    The Cowlitz is listed as temperature impaired on the WA State 303(d) list. It is also listed for arsenic however Ecology is in the process of de-listing this impairment. [M.5D; M.8A; M.8B; M.8C]
  - Water Resources Program/Watershed Planning:
    The planning process for WRIA 26 is dealing with water quantity and quality, stream flows and fish habitat. Potential restoration efforts address improving summer low flows through conservation and acquisition of water rights. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.6A; M.6B; M.6C; M.6D; M.7A; M.7B; M.8A; M.8B; M.8C; M.11A]

- ***Washington Department of Transportation***

  - Barrier Removal Program:
    WSDOT is working to improve blockages associated with I-5. [M.5D; M.8C; M.10A]

  - Road Maintenance Program

  WSDOT has an ESA Section 4(d) Road Maintenance Program. The Maintenance Program uses trained crews to primarily manage roadside vegetation, litter control, and maintenance of safety rest areas. [M.5C; M.8C]

- ***Salmon Recovery Funding Board (SRFB)/ Lower Columbia Fish Recovery Board***

  - Washington Salmon Recovery Act (RCW 77.85): As noted under preservation programs above, the SRFB and the LCFRB jointly administer a grant program that allocates federal Pacific Salmon Recovery Funds and State funds for habitat protection and restoration projects by state and local agencies, nonprofit organizations, and landowners. To date the SFRB has provided close to $900,000 for county barrier replacements and restoration efforts in this basin. [M.1A; M.2A; M.2B; M.3A; M.8A; M.9A; M.9B; M.10A]

- ***Conservation Commission/ Lewis Conservation District/Cowlitz Conservation District:*** The Conservation District provides technical assistance (e.g., farm plans) and incentives (e.g., Conservation Reserve and Enhancement Program) to encourage agricultural landowners to restore riparian areas and stream habitat. Both Conservation Districts have undertaken restoration projects in the lower Cowlitz Basin. M.3A; M.3C; M.4C; M.8A; M.8B; M.8C; M.9A; M.9B; M.10A]

Local Government Restoration Programs

- ***Cowlitz County***
  - Public Works Program:

The County inventoried culverts on county roads and is replacing and/or upgrading barrier culverts. Baxter Creek Fish Passage is an example of a culvert replacement project in the lower Cowlitz Basin. [M.10A]

- Cowlitz Noxious Weed Control Board: The Board has three primary programs that address weed control in the lower Cowlitz Basin; [M.3D]
  - ✓ Public education to prevent the spread of noxious weeds;
  - ✓ Survey County lands to assess emerging issues; and
  - ✓ Enforcement of noxious weed control

➢ ***Lewis County***
- Public Works Program: The County inventoried culverts on county roads and is replacing and/or upgrading barrier culverts. Skook Creek is an example of a culvert replacement project in the lower Cowlitz Basin; [M.10A]
- Lewis County Noxious Weed Control Board: The Board has three primary programs that address weed control in the upper Cowlitz Basin; [M.3D]
  - ✓ Public education to prevent the spread of noxious weeds;
  - ✓ Survey of the County to assess emerging issues; and
  - ✓ Enforcement of noxious weed control

Gap Analysis

Forest-related Programs**:** Given that 80 percent of lower Cowlitz Basin is forest land, the state forest practices rules and the Department of Natural Resources HCP play a substantial role in protecting and restoring watershed functions and habitat conditions at levels supporting recovery goals. Certainty of forestry-related protection and restoration programs is relatively high because programs are being implemented and, for the most part, fully funded. Program areas of concern include state funding for small commercial forest landowners and the continued potential for hydrologic impacts caused by past harvest practices. Monitoring of watershed processes and habitat conditions will be required to confirm the effectiveness of these measures.

Protection-related Programs: Non-federal lands in the lower Cowlitz Basin have limited protections through the land use regulatory mechanisms Cowlitz and Lewis Counties. Cowlitz County programs lack effective provisions that commonly are used to direct growth away from sensitive habitat, preserve watershed processes, protect streams and wetlands, and manage stormwater. Lewis County land use regulations afford a slightly higher level of protection, but do not have measures tailored to protect watershed process and habitat conditions critical to recovery of salmon and steelhead. In addition, as in all lower Columbia subbasins, there are very limited protection mechanisms to ensure that agricultural practices protect riparian areas and hydrologic functions.

Restoration-related Programs: Over a long period of time, improvements to the lower Cowlitz Basin will occur as a result of improved forest management practices that are already in place. Active restoration in the lower mainstem should focus on floodplain function and channel migration, as well as restoring off-channel and side-channel habitats. Programs to address these issues are currently not in place. Improved restoration mechanisms habitat and watershed conditions adversely affected by agricultural practices throughout the lower Cowlitz Basin are needed. Relative to the hydroelectric facilities, upstream and downstream passage for coho, steelhead, and spring chinook is needed to allow to access high-quality habitats upstream of the reservoirs. Recovery of Spring Chinook, in particular, hinges upon success of the Tacoma Public Utilities and Lewis PUD passage program. Actions to address downstream impacts of the hydro-electric facilities are also important to salmon and steelhead recovery efforts. These include: monitoring and augmentation of gravel, where and when necessary; Augmentation of LWD; and assurance of flow regimes needed for downstream spawning and rearing.

Table 6-9. Program Actions to Address Gaps

Action #	Lead Agency	Proposed Action
L-COW.1	Cowlitz County, Lewis County, Vader, Toledo, Winlock, Longview, Kelso	Develop and implement controls to adequately protect riparian areas to maintain currently functional and restored habitat around rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Require mitigation, where necessary, to offset unavoidable damage to habitat conditions in riparian management areas
L-COW.2	Cowlitz County	Develop and implement stormwater discharge controls to protect water quality and quantity and reduce localized stream flow impacts detrimental to fish —including peak and base flows
L-COW.3	Cowlitz County, Vader, Toledo, Winlock, Longview, Kelso	Development and implement controls to protect historic stream meander patterns and channel migration zones and avoid hardening stream banks and shorelines
L-COW.4	Cowlitz County, Lewis County, Vader, Toledo, Winlock, Longview, Kelso	Development and implement controls and development standards to adequately protect wetlands, wetland buffers, and wetland function.
L-COW.5	Cowlitz County, Lewis County, Vader, Toledo, Winlock, Longview, Kelso	Develop and implement controls to address erosion and sediment run-off during (and after) construction to prevent sediment and pollutant discharge to streams, wetlands and other water bodies
L-COW.6	Cowlitz County, Lewis County, Vader, Toledo, Winlock	Apply land use and resource protection code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
L-COW.7	FEMA	Update floodplain maps using Best Available Science
L-COW.8	State of Washington	Provide state funding for small forest owners in the lower Cowlitz Basin to a level sufficient to achieve the road and barrier improvements of Forest and Fish on a schedule parallel to private industrial forest owners
L-COW.9	Forest Managers LCFRB, and DFW	Identify and sequence early action forest-wide restoration projects that analysis indicates could provide significant benefits. In these cases, it may be appropriate to identify outside funding to initiate these early actions
L-COW.10	LCFRB, WDNR. WSDOT, Counties, cities, private property owners.	Develop and implement a coordinated and strategic barrier removal program based on watershed fish priorities and ensuring an effective and efficient sequencing of barrier removal work.
L-COW.11	Cowlitz County, Lewis County	Utilize a combination of public outreach/education and, incentives, and to promote (1) stewardship practices for protecting habitat and water quality and (2) landowner support of and participation in habitat restoration efforts.
L-COW.12	State of	Close the lower Cowlitz Basin to further surface water withdrawals,

	Washington (DOE, DFW)	including groundwater in connectivity with surface waters; curtail unauthorized withdrawals
L-COW.13	LCFRB, WDFW, Cowlitz County, Lewis County, Cowlitz CD, LCFEG	Build capacity (e.g. technical and administrative skills, personnel and fiscal resources) needed to allow agencies and organizations to undertake protection and restoration projects, including noxious weed control in a reasonable period time.
L-COW.14	SRFB, BPA, NOAA, USFWS, DOE, ACOE	Increase available funding for projects that implement measures and address underlying threats
L-COW.15	State of Washington (Dept of Agriculture, and Department of Ecology)	Develop and implement agricultural practices and regulations to protect riparian conditions and water quality
L-COW.16	Cowlitz/Lewis Conservation District	Expand landowner incentive (e.g. CREP) and education plans to promote further habitat protection and restoration.
L-COW.17	LCFRB, Cowlitz CD, Cowlitz County, Lewis County	Address threats proactively by building agreement on priorities among the various program implementers
L-COW.18	Tacoma Public Utilities, Lewis PUD	Increase fish and wildlife habitat mitigation measures (upstream and downstream) commensurate with recovery goals for populations affected by hydrosystem impacts

7 Cowlitz Subbasin - Upper Cowlitz

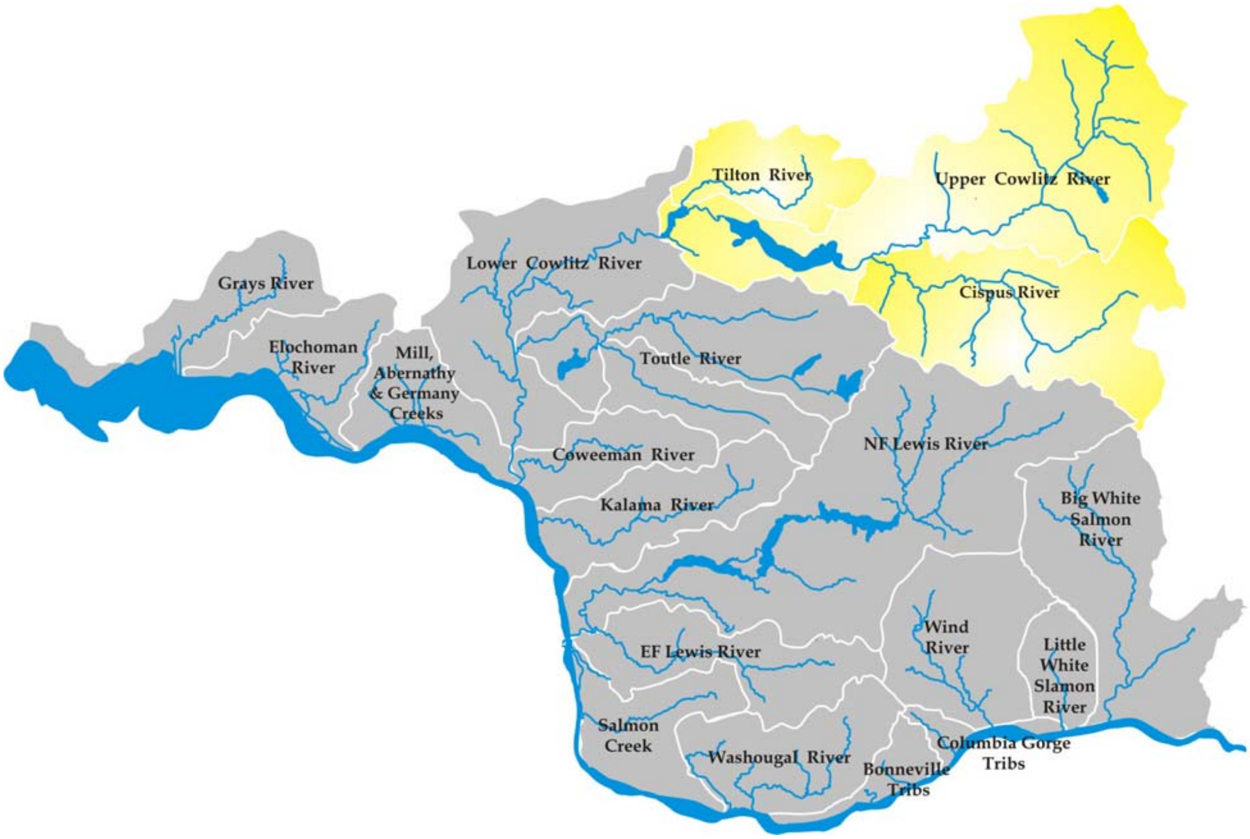


Figure 7-1. Location of the Upper Cowlitz River Basin within the Lower Columbia River Basin.

7.1 Basin Overview

The upper Cowlitz River basin comprises approximately 1,390 square miles in Lewis, Skamania, Yakima, and Pierce counties. The basin is situated between Mt. Ranier, Mt. Adams, and Mt. St. Helens and flows generally southwest. The downstream end of the basin is marked by Mayfield Dam. Major tributaries include the Cispus, Clear Fork, Ohanapecosh, and Tilton. The basin is part of WRIA 26.

The upper Cowlitz basin will play key role in the recovery of salmon and steelhead. The basin has historically supported populations of fall chinook, spring chinook, winter steelhead, and coho. Today, chinook and steelhead are listed as threatened under the ESA. Coho salmon are a candidate for listing. Other fish species of interest are Pacific lamprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

Upper Cowlitz salmon and steelhead are affected by a variety of in-basin and out-of basin factors including stream, Columbia River mainstem, estuary, and ocean habitat conditions; harvest; hatcheries; and ecological relationships with other species. Analysis has demonstrated that recovery cannot be achieved by addressing only one limiting factor. Recovery will require action to reduce or eliminate all manageable factors or threats. The deterioration of habitat conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonids within the Columbia Basin. Direct harvest of listed salmon and steelhead is prohibited but sport and commercial fisheries focusing on hatchery fish and other healthy wild populations, primarily in the mainstem Columbia and ocean, incidentally affect ESA-listed upper Cowlitz fish. Cowlitz

Salmon Hatchery operates within the basin with the potential to both adversely affect wild salmon and steelhead populations and to assist in recovery efforts. Key ecological interactions of concern include effects of nonnative species; nutrient inputs from salmon carcasses; and predation by species affected by development including Caspian terns, northern pikeminnow, seals, and sea lions. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the Upper Cowlitz Subbasin.

Forestry is the dominant land use in the upper Cowlitz 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 in the basin (Gifford Pinchot National Forest and Mt. Rainier National Park). Much of the private land in the river valleys is agricultural and residential, with substantial impacts to riparian and floodplain areas in places.

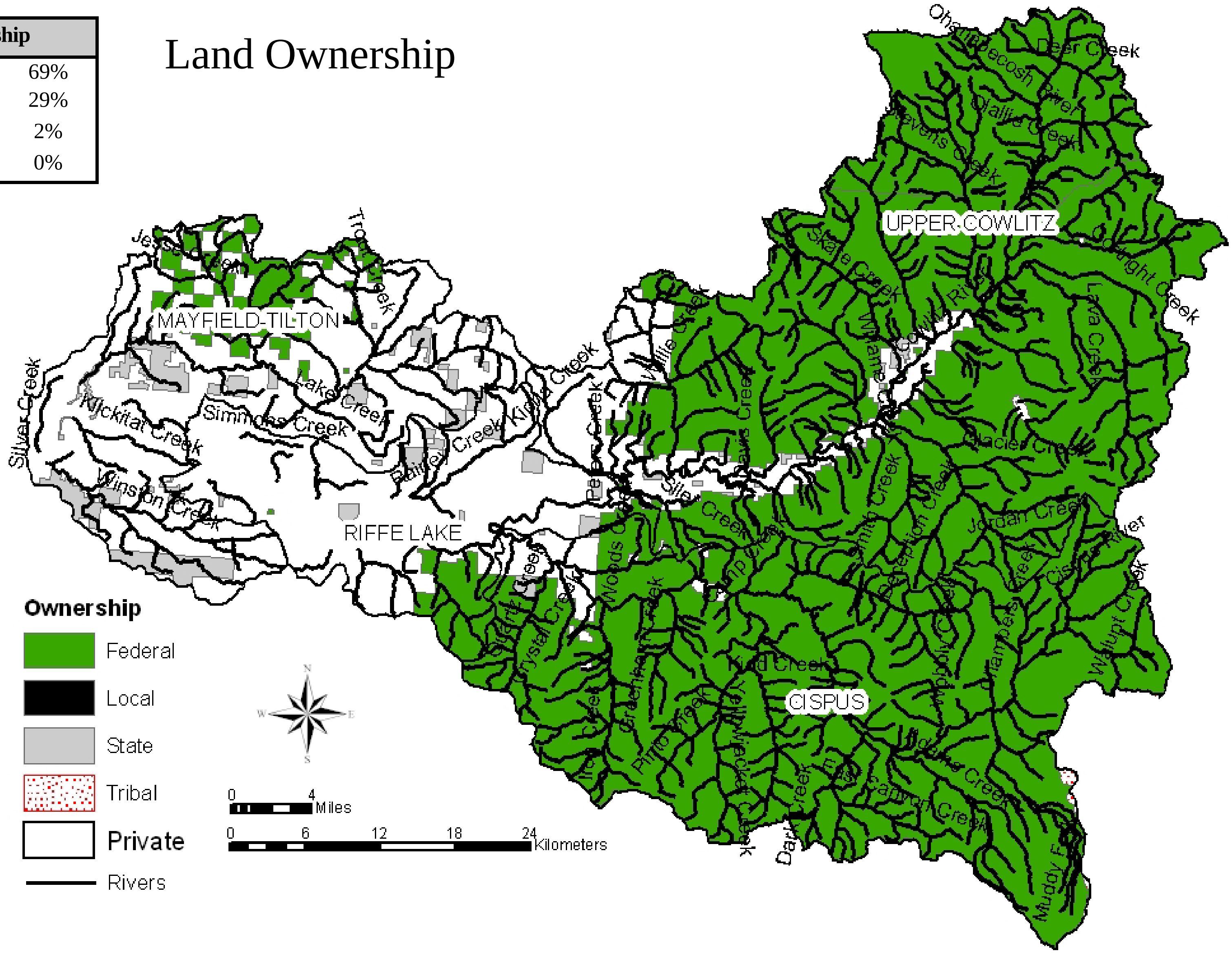
The upper Cowlitz is mostly National Forest in the Cispus and upper mainstem Cowlitz basins. The mainstem Cowlitz River valley (above Cowlitz Falls Dam), much of the Tilton Basin, and tributary basins to the reservoirs are in private lands. Forestry is the greatest land use in the middle and upper elevations, whereas mixed uses, including agriculture and residential development, dominate lower elevation river valleys. The three dams on the mainstem inundated a significant portion of the historical steelhead, Chinook, and coho habitat. Fish are now transported around Mayfield Dam and released into the Tilton and upper Cowlitz (above Cowlitz Falls Dam). Downstream migrating smolts are captured and transported to below Mayfield Dam.

The areas with the greatest potential to support anadromous salmonids are the mainstem Cowlitz above Cowlitz Falls, the mainstem Cispus, and the mainstem Tilton and lower reaches of Tilton tributaries (WF, NF, SF). These areas provide the most abundant spawning and rearing habitats. They are all affected primarily by degraded watershed processes related to forest harvest and road building. Local impacts to floodplains and riparian areas are associated with channelization and development.

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. It is important that growth management policy adequately protect critical habitats and the conditions that create and support them.

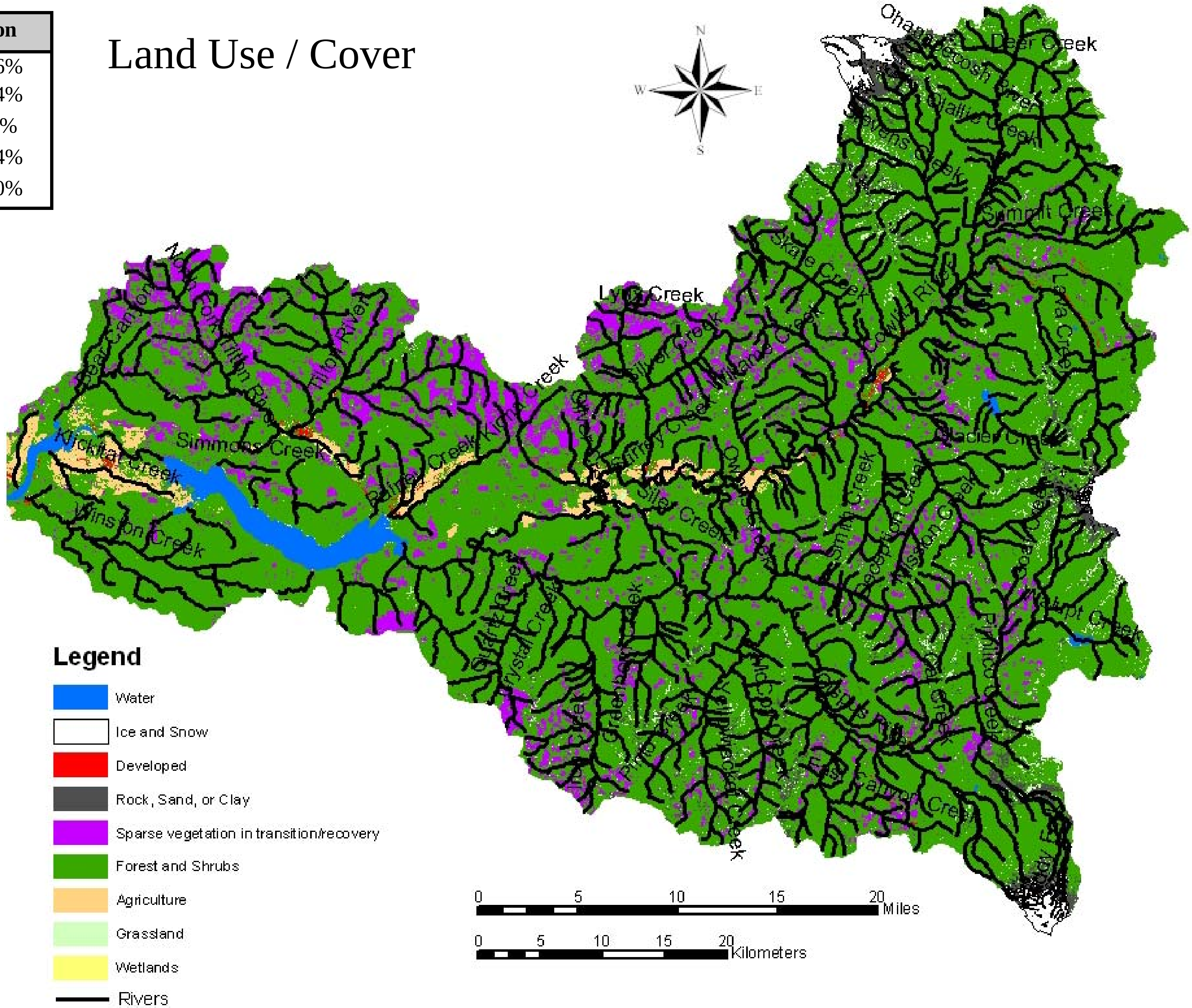
Land Ownership	
Federal	69%
Private	29%
State	2%
Other public	0%

Land Ownership



Vegetation Composition	
Late Seral	36%
Mid Seral	14%
Early Seral	6%
Other Forest	34%
Non Forest	10%

Land Use / Cover



7.2 Species of Interest

Focal salmonid species in the upper Cowlitz include fall Chinook, spring Chinook, winter steelhead, and coho. The health or viability of these populations is currently low for spring Chinook and winter steelhead, and very low for fall Chinook and coho. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Recovery goals call for restoring spring Chinook to a very high viability level. This level will provide for a 95% or better probability of population survival over 100 years. Recovery goals for winter steelhead and coho are for medium viability levels which provide a 75-95% chance of persistence over 100 years. The recovery goal level for fall Chinook is the same as the current status of very low. This allows a less than 40% chance of persistence over 100 years.

Other species of interest include coastal cutthroat trout and Pacific lamprey. Regional objectives for these species are described in Volume I, Chapter 6. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for other species. Cutthroat will benefit from improvements in stream habitat conditions for salmonids. Lamprey are also expected to benefit from habitat improvements in the estuary, Columbia River mainstem, and upper Cowlitz subbasin although specific spawning and rearing habitat requirements of lamprey are not well known.

Table 7-1. 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	1,400-10,800
Spring Chinook	Threatened	Yes	Low	NA	High+	2,800-8,100
Winter Steelhead	Threatened	Yes	Low	NA	Medium	600-1,600
Coho	Candidate	Yes	Very Low	NA	Medium	unknown

Fall Chinook – 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.

Spring Chinook – 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.

Winter Steelhead – 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.

Coho – 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.

Coastal cutthroat – 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.

Pacific lamprey – Lamprey migration to the upper Cowlitz basin was restricted after Mayfield Dam was completed in 1962.

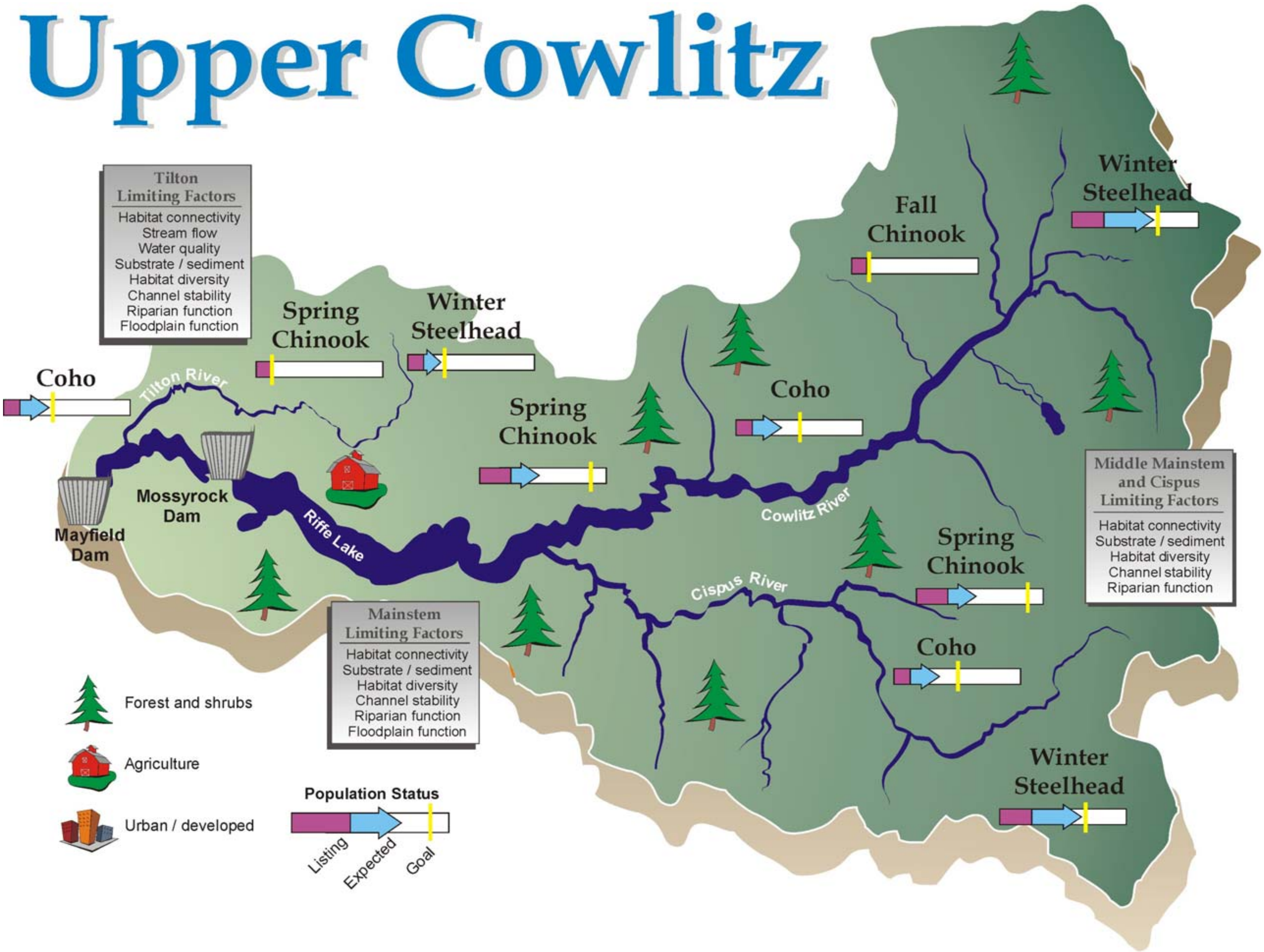
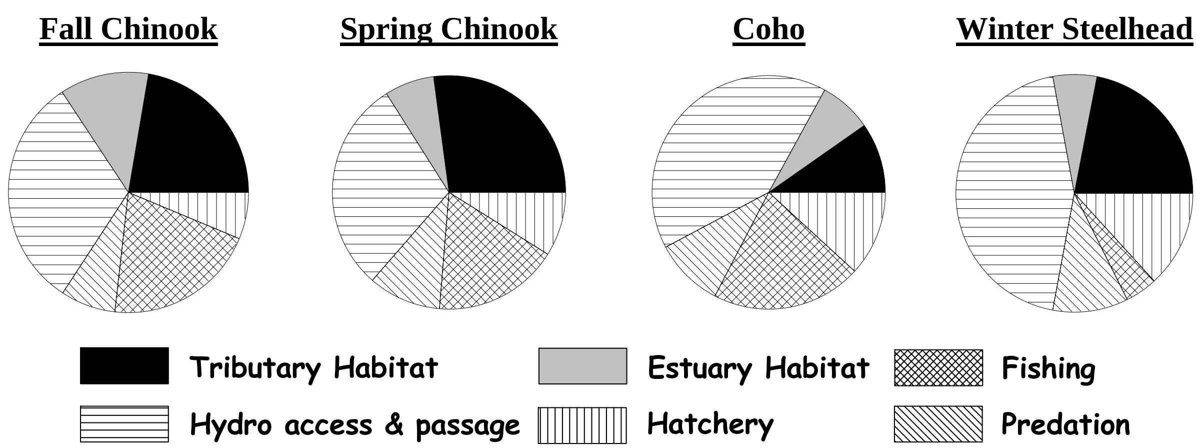


Figure 7-2. Summary of habitat limiting factors, population status, expected population improvement trend with existing programs and biological objectives depicted for the Upper Cowlitz Basin.

7.3 Potentially Manageable Impacts

Stream habitat, estuary/mainstem habitat, harvest, hatchery and predation effects have all contributed to reduced salmonid productivity, numbers, and population viability in the upper Cowlitz subbasin. The pie charts below represent the relative order of magnitude of quantifiable effects for each of these factors for each focal species. The preferred recovery scenario targets an equivalent reduction in each impact factor in proportion to the magnitude of the effect. Population-specific targets are discussed in further detail in Volume I, Chapter 6.

- Fall Chinook, spring Chinook, winter steelhead and coho in the upper Cowlitz, Cispus and Tilton suffer the greatest loss from hydrosystem impacts of all impact factors.
- Loss of tributary and estuary habitat quality and quantity has significant impacts on all four populations. Losses are greatest for fall and spring Chinook.
- Coho, spring Chinook and fall Chinook sustain moderate losses from harvest impacts. Impacts to winter steelhead are relatively minor.
- Hatchery impacts are moderately important to winter steelhead, but are relatively minor for spring and fall Chinook and coho.
- Predation impacts in the upper Cowlitz, Tilton, and Cispus are relatively minor for all four populations.



Note: Pie charts display data for the Upper Cowlitz River only.

Figure 7-3. Relative contribution of potentially manageable impacts for upper Cowlitz populations.

7.4 Limiting Factors, Threats, and Measures

7.4.1 Hydropower Operation and Configuration

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. A program to reintroduce spring Chinook, coho and winter steelhead to the habitats of the upper Cowlitz and Cispus rivers, upstream of Cowlitz Falls Dam, was initiated in 1994. In addition, winter steelhead are being supplemented into the Tilton River. Success of reintroduction is critical for spring Chinook ESU recovery as the most significant habitat for lower Columbia spring Chinook is above the Cowlitz dams. A significant amount of habitat for Cowlitz winter steelhead and coho is also located in the upper Cowlitz watershed. The key to successful reintroduction will be adequate passage of juveniles and adults. In addition, upper Cowlitz anadromous species are affected by mainstem Columbia hydro operations and flow regimes which affect habitat in migration corridors and in the estuary. These factors are described in further detail in Volume I, Chapter 4. Mainstem hydro factors and threats are addressed by regional strategies and measures identified in Volume I, Chapter 7. Key regional strategies and measures applying to the upper Cowlitz populations include:

D.S1 Restore access of key populations to blocked habitats in historically accessible subbasins or portions of subbasins where necessary to support region wide recovery.

Access to and from the habitats in the Upper Cowlitz and Cispus river systems is essential to meet biological objectives for spring Chinook, coho and winter steelhead. Adequate passage is a key element to achieving recovery objectives.

D.M1 Evaluate and actively implement anadromous fish reintroduction upstream of Cowlitz, Lewis, and White Salmon dams and facilities as part of dam relicensing processes.

Continual improvement in juvenile collection efficiciency at Cowlitz Falls Dam, in particular for spring Chinook, will be necessary to meet recovery objectives. Fish management plans should clearly link adaptive management plans to needed juvenile passage efficiencies to meet population goals.

7.4.2 Harvest

Most harvest of wild upper Cowlitz basin salmon and steelhead occurs incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. This mortality is lower for steelhead than coho or spring Chinook. No harvest of chum occurs in ocean fisheries, there are no directed Columbia River or Cowlitz Basin chum fisheries and retention of chum is prohibited in Columbia River and Cowlitz sport fisheries. Some chum are impacted incidental to fisheries directed at coho and winter steelhead. 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 fin-marked hatchery fish and release unmarked wild fish. 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.

Measures 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. The regional measures 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 Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest measures with significant application to to upper Cowlitz subbasin populations are summarized in the following table:

Table 7-2. Regional harvest measures from Volume I, Chapter 7 with significant application to Upper Cowlitz Subbasin populations.

Measure	Description	Comments
F.M18	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	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.M19	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	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.M24	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	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.

7.4.3 Hatcheries

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

There are no salmon or steelhead hatcheries operating in the upper Cowlitz basin. Mossyrock Hatchery produces trout for regional plants into Sothwest 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 7-3. 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). Regional hatchery measures identified in Volume I, Chapter 7 with potential applications at facilities within the upper Cowlitz subbasin are summarized in Table 7-4.

Table 7-4. Regional hatchery measures from Volume I, Chapter 7 with potential implementation actions in the Upper Cowlitz Subbasin.

Measure	Description	Comments
H.M2,5	Integrated hatchery and wild program for winter steelhead, coho, and spring Chinook.	Assures fitness of the naturally-produced fish which will improve population productivity. Integrated programs would be developed specific to the upper Cowlitz populations in the BRAP procedure with consideration for reintroduction operations and habitat
H.M21,38,30	Use only local brood stock in the coho and spring Chinook hatchery program. Maintain local late-timed winter steelhead program.	This will assure hatchery and wild integrated programs and reintroduction to continue with stocks ecologically adapted to the upper Cowlitz basin.
H.M32,34,41	Mark hatchery steelhead, coho, spring Chinook with an adipose fin-clip for identification and selective harvest.	Marking hatchery fish allows for identification of hatchery fish in the natural spawning grounds and at collection facilities which enables accurate accounting of wild fish. Marking also enables selective fisheries to retain hatchery fish and release wild fish.
H.M19,29,37	Hatchery program utilized for supplementation and reintroduction of wild, coho, spring Chinook, and winter steelhead populations.	Continue reintroduction program efforts in the upper Cowliz and Tilton basins.
H.M8	Adaptively manage hatchery programs to further protect and enhance natural populations and improve operational efficiencies.	Appropriate research, monitoring, and evaluation programs along with guidance from regional hatchery evaluations will be utilized to improve the survival and contribution of hatchery fish, reduce impacts to natural fish, and increase benefits to natural fish in the upper Cowlitz basin.
H.M18	Evaluate facilities used for reintroduction of salmon and steelhead.	Evaluation would include juvenile collection efficiency, adult and juvenile sorting, adequacy of hatchery rearing and holding, marking, transportation, and life cycle survival estimates.

7.4.4 Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Upper Cowlitz salmon and steelhead are affected throughout their lifecycle by ecological interactions with non-native species, food web components, and predators. Interactions are similar for upper Cowlitz populations to those of most other subbasin salmonid populations. These interactions are described in further detail in Volume I, Chapter 4. Ecological Interactions are addressed by regional strategies and measures identified in Volume I, Chapter 7.

7.4.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. 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 are similar for upper Cowlitz populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook than spring Chinook, steelhead, and coho. Estuary and mainstem effects on upper Cowlitz salmon populations are addressed by regional strategies and measures identified in Volume I and the Columbia Mainstem and Estuary Subbasin sections of Volume II.

7.4.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity have significantly altered watershed processes and reduced both the quality and quantity of habitat needed to sustain viable populations of salmon and steelhead. Although upper Cowlitz populations are most affected by access and passage issues associated with the mainstem hydropower system, stream habitat conditions also have a large impact on the health and viability of salmon and steelhead.

Subwatersheds, reaches, and habitat attributes have been prioritized for protection and/or restoration based on the plan's biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Priority areas for habitat preservation and restoration are identified in Figure 7-4 and Figure 7-5. A summary of the primary habitat limiting factors and threats are presented inTable 7-6. Habitat measures and related information are presented in Table 7-7. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 7-6. Reach- and subwatershed-scale limiting factors generated from the technical assessment are included in Table 7-5. Details on species-specific spatial priorities and limiting factors at the subbasin level may be found in Volume II of the Technical Foundation. A description of the methodology used to generate composite (multi-species) reach and subwatershed priorities can be found in the introduction to this volume of the recovery plan.

The areas with the greatest current or potential contribution to focal salmonid population health and productivity are listed below. Tier 1 and 2 reaches within these priority areas are included in the list. The habitat limiting factors, threats, and measures included in this chapter focus primarily on the priority areas and the Tier 1 and 2 reaches within them. Tier 3, 4, and non-tiered reaches are considered secondary priority, but in many cases, these lower priority areas will also require restoration and preservation actions in order to achieve recovery objectives. Watershed process measures generally focus on the entire basin as opposed to being limited only to high priority areas because conditions in high priority areas are often influenced by cumulative watershed effects. High priority areas and reaches in the upper Cowlitz basin include the following:

- Upper mainstem Cowlitz & tributaries – Upper Cowlitz 1A-2; Silver Cr; Johnson Cr; Hall Cr
- Cispus River & tributaries – Cispus 1A, 1C, 1F-3; Yellowjacket 1
- Tilton River & tributaries – Tilton 1, 3-6; EF Tilton 1-2

The following paragraphs provide a brief overview of each of these areas, including species most affected, land-use threats, and the general type of measures that will be necessary for recovery. Additional detail can be found in the tables and figures that follow.

While reach level habitat conditions often result from local factors, they are also affected or shaped by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input, and large woody debris recruitment are often affected by or result from upstream conditions and degraded watershed processes. Access to key reaches may also be affected by barriers that occur downstream of a reach. Accordingly, restoration of a priority reach may require action outside the targeted reach. The IWA analysis was used to identify potential upstream watershed areas that could influence reach level habitat attributes. EDT was used to allow a relative comparison of reaches and habitat attributes within a reach.

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.

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 restoration and preservation of basin-wide watershed process conditions (runoff, sediment supply).

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.

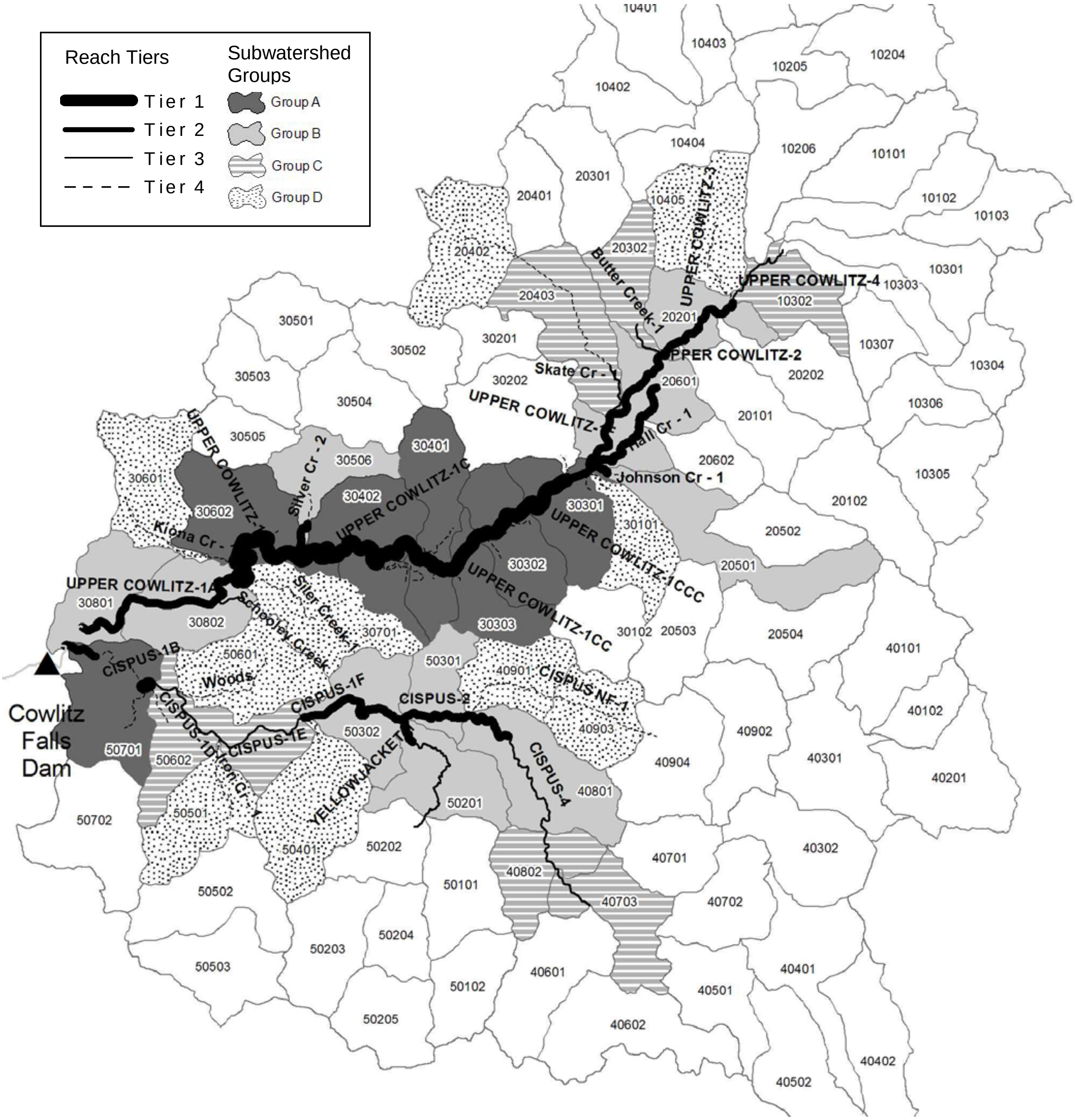


Figure 7-4. Reach tiers and subwatershed groups in the Upper Cowlitz and Cispus Basins. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. 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.

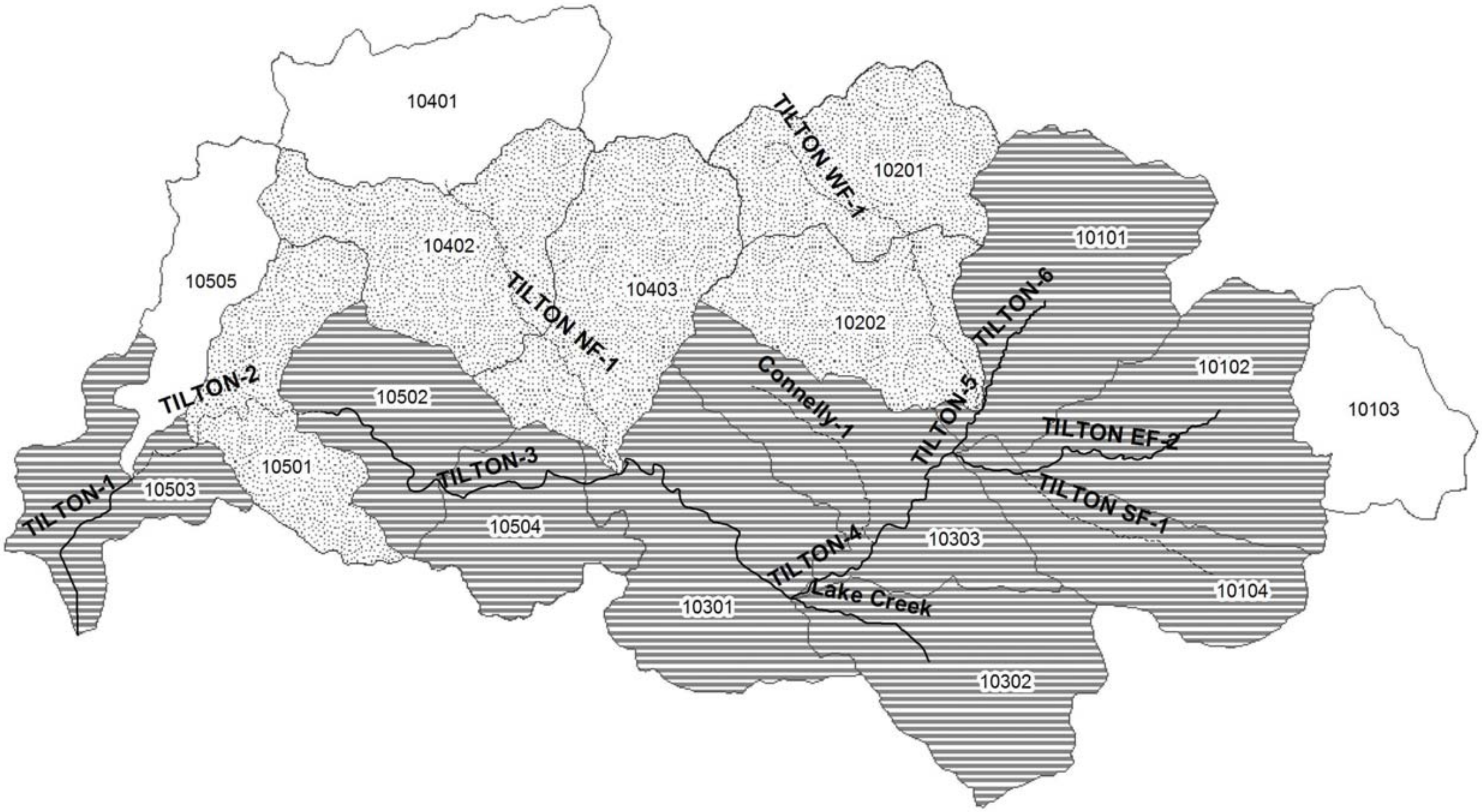


Figure 7-5. Reach tiers and subwatershed groups in the Tilton Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities at the reach 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.

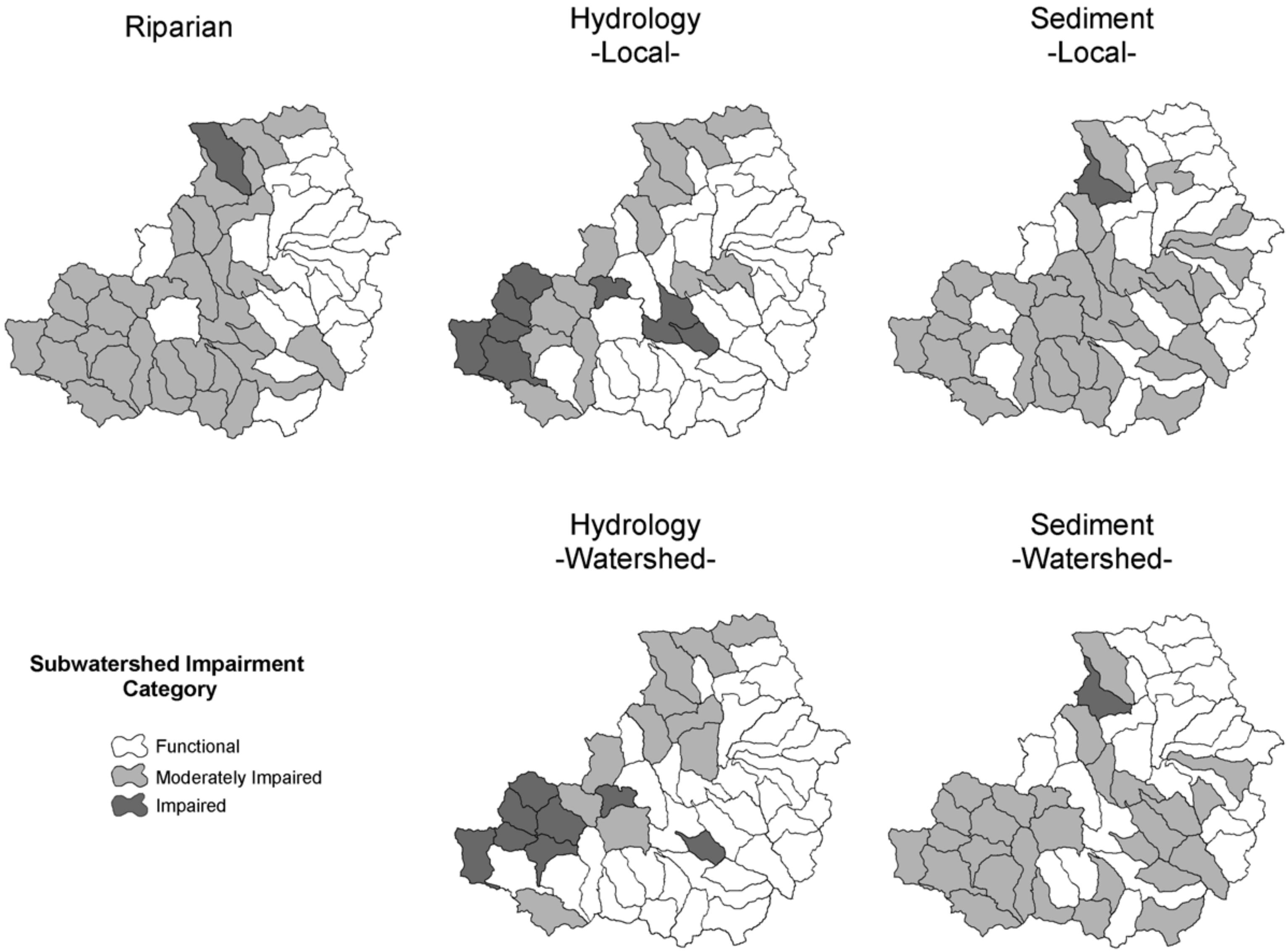


Figure 7-6. IWA subwatershed impairment ratings by category for the Upper Cowlitz Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

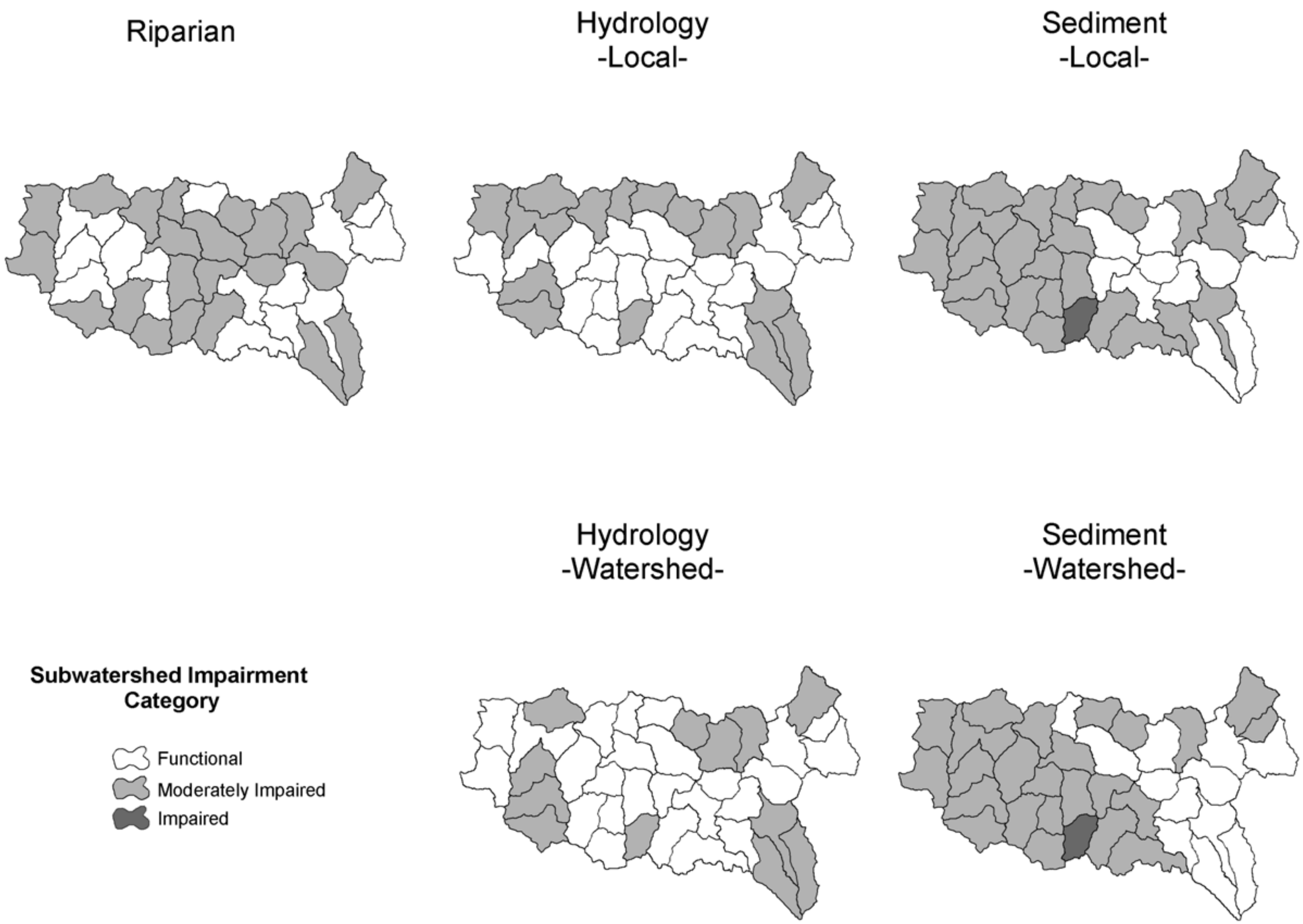


Figure 7-7. IWA subwatershed impairment ratings by category for the Cispus Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

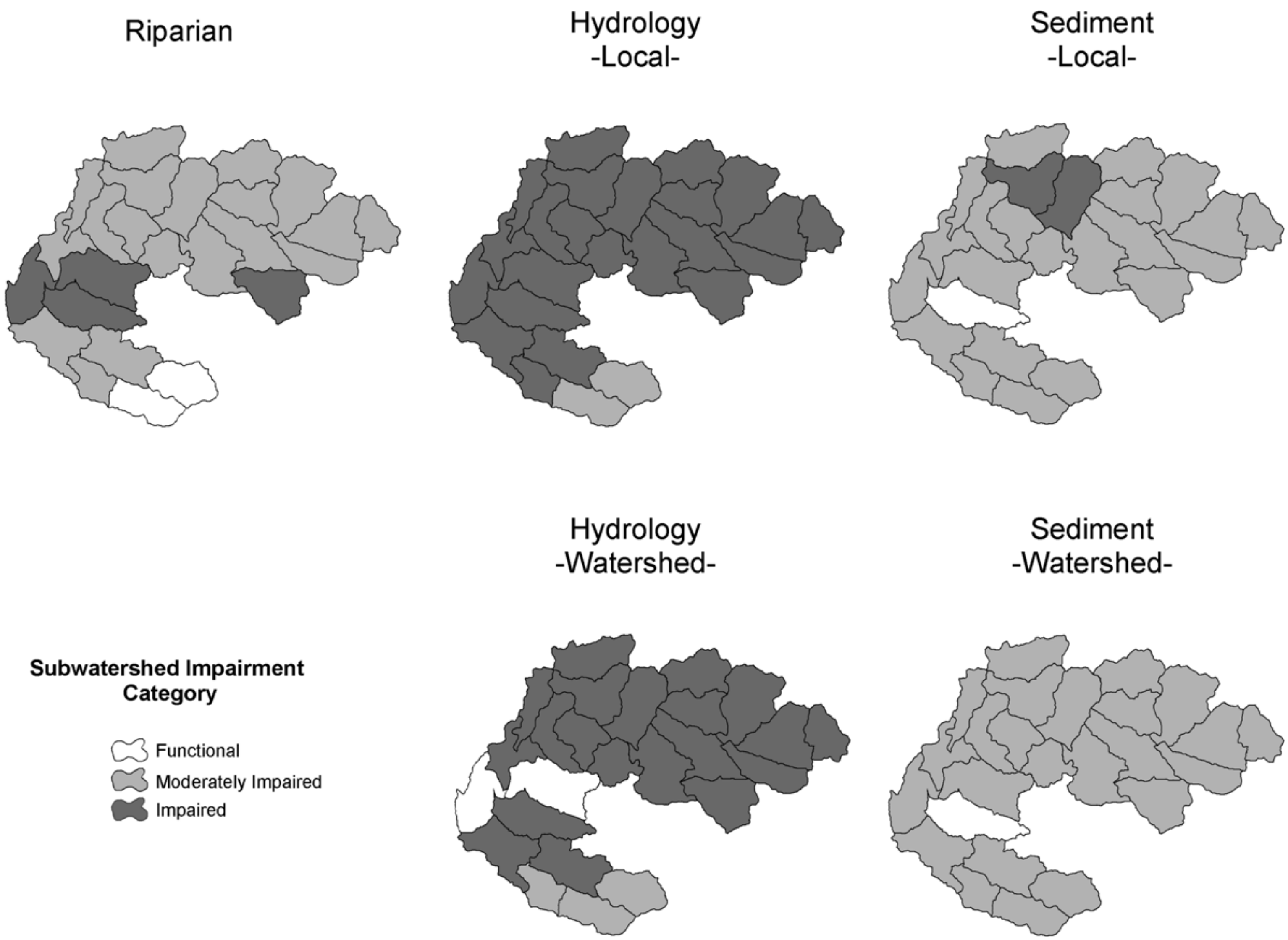


Figure 7-8. IWA subwatershed impairment ratings by category for the Mayfield-Tilton Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 7-5. Summary tables 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.

Upper Cowlitz & Cispus

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) Hydrology	Watershed processes (local) Sediment	Watershed processes (local) Riparian	Watershed processes (watershed) Hydrology	Watershed processes (watershed) 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	ChS	CISPUS-1C	egg incubation fry colonization summer rearing winter rearing	channel stability habitat diversity sediment	PR	M	M	M	F	M
		CISPUS-1B	StW									
		CISPUS-1C	Coho									
		Quartz Cr - 1	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

Tilton

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): Hydrology	Watershed processes (local): Sediment	Watershed processes (local): Riparian	Watershed processes (watershed): Hydrology	Watershed processes (watershed): 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

Table 7-6. 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				**Threats**			
	CO	**CI**	**TI**		**CO**	**CI**	**TI**
Habitat connectivity				***Hydropower operations***			
Blockages to off-channel habitats	✓		✓	Passage obstructions (dams)	✓	✓	✓
Blockages to channel habitats due to structures	✓	✓	✓	***Agriculture/grazing***			
Habitat diversity				Clearing of vegetation	✓		
Lack of stable instream woody debris	✓	✓	✓	Riparian grazing	✓		
Altered habitat unit composition	✓	✓	✓	Floodplain filling	✓		
Loss of off-channel and/or side-channel habitats	✓		✓	***Urban/rural development***			
Channel stability				Clearing of vegetation	✓		✓
Bed and bank erosion	✓	✓	✓	Floodplain filling	✓		✓
Channel down-cutting (incision)	✓	✓	✓	Roads – riparian/floodplain impacts	✓		✓
Mass wasting		✓		***Forest practices***			
Riparian function				Timber harvests –sediment supply impacts	✓	✓	✓
Reduced stream canopy cover	✓	✓	✓	Timber harvests – impacts to runoff			✓
Reduced bank/soil stability	✓	✓	✓	Riparian harvests (historical)	✓		✓
Exotic and/or noxious species	✓		✓	Forest roads – impacts to sediment supply	✓	✓	✓
Reduced wood recruitment	✓	✓	✓	Forest roads – impacts to runoff			✓
Floodplain function				***Channel manipulations***			
Altered nutrient exchange processes	✓		✓	Bank hardening	✓		✓
Reduced flood flow dampening	✓		✓	Channel straightening	✓		✓
Restricted channel migration	✓		✓	Artificial confinement	✓		✓
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			✓				

Table 7-7. Habitat measures in priority areas, with reference to limiting factors addressed, threats addressed, target species, and estimated time until benefits would be realized (time). Tier 1 and 2 reaches, or other areas of known priority, are listed under the location column for some measures (i.e., stream corridor measures). Reaches not included in the table (Tier 3, 4, and non-tiered reaches) are considered secondary priority.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
1. Protect and restore floodplain function and channel migration processes ***A. Set back, breach, or remove artificial channel confinement structures***					
Upper mainstem Cowlitz Upper Cowlitz 1A-1CC, 2 ***Tilton mainstem*** Tilton 3-4	• Blockages to off-channel habitats • Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes	• Floodplain filling • Channel straightening • Artificial confinement	• All species	2-15 years	Great potential benefit due to improvements in many limiting factors. This passive restoration approach can allow channels to restore naturally once confinement structures are removed. There are challenges with implementation on private lands due to existing infrastructure already in place, potential flood risk to property, and large expense.
2. Protect and restore off-channel and side-channel habitats ***A. Restore historical off-channel and side-channel habitats where they have been eliminated*** ***B. Provide access to blocked off-channel habitats***					
Upper mainstem Cowlitz Upper Cowlitz 1A-1CC, 2 ***Tilton mainstem*** Tilton 3-4	• Blockages to off-channel habitats • Loss of off-channel and/or side-channel habitats • Altered habitat unit composition	• Floodplain filling • Channel straightening • Artificial confinement	• All species	2-15 years	There are challenges with implementation on private lands due to existing infrastructure already in place, potential flood risk to property, and large expense.
3. Protect and restore riparian function ***A. Reforest riparian zones*** ***B. Allow for the passive restoration of riparian vegetation*** ***C. Livestock exclusion fencing*** ***D. Invasive species eradication*** ***E. Hardwood-to-conifer conversion***					
Upper mainstem Cowlitz Upper Cowlitz 1A-1CC, 2 ***Cispus mainstem*** Cispus 1F	• Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability	• Timber harvest – riparian harvests • Riparian grazing • Clearing of vegetation due to	• All species	20-100 years	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. Riparian protections on forest lands are provided for

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
Tilton mainstem Tilton 3-4	• Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or noxious species	rural development and agriculture			under current harvest policy. Riparian restoration projects are relatively inexpensive and are often supported by landowners. There is limiting opportunity for riparian restoration along the mainstem Cispus. The primary emphasis should be placed on allowing for the maturity of existing riparian forests. Whereas the specified stream reaches are the highest priority for riparian measures, riparian restoration and preservation should occur throughout the basin since riparian conditions affect downstream reaches. Use IWA riparian ratings to help identify restoration and preservation opportunities.
4. Protect and restore natural sediment supply processes ***A. Address forest road related sources*** ***B. Address timber harvest related sources***					
Entire basin	• Excessive fine sediment • Excessive turbidity • Embedded substrates	• Timber harvest – impacts to sediment supply • Forest roads – impacts to sediment supply	• All species	5-50 years	High potential benefit due to sediment effects on egg incubation and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. Use IWA impairment ratings to identify restoration and preservation opportunities.
5. Protect and restore runoff processes ***A. Address forest road impacts*** ***B. Address timber harvest impacts*** ***C. Limit additional watershed imperviousness***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Timber harvest – impacts to runoff • Forest roads – impacts to runoff	• All species	5-50 years	High potential benefit due to flow effects on habitat formation, redd scour, and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. Use IWA impairment ratings to identify restoration and preservation opportunities.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
6. Protect and restore instream flows ***A. Water rights closures*** ***B. Purchase or lease existing water rights*** ***C. Relinquishment of existing unused water rights*** ***D. Enforce water withdrawal regulations*** ***E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Water withdrawals	• All species	1-5 years	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.
7. Protect and restore water quality ***A. Restore the natural stream temperature regime***					
Entire basin	• Altered stream temperature regime	• Riparian harvests • Riparian grazing • Clearing of vegetation for agriculture or residential uses	• All species	1-50 years	Primary emphasis for restoration should be placed on stream segments that are listed on the 2004 303(d) list.
8. Protect and restore instream habitat complexity ***A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting*** ***B. Structurally modify stream channels to create suitable habitat types***					
Upper mainstem Cowlitz Upper Cowlitz 1A-2; Silver Cr; Johnson Cr; Hall Cr ***Cispus mainstem*** Cispus 1A, 1C, 1F-3; Yellowjacket 1 ***Tilton mainstem*** Tilton 1,3-6; EF Tilton 1-2	• Lack of stable instream woody debris • Altered habitat unit composition	• None (symptom-focused restoration strategy)	• Coho • Winter steelhead • Spring Chinook	2-10 years	Moderate potential benefit due to the high chance of failure. Failure is probable if habitat-forming processes are not also addressed. These projects are relatively expensive for the benefits accrued. Moderate to high likelihood of implementation given the lack of hardship imposed on landowners and the current level of acceptance of these type of projects.
9. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development ***A. Plan growth and development to avoid sensitive areas (e.g., wetlands, riparian zones, floodplains, unstable geology)*** ***B. Encourage the use of low-impact development methods and materials*** ***C. Apply mitigation measures to off-set potential impacts***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	The Tilton and upper mainstem Cowlitz have the greatest risks of development. Most of the Cispus Basin is within the Gifford Pinchot

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
					National Forest and the potential for development is low. The focus should be on management of land-use conversion and managing continued development in sensitive areas (e.g., wetlands, stream corridors, unstable slopes). Many critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary mechanisms need to be put in place to restore currently degraded habitats.
10. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection ***A. Purchase properties outright through fee acquisition and manage for resource protection*** ***B. Purchase easements to protect critical areas and to limit potentially harmful uses*** ***C. Lease properties or rights to protect resources for a limited period***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit. These programs are under-funded and have low landowner participation.

7.5 Program Gap Analysis

The upper Cowlitz Basin (~1,390 sq mi) is predominantly forest lands. Its headwaters begin in the Gifford Pinchot National Forest before entering three hydroelectric reservoirs managed by Tacoma Public Utilities and the Lewis Public Utility District. The three reservoirs include Scanewa, Riffe, and Mayfield.

- Lands managed by the U.S. Forest Service and the National Park Service (~960 sq mi) are divided into multiple management units. These include Mt Rainier National Park, William O Douglas Wilderness, Tatoosh Wilderness, Goat Rocks Wilderness, and the Cowlitz Ranger District;
- Lands along the Cowlitz River downstream from Coal Creek are a mix of small- and industrial commercial forestry lands (~145 sq mi), Department of Natural Resources forest lands (~28 sq mi), and other private lands (~257 sq mi);
- Most of the lands in the upper Cowlitz Basin are located within Lewis County. A small portion of the basin falls within Pierce, Skamania, and Yakima Counties. Tacoma Public Utilities manages Mayfield and Riffe Reservoirs, while Lewis PUD is responsible for Scanewa Reservoir. All three reservoirs are governed by licenses issued by the Federal Energy Regulatory Commission. Programs implemented under the current license address flow, habitat, hatcheries, and water quality.

<u>Protection Programs</u>

Protection programs in the upper Cowlitz Basin are implemented by the Mt Rainier National Park, Gifford Pinchot NF, small- and industrial-commercial forest owners pursuant to Washington forest practice rules, Lewis County, and other non-governmental organizations. Protection programs in this analysis include those programs that protect habitat conditions or watershed functions through regulatory measures, through acquisition of sensitive habitats or protective easements, incentives, or by applying standards to new development that protects resources by avoiding damaging impacts. Major programs implementing protection measures are identified below.

Federal Programs

➢ ***U.S. Forest Service Gifford Pinchot National Forest***

- <u>Gifford Pinchot NF's Forest Plan</u>: The plan provides high levels of protection for fish habitat, riparian areas and forest stands within the upper Cowlitz Basin:
  - ✓ Riparian buffers in all areas of the Gifford Pinchot NF include at least 300' setbacks.
  - ✓ Matrix (multiple objective) lands in the upper Cowlitz observe the forest-wide 'no clear cut' policy.
  - ✓ Significant acreage of Gifford Pinchot upper Cowlitz lands are within the Late Successional Reserves Program (e.g., Packwood, Woods, Quartz units). Thinning occurs in riparian areas to support healthier late successional stands.
  - ✓ Congressional Reserve Areas in the upper Cowlitz are 'no touch' areas. This includes lands within the William O Douglas Wilderness, Tatoosh Wilderness, and Goat Rocks Wilderness.
  - ✓ Administratively Withdrawn Areas include reaches in the Cispus, upper Cowlitz, Ohanapecosh, and Johnson Creek. These areas receive high levels of protection.
  - ✓ The plan addresses measures [M.3A, M.3B, M.4A, M.4B, M.5A, M.5B, and M.7A.

- ***National Park Service Mt Rainier National Park*** is managed to preserve and protect the natural character of lands within its jurisdiction. Park management affords a high level of protection for habitat and watershed processes. [M.3A; M.3B; M.4A; M.4B; M.5B; M.7A]

- ***U.S. Army Corps of Engineers***
  - Regulatory Programs: U.S. Army Corps of Engineers administers the Section 10 (Rivers and Harbor Act) and Section 404 (Clean Water Act) permit processes. Section 10 requires approval of any activity in, above, or below a navigable river, which affects course, location, condition, or capacity of navigable waters. Section 404 requires prior approval of dredging, filling, grading, clearing, and bank hardening. In waters used by listed fish species, the permits are subject to ESA Section 7 consultation with NOAA Fisheries to ensure that any approved action is adequately protective of the ESA listed fish. [M.1A; M.2A; M.2B; M.8A; M.8B]

- ***Federal Energy Regulatory Commission (FERC)***
  - Licensing of Hydroelectric Projects: Tacoma and Lewis County PUD operate hydroelectric facilities on the upper Cowlitz pursuant to FERC licenses. The licenses prescribe protection measures to be implemented by the utilities over the term of the licenses. A licensing settlement agreement between Tacoma Power and federal and state agencies, Lewis County, the Yakama Indian Nation and various non-governmental organizations (NGOs) prescribes additional measures for the Tacoma Power Cowlitz Hydro Project (Barrier, Mayfield and Mossyrock Dams and associated reservoirs). [M.3A; M.3B; M.7A; M.8A; M.8B]

State Programs

- ***Department of Natural Resources***
  - State Forest Land HCP: State forest lands are managed under the provisions of a Habitat Conservation Plan (HCP). The Habitat Conservation Plan has protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. These activities address measures M.3A, M.3B, M.4A, M.4B, M.5B, and M.7A.

  - State Forest Practices: Riparian areas and watershed functions on small- and industrial forest lands are protected under the State of Washington Forest Practices Rules, including the Forest and Fish Module. These rules provide for riparian buffers, harvest restrictions, sensitive area protections, and protective standards for new road construction. These activities address measures M.3A, M.3B, M.4A, M.4B, M.5B, and M.7A.

- ***Department of Fish and Wildlife***

  - Hydraulics Project Approval (HPA): The Department administers the state Hydraulic Code. The purpose of this program is to protect stream conditions and habitat. The regulations apply to such activities as streambank protection, instream construction, culvert installation, channel changes or realignments, debris removal, and water diversion facilities. Those proposing such actions must obtain a Hydraulic Project Approval (HPA) permit. [M.1A; M.2A; M.2B; M.8A; M.8B]

- Habitat Program: The Department provides advice to local governments and landowners interested in measures to protect habitat values on their property. [M.1A; M.2A; M.2B; M.3A; M.5C; M.7A; M.8A; M.8B; M.9A; M.9B; M.9C]

➢ ***Washington Department of Ecology***

- Water Resources Program/Water Rights: Department of Ecology, in consultation with the Department of Fish and Wildlife, has administrative closed selected areas within the lower North Fork Lewis watershed to further surface and groundwater withdraws (where groundwater is in continuity with surface water). Existing administrative closures by the Department of Ecology protect surface waters from further withdrawals. Formal rule-making would strengthen the closures. The extent of unauthorized surface water withdrawals is unknown, but could exacerbate summer low flows on smaller tributaries. [M.6A; M.6B; M.6C; M.6D]

- Water Resources Program/Watershed Planning: In cooperation with the Lower Columbia Fish Recovery Board, other state and federal agencies, tribes, local governments, and citizens, the Department funds and participates in a state authorized watershed planning process for Water Resource Inventory Area (WRIA) 26 pursuant to RCW 90.82. The goal of the plan is to ensure adequate water for people and fish. The planning process is dealing with water quantity and quality, stream flows and fish habitat. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.6A; M.6B; M.6C; M.6D]

➢ ***Department of Transportation***

- Road Maintenance Program

WSDOT has an ESA Section 4(d) Road Maintenance Program. The Maintenance Program uses trained crews to primarily manage roadside vegetation, litter control, and maintenance of safety rest areas associated with SR 12. [M.3A; M.3D]

- Barrier Replacement Program

In partnership with Lewis County, WSDOT has provided over $430,000 in funding for county culvert assessment, design and engineering. In Salmon and Jones Creeks partial barriers have been replaced with these funds. [M.2A; M.2B]

➢ ***Conservation Commission/ Lewis Conservation District*** provides technical assistance and incentives (e.g., Conservation Reserve and Enhancement Program) to encourage agricultural landowners to protect riparian areas and stream habitat. Application of these programs is limited in the upper Cowlitz basin. These programs could help address measures M.3B; M.3C; M.7A; M.8A, and M.8B.

Local Government Programs

➢ ***Lewis County***

- Comprehensive Planning and Land Use Zoning: Lewis County comprehensive planning and zoning are subject to the requirements of the Washington Growth Management Act (GMA). Zoning is mixed throughout the upper Cowlitz, but significant agricultural zoning (R-20) exists within the valley floor. Some lands are zoned for rural residential uses. Critical Areas Ordinance: The County critical areas ordinance includes protections for fish and wildlife habitat. Stream buffers vary from 25 to 100 feet depending on DNR water typing and whether urban or rural uses are involved. Wetland buffers vary from 50 to 100 feet depending on type and the intensity of use involved. Existing agricultural practices are exempt. [M.9A; M.9B; M.9C]
- Road Maintenance: The County has not adopted road maintenance standards that are protective of fish habitat. [M.5C; M.7A]

Restoration Programs

Restoration programs in the upper Cowlitz Basin are implemented by a variety of agencies, organizations, and private interests. Major programs implementing protection measures are identified below.

Federal Programs

- ***U.S. Forest Service Gifford Pinchot National Forest:*** Restoration activities within the Cispus and Mainstem Cowlitz are a high priority for the U.S. Forest Service. Restoration efforts include placement of large wood, riparian thinning to improve stands, and road stabilization and decommissioning. [M.3A; M.3B; M.4A; M.4B; M.5A; M.5B; M.7A]

- ***Federal Energy Regulatory Commission (FERC)***
  - Licensing of Hydroelectric Projects: Tacoma and Lewis County PUD operate hydroelectric facilities on the upper Cowlitz pursuant to FERC licenses. The licenses prescribe protection measures to be implemented by the utilities over the term of the licenses. A licensing settlement agreement between Tacoma Power and federal and state agencies, Lewis County, the Yakama Indian Nation and various non-governmental organizations (NGOs) prescribes additional measures for the Tacoma Power Cowlitz Hydro Project (Barrier, Mayfield and Mossyrock Dams and associated reservoirs). Required restoration activities include:
    - ✓ Upstream and downstream passage for salmonids. Volitional passage facilities are conditioned on first establishing a self-sustaining population for any Tilton salmonid population and either spring chinook or winter steelhead above Mossyrock Dam.
    - ✓ Providing flows protective of salmonids below the project.
    - ✓ Augmentation of sediment and spawning gravel below the project.
    - ✓ Funding fish habitat restoration projects.
    - ✓ Large woody debris augmentation in the lower river.

State Programs

- ***Washington Department of Natural Resources***

  - State Forest Land Habitat Conservation Plan (HCP): The Department manages state forest lands pursuant to a Habitat Conservation Plan (HCP). The HCP road maintenance and restoration objectives require barrier upgrades and road abandonment and/or other improvements. [M.3A; M.3B; M.4A; M.4B; M.5B; M.7A]

- State Forest Practices Act:
  - ✓ Industrial forests within the lower NF Lewis Basin are governed by Forest and Fish regulations and have rigid schedules for maintaining and improving roads and removing barriers. Industrial landowners have 15 years to bring roads and barriers into compliance with regulations [M.4A; M4B; M.5A; M.5B; M.7A]
  - ✓ Small private forest owners are governed by Forest and Fish regulations; however their road and barrier maintenance and improvement programs are tied to state funding. In the State 2003-05 Biennial Budget, 2 million dollars was allocated statewide to support small private forest owners [M.4A; M.4B; M.5A; M.5B; M.7A]

➢ ***Washington Department of Fish and Wildlife***

- Habitat Program: The Department provides advice to local governments and landowners interested in measures to restoring watershed processes and stream habitat. [M.1A; M.2A; M.2B; M.3A; M.5C; M.7A; M.8A; M.8B; M.9A; M.9B; M.9C]

➢ ***Washington Department of Ecology***

- Water Quality Program:
  The Cowlitz is listed as for temperature impairment on the WA State 303(d) list. It is also listed for arsenic however Ecology is in the process of de-listing this impairment. [M.6A; M.6B; M.6C; M.6D]
- Water Resources Program/Watershed Planning:
  The planning process for WRIA 26 is dealing with water quantity and quality, stream flows and fish habitat. Potential restoration efforts address improving summer low flows through conservation and acquisition of water rights. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.6A; M.6B; M.6C; M.6D]

➢ ***Department of Transportation***

- Road Maintenance Program

WSDOT has an ESA Section 4(d) Road Maintenance Program. The Maintenance Program uses trained crews to primarily manage road-side vegetation, litter control, and maintenance of safety rest areas associated with SR 12. [M.3A; M.3D]

- Barrier Replacement Program

In partnership with Lewis County, WSDOT has provided over $430,000 in funding for county culvert assessment, design and engineering. In Salmon and Jones Creeks partial barriers have been replaced with these funds. [M.2A; M.2B]

- ***Salmon Recovery Funding Board (SRFB)/ Lower Columbia Fish Recovery Board (LCFRB)***

  - Washington Salmon Recovery Act (RCW 77.85): The SRFB and the LCFRB jointly administer a grant program that allocates federal Pacific Salmon Recovery Funds and State funds for habitat protection and restoration projects by state and local agencies, nonprofit organizations, and landowners. To date the SRFB has provided $772,000 in funding for restoration projects in Cispus and Lambert Creeks. [M.1A; M.2A; M.2B; M.3A; M.7A; M.8A; M.8B]

- ***Conservation Commission/ Lewis Conservation District:*** The Conservation District provides technical assistance (e.g., farm plans) and incentives (e.g., Conservation Reserve and Enhancement Program) to encourage agricultural landowners to restore riparian areas and stream habitat. Application of these programs is limited in the upper Cowlitz basin. [M.3A, M.3C, and M.7A]

Local Government Programs

- ***Lewis County***
  - Barrier Program: Public Works Program has inventoried culverts on county roads and is replacing and/or upgrading barrier culverts. [M.5C]

  - Lewis County Noxious Weed Control Board: The Board has three primary programs that address weed control in the upper Cowlitz Basin; [M.3D]
    - ✓ Public education to prevent the spread of noxious weeds;
    - ✓ Survey of the County to assess emerging issues; and
    - ✓ Enforcement of noxious weed control

Community Programs

- ***Cowlitz Game and Anglers and Cowlitz Volunteers*** are non-profit organizations that perform restoration projects in the upper Cowlitz Basin. An example is the Hall Creek project where the SRFB provided a $141,000 grant for a supplementation project. [M.2B]

Gap Analysis

Forest-related Programs: In the upper Cowlitz Basin, U.S. Forest Service and National Park Service programs, the DNR forest management HCP, and the state forest practice rules apply to over 70 percent of the upper Cowlitz basin. Collectively these programs effectively provide for the protection and restoration of watershed functions and habitat conditions at levels supporting recovery goals. Certainty of forestry-related protection and restoration programs is relatively high because programs are being implemented and, for the most part, fully funded. Program areas of concern include state funding for small commercial forest landowners and the continued potential for hydrologic impacts caused by past harvest practices. Monitoring of watershed processes and habitat conditions will be required to confirm the effectiveness of these measures.

Protection-related Programs: Non-federal lands in the upper Cowlitz Basin have varying levels of protection through county and city land use regulations. Areas of concern include limited agricultural protections, the adequacy of local land use regulation, and inconsistent protection levels across jurisdictions.

Restoration-related Programs: Relative to the hydroelectric facilities, upstream and downstream passage for coho, steelhead, and spring chinook are fundamental to successful reintroduction of salmonid species. Recovery of Spring Chinook, in particular, hinges upon success of the Tacoma Public Utilities and Lewis PUD passage program. Actions to address downstream impacts of the hydroelectric facilities are also important to salmon and steelhead recovery efforts. These include: monitoring and augmentation of gravel and large woody debris, where and when necessary, and assurance of flow regimes needed for downstream spawning and rearing.

Table 7-8. Actions to Address Gaps

Action #	Lead Agency	Proposed Action
U-COW.1	Lewis County, Packwood; Morton; Mossyrock	Develop and implement controls to adequately protect riparian areas to maintain functional habitat as well as restored habitat conditions around all rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Require mitigation, where necessary, to offset unavoidable damage to habitat conditions in riparian management areas
U-COW.2	Lewis County, Packwood; Morton; Mossyrock	Zoning and development standards to adequately protect wetlands, wetland buffers, and wetland function.
U-COW.3	Lewis County, Packwood; Morton; Mossyrock	Develop and implement controls to address erosion and sediment run-off during (and after) construction to prevent sediment and pollutant discharge to streams, wetlands and other water bodies
U-COW.4	Lewis County, Packwood; Morton; Mossyrock	Apply land use code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
U-COW.5	State of Washington	Provide state funding for small forest owners in the upper Cowlitz Basin to a level sufficient to achieve the road and barrier improvements of Forest and Fish on a schedule parallel to private industrial forest owners
U-COW.6	Forest Managers LCFRB, and DFW	Identify and sequence early action forest-wide restoration projects that analysis indicates could provide significant benefits. In these cases, it may be appropriate to identify outside funding to initiate these early actions
U-COW.7	State of Washington, LCFRB, CC	Build institutional capacity for agencies and organizations to undertake protection and restoration projects
U-COW.8	Tacoma Public Utilities, Lewis PUD	Provide efficient passage and collection facilities for coho, steelhead, and spring chinook populations to make use of habitats above Scanewa Reservoir
U-COW.9	Tacoma Public Utilities, Lewis PUD	Increase fish and wildlife habitat mitigation measures (upstream and downstream) commensurate with recovery goals for populations affected by hydrosystem impacts
U-COW.10	Lewis County, Lewis CC, Friends of Cowlitz	Utilize a combination of public outreach/education, incentives, and authority to positively influence landowner behaviors toward land stewardship in practices not covered by land use regulations
U-COW.11	WRIA 27/28 PU, DOE, DFW	Close the upper Cowlitz River to further surface water withdrawals, including groundwater in connectivity with surface waters
U-COW.12	LCFRB, Lewis County, DFW	Build institutional capacity for agencies and organizations to undertake additional protection and restoration projects, including noxious weed control
U-COW.13	SRFB, Fish and Wildlife Foundation, BPA, NOAA, DOE	Increase available funding for projects that implement measures and addresses underlying threats
U-COW.14	State of Washington (Dept of Agriculture)	Develop and implement agricultural practices and regulations to protect riparian conditions and water quality
U-COW.15	LCFRB, Lewis CD, Lewis County, Friends of the Cowlitz	Address threats proactively by building agreement on priorities among the various program implementers
U-COW.16	FEMA	Update floodplain maps using Best Available Science

8 Cowlitz Subbasin – Toutle

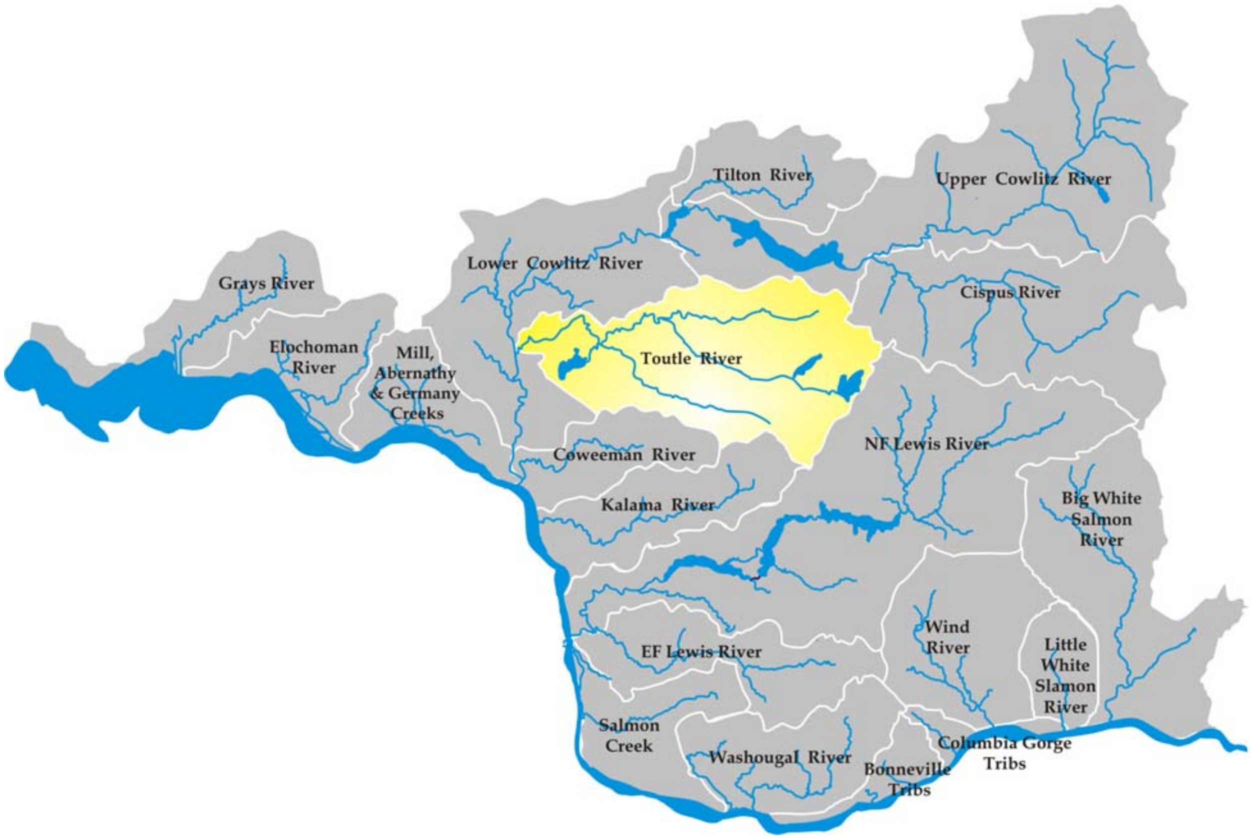


Figure 8-1. Location of the Toutle River Basin within the Lower Columbia River Basin.

8.1 Basin Overview

The Toutle River basin comprises approximately 513 square miles, primarily in Cowlitz County with some tributaries in Lewis and Skamania counties. The Toutle River enters the Cowlitz approximately 5 miles upstream of the town of Castle Rock, Washington. Principal tributaries include the Green River and, South Fork and North Fork Toutle. The basin is part of WRIA 26.

The Toutle Basin will play a key role in the recovery of salmon and steelhead. The North Fork Toutle Basin has historically supported populations of fall Chinook, winter steelhead, and coho. The South Fork Toutle Basin has historically supported populations of spring Chinook, winter steelhead, and coho. Today, Chinook and steelhead are listed as threatened under the ESA. Coho salmon are a candidate for listing. Other fish species of interest are Pacific Lamprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

Toutle salmon and steelhead are affected by a variety of in-basin and out-of basin factors including stream, Columbia River mainstem, estuary, and ocean habitat conditions; harvest; hatcheries; and ecological relationships with other species. Analysis has demonstrated that recovery cannot be achieved by addressing only one limiting factor. Recovery will require action to reduce or eliminate all manageable factors or threats. The deterioration of habitat conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonids within the Columbia Basin. Direct harvest of listed salmon and steelhead is prohibited but sport and commercial fisheries focusing on hatchery fish and other healthy wild populations, primarily in the mainstem Columbia and ocean, incidentally affect ESA-listed Toutle fish. North Toutle Hatchery operates within the North Fork Toutle with the potential to both adversely affect wild salmon and steelhead populations and to assist in recovery efforts. Releases from Skamania Hatchery are made into the South Fork Toutle. Key ecological interactions of concern include effects of nonnative species; nutrient inputs from salmon carcasses; and predation by species affected by development including Caspian terns, northern pikeminnow, seals, and sea lions. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the Toutle Subbasin.

Forestry is the dominant land use and commercial forestland makes up over 90% of the basin. Much of the upper basin around Mount St. Helens is within the Mount St. Helens National Volcanic Monument and is managed by the U.S. Forest Service. A significant proportion of the forests to the north and west of Mount St. Helens were decimated in the 1980 eruption. Intensive forest harvest and road building followed the eruption and contributed to widespread sediment and flow impairment. The majority of the forest is now in early seral or ‘other forest’ (bare soil, shrubs) vegetation conditions.

Of the three primary tributaries (North Fork, South Fork, Green River), the North Fork Toutle suffered the greatest eruption-related impacts, followed by the South Fork and then the Green River, which was mostly spared the devastating mud and debris flows. The North Fork historically provided productive habitats for steelhead and Chinook but productivity continues to remain limited due to eruption and forestry impacts. The sediment loads in the North Fork remain very high, with a braided channel that is under frequent adjustment. The North Fork is further impacted by the Sediment Retention Structure (SRS). The SRS was created in an effort to retain sediments following the eruption, but has become a persistent source of sediment to downstream reaches. The SRS is also a passage barrier and fish are currently transported around the structure.

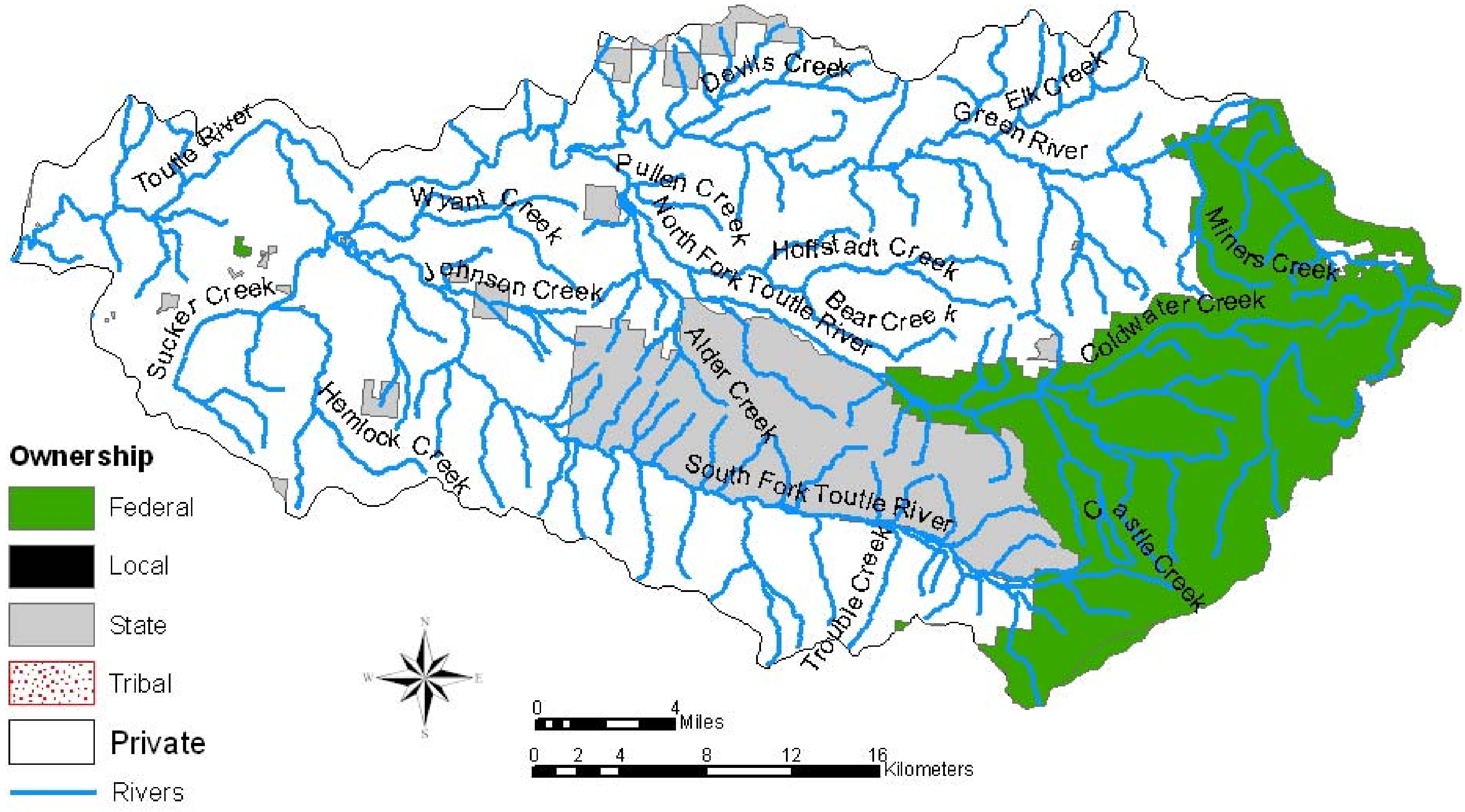
The South Fork, which also continues to suffer from high sediment loads, is recovering more rapidly than the North Fork. The South Fork has high restoration as well as preservation value for steelhead and Chinook. The Green River also has high restoration and preservation value.

The lower mainstem is utilized by fall Chinook and historically provided chum habitat. These reaches were heavily degraded by the dredging of eruption-related sediments and the placement of these sediments in the floodplain. Channels are currently disconnected from floodplains and channel instability remains high.

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%

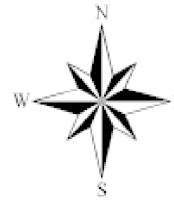
Land Ownership	
Private	54%
Federal	28%
State	18%
Other public	0%

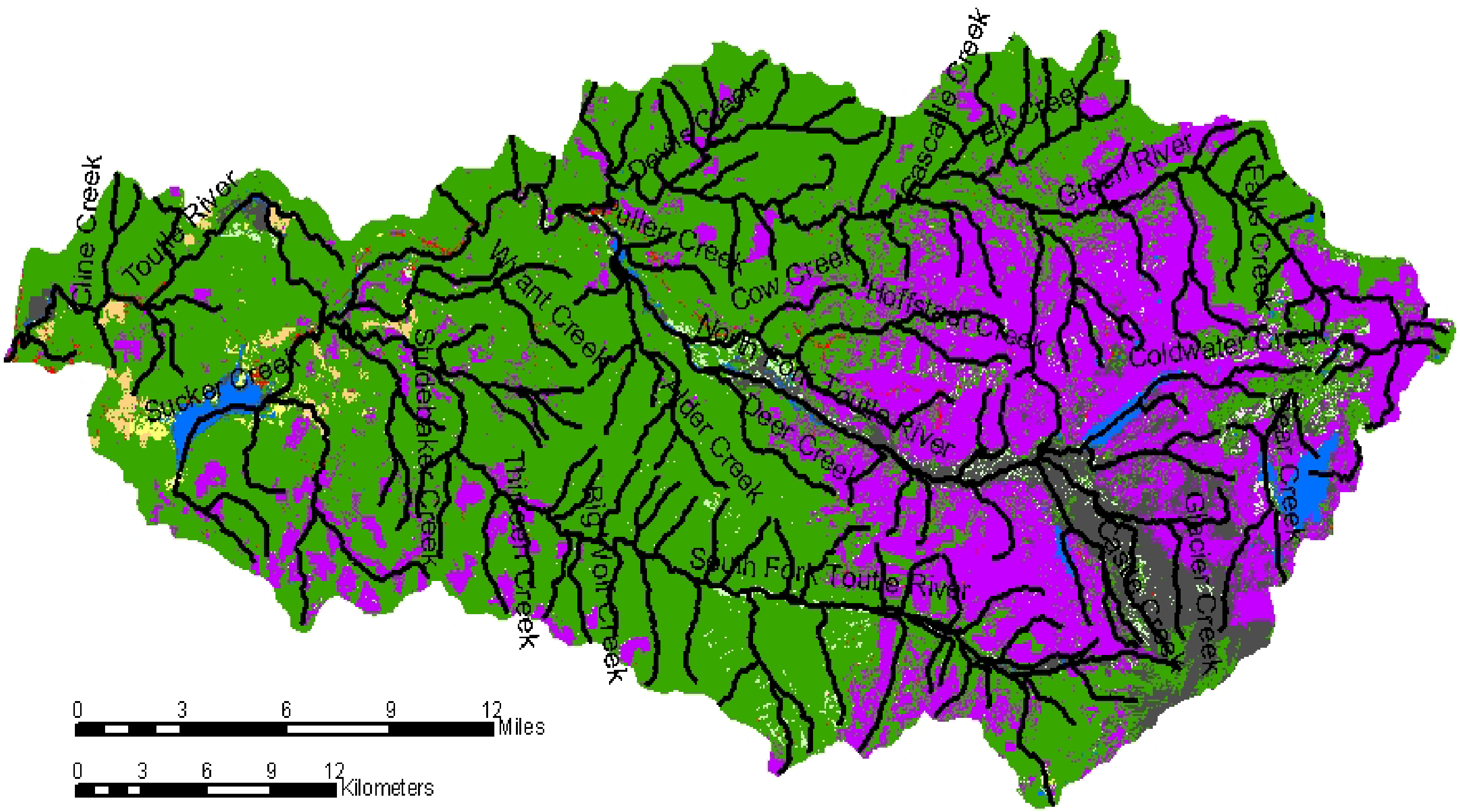
Land Ownership



Vegetation Composition	
Late Seral	4%
Mid Seral	23%
Early Seral	8%
Other Forest	61%
Non Forest	4%

Land Use / Cover





8.2 Species of Interest

8.2.1 North Fork Toutle

Focal salmonid species in the North Fork Toutle include fall Chinook, winter steelhead, chum and coho. The health or viability of all focal populations is currently low. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Recovery goals call for restoring winter steelhead and coho to a high viability level. This level will provide for a 95% probability of population survival over 100 years. The recovery goal for fall Chinook is low viability which allows for a 40-74% chance of persistence over 100 years.

Other species of interest in the NF Toutle include coastal cutthroat trout and Pacific lamprey. Regional objectives for these species are described in Volume I, Chapter 6. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for these other species. Cutthroat will benefit from improvements in stream habitat conditions for salmonids. 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 of lamprey are not well known.

Table 8-1. 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	1,400-14,100
Winter steelhead	Threatened	No	Low	100-300	High	700-3,500
Coho	Candidate	Yes	Low	unknown	High	unknown

Fall Chinook – 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 hatchery origin fish spawning in the Lower 0.5 mile of the Green River. Prior to the eruption of Mt. St. Helens in 1980, the majority of fall Chinook spawning occurred in the lower 5 miles of the mainstem 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.

Winter Steelhead – 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.

Coho – The historical NF Toutle adult population is estimated as high as 60,000 fish, with the majority of returns early stock which spawn in November. Current returns are unknown but assumed to be low since the 1980 eruption of Mt. St. Helens. A number of hatchery produced fish spawn naturally. Natural spawning can occur in most areas of the Green and NF Toutle, most notably Devils and Elk creeks on the Green and Alder, Hoffstadt, and Bear creeks on the NF Toutle. Juvenile rearing occurs upstream and downstream of spawning areas. Juveniles rear for a full year in the Toutle Basin before migrating as yearlings in the spring.

Coastal Cutthroat – 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.

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.

8.2.2 South Fork Toutle

Focal salmonid species in the South Fork Toutle basin include spring Chinook, winter steelhead, and coho. SF Toutle chum are considered part of the lower Cowlitz population and fall Chinook part of the mainstem Toutle population. The health or viability of the focal populations is currently very low for spring Chinook, low for coho, and medium for winter steelhead. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Recovery goals call for restoring winter steelhead and coho to a high or very high viability level. This level will provide for a 95% or better probability of population survival over 100 years. The recovery goal for spring Chinook is medium viability which allows for a 75-95% chance of persistence over 100 years.

Table 8-2. 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	1,400-3,400
Winter Steelhead	Threatened	Yes	Med	200-2,500	High+	1,400-1,900
Coho	Candidate	No	Low	unknown	High	unknown

Spring Chinook – The historical Toutle population (including mainstem, SF and NF) is estimated from 4,000-40,000, although these estimates may be high. Only 400 spring Chinook were counted in 1951. The current return is likely less than 200 fish. Spawning occurs from late August –early October. Juveniles typically spend a full year rearing in the Toutle and migrate to the Columbia in the spring of their second year.

Winter Steelhead – The historical SF Toutle adult population is estimated from 4,000-4,500 fish. Current natural spawning returns range from 200-2,500 fish. In-breeding with hatchery produced summer steelhead is thought to be low because of differences in spawn timing. Spawning occurs primarily in the mainstem SF Toutle, and Studebaker, Johnson, and Bear creeks. Spawning time is early 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 SF Toutle.

Coho – The historical SF Toutle adult population is estimated from 15,000-40,000, with the majority of returns early stock coho. Early coho spawning occurs primarily in early to mid-November. Current returns are unknown but assumed to be low. Natural spawning can occur in most areas of the basin including the mainstem, and Outlet, Johnson, Studebaker, Bear, and

Herrington creeks. Juvenile rearing occurs upstream and downstream of spawning areas. Juveniles rear for a full year in the SF Toutle basin before migrating as yearlings in the spring.

Coastal Cutthroat – Coastal cutthroat abundance in the SF Toutle has not been quantified but the population is considered depressed. Both anadromous and resident forms of cutthroat trout are present in the basin. Anadromous cutthroat enter the SF Toutle from September-December and spawn from January through June. Most juveniles rear 2-4 years before migrating from their natal stream.

Pacific lamprey – Information on lamprey abundance is limited and does not exist for the Sf Toutle 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 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 Toutle Basin. Juveniles rear in freshwater up to 6 years before migrating to the ocean.

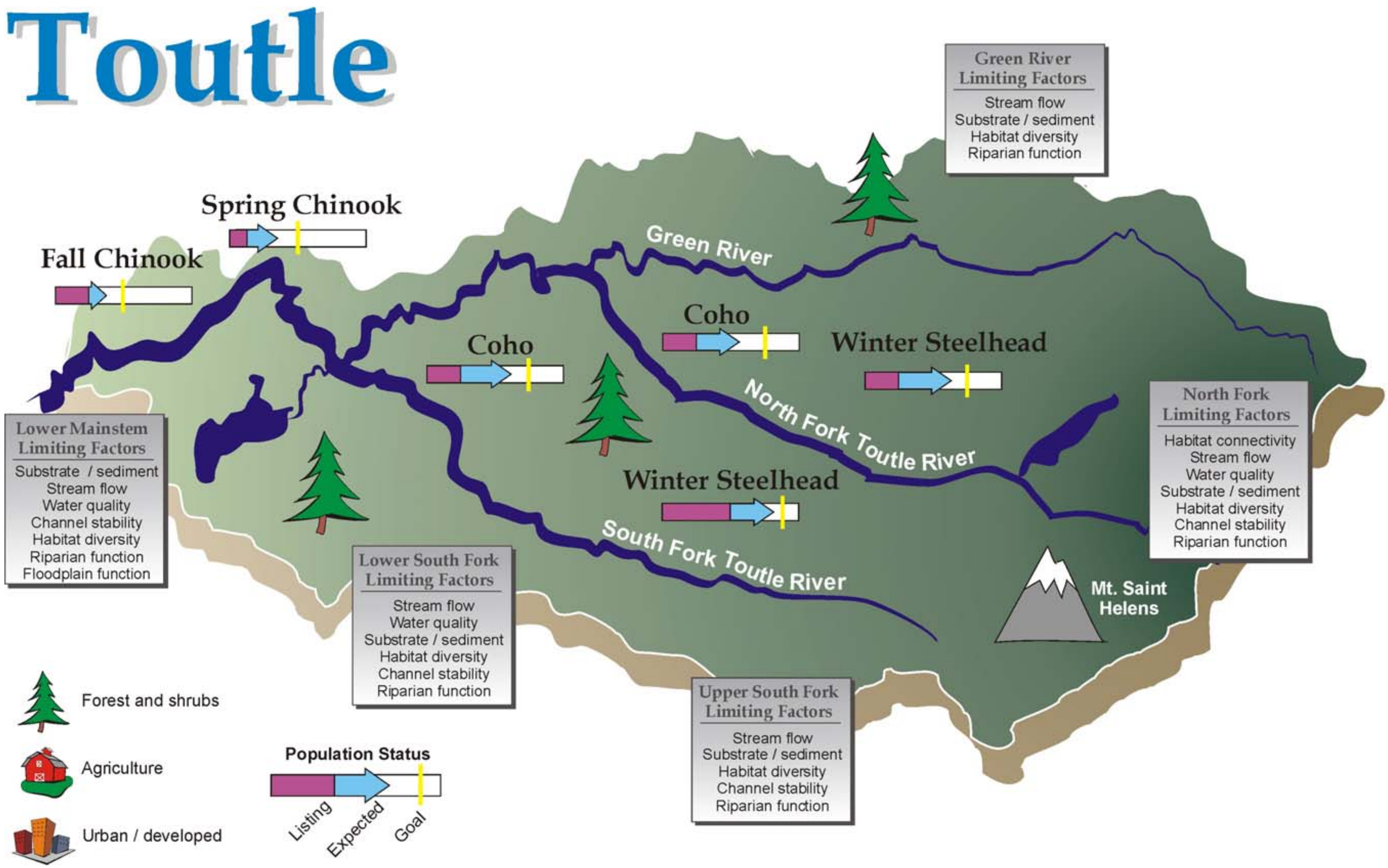


Figure 8-2. Summary of habitat limiting factors, population status, expected population improvement trend with existing programs, and biological objectives depicted for the Toutle Basin.

8.3 Potentially Manageable Impacts

Stream habitat, estuary/mainstem habitat, harvest, hatchery and predation effects have all contributed to reduced salmonid productivity, numbers, and population viability in the Toutle subbasin. The pie charts below represent the relative order of magnitude of quantifiable effects for each of these factors for each focal species. The preferred recovery scenario targets an equivalent reduction in each impact factor in proportion to the magnitude of the effect. Population-specific targets are discussed in further detail in Volume I, Chapter 6.

- Loss of tributary habitat quantity and quality is highly important to all three populations, and is extremely important to winter steelhead. Effects from losses to estuary habitat are relatively minor.

- Harvest is important to both spring Chinook and coho, but is of lesser importance to winter steelhead.
- Hatchery impacts are moderately important to coho and spring Chinook. For winter steelhead, hatchery impacts are non-existent.

- Predation impacts are moderately important to all three populations within the Toutle. Loss of tributary habitat quality and quantity is an important impact for all species, particularly for chum and steelhead. Loss of estuary habitat quality and quantity is also important, particularly for chum.

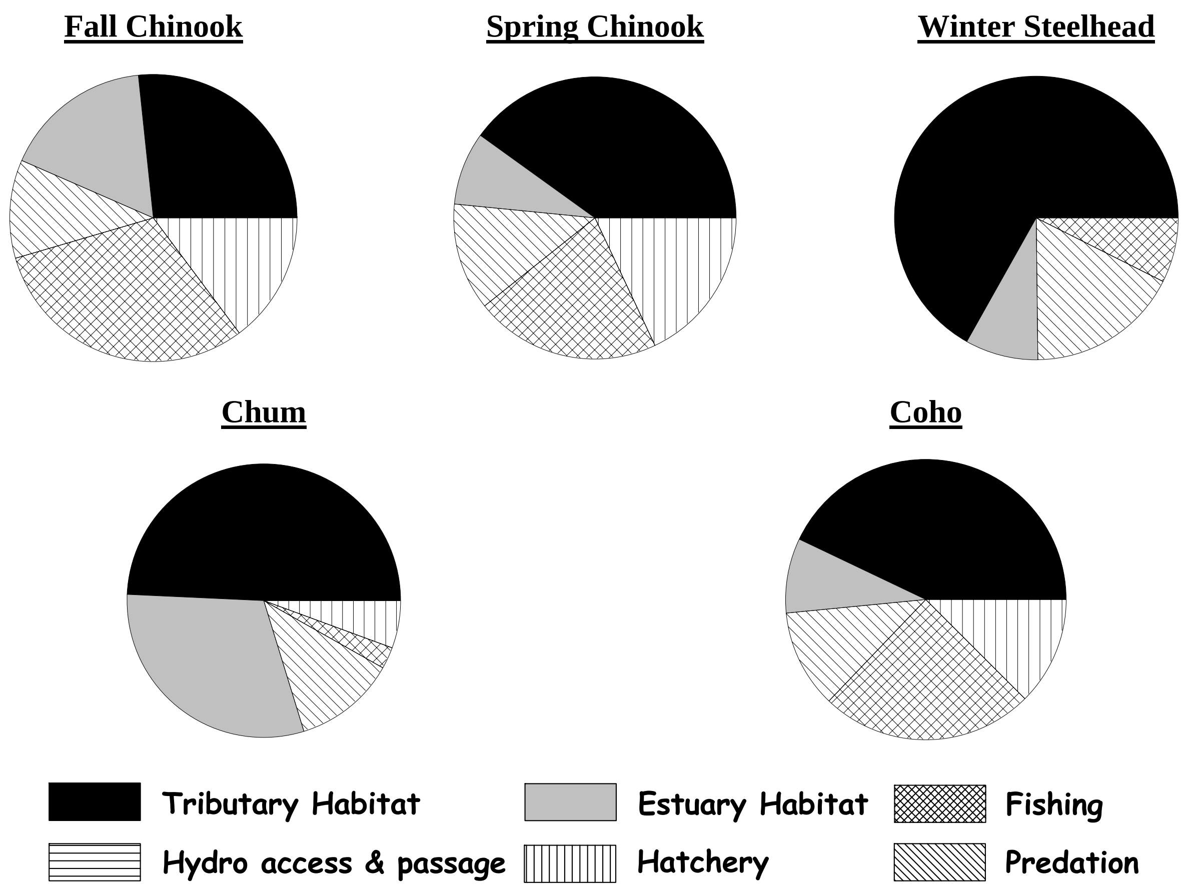


Figure 8-3. Relative contribution of potentially manageable impacts for Toutle populations.

8.4 Limiting Factors, Threats, and Measures

8.4.1 Hydropower Operation and Configuration

There are no hydro-electric dams in the Toutle River Basin. However, Toutle species are affected by mainstem Columbia hydro operations and flow regimes which affect habitat in migration corridors and in the estuary. Mainstem hydro factors and threats are addressed by regional strategies and measures identified in Volume I.

8.4.2 Harvest

8.4.2.1 *Toutle*

Most harvest of Toutle salmon and steelhead occurs incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. This mortality is very low for chum and steelhead, but is more significant for fall Chinook. Toutle fall Chinook are harvested in ocean and Columbia River commercial and sport fisheries as well as in-basin sport fisheries. Harvest is controlled by an ESA harvest limit associated with Coweeman natural fall Chinook. No harvest of chum occurs in ocean fisheries, there are no directed Columbia River or Toutle basin chum fisheries, 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 fin-marked hatchery fish and release unmarked wild fish. 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.

Measures 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. The regional measures 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 Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest measures with significant application to Toutle Subbasin populations are summarized in the following table:

Table 8-3. Regional harvest measures from Volume I, Chapter 7 with specific implementation actions in the Toutle Subbasin.

Measure	Description	Comments
F.M17	Monitor chum handle rate in winter steelhead and late coho tributary sport fisheries.	State agencies would include chum incidental handle assessments as part of their annual tributary sport fishery sampling plan.
F.M13	Develop a mass marking plan for hatchery tule Chinook for tributary harvest management and for naturally-spawning escapement monitoring.	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.M18	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	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.M19	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	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.M24	Maintain selective sport fisheries in Ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	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.

8.4.3 Hatcheries

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

8.4.3.1 *North Fork Toutle*

The North Toutle Hatchery (since 1952) produces fall Chinook, coho, and 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 8-4.North Toutle Hatchery Production.

Hatchery	Release Location	Fall Chinook	Early Coho	Summer Steelhead
North Toutle	Green River	2,500,000[1]	800,000	25,000

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 North Toutle facility 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 Technical Foundation, Volume IV). Regional hatchery measures identified in Volume I, Chapter 7 with potential applications to programs within the North Toutle subbasin are summarized in Table 7.

Table 8-5. Regional hatchery measures from Volume I, Chapter 7 with potential implementation actions in the Toutle Subbasin.

Measure	Description	Comments
H.M2,5,13,38	Integrated hatchery and wild program for fall Chinook. Evaluate potential for integration of an early stock coho program.	Assures fitness of the natural produced fish which will improve population productivity. Integrated programs would be developed specific to the Toutle populations in the BRAP procedure.
H.M14	Use only local broodstock in the fall Chinook hatchery program.	This measure will preclude transfer of outside basin stock into the North Toutle Hatchery program. This will enable a hatchery and wild integrated program to be developed with fall Chinook that are ecologically adapted to the Toutle Basin.
H.M15,32,40	Juvenile release strategies to minimize interactions with naturally spawning fish	Release strategies are aimed at reducing or avoiding interactions with wild steelhead, fall Chinook, coho by release timing and release location strategies.
H.M17,34,42	Mark hatchery steelhead, coho, fall Chinook with an adipose fin-clip for identification and selective harvest	Marking hatchery fish allows for identification of hatchery fish in the natural spawning grounds and at collection facilities which enables accurate accounting of wild fish. Marking also enables selective fisheries to retain hatchery fish and release wild fish.
H.M8	Adaptively manage hatchery programs to further protect and enhance natural populations and improve operational efficiencies.	Appropriate research, monitoring, and evaluation programs along with guidance from regional hatchery evaluations will be utilized to improve the survival and contribution of hatchery fish, reduce impacts to natural fish, and increase benefits to natural fish.
H.M2,6	Evaluate North Toutle Hatcheries facility operations.	The hatchery would be evaluated in the BRAP process for potential hazards associated with barriers to fish passage and adequacy of screens.

8.4.3.2 *South Fork Toutle*

There are no hatcheries operating in the South Fork Toutle Basin. Skamania stock summer steelhead are released into the South Fork Toutle as smolts for harvest opportunity. Skamania Hatchery steelhead are a composite stock and are genetically different from the naturally produced winter steelhead from the South Fork Toutle River. 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 8-6. South Fork Toutle River hatchery production.

Hatchery	Release Location	Summer Steelhead
Skamania	South Fork Toutle	25,000

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 Toutle 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 Technical Foundation, Volume IV). Regional hatchery measures identified in Volume I, Chapter 7 with potential applications at facilities within the South Fork Toutle Subbasin are summarized in Table 7.

Table 8-7. Regional hatchery measures from Volume I, Chapter 7 with potential implementation actions in the South Fork Toutle Subbasin.

Measure	Description	Comments
H.M32	Juvenile release strategies to minimize interactions with naturally-spawning fish.	Release strategies are aimed at reducing or avoiding interactions with wild steelhead, fall Chinook, coho by release timing and release location strategies.
H.M8	Adaptively manage hatchery programs to further protect and enhance natural populations and improve operational efficiencies.	Appropriate research, monitoring, and evaluation programs along with guidance from regional hatchery evaluations will be utilized to improve the survival and contribution of hatchery fish, reduce impacts to natural fish, and increase benefits to natural fish.

8.4.4 Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Toutle salmon and steelhead are affected throughout their lifecycle by ecological interactions with non-native species, food web components, and predators. Interactions are similar for Toutle populations to those of most other subbasin salmonid populations. These interactions are described in further detail in Volume I, Chapter 4. Ecological Interactions are addressed by regional strategies and measures identified in Volume I, Chapter 7.

8.4.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. 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 are similar for Toutle populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook than spring Chinook, steelhead, and coho. Estuary and mainstem effects on Toutle salmon populations are addressed by regional strategies and measures identified in Volume I and the Columbia Mainstem and Estuary Subbasin sections of Volume II.

8.4.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity 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 River basin have the greatest impact on the health and viability of salmon and steelhead relative to the other limiting factors and threats discussed in this chapter.

Subwatersheds, reaches, and habitat attributes have been prioritized for protection and/or restoration based on the plan's biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Priority areas for habitat preservation and restoration are identified in Figure 8-4. A summary of the primary habitat limiting factors and threats are presented in Table 8-9. Habitat measures and related information are presented in Table 8-10. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 8-5. Reach- and subwatershed-scale limiting factors generated from the technical assessment are included in Table 8-8. Details on species-specific spatial priorities and limiting factors at the subbasin level may be found in volume II of the Technical Foundation. A description of the methodology used to generate composite (multi-species) reach and subwatershed priorities can be found in the introduction to this volume of the recovery plan.

The areas with the greatest current or potential contribution to focal salmonid population health and productivity are listed below. Tier 1 and 2 reaches within these priority areas are included in the list. The habitat limiting factors, threats, and measures included in this chapter focus primarily on the priority areas and the Tier 1 and 2 reaches within them. Tiers 3, 4, and non-tiered reaches are considered secondary priority, but in many cases, these lower priority areas will also require restoration and preservation actions in order to achieve recovery objectives. Watershed process measures generally focus on the entire basin as opposed to being limited only to high priority areas because conditions in high priority areas are often influenced by cumulative watershed effects. High priority areas and reaches in the Toutle Basin include the following:

- Lower Toutle Mainstem - Toutle 1-5
- Lower North Fork and South Fork Toutle – NF Toutle 1-2; SF Toutle 1-3
- Upper South Fork Toutle – SF Toutle 4-20
- North Fork Toutle – NF Toutle 6-13
- Green River – Green River 1-9

The following paragraphs provide a brief overview of each of these priority areas, including species most affected, land-use threats, and the general type of measures that will be necessary for recovery. Additional detail can be found in the tables and figures that follow.

While reach level habitat conditions often result from local factors, they are also affected or shaped by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input and large woody debris recruitment are often affected by or result from upstream conditions and degraded watershed processes. Access to key reaches may also be affected by barriers that occur downstream of a reach. Accordingly, restoration of a priority reach may require action outside the targeted reach. The IWA analysis was used to identify potential upstream watershed areas that could influence reach level habitat attributes. EDT was used to allow a relative comparison of reaches and habitat attributes within a reach.

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.

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.

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.

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 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.

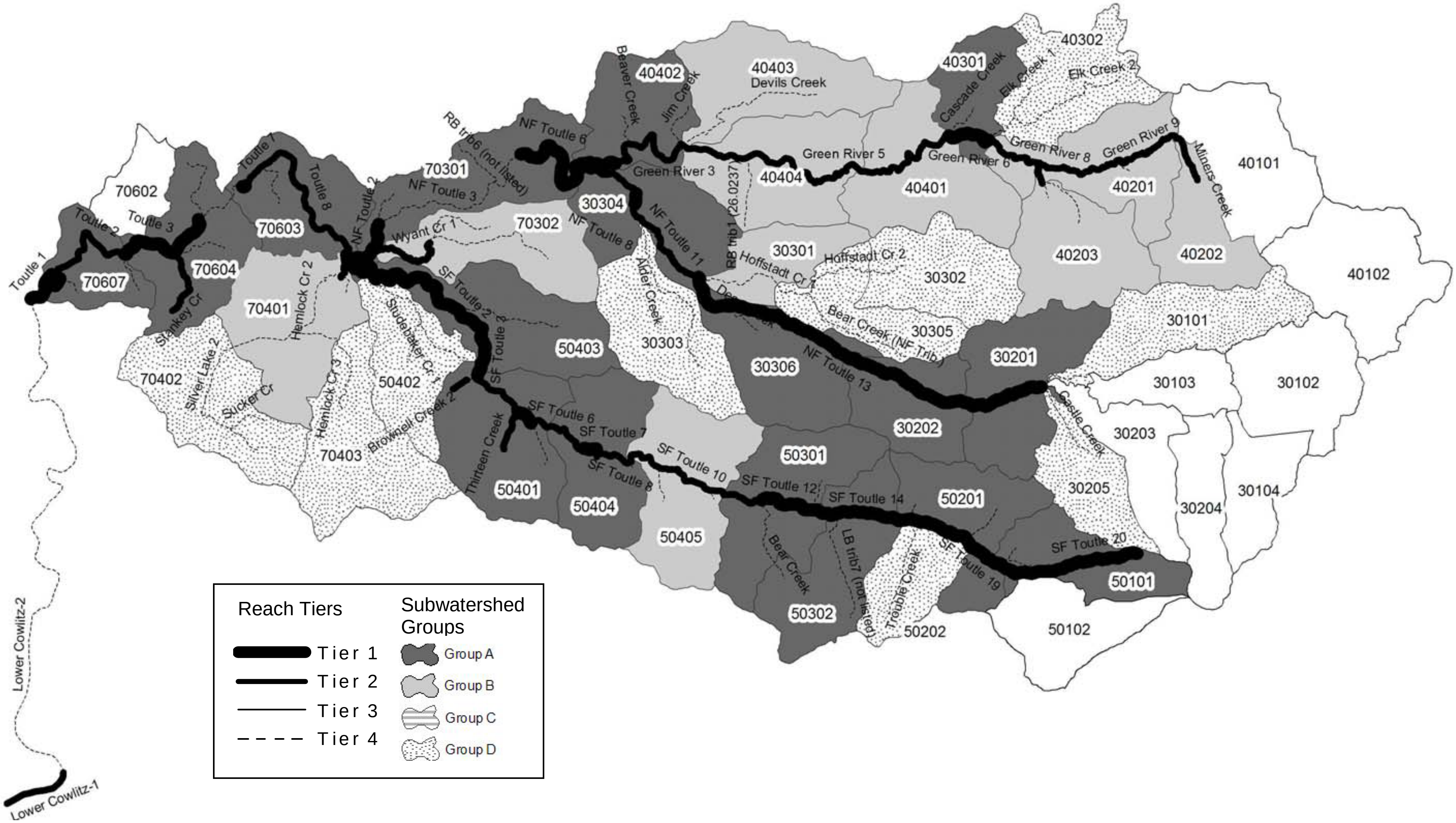


Figure 8-4. Reach tiers and subwatershed groups in the Toutle Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities at the reach 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.

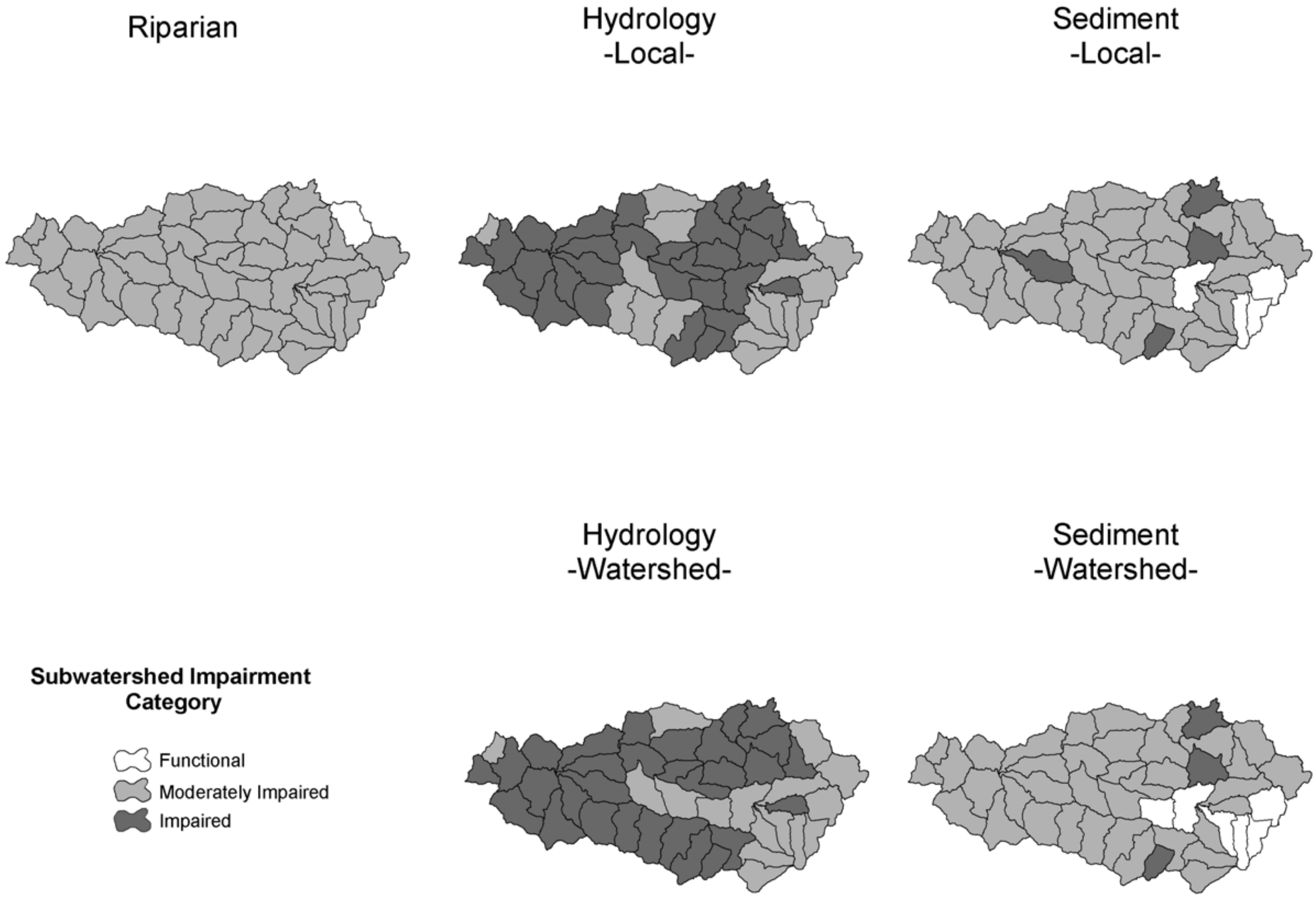


Figure 8-5. IWA subwatershed impairment ratings by category for the Toutle basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 8-8. 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-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): Hydrology	Watershed processes (local): Sediment	Watershed processes (local): Riparian	Watershed processes (watershed): Hydrology	Watershed processes (watershed): 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) Hydrology	Watershed processes (local) Sediment	Watershed processes (local) Riparian	Watershed processes (watershed) Hydrology	Watershed processes (watershed) 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) Hydrology	Watershed processes (local) Sediment	Watershed processes (local) Riparian	Watershed processes (watershed) Hydrology	Watershed processes (watershed) Sediment
B	70401	Hemlock Cr 1 Hemlock Cr 2 RB trib9 (not listed) Silver Lake 1 Silver Lake 2	StW Coho	none none				I	M	M	I	M
	70302	LB trib10 (not listed) Wyant Cr 1 Wyant Cr 2	StW Coho	none none				I	M	M	I	M
	50405	LB trib6 (not listed) SF Toutle 10 SF Toutle 11 SF Toutle 9 Whitten Creek	StW Coho ChF	none none SF Toutle 11 SF Toutle 9	Spawning Egg incubation Fry colonization Summer rearing	sediment	P	M	M	M	I	M
	40404	Green River 5 RB trib1 (26.0237)	StW Coho ChF	none none none				M	M	M	I	M
	40403	Devils Creek Green River 4	StW Coho ChF	none none Green River 4	Spawning Egg incubation Fry colonization	channel stability habitat diversity temperature sediment	P	M	M	M	M	M
	40401	Green River 5	StW Coho ChF	none none none				I	M	M	I	M
	40203	Shultz Cr trib Shultz Creek 1 Shultz Creek 2	StW Coho	none none				I	I	M	I	I
	40202	Miners Creek	StW Coho	none none				I	M	M	I	M
	40201	Green River 7 Green River 8 Green River 9 Tradedollar Creek	StW Coho ChF	none none none				I	M	M	I	M
	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 Coho	none none				I	M	M	I	M
	70402	Silver Lake 2 Sucker Cr	StW Coho	none none				I	M	M	I	M
	50402	RB trib10 (not listed) Studebaker Cr 1 Studebaker Cr 2	StW Coho	none none				I	M	M	I	M
	50202	LB trib8 (not listed) Trouble Creek	StW Coho	none none				I	I	M	I	I
	40302	Elk Cr trib Elk Creek 1 Elk Creek 2	StW Coho	none none				I	I	M	I	I
	30305	Bear Creek (NF Trib.) Hoffstadt Cr 1 Hoffstadt Cr 2	StW Coho	none none				I	M	M	I	M
	30303	Alder Creek_A Alder Creek_B	StW Coho	none none				M	M	M	M	M
	30302	Hoffstadt Cr 2	StW Coho	none none				I	M	M	I	M
	30205	Castle Creek	StW Coho	none none				M	M	M	M	M
	30101	Coldwater Creek	StW Coho	none none				M	M	M	M	M

Table 8-9. 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)				✓	

Table 8-10. Habitat measures in priority areas, with reference to limiting factors addressed, threats addressed, target species, and estimated time until benefits would be realized (time). Tier 1 and 2 reaches, or other areas of known priority, are listed under the location column for some measures (i.e. stream corridor measures). Reaches not included in the table (Tier 3, 4, and non-tiered reaches) are considered secondary priority.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
1. Protect and restore floodplain function and channel migration processes ***A. Set back, breach, or remove artificial channel confinement structures***					
Lower mainstem Toutle 1-5 ***Lower NF and lower SF*** NF Toutle 1-2, SF 1-3	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes	• Floodplain filling • Channel straightening • Artificial confinement • Dredge and fill activities	• Chum • Coho • Fall Chinook	2-15 years	Much of the channel confinement in these reaches is due to dredging of sediments and placement of spoils in floodplains following the 1980 eruption. This passive restoration approach can allow channels to restore naturally once confinement structures are removed. There are challenges with implementaiton on private lands due to existing infrastructure already in place, potential flood risk to property, potential increase in sediment supply to downstream reaches, and large expense.
2. Protect and restore off-channel and side-channel habitats ***A. Restore historical off-channel and side-channel habitats where they have been eliminated*** ***B. Provide access to blocked off-channel habitats*** ***C. Create new off-channel or side-channel habitats (i.e., spawning channels)***					
Lower mainstem Toutle 1-5 ***Lower NF and lower SF*** NF Toutle 1-2, SF 1-3	• Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats • Altered habitat unit composition	• Floodplain filling • Channel straightening • Artificial confinement • Dredge and fill activities	• Chum • Coho	2-15 years	Good potential benefit especially for chum, which have lost a significant portion of historically available off-channel habitat for spawning. Potential benefit is limited by moderate probability of success with creation of new habitats. There are challenges with implementation on private lands due to existing infrastructure already in place, potential flood risk to property, and large expense.
3. Protect and restore riparian function ***A. Reforest riparian zones*** ***B. Allow for the passive restoration of riparian vegetation*** ***C. Hardwood-to-conifer conversion***					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
Lower mainstem Toutle 1-5 ***Lower NF and lower SF*** NF Toutle 1-2, SF 1-3 ***Upper SF Toutle*** SF Toutle 4-20 ***Upper NF Toutle*** NF Toutle 6-13 ***Green River*** Green River 1-9	• Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris	• Timber harvest – riparian harvests • Clearing of vegetation due to rural development and agriculture	• All species	20-100 years	High potential benefit due to the many limiting factors that are addressed. Riparian impairment is related to harvest, agriculture, and eruption-related impacts. Riparian protections on forest lands are provided for under current harvest policy. Riparian restoration projects are relatively inexpensive and are often supported by landowners. Whereas the specified stream reaches are the highest priority for riparian measures, riparian restoration and preservation should occur throughout the basin since riparian conditions affect downstream reaches. Use IWA riparian ratings to help identify restoration and preservation opportunities.
4. Protect and restore natural sediment supply processes ***A. Address forest road related sources*** ***B. Address timber harvest related sources*** ***C. Address agricultural sources***					
Entire basin	• Excessive fine sediment • Excessive turbidity • Embedded substrates	• Timber harvest – impacts to sediment supply • Forest roads – impacts to sediment supply • Agricultural practices – impacts to sediment supply	• All species	5-50 years	High potential benefit due to sediment effects on egg incubation and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. There are challenges with implementation on agricultural lands due to few sediment-focused regulatory requirements for agricultural lands. Use IWA impairment ratings to identify restoration and preservation opportunities.
5. Protect and restore runoff processes ***A. Address forest road impacts*** ***B. Address timber harvest impacts***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Timber harvest – impacts to runoff • Forest roads – impacts to runoff	• All species	5-50 years	High potential benefit due to flow effects on habitat formation, redd scour, and early rearing. Improvements are expected on timber lands due to requirements under the new

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
					FPRs, the USFS Northwest Forest Plan, and forest land HCPs. Use IWA impairment ratings to identify restoration and preservation opportunities.
6. Protect and restore instream flows ***A. Water rights closures*** ***B. Purchase or lease existing water rights*** ***C. Relinquishment of existing unused water rights*** ***D. Enforce water withdrawal regulations*** ***E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Water withdrawals	• All species	1-5 years	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.
7. Protect and restore water quality ***A. Restore the natural stream temperature regime***					
Entire basin	• Altered stream temperature regime	• Riparian harvests	• All species	1-50 years	Primary emphasis for restoration should be placed on stream segments that are on the 2004 303(d) list.
8. Protect and restore instream habitat complexity ***A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting*** ***B. Structurally modify stream channels to create suitable habitat types***					
Lower mainstem Toutle 1-5 ***Lower NF and lower SF*** NF Toutle 1-2, SF 1-3 ***Upper SF Toutle*** SF Toutle 4-20 ***Upper NF Toutle*** NF Toutle 6-13 ***Green River*** Green River 1-9	• Lack of stable instream woody debris • Altered habitat unit composition	• None (symptom-focused restoration strategy)	• Coho • Winter steelhead • Summer steelhead • Spring Chinook	2-10 years	Moderate potential benefit due to the high chance of failure. Failure is probable if habitat-forming processes are not also addressed. These projects are relatively expensive for the benefits accrued. Moderate to high likelihood of implementation given the lack of hardship imposed on landowners and the current level of acceptance of these type of projects.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
9. Protect and restore fish access to channel habitats ***A. Sediment Retention Structure*** ***B. Culvert barriers on various tributary streams***					
NF Toutle - Sediment Retention Structure ***Culvert barriers on various small tribs***	• Blockages to channel habitats	• Sediment Retention Structure • Dams, culverts, in-stream structures	• Coho • Winter steelhead • Spring Chinook • Fall Chinook	immediate	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. Culverts or other barriers block as much as 23 miles of anadromous habitat, although this 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.
10. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development ***A. Plan growth and development to avoid sensitive areas (e.g., wetlands, riparian zones, floodplains, unstable geology)*** ***B. Encourage the use of low-impact development methods and materials*** ***C. Apply mitigation measures to off-set potential impacts***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	The focus should be on management of land-use conversion and managing continued development in sensitive areas (e.g., wetlands, stream corridors, unstable slopes). Critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary mechanisms need to be put in place to restore currently degraded habitats.
11. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection ***A. Purchase properties outright through fee acquisition and manage for resource protection*** ***B. Purchase easements to protect critical areas and to limit potentially harmful uses*** ***C. Lease properties or rights to protect resources for a limited period***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit. These programs are under-funded and have low landowner participation.

8.5 Program Gap Analysis

The Toutle Basin (~513 sq mi) is located primarily in Cowlitz County, but its headwaters are in Skamania County, with some tributaries of the Green River in Lewis County.

- Federal lands within the watershed (~143 sq mi) consist primarily of the U.S. Forest Service-managed Mt St Helens National Volcanic Monument (NVM);
- Large private industrial forest lands consist of 257 square miles and are the largest land use;
- Department of Natural Resources forestlands lands encompass about 92 square miles.
- Small forestlands (~20 sq mi) are found in the lower reaches of the Toutle Basin;
- Approximately 8 square miles in the headwaters of the Green River lie in Skamania County;
- The tributaries flowing south to the Green River and their watersheds are located in Lewis County;
- The remainder of the Toutle Basin is located in Cowlitz County.

Protection Programs

Protection programs in the Toutle Basin are implemented primarily by the Mt St Helens NVM, large and small industrial forest owners pursuant to the state forest practice rules, and Cowlitz and Lewis Counties. Protection programs in this analysis include those programs that protect habitat conditions or watershed functions through management policies and programs, regulatory measures, and acquisition of sensitive habitats or protective easements.

Federal Programs

➢ ***U.S. Army Corps of Engineers***

- Administers the Section 10 (Rivers and Harbor Act) and Section 404 (Clean Water Act) permit processes. Section 10 requires approval of any activity in, above, or below a navigable river, which affects course, location, condition, or capacity of navigable waters. Section 404 requires prior approval of dredging, filling, grading, clearing, and bank hardening. In waters used by listed fish species, the permits are subject to ESA Section 7 consultation with NOAA Fisheries to ensure that any approved action is adequately protective of the fish; [M.1A; M.2A; M.2B; M.4A; M.8A; M.8B]

➢ ***U.S. Forest Service***

- Mt St Helens National Volcanic Monument: In 1982 the President and Congress created the 110,000-acre National Volcanic Monument for research, recreation, and education. Inside the Monument, the environment is left to respond naturally to the disturbance. Much of the North and South Forks were extensively altered by the eruption. The habitat conditions in the South Fork are recovering more quickly than in the North Fork. [M.3A; M.3B; M.4A; M.4B; M.5A; M.5B; M.7A]

State Programs

➢ ***Department of Natural Resources***

- State Forest Land HCP:
  State forest lands are managed under the provisions of a Habitat Conservation Plan (HCP). The Habitat Conservation Plan has protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. These activities address measures M.3A, M.3B, M.4A, M.4B, M.5A, M.5B and M.7A.
- State Forest Practices:
  Riparian areas and watershed functions on small- and industrial forest lands are protected under the State of Washington Forest Practices Rules, including the Forest and Fish Module. These rules provide for riparian buffers, harvest restrictions, sensitive area protections, and protective standards for new road construction. These activities address measures M.3A, M.3B, M.4A, M.4B, M.5A, M.5B and M.7A.

➢ *Department of Fish and Wildlife*

- Hydraulics Project Approval (HPA): The Department administers the state Hydraulic Code. The purpose of this program is to protect stream conditions and habitat. The regulations apply to such activities as streambank protection, instream construction, culvert installation, channel changes or realignments, debris removal, and water diversion facilities. Those proposing such actions must obtain a Hydraulic Project Approval (HPA) permit. This regulatory process addresses measures M.1A, M.2A, M.2B, M.2C, M.8A, and M.8B.

- Habitat Program: The Department provides advice to local governments and landowners interested in measures to protect habitat values on their property. [M.1A; M.2A; M.2B; M.7A; M.8A; M.8B; M.9A; M.9B; M.10A; M.10B; M.10C]

➢ *Washington Department of Ecology*

- Water Resources Program/Water Rights: Department of Ecology, in consultation with the Department of Fish and Wildlife, has administrative closed selected areas within the lower Cowlitz basin to further surface and groundwater withdraws (where groundwater is in continuity with surface water). Existing administrative closures by the Department of Ecology protect surface waters from further withdrawals. Formal rule-making would strengthen the closures. The extent of unauthorized surface water withdrawals is unknown, but, given the low intensity of development, it is unlikely they would exacerbate summer low flows. [M.6A; M.6B; M.6C; M.6D]

- Water Resources Program/Watershed Planning: In cooperation with the Lower Columbia Fish Recovery Board, other state and federal agencies, tribes, local governments, and citizens, the Department funds and participates in a state authorized watershed planning process for Water Resource Inventory Area (WRIA) 26 pursuant to RCW 90.82. The goal of the plan is to ensure adequate water for people and fish. The planning process is dealing with water quantity and quality, stream flows and fish habitat. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.6A; M.6B; M.6C; M.6D; M.7A; M.10A]

➢ ***Department of Transportation***

- Road Maintenance Program

WSDOT has an ESA Section 4(d) Road Maintenance Program. The Maintenance Program uses trained crews to primarily manage roadside vegetation, litter control, and maintenance of safety rest areas associated with SR 12. [M.9]

Local Government Programs

➢ ***Cowlitz County***

- Comprehensive Planning and Land Use Regulations: [M.10A; M.10B; M.10C]
  - The comprehensive plan that applies to the non-federal lands, but contains no significant policies for the protection of watershed processes and stream habitat.
  - Zoning along State Highway 504 and county roads provides for one dwelling per 2 acres and one dwelling per 5 acres along non-county roads. [Measure12]
  - Cowlitz County has not adopted protective stream buffers.
  - Wetland buffers vary from 25’ to 200’ and are based upon soil type and wildlife utilization.
  - The County has not developed comprehensive ordinances for the protection of watershed processes or stream habitat conditions.
- Road Maintenance

  The County has not developed or implemented a road maintenance program to protect habitat. [M.9B]

➢ ***Lewis County***

- Comprehensive Planning and Land Use Regulations: County land use regulations have minor applicability within the watershed given the very small amount of land that is not federal or industrial and small forest ownership.

➢ ***Skamania County***

- Comprehensive Planning and Land Use Regulations: Since all ownership occurs within the Skamania County portion of the watershed is federal , Skamania County land use controls are not applicable;

Restoration Programs

Restoration programs in the Toutle Basin are implemented by a variety of agencies, organizations, and private interests. Major programs implementing protection measures are identified below:

Federal Programs

- ***U.S. Forest Service Mt St Helens NVM:*** Restoration only occurs passively. Monitoring and evaluation of natural restoration occurs in the Toutle; [M.3B]

- ***U.S. Army Corps of Engineers:*** The Corps built and operates a Sediment Retention Structure (SRS) on the North Fork Toutle that was designed to prevent additional sediment from Mt St Helens from entering the Cowlitz and Columbia Rivers. The SRS has relieved but not prevented downstream sediment problems; The SRS does represent a significant barrier to upstream habitats; [M.9A]

State Plans

- ***Washington Department of Natural Resources***

  - State Forest Land Habitat Conservation Plan (HCP): The Department manages state forest lands pursuant to a Habitat Conservation Plan (HCP). The HCP road maintenance and restoration objectives require barrier upgrades and road abandonment and/or other improvements. This program addresses measures M.3A, M.3B, M.4A, M.4B, M.5A, M.5B and M.9B.

  - State Forest Practices Act:

    - ✓ Industrial forests within the Toutle Basin are governed by Forest and Fish regulations and have rigid schedules for maintaining and improving roads and removing barriers. Industrial landowners have 15 years to bring roads and barriers into compliance with regulations.
    - ✓ Small private forest owners are governed by Forest and Fish regulations; however their road and barrier maintenance and improvement programs are tied to state funding. In the State 2003-05 Biennial Budget, 2 million dollars was allocated statewide to support small private forest owners.
    - ✓ This program addresses measures M.3A, M.3B, M.4A, M.4B, M.5A, M.5B and M.9A].

- ***Washington Department of Fish and Wildlife***

  - Habitat Program: The Department provides advice to local governments and landowners interested in measures to restoring watershed processes and stream habitat. [M.1A; M.2A; M.2B; M.7A; M.8A; M.8B; M.9A; M.9B; M.10A; M.10B; M.10C]

➢ ***Washington Department of Ecology***

- Water Quality Program: Herrington Creek and Green River are listed for temperature impairment on the WA State 303(d) list. [M.7A]
- Water Resources Program/Watershed Planning:
  The planning process for WRIA 26 is dealing with water quantity and quality, stream flows and fish habitat. Potential restoration efforts address improving summer low flows through conservation and acquisition of water rights. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.6A; M.6B; M.6C; M.6D; M.7A; M.10A]

➢ ***Salmon Recovery Funding Board (SRFB)/ Lower Columbia Fish Recovery Board***

- Washington Salmon Recovery Act (RCW 77.85): As noted under preservation programs above, the SRFB and the LCFRB jointly administer a grant program that allocates federal Pacific Salmon Recovery Funds and State funds for habitat protection and restoration projects by state and local agencies, nonprofit organizations, and landowners. To date the SRFB has provided $42,000 for restoration in Brownell Creek. [M.1A; M.2A; M.2B; M.3A; M.7A; M.8A; M.8B; M.9B; M.11A; M.11B]

Local Government Programs

➢ ***Cowlitz County***
- Public Works Program:
  The County inventoried culverts on county roads and is replacing and/or upgrading barrier culverts. [M.9B]

➢ ***Cowlitz Noxious Weed Control Board*** has three primary programs that address weed control in the lower Cowlitz Basin; [M.3D]
  - ✓ Public education to prevent the spread of noxious weeds;
  - ✓ Survey County lands to assess emerging issues; and
  - ✓ Enforcement of noxious weed control

Community Programs

➢ ***Friends of the Cowlitz*** is a non-profit organization designs and implements restoration projects and rears Summer Steelhead on the Toutle Basin.

Gap Analysis

Forest-related Programs: Ninety-five percent of the Toutle Basin is in forest use or restricted public use. Forestry programs play a substantial role in protecting and restoring watershed functions and habitat conditions at levels supporting recovery goals. Certainty of forestry-related protection and restoration programs is relatively high because programs are being implemented and, for the most part, fully funded. Program areas of concern include state funding for small commercial forest landowners and the continued potential for hydrologic impacts caused by past harvest practices. Monitoring of watershed processes and habitat conditions will be required to confirm the effectiveness of these measures.

Protection-related Programs: Non-federal lands in the upper Toutle Basin have limited protections through Cowlitz County land use regulatory mechanisms. County programs lack effective provisions that commonly are used to direct growth away from sensitive habitat, preserve watershed processes, protect streams and wetlands, and manage stormwater. In addition, as in all lower Columbia subbasins, there are very limited mechanisms to protect riparian areas and hydrologic functions.

Restoration-related Programs: Over a long period of time, improvements to the Toutle will occur as a result of improved forest management practices that are already in place. Impacts from the eruption of Mt St Helens will continue to influence the lower Toutle mainstem primarily due to bare soils and early seral forests. Active restoration in the lower mainstem should focus on floodplain function and channel migration, as well as restoring off-channel and side-channel habitats. Programs to address these issues are currently not in place.

Table 8-11. Program Actions to Address Gaps

Action #	Lead Agency	Proposed Action
TOUTLE.1	Cowlitz County	Develop and implement controls to adequately protect riparian areas to maintain currently functional and restored habitat around rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Require mitigation, where necessary, to offset unavoidable damage to habitat conditions in riparian management areas
TOUTLE.2	Cowlitz County	Development and implement controls to protect historic stream meander patterns and channel migration zones and avoid hardening stream banks and shorelines
TOUTLE.3	Cowlitz County	Development and implement controls and development standards to adequately protect wetlands, wetland buffers, and wetland function.
TOUTLE.4	Cowlitz County, Lewis County,	Develop and implement controls to address erosion and sediment run-off during (and after) construction to prevent sediment and pollutant discharge to streams, wetlands and other water bodies
TOUTLE.5	Cowlitz County, Lewis County,	Apply land use and resource protection code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
TOUTLE.6	State of Washington	Provide state funding for small forest owners in the Toutle Basin to a level sufficient to achieve the road and barrier improvements of Forest and Fish on a schedule parallel to private industrial forest owners
TOUTLE.7	Forest Managers LCFRB, and DFW	Identify and sequence early action forest-wide restoration projects that analysis indicates could provide significant benefits. In these cases, it may be appropriate to identify outside funding to initiate these early actions
TOUTLE.8	ACOE	Improve downstream sediment conditions resulting from the NF Toutle Sediment Retention Structure
TOUTLE.9	ACOE	Provide improved adult and juvenile fish passage at the NF Toutle Sediment Retention Structure.
TOUTLE.10	LCFRB, USFS, WDNR. WSDOT, Counties, cities, private property	Develop and implement a coordinated and strategic barrier removal program based on watershed fish priorities and ensuring an effective and efficient sequencing of barrier removal work.

	owners.	
TOUTLE.11	Cowlitz County, Lewis County	Utilize a combination of public outreach/education and, incentives, and to promote (1) stewardship practices for protecting habitat and water quality and (2) landowner support of and participation in habitat restoration efforts.
TOUTLE.12	State of Washington (DOE, DFW)	Close the Toutle Basin to further surface water withdrawals, including groundwater in connectivity with surface waters; curtail unauthorized withdrawals
TOUTLE.13	LCFRB, WDFW, Cowlitz County, Cowlitz CD, LCFEG	Build capacity (e.g. technical and administrative skills, personnel and fiscal resources) needed to allow agencies and organizations to undertake protection and restoration projects, including noxious weed control in a reasonable period time.
TOUTLE.14	SRFB, BPA, NOAA, USFWS, DOE, ACOE	Increase available funding for projects that implement measures and address underlying threats
TOUTLE.15	State of Washington (Dept of Agriculture, and Department of Ecology)	Develop and implement agricultural practices and regulations to protect riparian conditions and water quality
TOUTLE.16	Cowlitz Conservation District	Expand landowner incentive (e.g. CREP) and education plans to promote further habitat protection and restoration.
TOUTLE.17	LCFRB, Cowlitz CD, Cowlitz County,	Address threats proactively by building agreement on priorities among the various program implementers
TOUTLE.18	FEMA	Update floodplain maps using Best Available Science

9 Cowlitz Subbasin – Coweeman

Figure 9-1. Location of the Coweeman River Basin within the Lower Columbia River Basin.

9.1 Basin Overview

The Coweeman River basin comprises approximately 200 square miles within Cowlitz County. The Coweeman enters the Cowlitz River just upstream of the mouth near Longview, Washington. Principal tributaries include Goble, Mulholland, and Baird creeks. The basin is part of WRIA 26.

The Coweeman Basin will play a key role in the recovery of salmon and steelhead. The basin has historically supported populations of fall Chinook, winter steelhead, and coho. Today, Chinook and steelhead are listed as threatened under the ESA. Coho salmon are a candidate for listing. Other fish species of interest are Pacific lamprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

Coweeman salmon and steelhead are affected by a variety of in-basin and out-of basin factors including stream, Columbia River mainstem, estuary, and ocean habitat conditions; harvest; hatcheries; and ecological relationships with other species. Analysis has demonstrated that recovery cannot be achieved by addressing only one limiting factor. Recovery will require action to reduce or eliminate all manageable factors or threats. The deterioration of habitat conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonids within the Columbia Basin. Direct harvest of listed salmon and steelhead is prohibited but sport and commercial fisheries focusing on hatchery fish and other healthy wild populations, primarily in the mainstem Columbia and ocean, incidentally affect ESA-listed Coweeman fish. Key ecological interactions of concern include effects of non-native species; nutrient inputs from salmon carcasses; and predation by species affected by development including Caspian terns, northern pikeminnow, seals, and sea lions. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the Coweeman Subbasin.

The Coweeman Basin is almost entirely privately owned (98%) and forestry is the dominant land use. Commercial forestland makes up over 90% of the basin. Much of the lower river valleys are in agricultural and residential uses, with substantial impacts to riparian areas and floodplains in places.

The mainstem Coweeman reaches provide the most spawning and rearing habitat for anadromous fish populations. The middle and upper reaches are most important for winter steelhead. Degraded conditions in these reaches currently limit steelhead production. Intensive upper basin forest harvest and road building have the greatest impact on these channels.

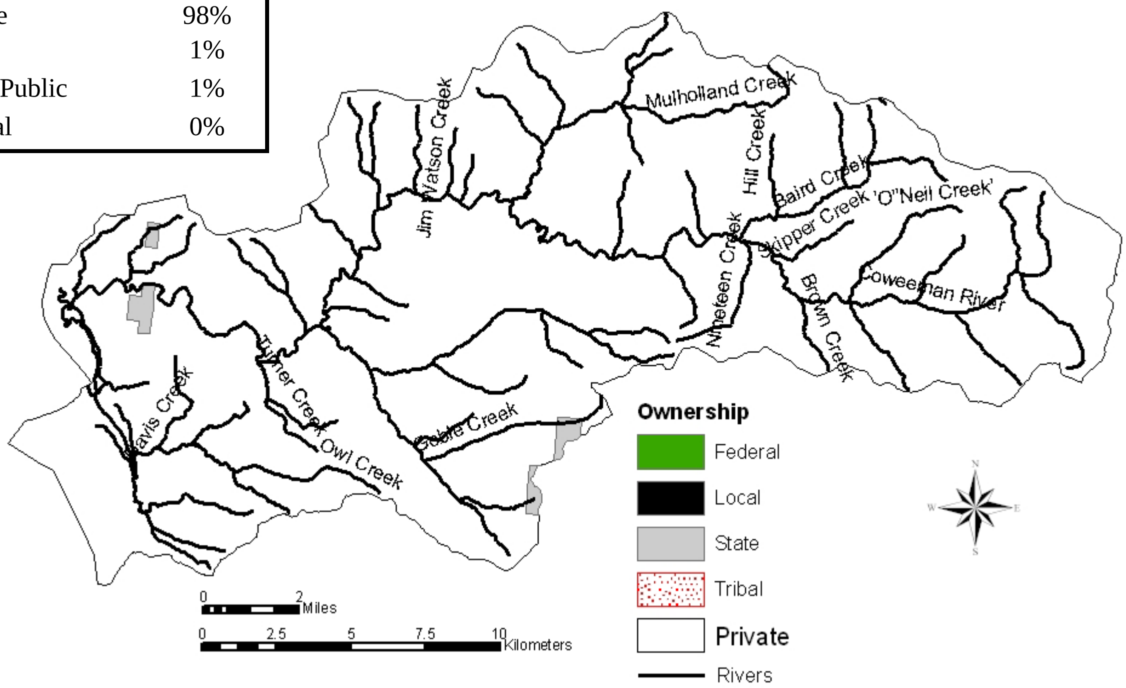
The lower and middle mainstem reaches are used heavily by fall Chinook for spawning. These reaches are impacted by agricultural development and timber harvest. Further degradation of these habitats would have a strong negative impact on the population. Efforts should focus on preventing further degradation as well as improving impaired conditions.

The lower mainstem historically provided productive habitat for chum, though few chum are believed to currently return to the Coweeman River. The reaches used by chum are largely impacted by urban development in the town of Kelso and agricultural and rural residential development just upstream.

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 town of Kelso has a projected change of 42% by 2020 (LCFRB 2001). Population growth will result in the 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 critical habitats and the conditions that create and support them.

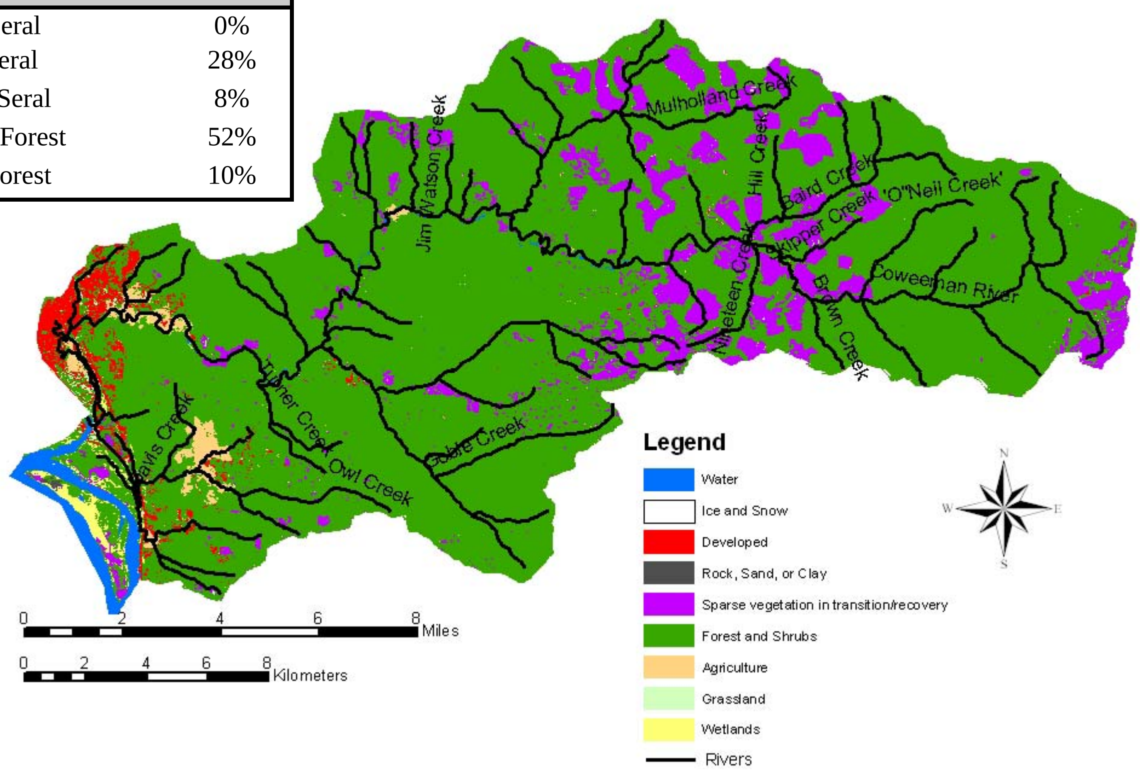
Land Ownership	
Private	98%
State	1%
Other Public	1%
Federal	0%

Land Ownership



Vegitation Composition	
Late Seral	0%
Mid Seral	28%
Early Seral	8%
Other Forest	52%
Non Forest	10%

Land Use / Cover



9.2 Species of Interest

Focal salmonid species in the Coweeman River include fall Chinook, winter steelhead, and coho. The chum population is considered part of the lower Cowlitz population. The health or viability of these populations is currently medium for fall Chinook, low to medium for winter steelhead, and low for coho. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Recovery goals call for restoring all three populations to a high or very high viability level. This level will provide for a 95% or better probability of population survival over 100 years. Other species of interest in the Coweeman Subbasin include coastal cutthroat trout and Pacific lamprey. Regional objectives for these species are described in Volume I, Chapter 6. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for these other species. Cutthroat will benefit from improvements in stream habitat conditions for salmonids. 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 of lamprey are not well known.

Table 9-1. 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+	3,000-4,100
Winter steelhead	Threatened	Yes	Low+	100-1,100	High	800-1,200
Coho	Candidate	No	Low	unknown	High	unknown

Fall Chinook – The historical adult population is estimated from 4,000-7,000 fish. The current natural spawning returns ranges 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.

Winter Steelhead – 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.

Coho – The historical adult population is estimated from 10,000-25,000, with the majority of returns being late stock which spawn from late November to March. Some early stock coho were also historically present with spawning occurring primarily in early to mid November. Current returns are unknown but assumed to be low. There is no hatchery coho production in the Coweeman. Natural spawning occurs primarily in the mainstem Coweeman, Mulholland Creek, and Baird Creek. Juvenile rearing occurs upstream and downstream of spawning areas. Juveniles rear for a full year in the Coweeman Basin before migrating as yearlings in the spring.

Coastal Cutthroat – 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.

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. 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.

Figure 9-2. Summary of habitat limiting factors, population status, expected population improvement trend with existing programs and biological objectives depicted for the Coweeman Basin.

9.3 Potentially Manageable Impacts

Stream habitat, estuary/mainstem habitat, harvest, hatchery and predation effects have all contributed to reduced salmonid productivity, numbers, and population viability in the Washougal Subbasin. The pie charts below represent the relative order of magnitude of quantifiable effects for each of these factors for each focal species. The preferred recovery scenario targets an equivalent reduction in each impact factor in proportion to the magnitude of the effect. Population-specific targets are discussed in further detail in Volume I, Chapter 6.

- Loss of tributary habitat quantity and quality has significant impacts on winter steelhead and coho populations. For fall Chinook, loss of tributary habitat is of moderate importance. Loss of estuary habitat is moderately important to fall Chinook, but is of minor importance to both winter steelhead and coho.
- Harvest impacts are of high importance to both fall Chinook and coho, but is of relatively minor importance to winter steelhead.
- Predation is moderately important to all three populations in the Coweeman.
- Impacts from hatcheries and the hydrosystem are relatively minor for each population.

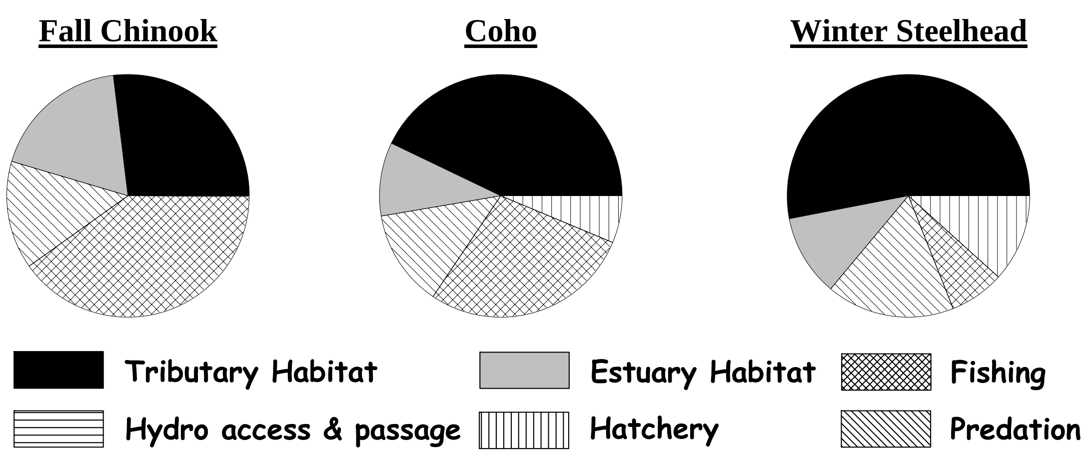


Figure 9-3. Relative contribution of potentially manageable impacts for Coweeman populations.

9.4 Limiting Factors, Threats, and Measures

9.4.1 Hydropower Operation and Configuration

There are no hydro-electric dams in the Coweeman River Basin. However, Coweeman species are affected by mainstem Columbia hydro operations and flow regimes which affect habitat in migration corridors and in the estuary. Mainstem hydro factors and threats are addressed by regional strategies and measures identified in Volume I.

9.4.2 Harvest

Most harvest of wild Coweeman salmon and steelhead is incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. This mortality is very low for chum and steelhead, but can be significant for fall Chinook. Coweeman fall Chinook are harvested in ocean and Columbia River commercial sport fisheries as well as in-basin sport fisheries. Harvest of Coweeman fall Chinook is controlled by an ESA harvest limit associated with a recovery exploitation rate established by NOAA Fisheries. Harvest of Coweeman coho occur in the ocean commercial and recreational fisheries off the Washington and Oregon Coasts and Columbia River. Wild coho impacts are limited by fishery management to retain marked hatchery fish and release unmarked wild fish. There are no sport fisheries for Chinook or coho in the Coweeman River. Incidental mortality of steelhead occurs in Columbia River commercial fisheries directed at Chinook and freshwater sport fisheries directed at hatchery steelhead. All recreational fisheries are managed to selectively harvest marked hatchery fish and commercial fisheries cannot retain hatchery or wild steelhead.

Measures 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. The regional measures 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 Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is generally more applicable to steelhead while regional management is more applicable to salmon. Harvest measures with significant application to Coweeman subbasin populations are summarized in the following table:

Table 9-2. Regional harvest measures from Volume I, Chapter 7 with significant application to Coweeman Subbasin.populations.

Measure	Description	Comments
F.M.13	Develop a regional mass marking program for tule fall Chinook	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.M18	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	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.M19	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	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.M24	Maintain selective sport fisheries in Ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	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.

9.4.3 Hatcheries

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

There are no hatcheries operating in the Coweeman Basin. A rearing pond on the Coweeman is used to acclimate winter steelhead tranferres in 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 9-3.Coweeman Basin hatchery production.

Hatchery	Release Location	Winter Steelhead
Elochoman	Coweeman	20,000

Regional hatchery strategies and measures are focused on evaluating and reducing biological risks and increasing the benefits to natural populations. Regional hatchery measures identified in Volume I, Chapter 7 with specific applications within the Coweeman subbasin are summarized in the following table:

Table 9-4. Regional hatchery measures from Volume I, Chapter 7 with specific implementation actions in the Coweeman Subbasin.

Measure	Description	Comments
H.M36	Evaluate supplementation of natural coho population with appropriate hatchery coho stock.	Research appropriate brood stock source and consider use of Coweeman rearing ponds as part of a coho supplementation strategy.
H.M32	Juvenile release strategies to minimize interactions with naturally spawning fish.	Release strategies are aimed at reducing or avoiding interactions with wild steelhead, fall Chinook, coho by release timing and release location strategies.
H.M17,34,41	Mark hatchery steelhead, coho, fall Chinook with an adipose fin-clip for identification and selective harvest.	Marking hatchery fish allows for identification of hatchery fish in the natural spawning grounds and at collection facilities which enables accurate accounting of wild fish. Marking also enables selective fisheries to retain hatchery fish and release wild fish.
H.M8	Adaptively manage hatchery programs to further protect and enhance natural populations and improve operational efficiencies.	Appropriate research, monitoring, and evaluation programs along with guidance from regional hatchery evaluations will be utilized to improve the survival and contribution of hatchery fish, reduce impacts to natural fish, and increase benefits to natural fish.

9.4.4 Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Coweeman salmon and steelhead are affected throughout their lifecycle by ecological interactions with non-native species, food web components, and predators. Interactions are similar for Coweeman populations to those of most other subbasin salmonid populations. Ecological Interactions are addressed by regional strategies and measures identified in Volume I.

9.4.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. 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 are similar for Coweeman populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook than spring Chinook, steelhead, and coho. Estuary and mainstem effects on Coweeman salmon and steelhead populations are addressed by regional strategies and measures identified in Volume I and the Columbia Mainstem and Estuary Subbasin sections of Volume II.

9.4.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity 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 River basin have the greatest impact on the health and viability of salmon and steelhead relative to the other limiting factors and threats discussed in this chapter.

Subwatersheds, reaches, and habitat attributes have been prioritized for protection and/or restoration based on the plan's biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Priority areas for habitat preservation and restoration are identified in Figure 9-4. A summary of the primary habitat limiting factors and threats are presented in Table 9-6. Habitat measures and related information are presented in Table 9-7. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 9-5. Reach- and subwatershed-scale limiting factors generated from the technical assessment are included in Table 9-5. Details on species-specific spatial priorities and limiting factors at the subbasin level may be found in volume II of the Technical Foundation. A description of the methodology used to generate composite (multi-species) reach and subwatershed priorities can be found in the introduction to this volume of the recovery plan.

The areas with the greatest current or potential contribution to focal salmonid population health and productivity are listed below. Tier 1 and 2 reaches within these priority areas are included in the list. The habitat limiting factors, threats, and measures included in this chapter focus primarily on the priority areas and the tier 1 and 2 reaches within them. Tier 3, 4, and non-tiered reaches are considered secondary priority, but in many cases, these lower priority areas will also require restoration and preservation actions in order to achieve recovery objectives. Watershed process measures generally focus on the entire basin as opposed to being limited only to high priority areas because conditions in high priority areas are often influenced by cumulative watershed effects. High priority areas and reaches in the Coweeman basin include the following:

- Lower mainstem – Coweeman 1-4

- Middle mainstem and Goble Creek – Canyon 1-2; Coweeman 5-12; Goble Creek 1, 4
- Upper mainstem and tributaries – Coweeman 13 – 22; Mulholland 2-3; Baird 1

The following paragraphs provide a brief overview of each of these priority areas, including species most affected, land-use threats, and the general type of measures that will be necessary for recovery. Additional detail can be found in the tables and figures that follow.

While reach level habitat conditions often result from local factors, they are also affected or shaped by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input and large woody debris recruitment are often affected by or result from upstream conditions and degraded watershed processes. Access to key reaches may also be affected by barriers that occur downstream of a reach. Accordingly, restoration of a priority reach may require action outside the targeted reach. The IWA analysis was used to identify potential upstream watershed areas that could influence reach level habitat attributes. EDT was used to allow a relative comparison of reaches and habitat attributes within a reach.

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.

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.

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.

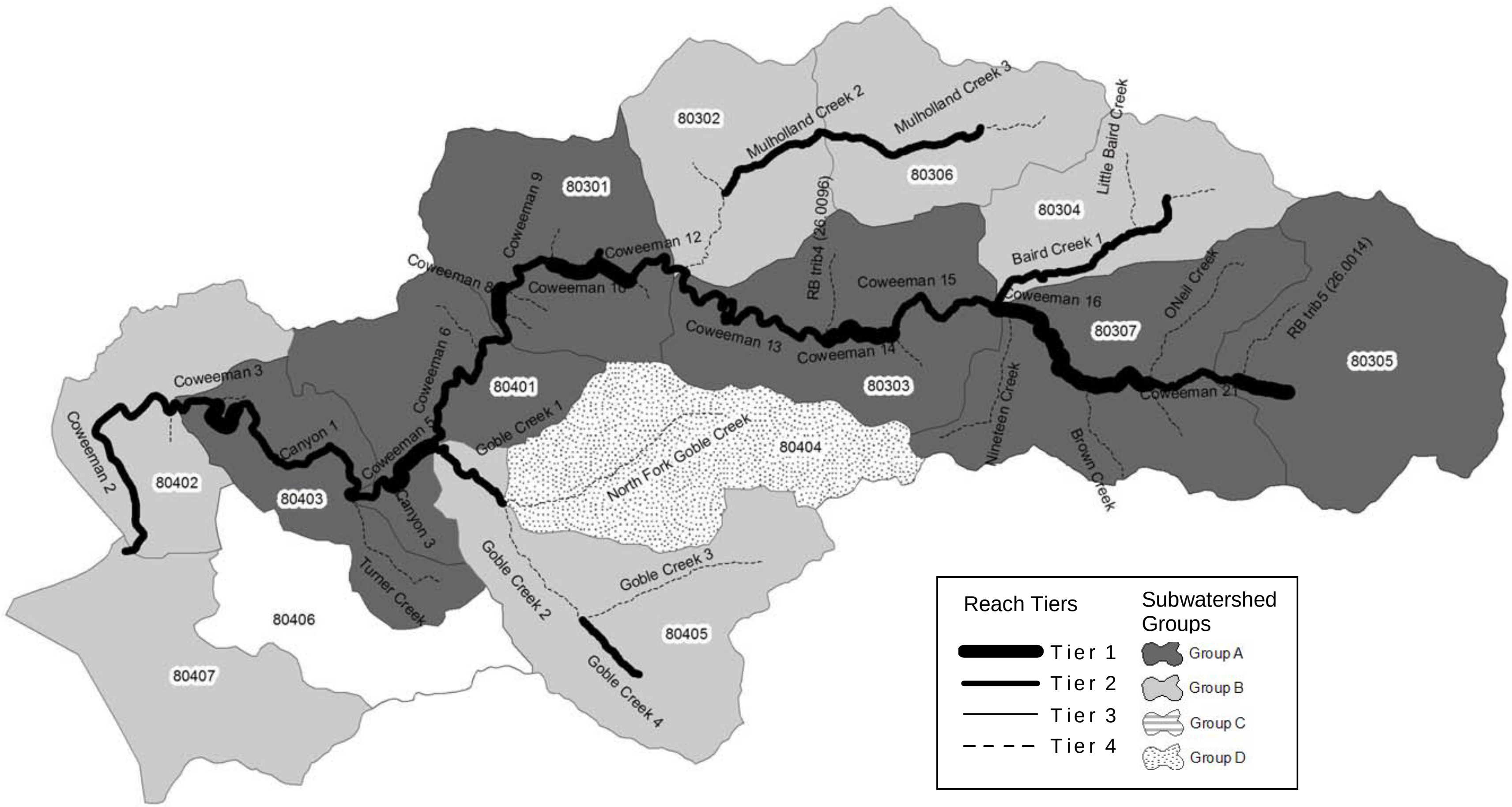


Figure 9-4. Reach tiers and subwatershed groups in the Coweeman Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities at the 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.

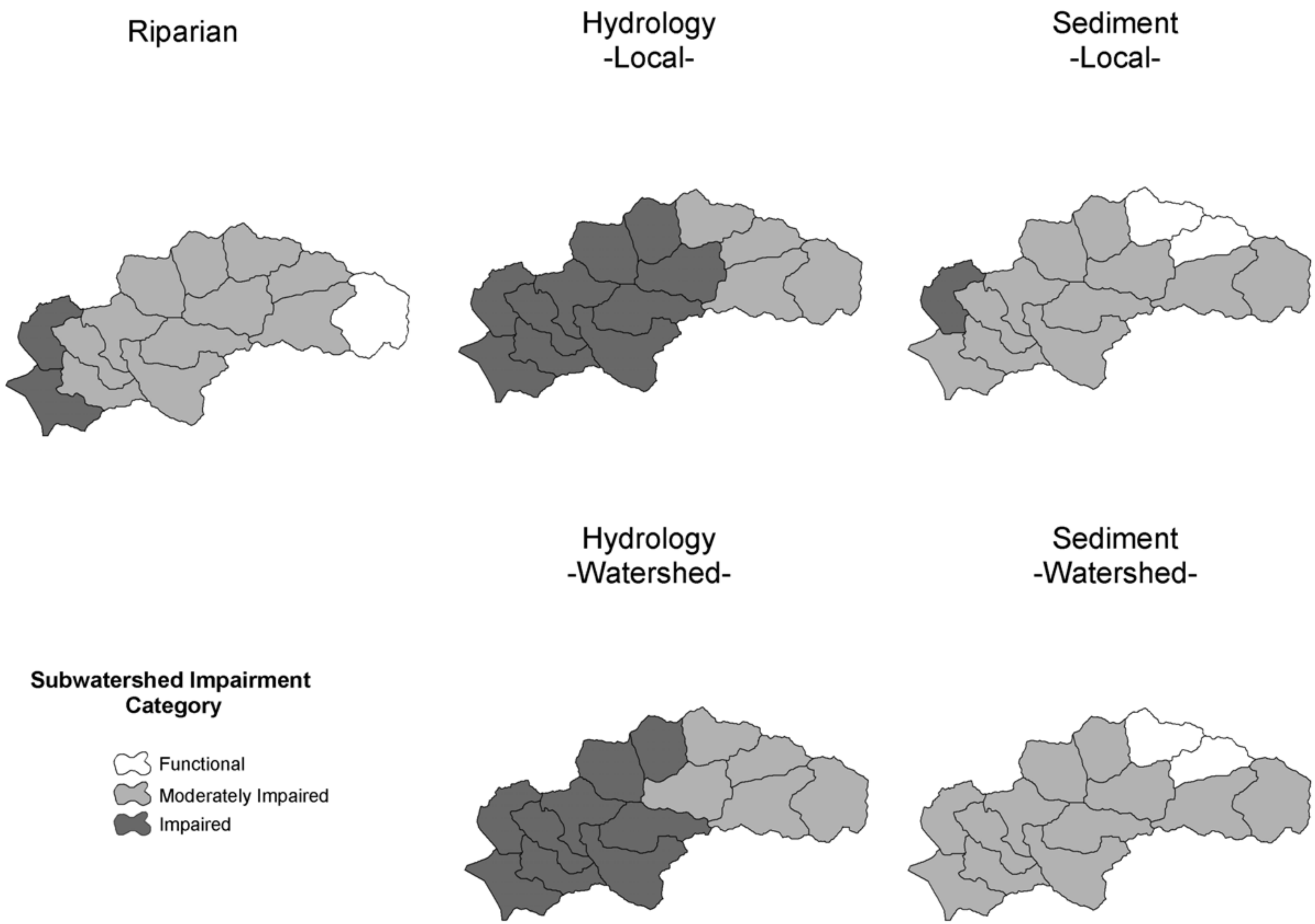


Figure 9-5. IWA subwatershed impairment ratings by category for the Coweeman Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 9-5. 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): Hydrology	Watershed processes (local): Sediment	Watershed processes (local): Riparian	Watershed processes (watershed): Hydrology	Watershed processes (watershed): 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								

Table 9-6. 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				Threats			
	LM	MM	UM		LM	MM	UM
Habitat diversity				***Agriculture/ grazing***			
Lack of stable instream woody debris	✓	✓	✓	Clearing of vegetation	✓	✓	
Altered habitat unit composition	✓	✓	✓	Riparian grazing	✓	✓	
Loss of off-channel and/or side-channel habitats	✓	✓		Floodplain filling	✓	✓	
Channel stability				***Rural development***			
Bed and bank erosion		✓		Clearing of vegetation		✓	
Riparian function				Roads – riparian/floodplain impacts		✓	
Reduced stream canopy cover	✓	✓		***Forest practices***			
Reduced bank/soil stability	✓	✓		Timber harvests –sediment supply impacts	✓	✓	✓
Exotic and/or noxious species	✓	✓		Timber harvests – impacts to runoff	✓	✓	✓
Reduced wood recruitment	✓	✓		Riparian harvests (historical)		✓	✓
Floodplain function				Forest roads – impacts to sediment supply	✓	✓	✓
Altered nutrient exchange processes	✓	✓		Forest roads – impacts to runoff	✓	✓	✓
Reduced flood flow dampening	✓	✓		Forest roads – riparian/floodplain impacts			✓
Restricted channel migration	✓	✓		Splash-dam logging (historical)	✓	✓	✓
Disrupted hyporheic processes	✓	✓		***Channel manipulations***			
Stream flow				Bank hardening	✓		
Altered magnitude, duration, or rate of change	✓	✓	✓	Channel straightening	✓		
Water quality				Artificial confinement	✓		
Altered stream temperature regime	✓	✓					
Bacteria	✓						
Substrate and sediment							
Excessive fine sediment	✓	✓	✓				
Embedded substrates	✓	✓	✓				

Table 9-7. Habitat measures in priority areas, with reference to limiting factors addressed, threats addressed, target species, and estimated time until benefits would be realized (time). Tier 1 and 2 reaches, or other areas of known priority, are listed under the location column for some measures (i.e. stream corridor measures). Reaches not included in the table (Tier 3, 4, and non-tiered reaches) are considered secondary priority.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
1. Protect and restore floodplain function and channel migration processes ***A. Set back, breach, or remove artificial channel confinement structures***					
Lower mainstem Coweeman 1-4 ***Middle mainstem+ Goble*** Coweeman 4-12, Goble 1	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes	• Floodplain filling • Channel straightening • Artificial confinement	• chum • coho • fall Chinook	2-15 years	Great potential benefit due to improvements in many limiting factors. This passive restoration approach can allow channels to restore naturally once confinement structures are removed. There are challenges with implementation due to existing infrastructure already in place, potential flood risk to property, and large expense.
2. Protect and restore off-channel and side-channel habitats ***A. Restore historical off-channel and side-channel habitats where they have been eliminated*** ***B. Create new off-channel or side-channel habitats (i.e. spawning channels)***					
Lower mainstem Coweeman 1-4 ***Middle mainstem and Goble*** Coweeman 5-12, Goble 1	• Loss of off-channel and/or side-channel habitat • Altered habitat unit composition	• Floodplain filling • Channel straightening • Artificial confinement	• Chum • Coho	2-15 years	Good potential benefit especially for chum, which have lost a significant portion of historically available off-channel habitat for spawning. Potential benefit is limited by moderate probability of success with creation of new habitats. There are challenges with implementation due to existing infrastructure already in place, potential flood risk to property, and large expense.
3. Protect and restore riparian function ***A. Reforest riparian zones*** ***B. Allow for the passive restoration of riparian vegetation*** ***C. Livestock exclusion fencing*** ***D. Invasive species eradication*** ***E. Hardwood-to-conifer conversion***					
Lower mainstem Coweeman 1-4 ***Middle mainstem and Goble***	• Reduced stream canopy cover • Altered stream temperature regime	• Timber harvest – riparian harvests • Riparian grazing • Clearing of	• All species	20-100 years	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. Riparian

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
Canyon 1 - Coweema n 12, Goble 1, 4 ***Upper mainstem + tribs*** Coweeman 13-22, Mulholland 2-3, Baird 1	• Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or noxious species	vegetation due to rural development and agriculture			protections on forest lands are provided for under current harvest policy. Riparian restoration projects are relatively inexpensive and are often supported by landowners. Whereas the specified stream reaches are the highest priority for riparian measures, riparian restoration and preservation should occur throughout the basin since riparian conditions affect downstream reaches. Use IWA riparian ratings to help identify restoration and preservation opportunities.
4. Protect and restore streambank stability ***A. Restore eroding streambanks***					
Middle mainstem+ Goble Canyon 1 - Coweema n 12, Goble 1, 4 ***Upper mainstem + tribs*** Coweeman 13-22, Mulholland 2-3, Baird 1	• Reduced bank/soil stability • Excessive fine sediment • Embedded substrates	• Artificial confinement • Clearing of vegetation • Roads – riparian / floodplain impacts • Riparian grazing	• Fall Chinook • Coho • Winter steelhead	5-50 years	Most areas of bank instability are located between river mile 17 and 26. Bio-engineered approaches that rely on structural as well as vegetative measures are the most appropriate. These projects have a high risk of failure if causative factors are not adequately addressed.
5. Protect and restore natural sediment supply processes ***A. Address forest road related sources*** ***B. Address timber harvest related sources*** ***C. Address agricultural sources***					
Entire basin	• Excessive fine sediment • Embedded substrates	• Timber harvest – impacts to sediment supply • Forest roads – impacts to sediment supply • Agricultural practices – impacts to sediment supply	• All species	5-50 years	High potential benefit due to sediment effects on egg incubation and early rearing. Improvements are expected on timber lands due to requirements under the new Forest Practices Rules (FPRs) and forest land HCPs. There are challenges with implementation on agricultural lands due to few sediment-focused regulatory requirements for agricultural lands. Use IWA impairment ratings to identify restoration and preservation opportunities.
6. Protect and restore runoff processes ***A. Address forest road impacts*** ***B. Address timber harvest impacts*** ***C. Limit additional watershed imperviousness***					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Timber harvest – impacts to runoff • Forest roads – impacts to runoff • Clearing of vegetation due to agriculture and rural development	• All species	5-50 years	High potential benefit due to flow effects on habitat formation, redd scour, and early rearing. Improvements are expected on timber lands due to requirements under the new Forest Practices Rules (FPRs) and forest land HCPs. Use IWA impairment ratings to identify restoration and preservation opportunities.
7. Protect and restore instream flows ***A. Water rights closures*** ***B. Purchase or lease existing water rights*** ***C. Relinquishment of existing unused water rights*** ***D. Enforce water withdrawal regulations*** ***E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Water withdrawals	• All species	1-5 years	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.
8. Protect and restore water quality ***A. Restore the natural stream temperature regime*** ***B. Reduce fecal coliform bacteria levels***					
Entire basin	• Altered stream temperature regime • Bacteria	• Riparian harvests • Riparian grazing	• All species	1-50 years	Primary emphasis for restoration should be placed on stream segments that are listed on the 2004 303(d) list.
9. Protect and restore instream habitat complexity ***A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting*** ***B. Structurally modify stream channels to create suitable habitat types***					
Lower mainstem Coweeman 1-4 ***Middle mainstem and Goble*** Canyon 1 - Coweema n 12, Goble 1, 4 ***Upper mainstem and tribs*** Coweeman 13-22, Mulholland 2-3, Baird 1	• Lack of stable instream woody debris • Altered habitat unit composition	• None (symptom-focused restoration strategy)	• Coho • Winter steelhead	2-10 years	Moderate potential benefit due to the high chance of failure. Failure is probable if habitat-forming processes are not also addressed. These projects are relatively expensive for the benefits accrued. Moderate to high likelihood of implementation given the lack of hardship imposed on landowners and the current level of acceptance of these type of projects.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
10. Protect and restore fish access to channel habitats ***A. Culverts on tributary streams***					
Culverts on several small tributaries throughout basin	• Blockages to channel habitats	• Dams, culverts, in-stream structures	• Coho • Winter steelhead	immediate	As many as 9 miles of potentially accessible habitat are blocked by culverts or other barriers (approximately 15 barriers total). The blocked habitat is believed to be marginal in most cases and no individual barriers account for a substantial share of the blocked habitat. Passage restoration projects should focus on cases where it can be demonstrated that there is good potential benefit and reasonable project costs.
11. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development ***A. Plan growth and development to avoid sensitive areas (e.g. wetlands, riparian zones, floodplains, unstable geology)*** ***B. Encourage the use of low-impact development methods and materials*** ***C. Apply mitigation measures to off-set potential impacts***					
Entire basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	The focus should be on management of land-use conversion and managing continued development in sensitive areas (e.g. wetlands, stream corridors, unstable slopes). Many critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary mechanisms need to be put in place to restore currently degraded habitats.
12. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection ***A. Purchase properties outright through fee acquisition and manage for resource protection*** ***B. Purchase easements to protect critical areas and to limit potentially harmful uses*** ***C. Lease properties or rights to protect resources for a limited period***					
Entire basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit. These programs are under-funded and have low landowner participation.

9.5 Program Gap Analysis

The Coweeman Basin (~200 sq mi) is located exclusively in Cowlitz County:

- There is no federal land ownership in the Coweeman Basin.
- Large industrial forest lands (~175 sq miles) are the largest land use.
- Small private forest lands (~20 sq mi) are found in the lower reaches of the Coweeman Basin.
- Department of Natural Resources managed state lands represent a minor public land holding (~2 sq mi) has minor public land holdings within the Coweeman Basin.
- All of the Coweeman Basin is located in Cowlitz County.
- Population in the Coweeman Basin is primarily found along Rose Valley Road (parallel with the river) and can be expected to increase relative to growth in the Longview/Kelso area (Kelso is expected in grow 42% by 2020).

Protection Programs

The principle programs for watershed and stream habitat protection in the Coweeman Basin are Washington forest practice regulations administered by the Department of Natural Resources and Cowlitz County land use regulations. Protection programs in this analysis include those programs that protect habitat conditions or watershed functions through regulatory measures, incentives, acquisition of properties or easements, or by applying standards to new development that protects resources by avoiding damaging impacts. Key programs implementing measures are identified below:

Federal Programs

- ***U.S. Army Corps of Engineers*:**
  - Regulatory Programs: U.S. Army Corps of Engineers administers the Section 10 (Rivers and Harbor Act) and Section 404 (Clean Water Act) permit processes. Section 10 requires approval of any activity in, above, or below a navigable river, which affects course, location, condition, or capacity of navigable waters. Section 404 requires prior approval of dredging, filling, grading, clearing, and bank hardening. In waters used by listed fish species, the permits are subject to ESA Section 7 consultation with NOAA Fisheries to ensure that any approved action is adequately protective of the ESA listed fish. [M.1A; M.2A; M.2B; M.4A; M.9A; M.9B]

State Programs

- ***Department of Natural Resources***
  - State Forest Land Habitat Conservation Plan (HCP):
    State forest lands are managed under the provisions of a HCP. The HCP protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8A]

  - State Forest Practice Rules:
    Riparian areas and watershed functions on small- and industrial forest lands are protected under the State of Washington Forest Practices Rules, including the Forest and Fish

Module. These rules provide for riparian buffers, harvest restrictions, sensitive area protections, and protective standards for new road construction. [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8A]

- ***Department of Fish and Wildlife***

  - Hydraulics Project Approval (HPA): The Department administers the state Hydraulic Code. The purpose of this program is to protect stream conditions and habitat. The regulations apply to such activities as streambank protection, instream construction, culvert installation, channel changes or realignments, debris removal, and water diversion facilities. Those proposing such actions must obtain a Hydraulic Project Approval (HPA) permit. [M.1A; M.2A; M.2B; M.4A; M.9A; M.9B]

  - Habitat Program: The Department provides advice to local governments and landowners interested in measures to protect habitat values on their property. [M.3A; M.4A; M.8A; M.9A; M.9B; M.10A; M.11A; M.11B; M.11C]

- ***Department of Ecology***

  - Water Resources Program/Water Rights: Department of Ecology, in consultation with the Department of Fish and Wildlife, has administrative closed selected areas within the Coweeman Basin to surface and groundwater withdraws (where groundwater is in continuity with surface water). Existing administrative closures by the Department of Ecology protect surface waters from further withdrawals. Formal rule-making would strengthen the closures. The extent of unauthorized surface water withdrawals is unknown, but could exacerbate summer low flows. [M.7A, M.7B, M.7C, M.7D]

  - Water Resources Program/Watershed Planning: In cooperation with the Lower Columbia Fish Recovery Board, other state and federal agencies, tribes, local governments, and citizens, the Department funds and participates in a state authorized watershed planning process for Water Resource Inventory Area (WRIA) 26 pursuant to RCW 90.82. The goal of the plan is to ensure adequate water for people and fish. The planning process is dealing with water quantity and quality, stream flows and fish habitat. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.6C; M.7A; M.7B; M.7C; M.7D; M.7E; M.8A; M.8B]

- ***Salmon Recovery Funding Board (SRFB)/ Lower Columbia Fish Recover Board (LCFRB)***

  - Washington Salmon Recovery Act (RCW 77.85): The SRFB and the LCFRB jointly administer a grant program that allocates federal Pacific Salmon Recovery Funds and State funds for habitat protection and restoration projects by state and local agencies, nonprofit organizations, and landowners. To date, no habitat grants under this program have been awarded for work in the Coweeman watershed. [M.1A; M.2A; M.2B; M.3A; M.4A; M.8A; M.8B; M.9A; M.9B; M.10A; M.12A; M.12B; M.12C]

- ***State Conservation Commission/Cowlitz Conservation District***

- The District works directly with agriculture interests in the Coweeman watershed. The Farm Plan Program and Conservation Reserve Enhancement Program both provide landowners voluntary incentives to protect watershed and habitat conditions. [M.3C; M.4A; M.5C; M.8A]

Local Government Programs

➢ ***Cowlitz County***

- Land Use:

  ✓ Comprehensive Plan/ Land Use Zoning: With the exception of the requirement to adopt a Critical Areas Ordinance, the County is exempt from the Washington Growth Management Act (GMA). It adopted a comprehensive plan in 1976 to guide growth and development. Zoning in the Coweeman watershed allows one dwelling per 2 acres along the Rose Valley Road and other County roads and one dwelling per 5 acres along non-county roads

  ✓ Critical Areas Ordinance: Pursuant to the GMA, Cowlitz County has adopted a Critical Areas Ordinance addressing wetlands, fish and wildlife habitat, flood prone areas, geologic hazards, and critical aquifer recharge areas. The ordinance is generic and provides limited protection of watershed and habitat critical to listed fish. It focuses heavily on mitigation, rather than protection. No stream buffers have been adopted. Wetland buffers vary from 25' to 200' and are based upon soil type and wildlife utilization

  ✓ Grading Ordinance: The County is considering the adoption of a state mandated grading ordinance. [M.11A; M.11B; M.11C]

- Road Maintenance: The County has not yet developed or implemented a road maintenance program with measures to protect habitat. [M.6C; M.10A]

Restoration Programs

Restoration programs in the Coweeman Basin are implemented by a variety of agencies, organizations, and private interests. Major programs implementing protection measures are identified below:

Federal Programs

No active programs.

State Programs

➢ ***Department of Natural Resources***

- State Forest Land Habitat Conservation Plan (HCP): The Department manages state forest lands pursuant to a Habitat Conservation Plan (HCP). The HCP road maintenance and restoration objectives requires barrier upgrades and road abandonment and/or other improvements [M.3A; M.3B; M.4A; M.5A; M.5B; M.6A; M.6B; M.8A; M.10A]

- State Forest Practice Rules: Large Industrial forests within the Coweeman Basin are governed by Forest and Fish regulations and have rigid schedules for maintaining and improving roads and removing barriers. Industrial landowners have 15 years to bring roads and barriers into compliance with regulations. Small private forest owners are governed by Forest and Fish regulations; however their road and barrier maintenance and improvement programs are tied to state funding. In the State 2003-05 Biennial Budget, 2 million dollars was allocated statewide to support small private forest owners; [M.3A; M.3B; M.4A; M.5A; M.5B; M.6A; M.6B; M.8A; M.10A]

➢ ***Department of Ecology***

Local Programs

➢ ***Cowlitz County*:** The County has corrected a number of blocking culverts on county roads. None have been identified for work in the Coweeman watershed. [M.10A]

➢ ***Cowlitz Noxious Weed Control Board*:** Invasive plant species such as Japanese knotweed, threaten properly function riparian conditions by displacing native species. The Board has three primary programs that address weed control in the Coweeman Basin; [M.3D]

- Public education to prevent the spread of noxious weeds;
- Survey County lands to assess emerging issues; and
- Enforcement of noxious weed control

Community Programs

No active programs.

Gap Analysis

Forest-related Programs: In the Coweeman Basin, forest-related programs have a substantial role in protecting and restoring watershed functions and habitat conditions at levels supporting recovery goals. These programs apply to over 98% of the basin. Certainty of forestry-related protection and restoration programs is relatively high because programs are being implemented and, for the most part, fully funded. Program areas of concern include state funding for small commercial forest landowners and the continued potential for hydrologic impacts caused by past harvest practices. Monitoring of watershed processes and habitat conditions will be required to confirm the effectiveness of these measures.

Protection-related Programs: The regulatory programs of the U.S. Army Corps of Engineers and the state Department of Fish and Wildlife provide good protection for instream habitat conditions, but little or no protection for riparian areas and upland watershed processes. Lands not managed for timber in the Coweeman Basin are covered by Cowlitz County land use regulatory regulations. County programs lack effective provisions that commonly are used to proactively direct growth, protect streams and wetlands, and manage stormwater. There are very limited regulatory mechanisms for agricultural practices relative to protection riparian areas and hydrologic processes. Voluntary incentive programs and technical assistance from the Conservation District helps promote stewardship and protection of watershed processes and habitat conditions.

Restoration-related Programs: Over the long-term, improvements to the Coweeman watershed will occur as a result of improved forest management practices that are already in place. Active restoration in the lower mainstem should focus on floodplain function and channel migration, as well as restoring off-channel and side-channel habitats. Programs to address these issues are currently not in place or not active in the watershed.

Table 9-8. Actions to Address Gaps

Action #	Lead Agency	Proposed Action
COWEE.1	Cowlitz County	Develop and implement controls to adequately protect riparian areas to maintain currently functional habitat as well as restored habitat needed habitat conditions around all rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Require mitigation, where necessary, to offset unavoidable damage to habitat conditions in riparian management areas
COWEE.2	Cowlitz County	Develop and implement stormwater discharge controls to protect water quality and quantity and reduce localized stream flow impacts detrimental to fish —including peak and base flows
COWEE.3	Cowlitz County	Protect historic stream meander patterns and channel migration zones and avoid hardening stream banks and shorelines
COWEE.4	Cowlitz County	Zoning and development standards to adequately protect wetlands, wetland buffers, and wetland function.
COWEE.5	Cowlitz County	Develop and implement controls to address erosion and sediment run-off during (and after) construction to prevent sediment and pollutant discharge to streams, wetlands and other water bodies
COWEE.6	Cowlitz County	Apply land use code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
COWEE.7	State of Washington	Provide state funding for small forest owners in the Coweeman Basin to a level sufficient to achieve the road and barrier improvements of Forest and Fish on a schedule parallel to private industrial forest owners
COWEE.8	Forest Managers LCFRB, and DFW	Identify and sequence early action forest-wide restoration projects that analysis indicates could provide significant benefits. In these cases, it may be appropriate to identify outside funding to initiate these early actions
COWEE.9	Cowlitz County,	Utilize a combination of public outreach/education, incentives, and authority to positively influence landowner behaviors toward land stewardship in practices not covered by land use regulations
COWEE.10	WRIA 27/28 PU, DOE, DFW	Close the Coweeman Basin to further surface water withdrawals, including groundwater in connectivity with surface waters; curtail unauthorized withdrawals
COWEE.11	LCFRB, Cowlitz County, DFW	Build institutional capacity for agencies and organizations to undertake additional protection and restoration projects, including noxious weed control
COWEE.12	SRFB, Fish and Wildlife Foundation, BPA, NOAA, DOE	Increase available funding for projects that implement measures and addresses underlying threats
COWEE.14	State of Washington (Dept of Agriculture)	Develop and implement agricultural practices and regulations to protect riparian conditions and water quality
COWEE.15	LCFRB, Cowlitz CD, Cowlitz County	Address threats proactively by building agreement on priorities among the various program implementers
COWEE.16	FEMA	Update Floodplain Maps

10 Kalama River Subbasin

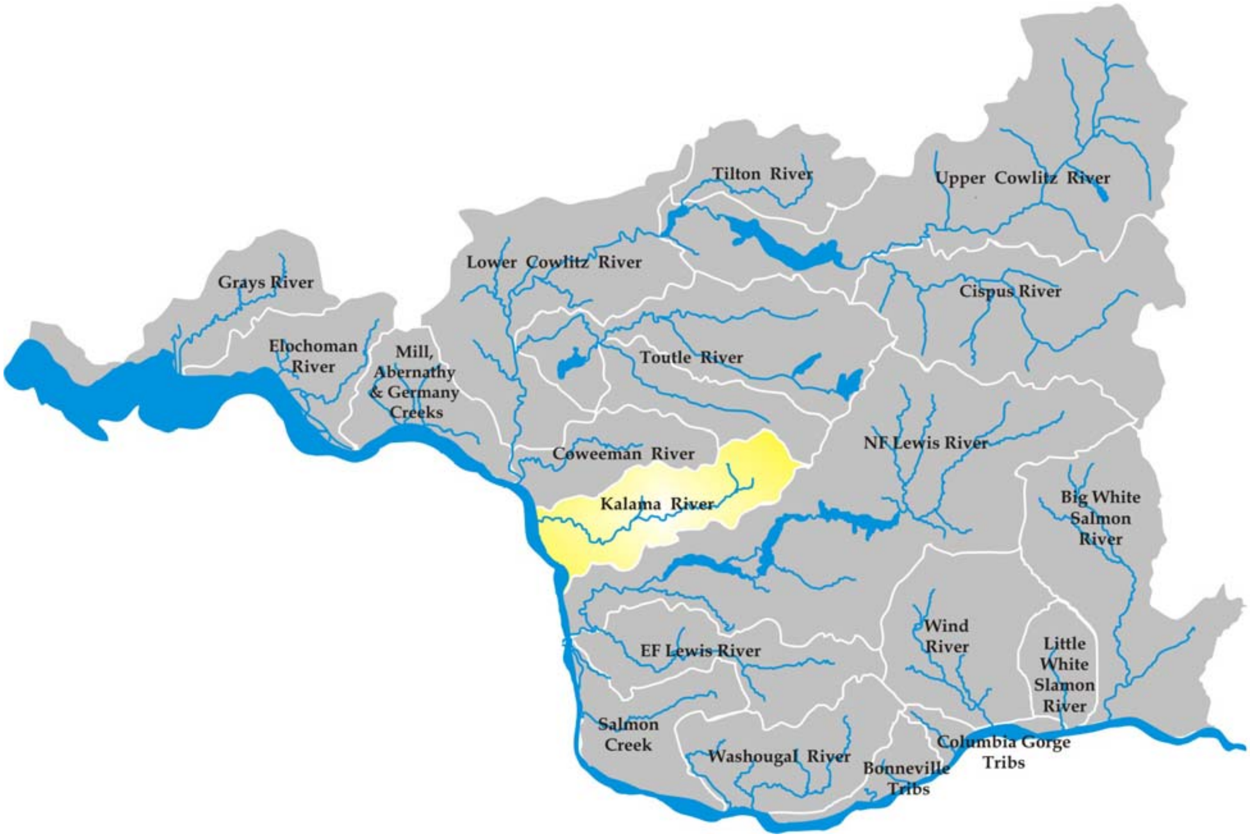


Figure 10-1. Location of the Kalama River Subbasin within the Lower Columbia River Basin.

10.1 Basin Overview

The Kalama River Subbasin comprises approximately 205 square miles in Cowlitz County. The river enters the Columbia at RM 73, approximately 8 miles upstream of Longview, Washington. The principle tributary to the Kalama is Gobar Creek. The subbasin is part of WRIA 27.

The Kalama Subbasin will play a key role in the recovery of salmon and steelhead. The subbasin has historically supported populations of fall and spring Chinook, winter and summer steelhead, chum, and coho. Today, Chinook, steelhead and chum are listed as threatened under the ESA. Coho salmon are a candidate for listing. Other fish species of interest are Pacific lamprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

Kalama salmon and steelhead are affected by a variety of in-basin and out-of basin factors including stream, Columbia River mainstem, estuary, and ocean habitat conditions; harvest; hatcheries, and ecological relationships with other species. Analysis has demonstrated that recovery cannot be achieved by addressing only one limiting factor. Recovery will require action to reduce or eliminate all manageable factors or threats. The deterioration of habitat conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonids within the Columbia Basin. Direct harvest of listed salmon and steelhead is prohibited but sport and commercial fisheries focusing on hatchery fish and other healthy wild populations, primarily in the mainstem Columbia and ocean, incidentally affect ESA-listed Kalama fish. Kalama Falls and Fallert Creek hatcheries operate within the basin with the potential to both adversely affect wild salmon and steelhead populations and to assist in recovery efforts. Key ecological interactions of concern include effects of non-native species; nutrient inputs from salmon carcasses; and predation by species affected by development including Caspian terns, northern pikeminnow, seals, and sea lions. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the Kalama Subbasin.

Most of the basin is forested and nearly the entire basin is managed for commercial timber production (96%). Only 1.3% is non-commercial forest and 1.5% is cropland. Areas along the lower river have experienced industrial and residential development, resulting in channelization of the lower river. A portion of the upper basin is located within the Mount St. Helens National Volcanic Monument. National Monument land is managed primarily for natural resource protection and tourism.

The Kalama mainstem provides most of the available spawning and rearing habitat in the subbasin, except for a few tributaries that support steelhead and spring Chinook. The mainstem has been severely impacted by logging and road building throughout the subbasin and to some extent by agricultural, rural residential development, and commercial development along the lower river.

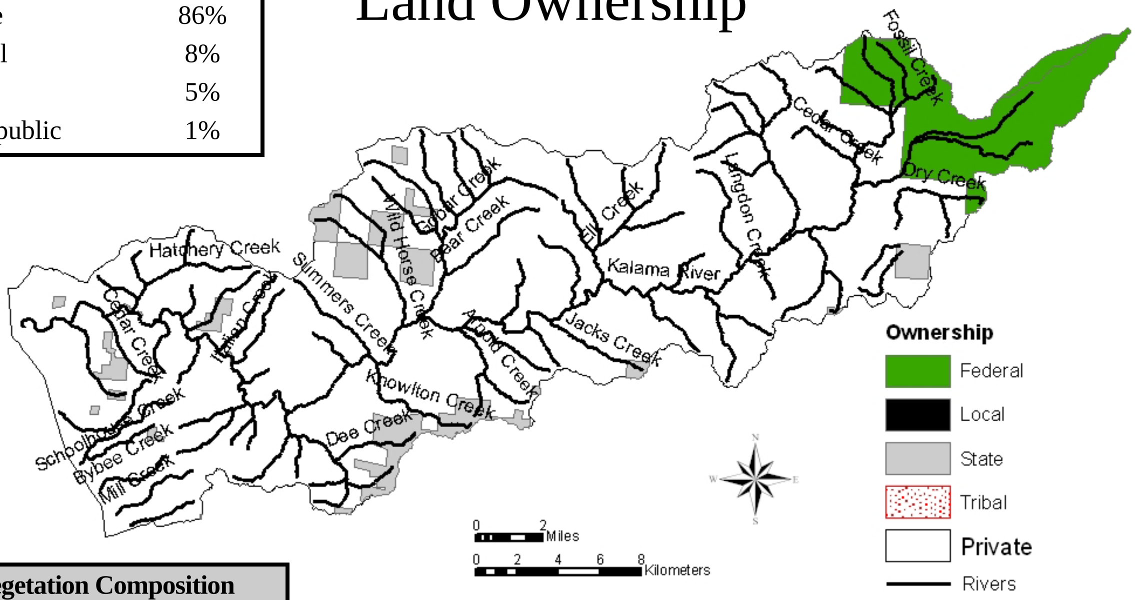
The important reaches for steelhead and spring Chinook are in the middle and upper mainstem and in the lower reaches of a few tributaries (NF Kalama, Gobar Creek, Wildhorse Creek, Little Kalama River). These habitats currently support healthy runs of steelhead. Further degradation of these reaches would jeopardize populations. Of particular importance are the mainstem canyon reaches, which are critical for parr rearing.

The lower mainstem reaches are the most important for chum, fall Chinook, and coho. These reaches suffer from impaired channel stability and habitat diversity, which are related to riparian and floodplain impacts from rural residential development, commercial development, agriculture, and transportation corridors. Sedimentation of these reaches is related to basin-wide forestry practices. Further degradation of these reaches would severely impact chum and fall Chinook. Restoration would yield substantial benefits.

Population density and development in the watershed are low. The year 2000 population was approximately 5,300 persons (LCFRB 2001). The town of Kalama, located near the mouth, is the only urban area in the basin.

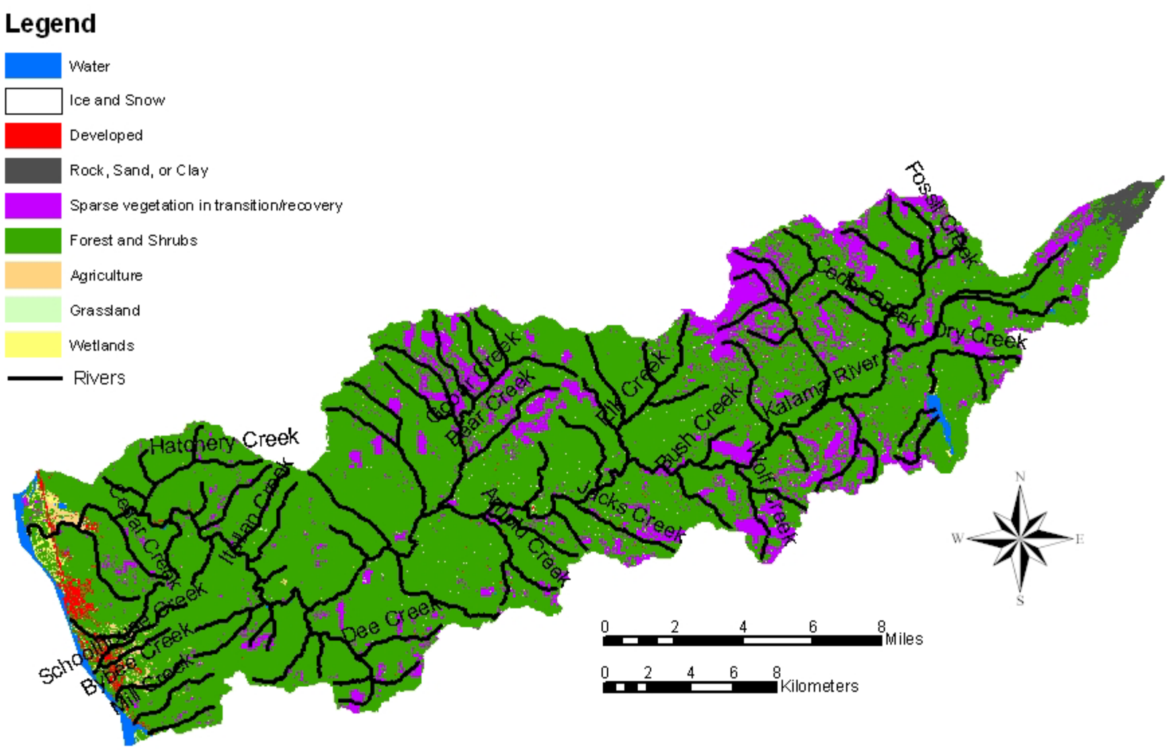
Land Ownership	
Private	86%
Federal	8%
State	5%
Other public	1%

Land Ownership



Vegetation Composition	
Late Seral	4%
Mid Seral	23%
Early Seral	9%
Other Forest	55%
Non Forest	9%

Land Use / Cover



10.2 Species of Interest

Focal salmonid species in the Kalama basin include fall Chinook, spring Chinook, winter steelhead, summer steelhead, chum, and coho. The health or viability of these populations ranges from very low (chum and spring Chinook) to above medium (winter steelhead). Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Recovery goals call for restoring Chinook and steelhead populations to a high or very high viability level. This level will provide for a 95% or better probability of population survival over 100 years. Chum recovery goals call for medium viability levels providing a 75-95% probability of persistence over 100 years. Recovery goals for coho are low, providing for a 40-75% chance of survival over 100 years.

Other species of interest in the Kalama Subbasin include coastal cutthroat trout and Pacific lamprey. Regional objectives for these species are described in Volume I, Chapter 6. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for these other species. Cutthroat will benefit from improvements in stream habitat conditions for salmonids. Lamprey are also expected to benefit from habitat improvements in the estuary, Columbia River mainstem, and Kalama subbasin although specific spawning and rearing habitat requirements of lamprey are not well known.

Table 10-1. Current viability status of Kalama 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+	3,800-20,000	High	1,300-3,200
Spring Chinook	Threatened	Yes	Very Low	50-600	High	900-1,400
Winter Steelhead	Threatened	Yes	Med+	500-2,300	High+	600-700
Summer Steelhead	Threatened	Yes	Low+	200-2,300	High	700-1,000
Chum	Threatened	No	Very Low	<50	Low	1,100-12,200
Coho	Candidate	Yes	Low	Unknown	Medium	unknown

Fall Chinook– The historical Kalama adult population is estimated from 3,800-20,000 fish. The current natural spawning numbers are similar, but the majority of the returns are hatchery fall Chinook released as juveniles from the Kalama hatchery facilities. Natural spawning occurs from late September through October in eleven miles of the mainstem Kalama from Kalama Falls Hatchery downstream to just above the I-5 Bridge. Juvenile rearing occurs near and downstream of the spawning areas. Juveniles migrate from the Kalama in the spring and early summer of their first year.

Spring Chinook–The historical Kalama adult population is estimated from 6,000-15,000 fish, although these estimates may be high. The majority of the habitat for spring Chinook production is upstream of the lower Kalama Falls which was an historical passage block for Chinook. Current natural spawning numbers range from less than 50 to 600, with the majority of the natural spawners originating from the Kalama hatcheries. Natural spawning occurs in the mainstem above the lower Kalama Falls, when fish are passed above Kalama Falls Hatchery, and in the mainstem in the first few miles downstream of the Kalama Falls Hatchery. Juveniles rear for a full year before migrating from the Kalama in the spring.

Winter Steelhead– The historical Kalama adult population is estimated from 1,000-8,000 fish. Current natural spawning returns range from 500-2,300. In-breeding with Skamania Hatchery produced steelhead is thought to be low because of differences in spawn timing. Spawning occurs primarily in the mainstem and tributaries upstream of Kalama Falls Hatchery. Spawning generally occurs from early 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 Kalama.

Summer Steelhead– The historical Kalama adult population is estimated from 1,300-7,000 fish. Current natural spawning returns range from 200-2,300 fish. In-breeding with Skamania Hatchery produced steelhead is thought to be low because of differences in spawn timing. Spawning occurs primarily in the mainstem and tributaries upstream of Kalama Falls Hatchery. Spawn timing is generally from February to April. Juvenile rearing occurs both downstream and upstream of the spawning areas. Juveniles rear for a full year or more before migrating from the Kalama.

Chum– The historical Kalama adult population is estimated from 15,000-40,000. Current natural spawning estimate is less than 50 fish in the Kalama. Spawning occurs in the lower reaches of the mainstem Kalama between Modrow Bridge and lower Kalama Falls. Spawn timing is mid November-December. Natural spawning chum in the Kalama are all naturally produced as no hatchery chum are released in the area. Juveniles rear in the lower reaches for a short period in the early spring and quickly migrate to the Columbia.

Coho– The historical Kalama adult population is estimated from 2,000-26,000, with both early and late stock present. Early coho spawn primarily in November while late stock spawning is spread from late November to March. Current returns are unknown but assumed to be very low. A number of hatchery produced fish spawn naturally. Natural spawning occurs in the mainstem and tributaries downstream of lower Kalama Falls. Juveniles rear for a full year in the Kalama Basin before migrating as yearlings in the spring.

Coastal Cutthroat– Coastal cutthroat abundance in the Kalama has not been quantified but the population is considered depressed. Both anadromous and resident forms of cutthroat trout are found in the basin. Counts of adult cutthroat trout at the Kalama Falls fishway and smolt production estimates indicate a declining trend in abundance. Anadromous cutthroat enter the Kalama 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 1999.

Pacific lamprey– Information on lamprey abundance is limited and does not exist for the Kalama Basin population. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have declined in the Kalama Basin also. 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 Kalama Basin. Juveniles rear in freshwater up to 6 years before migrating to the ocean.

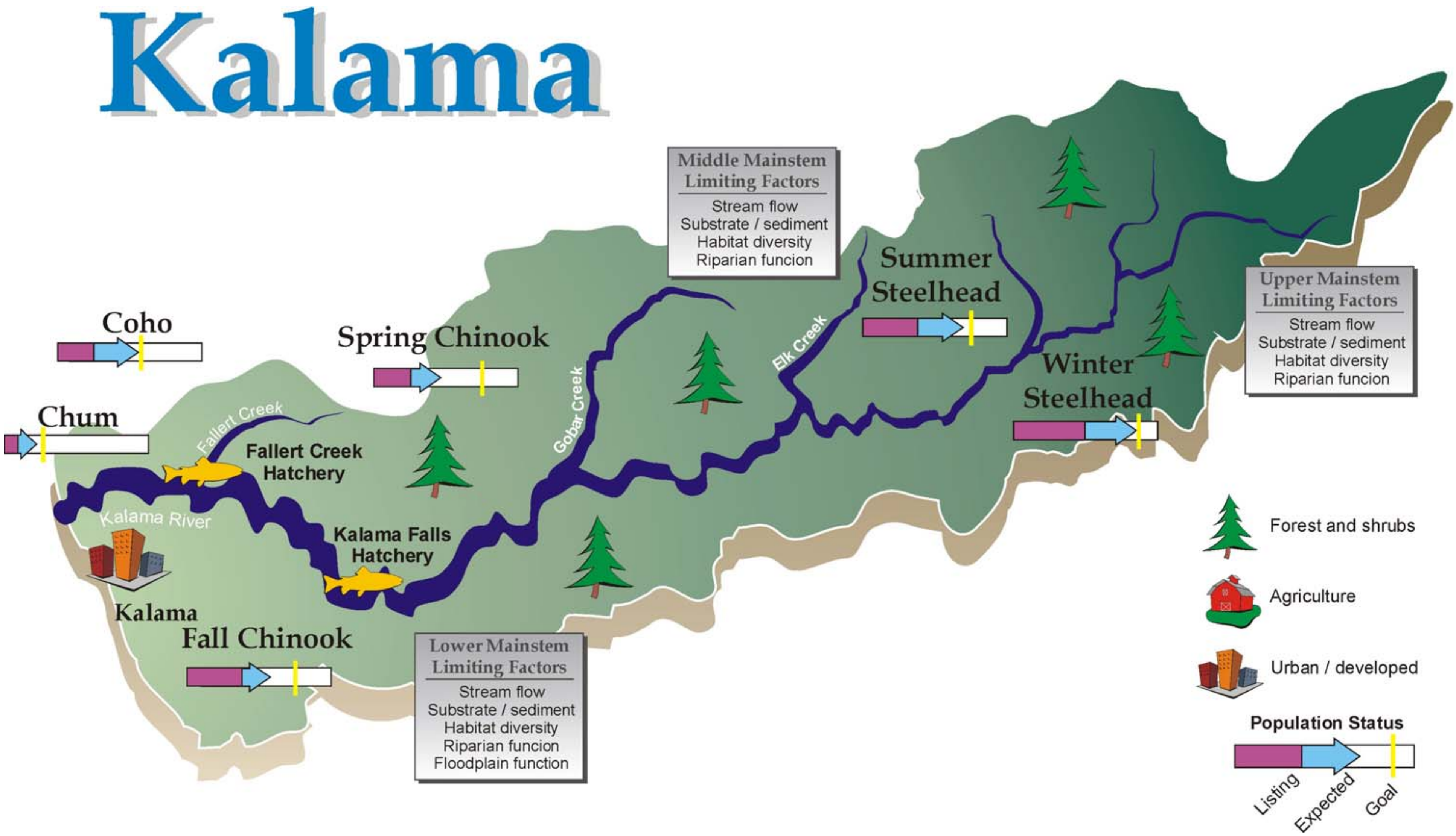


Figure 10-2. Summary of habitat limiting factors, population status, expected population improvement trend with existing programs, and biological objectives depicted for the Kalama Subbasin.

10.3 Potentially Manageable Impacts

Stream habitat, estuary/mainstem habitat, harvest, hatchery and predation effects have all contributed to reduced salmonid productivity, numbers, and population viability in the Kalama Subbasin. The pie charts below represent the relative order of magnitude of quantifiable effects for each of these factors for each focal species. The preferred recovery scenario targets an equivalent reduction in each impact factor in proportion to the magnitude of the effect. Population-specific targets are discussed in further detail in Volume I, Chapter 6.

- Loss of tributary habitat quality and quantity is an important impact for all species, particularly for chum. Loss of estuary habitat quality and quantity is also important, particularly for chum and winter steelhead. The combination of tributary and estuary habitat factors account for 82% and 63% of the relative impact to chum and winter steelhead, respectively.
- Harvest has a large relative impact on fall and spring Chinook and coho and moderate impact on winter and summer steelhead. Harvest effects on chum are minimal.
- Hatchery impacts are substantial for coho and fall and spring Chinook, and are minimal for steelhead and chum.
- Predation impacts are moderate for winter and summer steelhead, but appear less important for coho, chum, and fall and spring Chinook.
- Hydrosystem access and passage impacts appear to be relatively minor for all species.

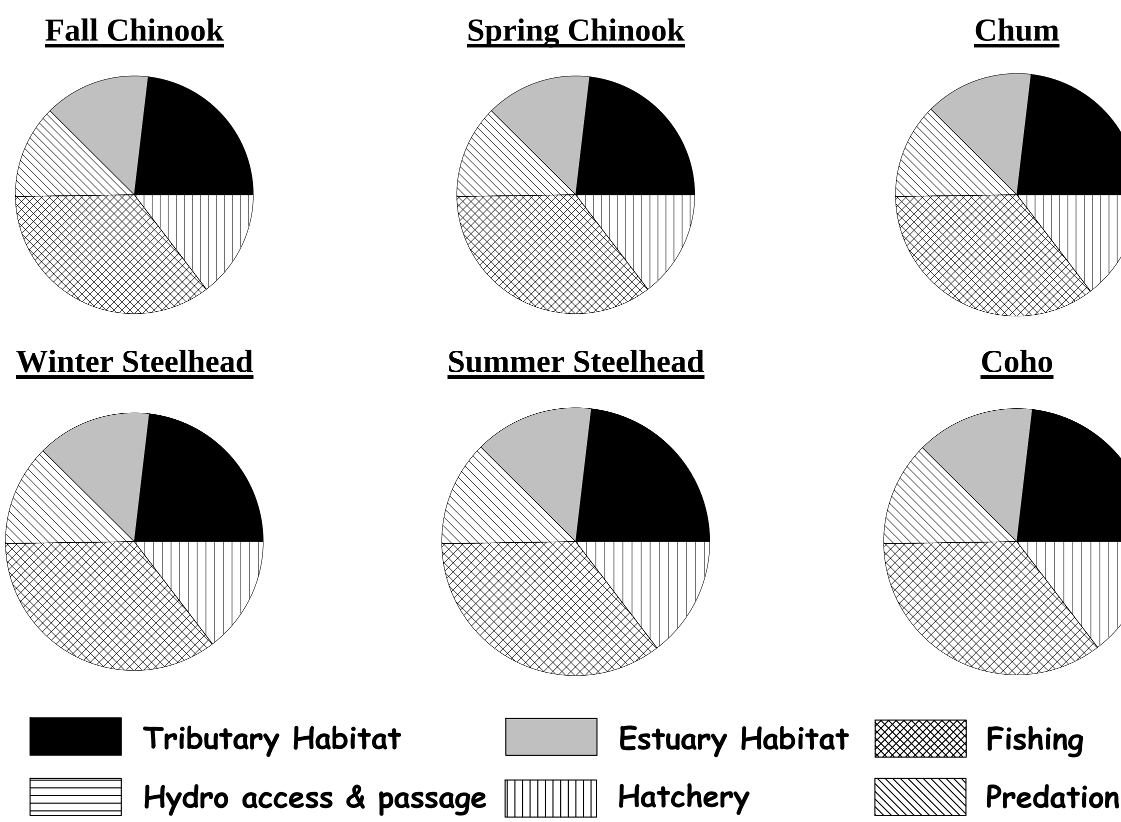


Figure 10-3. Relative contribution of potentially manageable impacts for Kalama populations.

10.4 Limiting Factors, Threats, and Measures

10.4.1 Hydropower Operation and Configuration

There are no hydro-electric dams in the Kalama River Basin. However, Kalama species are affected by mainstem Columbia hydro operations and flow regimes which affect habitat in migration corridors and in the estuary. Mainstem hydro factors and threats are addressed by regional strategies and measures identified in Volume I, Chapter 7.

10.4.2 Harvest

Most harvest of wild Kalama salmon and steelhead is incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. This mortality is very low for chum and steelhead, but is more significant for fall Chinook. Kalama fall Chinook are harvested in ocean and Columbia River commercial and sport fisheries as well as in-basin sport fisheries. Harvest is controlled by an ESA harvest limit associated with Coweeman natural fall Chinook. No harvest of chum occurs in ocean fisheries, there is no directed Columbia River or Kalama Basin chum fisheries and retention of chum is prohibited in Columbia River and Kalama sport fisheries. Chum are impacted incidental to fisheries directed at coho and winter steelhead. Harvest of Kalama 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 Kalama Basin. Wild coho impacts are limited by fishery management to retain fin-marked hatchery fish and release unmarked wild fish. 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.

Measures 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. The regional measures 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 Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest measures with significant application to Kalama Subbasin populations are summarized in the following table:

Table 10-2. Regional harvest measures from Volume I, Chapter 7 with significant application to the Kalama Subbasin populations.

Measure	Description	Comments
F.M17	Monitor chum handle rate in winter steelhead and late coho tributary sport fisheries.	State agencies would include chum incidental handle assessments as part of their annual tributary sport fishery sampling plan.
F.M13	Develop a mass marking plan for hatchery tule Chinook for tributary harvest management and for naturally-spawning escapement monitoring.	Provides the opportunity to implement selective tributary sport fishing regulations in the Kalama 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.M18	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	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.M19	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	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.M24	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	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.

10.4.3 Hatcheries

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

There are two hatcheries operating in the Kalama basin. Fallert Creek Hatchery (since 1895) operates in conjunction with Kalama Falls Hatchery (since 1959) to produces winter and summer steelhead, fall Chinook, spring Chinook, and coho for harvest opportunity. Gobar Pond (RM 19) is used to acclimate steelhead and spring Chinook smolts prior to release. Hatchery produced steelhead include Skamania summer, Cowlitz and Beaver Creek winters, as well as steelhead originating from Kalama wild summer and winter brood stock. Skamania and Beaver Creek hatchery steelhead are a composite stock and are genetically different from the naturally produced steelhead in the Kalama. 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. Fall Chinook are derived from Kalama stock and there have been few transfers of outside fall Chinook stock into Kalama Basin hatcheries. Spring Chinook are primarily Kalama origin with some history of transfers from Cowlitz Hatchery. Both early and late coho are produced from the

Kalama hatcheries. The main threats from the salmon hatchery programs are domestication of natural fall Chinook and coho and potential ecological interactions between the hatchery and natural juvenile salmon.

Table 10-3. Kalama Basin hatchery production.

Hatchery	Release Location	Fall Chinook	Early Coho	Late coho	Winter Steelhead	Summer Steelhead
Fallert Creek	Kalama	2,500,000	350,000			30,000
Kalama Falls	Kalama	2,500,000		350,000	45,000	
					45,000(wild)	60,000(wild)

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 Kalama 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). Regional hatchery measures identified in Volume I, Chapter 7 with potential applications at facilities within the Kalama Subbasin are summarized in Table 10-4.

Table 10-4. Regional hatchery measures from Volume I, Chapter 7 with potential implementation actions in the Kalama Subbasin.

Measure	Description	Comments
H.M2,5,13,38	Integrated hatchery and wild program for fall Chinook. Evaluate potential for integration of hatchery and wild coho.	Assures fitness of the natural produced fish which will improve population productivity. Integrated programs would be developed specific to the Kalama populations in the BRAP procedure.
H.M14	Use only local brood stock in the fall Chinook hatchery program.	This measure will preclude transfer of outside basin stock into the Kalama hatchery program. This will enable a hatchery and wild integrated program to be developed with fall Chinook that are ecologically adapted to the Kalamal Basin.
H.M15,22,32,40	Juvenile release strategies to minimize interactions with naturally spawning fish.	Release strategies are aimed at reducing or avoiding interactions with wild steelhead, fall Chinook, coho by release timing and release location strategies.
H.M17,32,34,41	Mark hatchery steelhead, coho, fall Chinook, and spring Chinook with an adipose fin-clip for identification and selective harvest.	Marking hatchery fish allows for identification of hatchery fish in the natural spawning grounds and at collection facilities which enables accurate accounting of wild fish. Marking also enables selective fisheries to retain hatchery fish and release wild fish.
H.M1,36	Hatchery program utilized for supplementation and enhancement of wild coho populations.	. Supplementation programs for Kalama natural coho could be developed with appropriate brood stock in the Kalama hatcheries.
H.M8	Adaptively manage hatchery programs to further protect and enhance natural populations and improve operational efficiencies.	Appropriate research, monitoring, and evaluation programs along with guidance from regional hatchery evaluations will be utilized to improve the survival and contribution of hatchery fish, reduce impacts to natural fish, and increase benefits to natural fish.
H.M6	Evaluate Fallert Creek and Kalama Falls hatcheries facility operations.	Both facilities would be evaluated in the BRAP process for potential hazards associated with barriers to fish passage and adequacy of screens

10.4.4 Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Kalama salmon and steelhead are affected throughout their lifecycle by ecological interactions with non-native species, food web components, and predators. Interactions are similar for Kalama populations to those of most other subbasin salmonid populations. Ecological Interactions are addressed by regional strategies and measures identified in Volume I.

10.4.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. 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 are similar for Kalama populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook than spring Chinook, steelhead, and coho. Estuary and mainstem effects on Kalama salmon and steelhead populations are addressed by regional strategies and measures identified in Volume I and the Columbia Mainstem and Estuary Subbasin sections of Volume II.

10.4.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity 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 Kalama subbasin have the greatest impact on the health and viability of salmon and steelhead relative to the other limiting factors and threats discussed in this chapter.

Subwatersheds, reaches, and habitat attributes have been prioritized for protection and/or restoration based on the plan's biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Priority areas for habitat protection and restoration are shown in Figure 10-4. A summary of the primary habitat limiting factors and threats are presented in Table 10-6. Habitat measures and related information are presented in Table 10-7. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 10-5. Reach- and subwatershed-scale limiting factors generated from the technical assessment are included in Table 10-5. Details on species-specific spatial priorities and limiting factors at the subbasin level may be found in Volume II of the Technical Foundation. A description of the methodology used to generate composite (multi-species) reach and subwatershed priorities can be found in the introduction to this volume of the recovery plan.

The areas with the greatest current or potential contribution to focal salmonid population health and productivity are listed below. Tier 1 and 2 reaches within these priority areas are included in the list. The habitat limiting factors, threats, and measures included in this chapter focus primarily on the priority areas and the Tier 1 and 2 reaches within them. Tier, 3, 4, and non-tiered reaches are considered secondary priority, but in many cases, these lower priority areas will also require restoration and preservation actions in order to achieve recovery objectives. Watershed process measures generally focus on the entire basin as opposed to being limited only to high priority areas because conditions in high priority areas are often influenced by cumulative watershed effects. High priority areas and reaches in the Kalama basin include the following:

- Lower Kalama mainstem – Kalama 2-6
- Middle Kalama mainstem & tributaries – Kalama 8-12; Gobar Creek
- Upper Kalama mainstem & tributaries – Kalama 15-21; NF Kalama River

The following paragraphs provide a brief overview of each of these priority areas, including species most affected, land-use threats, and the general type of measures that will be necessary for recovery. Additional detail can be found in the tables and figures that follow.

While reach level habitat conditions often result from local factors, they are also affected or shaped by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input and large woody debris recruitment are often affected by or result from upstream conditions and degraded watershed processes. Access to key reaches may also be affected by barriers that occur downstream of a reach. Accordingly, restoration of a priority reach may require action outside the targeted reach. The IWA analysis was used to identify potential upstream watershed areas that could influence reach level habitat attributes. EDT was used to allow a relative comparison of reaches and habitat attributes within a reach.

The lower Kalama mainstem from the mouth to Dee Creek contains productive habitat for fall Chinook, chum, and coho. These reaches are primarily impacted by forest practices, though agriculture and rural development affect riparian areas and floodplains in the lower 2 reaches. The most effective recovery measures will involve riparian and floodplain restoration in reach Kalama 2 and 3, as well as addressing basin-wide forest and road conditions.

The middle mainstem Kalama and major tributaries (i.e., Gobar Creek) contain productive habitats for steelhead and spring Chinook. Coho, fall Chinook, and chum do not typically ascend lower Kalama Falls to access these habitats. Forestry is the dominant land use surrounding these reaches. Stream-adjacent roadways impact riparian function. The most effective recovery measures will include preservation and restoration of riparian and upland forest and road conditions.

The upper Kalama mainstem and tributaries (i.e., NF Kalama) are used primarily by summer steelhead. These reaches are heavily impacted by forest practices. The most effective recovery measures will include preservation and restoration of riparian and upland forest and road conditions.

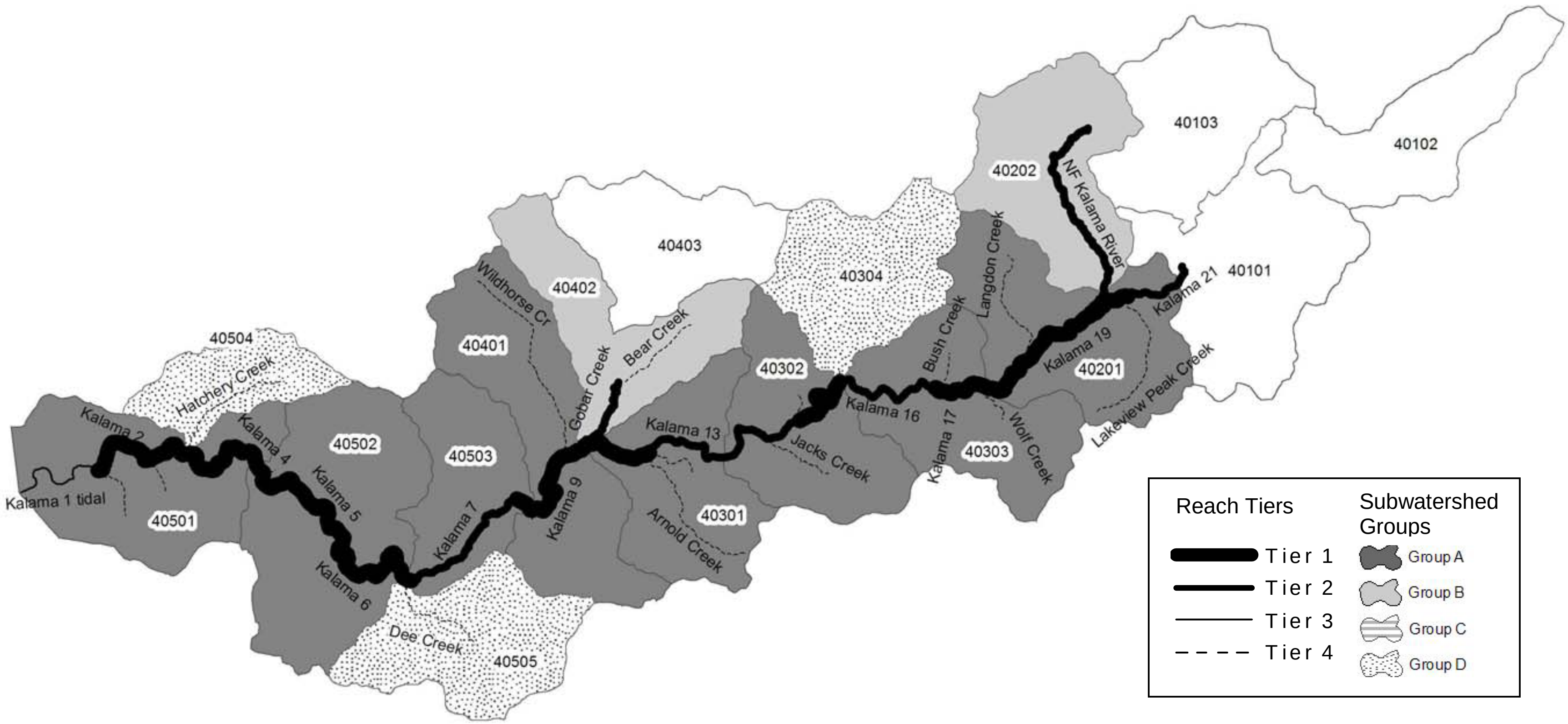


Figure 10-4. Reach tiers and subwatershed groups in the Kalama Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities at the 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.

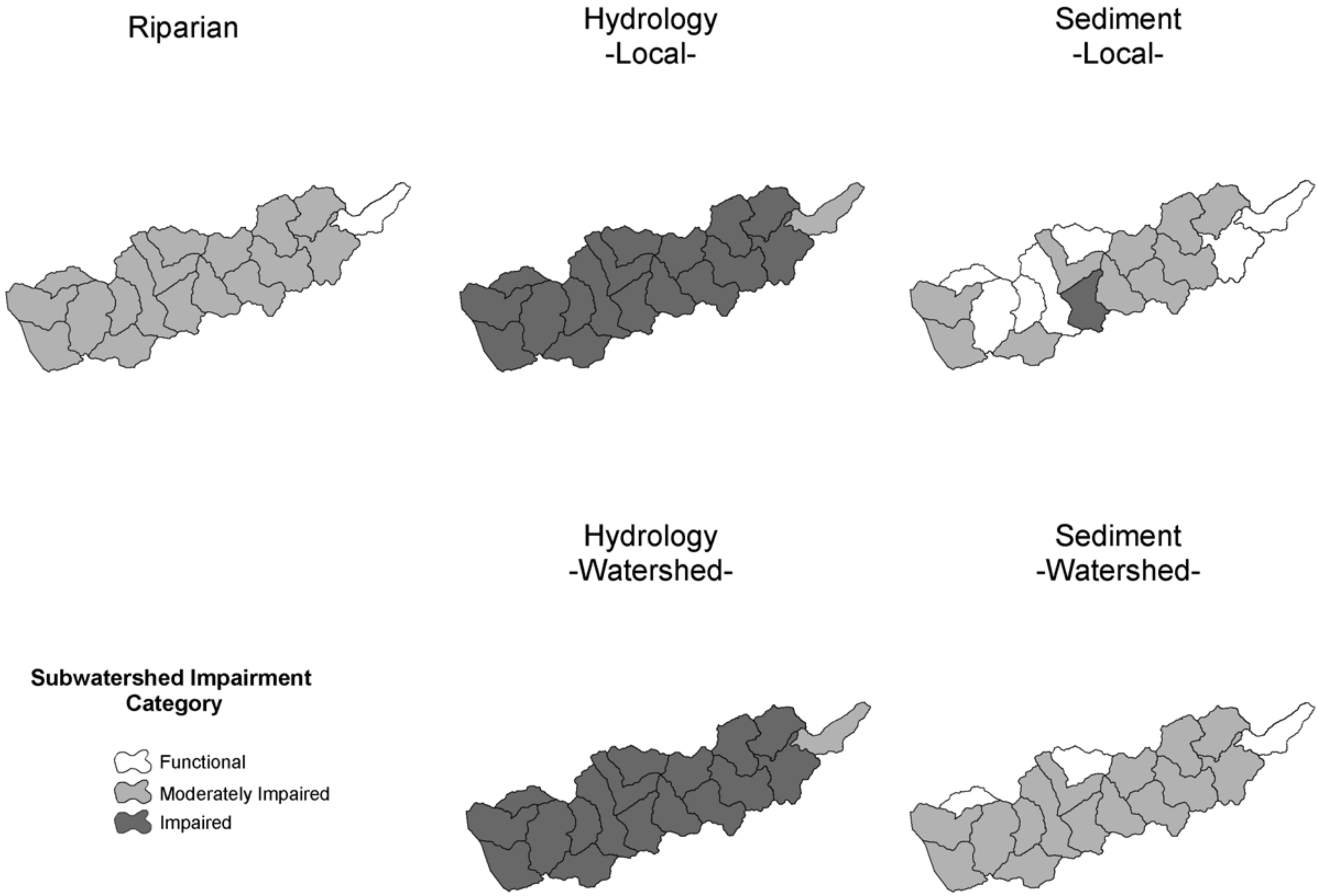


Figure 10-5. IWA subwatershed impairment ratings by category for the Kalama Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 10-5. 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	Subwatershed	Reaches within subwatershed	Species Present	High priority reaches by species	Critical life stages by species	High impact habitat factors	Restoration or preservation emphasis	Watershed processes (local) Hydrology	Watershed processes (local) Sediment	Watershed processes (local) Riparian	Watershed processes (watershed) Hydrology	Watershed processes (watershed) Sediment
A	40503	Kalama 7 Kalama 8 Summers Creek	StS	none				I	F	M	I	M
			StW	Kalama 8	egg incubation summer rearing winter rearing	habitat diversity sediment	PR					
			ChS	Kalama 8	spawning egg incubation fry colonization	sediment	PR					
	40502	Kalama 5 Kalama 6 Lower Falls Indian Creek	StS	Kalama 6	summer rearing winter rearing adult holding	none	P	I	F	M	I	M
			StW	Kalama 5 Kalama 6	egg incubation fry colonization summer rearing winter rearing	none	R					
			ChS	Kalama 6	spawning egg incubation fry colonization	sediment	P					
			ChF	none								
			Chum	Kalama 5	spawning egg incubation fry colonization adult holding	none	P					
			Coho	none								
	40501	Kalama 1 tidal Kalama 2 Kalama 3 Kalama 4 Spencer Creek Cedar Creek	StS	none				I	M	M	I	M
			StW	Kalama 4	spawning egg incubation fry colonization summer rearing winter rearing	habitat diversity	R					
			ChS	none								
			ChF	Kalama 2 Kalama 3	spawning egg incubation fry colonization adult holding	habitat diversity sediment	PR					
			Chum	Kalama 2	spawning egg incubation fry colonization adult holding	habitat diversity	PR					
			Coho	Kalama 2 Kalama 3	spawning egg incubation fry colonization summer rearing winter rearing adult migrant	habitat diversity key habitat quantity	R					
	40401	Kalama 10 Kalama 9 Wildhorse Creek Knowlton Creek	StS	none				I	F	M	I	M
			StW	Kalama 10 Kalama 9	egg incubation summer rearing winter rearing	habitat diversity sediment	PR					
			ChS	Kalama 10 Kalama 9	egg incubation fry colonization summer rearing	habitat diversity sediment	P					
	40303	Bush Creek Kalama 16 Kalama 17 Wolf Creek	StS	Kalama 17	egg incubation summer rearing winter rearing	habitat diversity flow sediment	PR	I	M	M	I	M
			ChS	none								
	40302	Jacks Creek Kalama 14 Kalama 15 Lost Creek	StS	none				I	M	M	I	M
			ChS	Kalama 15	egg incubation fry colonization summer rearing	sediment	P					
	40301	Arnold Creek Kalama 11 Kalama 12 Kalama 13 Unnamed Creek	StS StW ChS	none none Kalama 11 Kalama 12	egg incubation fry colonization summer rearing	habitat diversity sediment	P	I	I	M	I	M
	40201	Kalama 18 Kalama 19 Kalama 20 Kalama 21 Lakeview Peak Creek Langdon Creek	StS	Kalama 18 Kalama 19 Kalama 20	egg incubation summer rearing winter rearing adult holding	habitat diversity flow sediment	PR	I	M	M	I	M
			ChS	none								
B	40402	Bear Creek Gobar Creek	StS	none				I	M	M	I	M
			StW	none								
	40202	North Fork Kalama River	StS	none				I	M	M	I	M
D	40505	Little Kalama River	StW	none				I	M	M	I	M
	40504	Hatchery Creek	ChF	none				I	F	M	I	F
			Chum	none								
			Coho	none								
	40304	Elk Creek	StS	none				I	M	M	I	M

Table 10-6. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the lower Kalama mainstem (LM), middle Kalama mainstem & tributaries (MK), and the upper Kalama mainstem & tributaries (UK). Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors				Threats			
	LM	MK	UK		LM	MK	UK
Habitat connectivity				***Agriculture/grazing***			
Blockages to stream channel habitats	✓	✓		Clearing of vegetation	✓		
Habitat diversity				Riparian grazing	✓		
Lack of stable instream woody debris	✓	✓	✓	Floodplain filling	✓		
Altered habitat unit composition	✓	✓	✓	***Rural development***			
Loss of off-channel and/or side-channel habitats	✓			Clearing of vegetation	✓		
Riparian function				Floodplain filling	✓		
Reduced bank/soil stability	✓	✓	✓	Roads – riparian/floodplain impacts	✓		
Exotic and/or noxious species	✓			***Forest practices***			
Reduced wood recruitment	✓	✓	✓	Timber harvests – impacts to sediment supply	✓	✓	✓
Floodplain function				Timber harvests – impacts to runoff	✓	✓	✓
Altered nutrient exchange processes	✓			Riparian harvests	✓	✓	✓
Reduced flood flow dampening	✓			Forest roads – impacts to sediment supply	✓	✓	✓
Restricted channel migration	✓			Forest roads – impacts to runoff	✓	✓	✓
Disrupted hyporheic processes	✓			Forest roads – riparian / floodplain impacts		✓	✓
Stream flow							
Altered magnitude, duration, or rate of change	✓	✓	✓				
Substrate and sediment							
Excessive fine sediment	✓	✓	✓				
Embedded substrates	✓	✓	✓				

Table 10-7. Habitat measures in priority areas, with reference to limiting factors addressed, threats addressed, target species, and estimated time until benefits would be realized (time). Tier 1 and 2 reaches, or other areas of known priority, are listed under the location column for some measures (i.e., stream corridor measures). Reaches not included in the table (Tier, 3, 4, and non-tiered reaches) are considered secondary priority.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
1. Protect and restore floodplain function and channel migration processes ***A. Set back, breach, or remove artificial channel confinement structures***					
Lower mainstem Kalama 2	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes	• Floodplain filling • Channel straightening • Artificial confinement	• Chum • Coho • Fall chinook	2-15 years	Great potential benefit due to improvements in many limiting factors. This passive restoration approach can allow channels to restore naturally once confinement structures are removed. There are challenges with implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense.
2. Protect and restore off-channel and side-channel habitats ***A. Restore historical off-channel and side-channel habitats where they have been eliminated*** ***B. Provide access to blocked off-channel habitats*** ***C. Create new off-channel or side-channel habitats (i.e., spawning channels)***					
Lower mainstem Kalama 2	• Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats • Altered habitat unit composition	• Floodplain filling • Channel straightening • Artificial confinement	• Chum • Coho	2-15 years	Good potential benefit especially for chum, which have lost a significant portion of historically available off-channel habitat for spawning. Potential benefit is limited by moderate probability of success with creation of new habitats. There are challenges with implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense.
3. Protect and restore riparian function ***A. Reforest riparian zones*** ***B. Allow for the passive restoration of riparian vegetation*** ***C. Livestock exclusion fencing*** ***D. Invasive species eradication*** ***E. Hardwood-to-conifer conversion***					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
Lower mainstem Kalama 2-6 ***Middle mainstem & tributaries*** Kalama 8-12, Gobar Cr ***Upper mainstem & tributaries*** Kalama 15-20, NF Kalama	• Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or noxious species	• Riparian harvests • Riparian grazing • Clearing of vegetation due to rural development & agriculture • Roads – riparian/floodplain impact	• All species	20-100 years	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. Riparian protections on forest lands are provided for under current harvest policy. Riparian restoration projects are relatively inexpensive and are often supported by landowners. Whereas the specified stream reaches are the highest priority for riparian measures, riparian restoration and preservation should occur throughout the basin since riparian conditions affect downstream reaches. Use IWA riparian ratings to help identify restoration and preservation opportunities.
4. Protect and restore natural sediment supply processes ***A. Address forest road related sources*** ***B. Address timber harvest related sources***					
Entire basin	• Excessive fine sediment • Embedded substrates	• Forest roads – impacts to sediment supply • Timber harvest – impacts to sediment supply	• All species	5-50 years	High potential benefit due to sediment effects on egg incubation and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. Use IWA impairment ratings to identify restoration and preservation opportunities
5. Protect and restore runoff processes ***A. Address forest road impacts*** ***B. Address timber harvest impacts***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Timber harvest – impacts to runoff • Forest roads – impacts to runoff	• All species	5-50 years	High potential benefit due to flow effects on habitat formation, redd scour, and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. Use IWA impairment ratings to identify restoration and preservation opportunities.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
6. Protect and restore instream flows ***A. Water rights closures*** ***B. Purchase or lease existing water rights*** ***C. Relinquishment of existing unused water rights*** ***D. Enforce water withdrawal regulations*** ***E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Water withdrawals (potential)	• All species	1-5 years	Instream flow management strategies for the Kalama basin have been identified as part of Watershed Planning for WRIA 27 (LCFRB 2004). Strategies include water rights closures, setting of minimum flows, and drought management policies.
7. Protect and restore instream habitat complexity ***A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting*** ***B. Structurally modify stream channels to create suitable habitat types***					
Lower mainstem Kalama 2-6 ***Middle mainstem & tributaries*** Kalama 8-12, Gobar Cr ***Upper mainstem & tributaries*** Kalama 15-20, NF Kalama	• Lack of stable instream woody debris • Altered habitat unit composition	• None (symptom-focused restoration strategy)	• Coho • Winter steelhead • Summer steelhead	2-10 years	Moderate potential benefit due to the high chance of failure. Failure is probable if habitat-forming processes are not also addressed. These projects are relatively expensive for the benefits accrued. Moderate to high likelihood of implementation given the lack of hardship imposed on landowners and the current level of acceptance of these type of projects.
8. Protect and restore fish access to channel habitats ***A. Culverts and other barriers on tributary streams***					
Hatchery (Fallert) Creek ***Spencer Creek*** ***Summers Creek*** ***Arnold Creek*** ***Knowlton Creek*** ***Other small tribs***	• Blockages to channel habitats	• Dams, culverts, in-stream structures	• Coho • Winter steelhead • Summer steelhead	Immediate	As many as 14 miles of potentially accessible habitat are blocked by culverts or other barriers (approximately 15 barriers total). The Kalama Hatchery on Hatchery (Fallert) Creek is a potential passage barrier. 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.
9. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
A. Plan growth and development to avoid sensitive areas (e.g., wetlands, riparian zones, floodplains, unstable geology) ***B. Encourage the use of low-impact development methods and materials*** ***C. Apply mitigation measures to off-set potential impacts***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	The focus should be on management of land-use conversion and managing continued development in sensitive areas (e.g., wetlands, stream corridors, unstable slopes). Many critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary mechanisms need to be put in place to restore currently degraded habitats.
10. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection ***A. Purchase properties outright through fee acquisition and manage for resource protection*** ***B. Purchase easements to protect critical areas and to limit potentially harmful uses*** ***C. Lease properties or rights to protect resources for a limited period***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit. These programs are under-funded and have low landowner participation.

10.5 Program Gap Analysis

The Kalama Basin (~205 sq mi) is located in Cowlitz County:

- Sixteen square miles of the basin fall in the U.S. Forest Service-managed Mt St Helens National Volcanic Monument (NVM).
- Large industrial forest lands (~143 sq miles) are the largest land use;
- Department of Natural Resources forestlands encompass about 10 square miles.
- Small private commercial forestland acreage is estimated at 10 square miles.
- Rural residential, commercial, agriculture, and transportation corridors affect the lower mainstem reaches.

Protection Programs

Protection programs in this analysis include those programs that protect habitat conditions or watershed functions through management policies and programs, regulatory measures, and acquisition of sensitive habitat or protective easements.

Federal Programs

- ***U.S. Army Corps of Engineers***

  - Administers the Section 10 (Rivers and Harbor Act) and Section 404 (Clean Water Act) permit processes. Section 10 requires approval of any activity in, above, or below a navigable river, which affects course, location, condition, or capacity of navigable waters. Section 404 requires prior approval of dredging, filling, grading, clearing, and bank hardening. In waters used by listed fish species, the permits are subject to ESA Section 7 consultation with NOAA Fisheries to ensure that any approved action is adequately protective of the fish; [M.1A; M.2A; M.2B; M.4A; M.7A; M.7B]

- ***U.S. Forest Service***

  - Mt St Helens National Volcanic Monument: In 1982 the President and Congress created the 110,000-acre National Volcanic Monument for research, recreation, and education. Inside the Monument, the environment is left to respond naturally to the disturbance of the eruption. The Kalama Basin was not significantly impacted by the eruption of Mt St Helens and its headwaters in the Mt St Helens NVM have excellent protection. [M.3B; M.4A; M.4B; M.5A; M.5B]

State Programs

- ***Department of Natural Resources***

  - State Forest Land HCP:

    State forestlands are managed under the provisions of a Habitat Conservation Plan (HCP). The Habitat Conservation Plan protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. [M.3A; M.3B; M.4A; M.4B; M.5A; M.5B]

  - State Forest Practices:

    Riparian zones and harvest restrictions represent significant protections under the State of Washington Forest Practices Rules, including the Forest and Fish Module. These rules also establish standards for new road construction for management of sediment, runoff, and the potential for slope failure. [M.3A; M.3B; M.4A; M.4B; M.5A; M.5B]

- ***Washington Department of Fish and Wildlife***

  - Washington State Hydraulic Code

    The Washington State Hydraulic Code is administered through the Washington Department of Fish and Wildlife. The purpose of this program is to protect stream conditions and habitat. The regulations apply to such activities as stream bank protection, instream construction, culvert installation, channel changes or realignments, debris removal, and water diversion facilities. Those proposing such actions must obtain a Hydraulic Project Approval (HPA) permit; [M.1A; M.2A; M.2B; M.4A; M.7A; M.7B]

  - Habitat Program: The Department provides advice to local governments and landowners interested in measures to protect habitat values on their property. [M.1A; M.2A; M.2B; M.2C; M.3A; M.7A; M.7B; M.8A; M.9A; M.9B; M.9C]

- ***Washington Department of Ecology***

  - Water Resources Program/Water Rights: Department of Ecology, in consultation with the Department of Fish and Wildlife, has administrative closed selected areas within the Kalama basin watershed to further surface and groundwater withdraws (where groundwater is in continuity with surface water). Existing administrative closures by the Department of Ecology protect surface waters from further withdrawals. Formal rule-making would strengthen the closures. The extent of unauthorized surface water withdrawals is unknown, but, given the low intensity of development in the basin, is not expected to be significant. The City of Kalama holds the largest water right in the Kalama basin. It is low in the basin and will likely not affect stream flows in the near-term. [M.6A; M.6B; M.6C; M.6D]

  - Water Resources Program/Watershed Planning: In cooperation with the Lower Columbia Fish Recovery Board, other state and federal agencies, tribes, local governments, and citizens, the Department funds and participates in a state authorized watershed planning process for Water Resource Inventory Area (WRIA) 26 pursuant to RCW 90.82. The goal of the plan is to ensure adequate water for people and fish. The planning process is dealing with water quantity and quality, stream flows and fish habitat. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.6A; M.6B; M.6C; M.6D; M.6E; M.9A]

- ***Washington Department of Transportation***
  - Highway maintenance program implements best management practices for the protection of habitat. [M.8A]

- ***Conservation Commission/ Cowlitz Conservation District*** provides technical assistance and incentives (e.g., Conservation Reserve and Enhancement Program) to encourage agricultural landowners to protect riparian areas and stream habitat. These programs could help address measures M.1A; M.2A; M.2B; M.3A; M.3C; M.7A; M.7B; M.8A.

Local Government Programs

- ***Cowlitz County***
  - Land Use: [M.9A; M.9B; M.9C]
    - The comprehensive plan that applies to the non-federal lands, but contains no significant policies for the protection of watershed processes and stream habitat.
    - Zoning along county roads provides for one dwelling per 2 acres and one dwelling per 5 acres along non-county roads.
    - Cowlitz County has not adopted protective stream buffers.
    - Wetland buffers vary from 25’ to 200’ and are based upon soil type and wildlife utilization.
    - The County has not developed comprehensive ordinances for the protection of watershed processes or stream habitat conditions.
  - Road Maintenance
    The County has not developed or implemented a road maintenance program to protect habitat. [M.8A]

Community Programs

- ***Columbia Land Trust*** is a nonprofit organization whose mission is to preserve and restore unique landscapes, natural areas, and sensitive habitats. The Trust has been pursuing the acquisition of sensitive habitat within the Kalama basin. [M.10A; M.10B]

Restoration Programs

Restoration programs in the Kalama Basin are implemented by a variety of agencies, organizations, and private interests. Major programs implementing protection measures are identified below:

Federal Programs

- ***U.S. Forest Service***
  - *Mt St Helens NVM:* Restoration only occurs passively. Monitoring and evaluation of natural restoration occurs in the Kalama; [M.3B]

State Programs

- ***Washington Department of Natural Resources***
  - State Forest Land Habitat Conservation Plan (HCP): The Department manages state forest lands pursuant to a Habitat Conservation Plan (HCP). The HCP road maintenance and restoration objectives require barrier upgrades and road abandonment and/or other improvements. This program addresses measures M.3A, M.3B, M.4A, M.4B, M.5A, M.5B and M.8A.
  - State Forest Practices Act:
    - ✓ Industrial forests within the lower Kalama Basin are governed by Forest and Fish regulations and have rigid schedules for maintaining and improving roads and removing barriers. Industrial landowners have 15 years to bring roads and barriers into compliance with regulations.
    - ✓ Small private forest owners are governed by Forest and Fish regulations; however their road and barrier maintenance and improvement programs are tied to state funding. In the State 2003-05 Biennial Budget, 2 million dollars was allocated statewide to support small private forest owners.
    - ✓ This program addresses measures M.3A, M.3B, M.4A, M.4B, M.5A, M.5B, and M.8A.

- ***Washington Department of Fish and Wildlife***
  - Habitat Program: The Department provides advice to local governments and landowners interested in measures to restoring watershed processes and stream habitat. [M.1A; M.2A; M.2B; M.2C; M.3A; M.7A; M.7B; M.8A; M.9A; M.9B; M.9C]

- ***Washington Department of Ecology***
  - Water Quality Program: The Kalama River and Hatchery (Fallert) Creek are listed for temperature impairment on the WA State 303(d) list.
  - Water Resources Program/Watershed Planning:

The planning process for WRIA 26 is dealing with water quantity and quality, stream flows and fish habitat. Potential restoration efforts address improving summer low flows through conservation and acquisition of water rights. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.6A; M.6B; M.6C; M.6D; M.6E; M.9A]

- ***Conservation Commission/ Cowlitz Conservation District*** provides technical assistance and incentives (e.g., Conservation Reserve and Enhancement Program) to encourage agricultural landowners to protect riparian areas and stream habitat. These programs could help address measures M.1A; M.2A; M.2B; M.3A; M.3C; M.7A; M.7B; M.8A.

- ***Salmon Recovery Funding Board (SRFB)/Lower Columbia Fish Recovery Board***

  - Washington Salmon Recovery Act: The SRFB and the LCFRB jointly administer a grant program that allocates federal Pacific Salmon Recovery Funds and State funds for habitat protection and restoration projects by state and local agencies, nonprofit organizations, and landowners. To date over $700,000 has been granted for work on the Kalama on Wildhorse Creek. [M.1A; M.2A; M.2B; M.2C; M.3A; M.7A; M.7B; M.8A; M.10A]

Local Government Restoration Program

- ***Cowlitz County***
  - Public Works Program:
    The County inventoried culverts on county roads and is replacing and/or upgrading barrier culverts. Removal of a barrier culvert at the confluence of wildhoures Creek and the Kalama opened 10 miles of habitat to salmon and steelhead.[M.9A]

  - Cowlitz Noxious Weed Control Board: The Board has three primary programs that address weed control in the lower Cowlitz Basin; [M.3D]
    - Public education to prevent the spread of noxious weeds;
    - Survey County lands to assess emerging issues; and
    - Enforcement of noxious weed control

Community Programs

- ***Lower Columbia Fly Fishers*** is a non-profit organization that works with landowners and sport fisherman to preserve and restore reaches in the basin. The group sponsors a supplementation program.

Gap Analysis

Forest-related Programs**:** Ninety percent of the Kalama Basin is in forest use. Accordingly, forestry programs play a substantial role in protecting and restoring watershed functions and habitat conditions at levels supporting recovery goals. Certainty of forestry-related protection and restoration programs is relatively high because programs are being implemented and, for the most part, fully funded. Program areas of concern include state funding for small commercial forest landowners and the continued potential for hydrologic impacts caused by past harvest practices. Monitoring of watershed processes and habitat conditions will be required to confirm the effectiveness of these measures.

Protection-related Programs: Cowlitz County land use regulations provide limited watershed and habitat protection. County programs lack effective provisions that commonly are used to direct growth away from sensitive habitat, preserve watershed processes, protect streams and wetlands, and manage stormwater. Although agriculture is a minor use within the basin, there are no effective measures to protect riparian areas and stream habitats from its effects.

Restoration-related Programs: Over a long period of time, improvements to the Kalama Basin will occur as a result of improved forest management practices that are already in place. Active restoration in the lower mainstem should focus on impaired channel stability and habitat diversity.

Table 10-8. Program Actions to Address Gaps

Action #	Lead Agency	Proposed Action
KALAMA.1	Cowlitz County	Develop and implement controls to adequately protect riparian areas to maintain currently functional and restored habitat around rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Require mitigation, where necessary, to offset unavoidable damage to habitat conditions in riparian management areas
KALAMA.2	Cowlitz County	Development and implement controls to protect historic stream meander patterns and channel migration zones and avoid hardening stream banks and shorelines
KALAMA.3	Cowlitz County	Development and implement controls and development standards to adequately protect wetlands, wetland buffers, and wetland function.
KALAMA.4	Cowlitz County	Develop and implement controls to address erosion and sediment run-off during (and after) construction to prevent sediment and pollutant discharge to streams, wetlands and other water bodies
KALAMA.5	Cowlitz County	Apply land use and resource protection code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
KALAMA.6	State of Washington	Provide state funding for small forest owners in the Kalama Basin to a level sufficient to achieve the road and barrier improvements of Forest and Fish on a schedule parallel to private industrial forest owners
KALAMA.7	Forest Managers LCFRB, and DFW	Identify and sequence early action forest-wide restoration projects that analysis indicates could provide significant benefits. In these cases, it may be appropriate to identify outside funding to initiate these early actions
KALAMA.8	LCFRB, USFS, WDNR. WSDOT, Cowlitz County, Kalama, private property owners.	Develop and implement a coordinated and strategic barrier removal program based on watershed fish priorities and ensuring an effective and efficient sequencing of barrier removal work.
KALAMA.9	Cowlitz County	Utilize a combination of public outreach/education and, incentives, and to promote (1) stewardship practices for protecting habitat and water quality and (2) landowner support of and participation in habitat restoration efforts.
KALAMA.10	State of	Close the Kalama Basin to further surface water withdrawals, including

	Washington (DOE, DFW)	groundwater in connectivity with surface waters; curtail unauthorized withdrawals
KALAMA.11	LCFRB, WDFW, Cowlitz County, Cowlitz CD, LCFEG	Build capacity (e.g. technical and administrative skills, personnel and fiscal resources) needed to allow agencies and organizations to undertake protection and restoration projects, including noxious weed control in a reasonable period time.
KALAMA.12	SRFB, BPA, NOAA, USFWS, DOE, ACOE	Increase available funding for projects that implement measures and address underlying threats
KALAMA.13	State of Washington (Dept of Agriculture, and Department of Ecology)	Develop and implement agricultural practices and regulations to protect riparian conditions and water quality
KALAMA.14	Cowlitz Conservation District	Expand landowner incentive (e.g. CREP) and education plans to promote further habitat protection and restoration.
KALAMA.15	LCFRB, Cowlitz CD, Cowlitz County,	Address threats proactively by building agreement on priorities among the various program implementers
KALAMA.16	FEMA	Update floodplain maps using Best Available Science

11 Lewis Subbasin - Lower North Fork Lewis

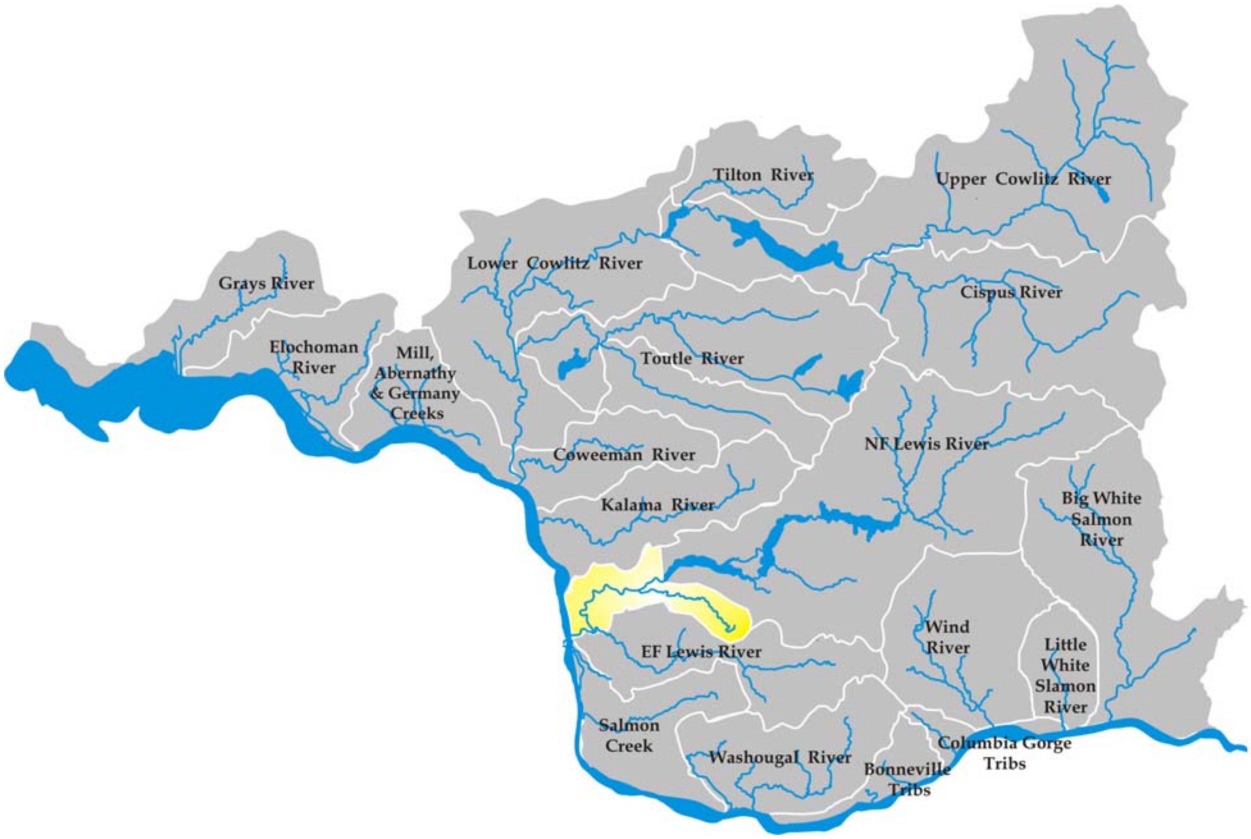


Figure 11-1. Location of the Lower North Fork Lewis River Basin within the Lower Columbia River Basin.

11.1 Basin Overview

The Lower North Fork Lewis Basin comprises approximately 100 square miles in Clark County. The river enters the Columbia at RM 87, between Ridgefield and Woodland, Washington. The principal tributary is Cedar Creek, and the upper end of the subbasin is marked by Merwin Dam. The basin is part of WRIA 27.

The Lower North Fork Lewis Basin will play a key role in the recovery of salmon and steelhead. The basin has historically supported populations of fall and spring Chinook, winter and summer steelhead, chum, and coho. Today, Chinook, steelhead and chum are listed as threatened under the ESA. Coho salmon are a candidate for listing. Other fish species of interest are Pacific Lamprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

Lower North Fork Lewis salmon and steelhead are affected by a variety of in-basin and out-of basin factors including stream, Columbia River mainstem, estuary, and ocean habitat conditions; harvest; hatcheries; and ecological relationships with other species. Analysis has demonstrated that recovery cannot be achieved by addressing only one limiting factor. Recovery will require action to reduce or eliminate all manageable factors or threats. The deterioration of habitat conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonids within the Columbia Basin. Direct harvest of listed salmon and steelhead is prohibited but sport and commercial fisheries focusing on hatchery fish and other healthy wild populations, primarily in the mainstem Columbia and ocean, incidentally affect ESA-listed lower North Fork Lewis fish. Lewis River, Speelyai, and Merwin hatcheries operate within the basin with the potential to both adversely affect wild salmon and steelhead populations and to assist in recovery efforts. Key ecological interactions of concern include effects of non-native species; nutrient inputs from salmon carcasses; and predation by species affected by development including Caspian terns, northern pikeminnow, seals, and sea lions. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the Lower North Fork Lewis Subbasin.

The bulk of the land is forested and a large percentage is managed as commercial forest. Agriculture and residential activities are found in valley bottom areas. Recreation uses and residential development have increased in recent years. Stand replacement fires, which burned large portions of the basin between 1902 and 1952, have had lasting effects on basin hydrology, sediment transport, soil conditions, and riparian function. The largest of these was the Yacolt Burn in 1902. Subsequent fires followed in 1927 and 1929.

The Lower North Fork Lewis Basin has experienced intensive watershed development along the mainstem Lewis, Cedar Creek, and the lower reaches of many tributaries. Timber harvests and road building have been widespread in the middle and upper elevation areas, which mostly lie within private commercial timberland.

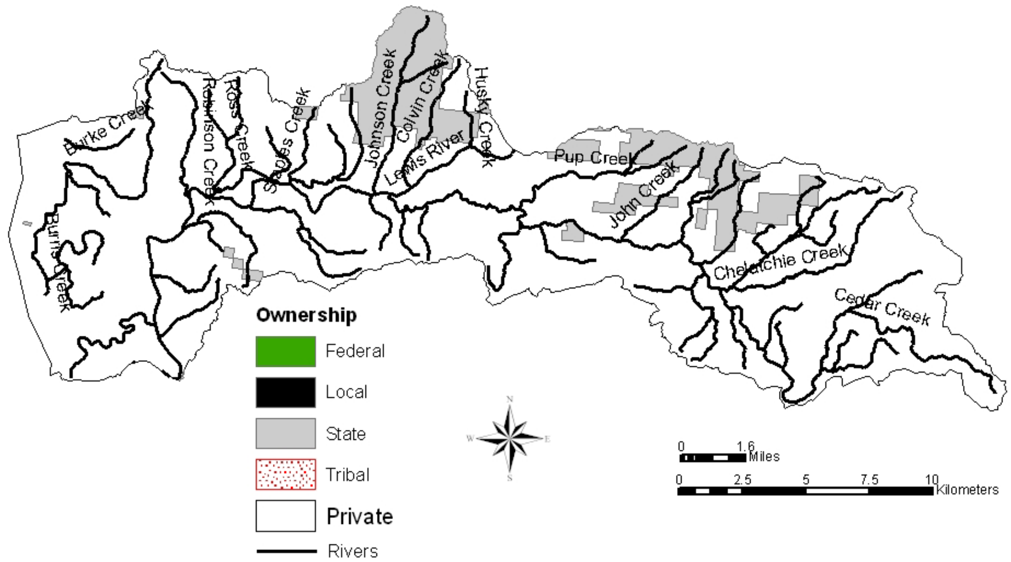
The most important aquatic habitat areas in the basin are upper Cedar Creek, lower Cedar Creek, and the mainstem Lewis between tidal influence and Cedar Creek. Upper Cedar Creek is very important for steelhead spawning and rearing, however, production is severely limited by habitat diversity, flow, and sediment issues that are related to the high degree of timber harvest and road building that occurred in the upper basin during the 1980s and 1990s. Lower Cedar Creek is also important for steelhead, in particular for parr rearing. These reaches are impacted by impaired sediment and flow processes stemming from upper basin logging/road building, but they also suffer from localized riparian impacts from agriculture and grazing.

The mainstem Lewis between tidal influence and the Cedar Creek confluence has lost a significant amount of habitat due to artificial confinement. An estimated 50% of the historical floodplain has been disconnected from the river. Habitat diversity is severely limited in this straightened and simplified channel. Riparian function is impaired due to development within riparian areas. Historical fall Chinook, chum, and coho production has been reduced as a result of habitat degradation in these reaches. Further degradation would pose great risks to the existing low levels of natural production.

The population of the basin is small. The 2000 population of the entire NF Lewis (including the Upper NF Lewis) was approximately 14,300 persons (LCFRB 2001). Small rural communities include Chelatchie and Amboy (Cedar Creek drainage). The largest population center is Woodland, which is situated on the lower mainstem. The population of Woodland is expected to grow by 233% between 2000 and 2020. 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.

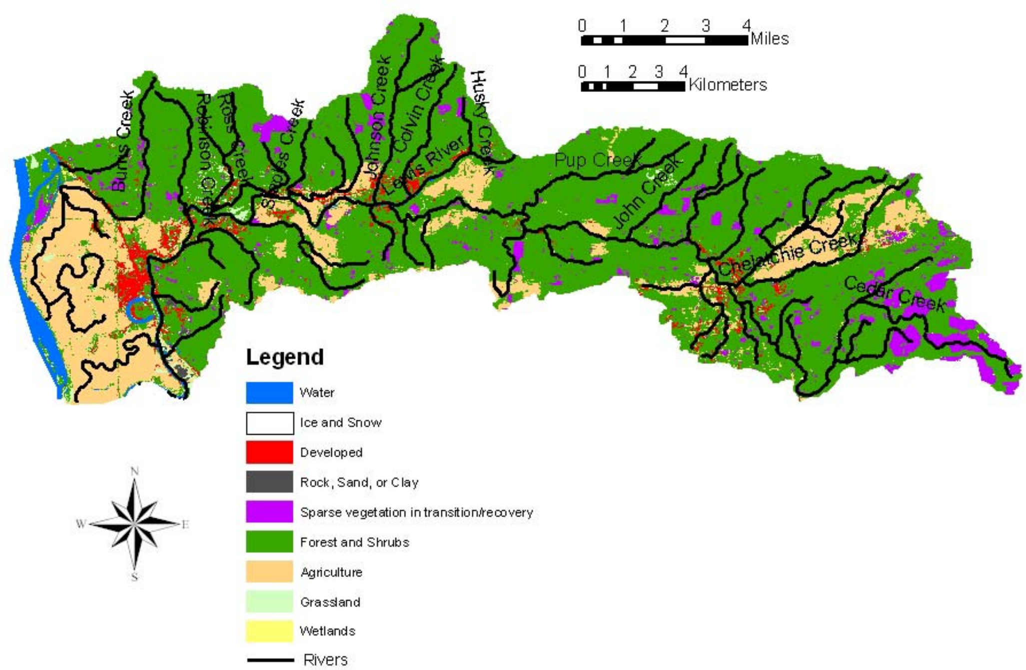
Land Ownership	
Private	84%
State	16%
Federal	0%
Other public	0%

Land Ownership



Vegetation Composition	
Late Seral	0%
Mid Seral	20%
Early Seral	2%
Other Forest	57%
Non Forest	21%

Land Use / Cover



11.2 Species of Interest

Focal salmonid species in the North Lewis River (including the upper Lewis basin) include fall Chinook, spring Chinook, chum (same as EF Lewis population), coho, winter steelhead, and summer steelhead. The current health or viability of the focal populations is very low for all, except low for winter steelhead and medium+ for fall Chinook. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Recovery goals call for restoring Chinook and chum to a high or very high viability level. This level will provide for a 95% or better probability of population survival over 100 years. Winter steelhead and coho recovery goals call for restoring viability to a medium level which would provide for a 75-95% chance of survival over the next 100 years. Summer steelhead viability recovery goals are very low and provide for a less than 40% chance of persistence over the next 100 years.

Other species of interest in the North Fork Lewis include coastal cutthroat trout and Pacific lamprey. Regional objectives for these species are described in Volume I, Chapter 6. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for these other species. Cutthroat will benefit from improvements in stream habitat conditions for salmonids. Lamprey are also expected to benefit from habitat improvements in the estuary, Columbia River mainstem, and lower North Fork Lewis subbasin although specific spawning and rearing habitat requirements of lamprey are not well known.

Table 11-1. Current viability status of lower North Fork Lewis 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	Med+	3,200-18,000	High+	6,500-16,600
Spring Chinook	Threatened	Yes	Very low	200-1,000	High	NA
Chum	Threatened	No	Very low	<100	High	1,100-71,000
Winter Steelhead	Threatened	Yes	Low	Unknown	Medium	NA
Summer Steelhead	Threatened	Yes	Very low	Unknown	Very low	600-1,200
Coho	Candidate	Yes	Very low	Unknown	Medium	Unknown

Fall Chinook– The historical North Lewis River fall Chinook adult population is estimated from 18,000-20,000 fish. Current natural spawning returns range from 3,200-18,000. The North Lewis fall Chinook population exceeds WDFW's escapement goal in most years and was considered healthy in WDFW's 2002 stock assessment. There is no hatchery fall Chinook program in the North Lewis. Spawning is primarily concentrated in four miles of river immediately downstream of Merwin Dam. Natural spawning occurs later than most other lower Columbia fall Chinook populations, extending from late October through January and peaking in mid-November. Juvenile rearing occurs near and downstream of the spawning area, most notably in the Eagle Island area. Juveniles emerge in early spring and migrate to the Columbia in late spring and summer of their first year.

Spring Chinook– The historical North Lewis River adult population estimate is from 10,000-50,000 fish. Current natural spawning returns range from 200-1,000 and are almost entirely hatchery produced fish. Historical spawning was almost entirely in the upper Lewis Basin which was blocked by Merwin Dam in 1931. Spring Chinook are expected to be reintroduced above the hydrosystem in the near future. The majority of upper Lewis spawning habitat is above Swift Reservoir in the main North Lewis, the Muddy River, Clearwater Creek, and Clear Creek. Spawning in the lower North Lewis occurs in the first 2 miles below Merwin Dam and in Cedar Creek. Spawning occurs in late August and September. Juveniles rear in the Lewis Basin for a full year before migrating to the Columbia in the spring.

Winter Steelhead– The historical North Lewis River adult population is estimated from 6,000-24,000 fish. Current natural spawning returns are presumed to be very low and are limited to habitat below Merwin Dam. Winter steelhead are expected be reintroduced to habitats upstream of the Lewis River hydrosystem in the near future, where the majority of winter steelhead habitat is available. The preferred stock for reintroduction is late-timed wild winter returning to the North Lewis and trapped at Merwin Dam. Spawning occurs in the lower North Lewis and tributaries below Merwin Dam, most notably in Cedar Creek. The majority of habitat in the upper Lewis is in the main North Lewis and tributaries upstream of Swift Dam. 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 Lewis basin.

Summer Steelhead– The historical North Lewis River adult population is estimated as high as 20,000 fish. Current natural spawning returns are presumed to be very low. Habitat assessments indicate that North Lewis summer steelhead were historically present upstream of Merwin Dam, but in small numbers in tributaries of Merwin Reservoir. Current spawning occurs in the lower North Lewis and tributaries below Merwin Dam, most notably in Cedar Creek. Skamania stock hatchery summer steelhead are released into the North Lewis basin for harvest opportunity. Wild summer steelhead 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 Lewis Basin.

Coho– The historical North Lewis River adult population is estimated from 7,500-85,000 fish. Both early and late stocks were present historically, with early stock primarily spawning in the upper Lewis. Current returns are unknown but assumed be low and limited to the habitat downstream of Merwin Dam. Early coho are expected to be reintroduced to the habitat upstream of the hydrosystem in the near future. Natural spawning currently occurs in tributaries below Merwin Dam including Ross, Johnson, Colvin, NF and SF Chelatchie, and Cedar creeks. A number of hatchery produced fish spawn naturally. Early stock coho spawn from late October into November and late stock spawn from late November to March. Juvenile rearing occurs upstream and downstream of spawning areas. Juveniles rear for a full year in the Lewis Basin before migrating as yearlings in the spring.

Chum– Historical adult populations produced from the Lewis Basin (including the mainstem, North, and East Lewis) are estimated from 120,000-300,000. Current natural spawning is estimated at less than 100 fish. Natural spawning occurs in the lower reaches of the mainstem, North Fork, East Fork, and in Cedar Creek. Adult spawning peaks in December. Chum in the Lewis Basin are all naturally-produced as no hatchery chum are released in the area. Juveniles rear in the lower reaches for a short period in the early spring and quickly migrate to the Columbia.

Bull Trout– There may have been both fluvial and resident bull trout populations in the North Lewis River historically. The current bull trout populations in Swift and Yale reservoirs are isolated because there is no upstream passage at the dams. Genetic samples show significant differences between these populations indicating there may have been biological separation prior to construction of Swift Dam in 1958. Current peak counts of spawners in Cougar Creek range from 0-40 fish, and Swift Reservoir spawning population estimates range from 100-900 fish.

Spawning occurs primarily in Cougar Creek (Yale population), and in Pine and Rush creeks (Swift population).

Coastal Cutthroat– Coastal cutthroat abundance in the North Lewis River has not been quantified but the population is considered depressed. Anadromous cutthroat trout are present in in the North Fork Lewis and tributaries upstream to Merwin Dam, resident forms are present throughout the basin, and adfluvial forms are present in the reservoirs. Anadromous cutthroat enter the North Lewis from July-December and spawn from December to June. Most juveniles rear 2-3 years before migrating from their natal stream.

Pacific lamprey– Information on lamprey abundance is limited. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have also declined in the Lewis Basin. The UFWS coducted lamprey studies in Cedar Creek in 2000 and 2001. Their data indicates notable lamprey presence, primarily Pacific lamprey, but also western brook lamprey in Cedar Creek. The adult lamprey return from the ocean to spawn in the spring and summer. Juveniles rear in freshwater up to 6 years before migrating to the ocean.

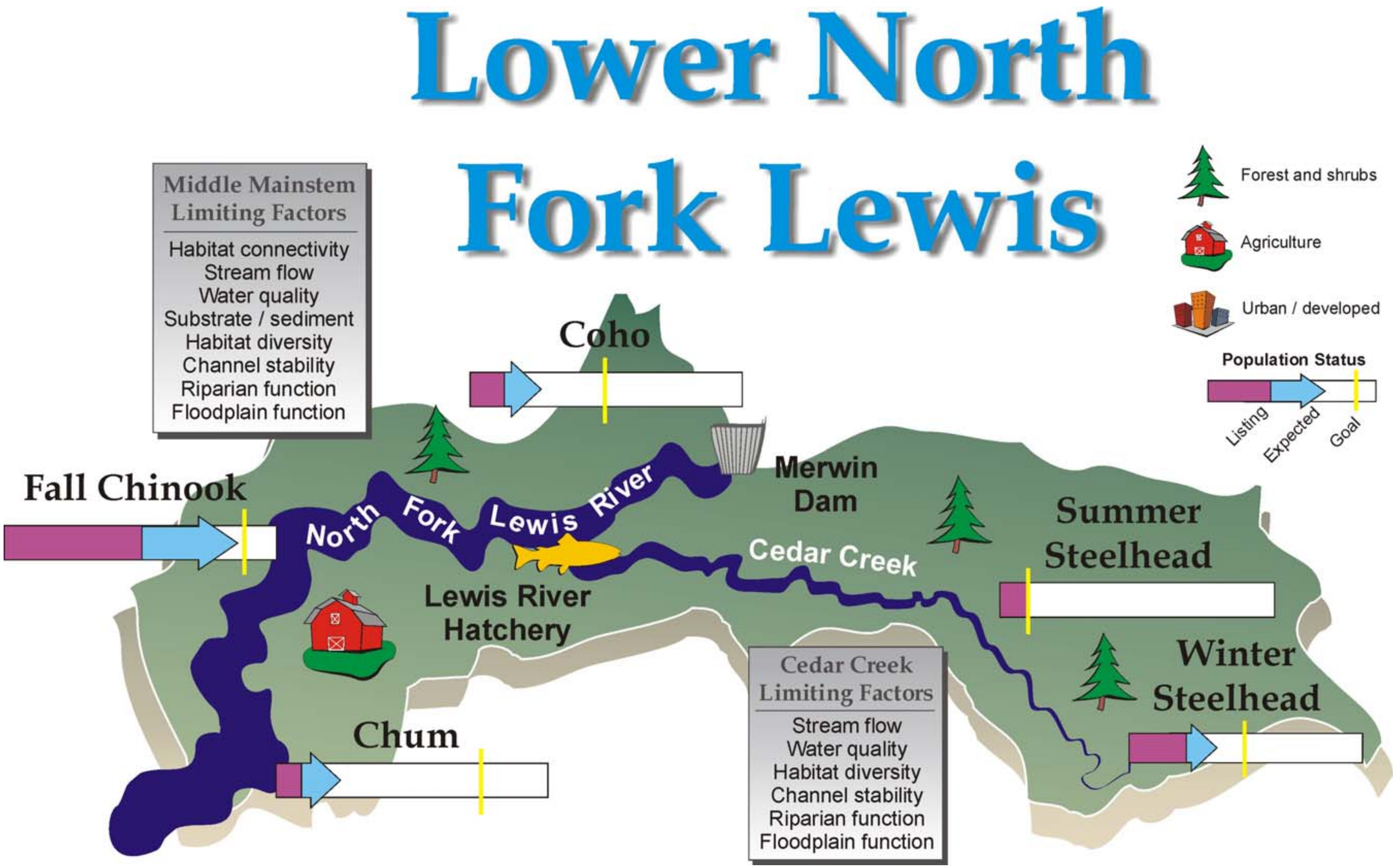


Figure 11-2. Summary of habitat limiting factors, population status, expected population improvement trend with existing programs, and biological objectives depicted for the Lower North Fork Lewis Basin.

11.3 Potentially Manageable Impacts

Stream habitat, estuary/mainstem habitat, harvest, hatchery and predation effects have all contributed to reduced salmonid productivity, numbers, and population viability in the North Fork Lewis Subbasin. The pie charts below represent the relative order of magnitude of quantifiable effects for each of these factors for each focal species. The preferred recovery scenario targets an equivalent reduction in each impact factor in proportion to the magnitude of the effect. Population-specific targets are discussed in further detail in Volume I, Chapter 6.

- Loss of tributary habitat quality and quantity is an important impact for all species, particularly for chum and steelhead. Loss of estuary habitat quality and quantity is also important, particularly for chum.
- Harvest has a large relative impact on fall Chinook and moderate impacts on coho and spring Chinook. Harvest effects on winter and summer steelhead and chum are minimal.
- Hatchery impacts include domestication of natural populations (most applicable to Chinook and coho) and ecological interactions which can impact all species to variable degrees.
- Predation impacts of northern pikeminnow, Caspian terns, and marine mammals in the mainstem and estuary are moderate for winter and summer steelhead, but appear to be less important for coho, chum, and fall Chinook.
- Hydrosystem access and passage impacts are significant for spring Chinook, winter steelhead, and coho.

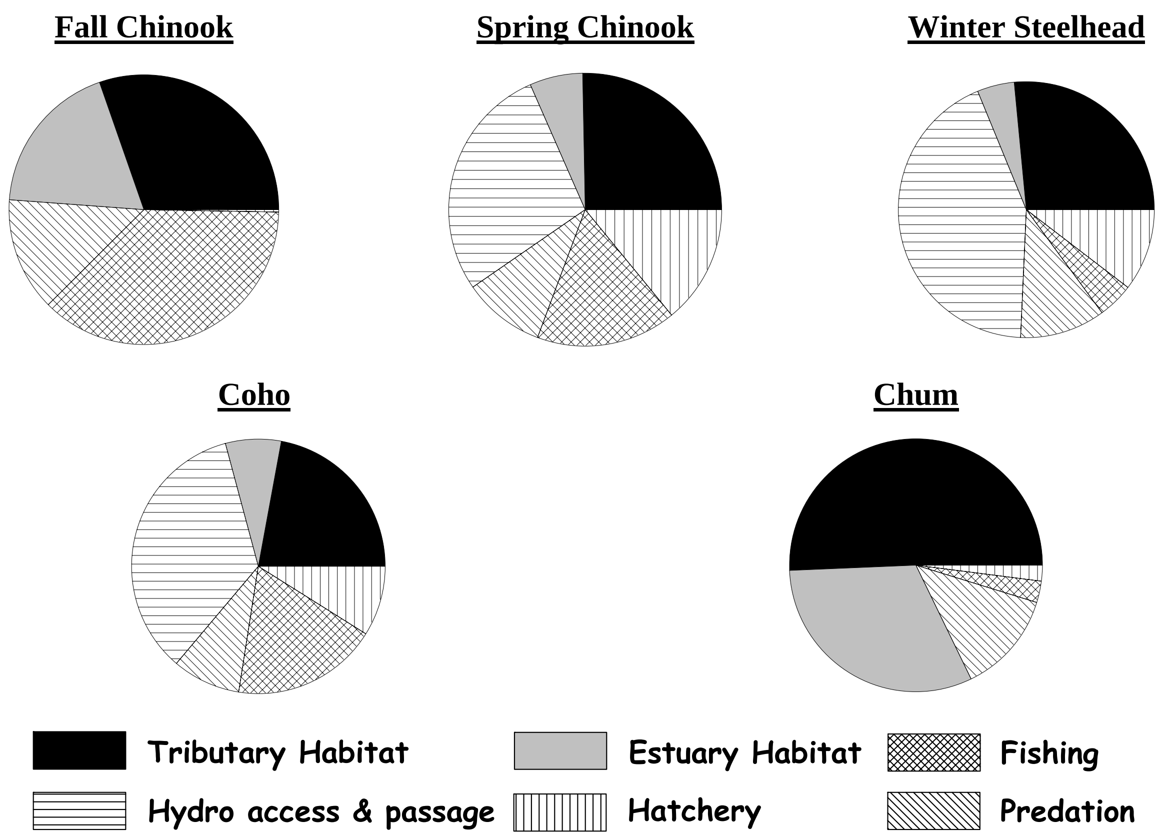


Figure 11-3. Relative contribution of potentially manageable impacts for lower North Fork Lewis populations.

11.4 Limiting Factors, Threats, and Measures

11.4.1 Hydropower Operation and Configuration

The three hydro-electric dams on the Lewis River are considered to be located in the upper Lewis basin. However, lower North Fork Lewis species, in particular fall Chinook, are affected by flow regimes from Lewis River hydro operations which effect spawning and rearing habitat in the lower Lewis. The quantity and quality of fall Chinook habitat in the lower Lewis 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 North Lewis 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 North Fork Lewis populations are displayed in the following table.

Table 11-2. Regional hydropower measure from Volume I, Chapter 7 with significant application to North Lewis 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 North Fork Lewis a, is affected by the water flow discharged at Merwin Dam. The operational plans for the Lewis 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.

11.4.2 Harvest

Most harvest of wild North Lewis salmon and steelhead occurs incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. This mortality is very low for chum and steelhead, but is more significant for fall Chinook. North Lewis fall and spring Chinook are harvested in ocean and Columbia River commercial and sport fisheries as well as in-basin sport fisheries. Ocean and freshwater harvest of fall Chinook is controlled by a spawning escapement goal of 5,700 adults in the North Lewis River. Wild spring Chinook impacts are limited by Columbia River and Lewis River fishery management provisions to retain fin-marked hatchery fish and release unmarked wild fish. No harvest of chum occurs in ocean fisheries, there is no directed Columbia River or Lewis basin chum fisheries and retention of chum is prohibited in Columbia River and Lewis River sport fisheries. Some chum can be impacted incidental to fisheries directed at coho and winter steelhead. Harvest of North Lewis 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 Lewis Basin. Wild coho impacts are limited by fishery management provisions to retain marked hatchery fish and release unmarked wild fish. 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.

Measures 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. The regional measures 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 Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest measures that have significant application to the lower North Lewis subbasin are summarized in the following table:

Table 11-3. Regional harvest measures from Volume I, Chapter 7 with significant application to North Lewis Subbasin populations.

Measure	Description	Comments
F.M17	Monitor chum handle rate in winter steelhead and late coho tributary sport fisheries.	State agencies would include chum incidental handle assessments as part of their annual tributary sport fishery sampling plan.
F.M18	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	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.M19	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	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.M24	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	Mass marking of lower Columbia River spring Chinook, 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.
F.M10	Manage ocean, Columbia River and tributary fisheries to meet the spawning escapement goal for lower Columbia bright fall Chinook.	Ocean and freshwater fisheries wuld continue to be managed to achieve the Lewis River wild fall Chinook escapement goal. The escapement goal would be assessed by WDFW and NOAA fisheries to assure consistency with biological objectives.
F.M30	Develop a harvest plan for wild spring Chinook as populations are reestablished.	Adaptively manage harvest to respond to biological objectives for reintroduced Lewis River spring Chinook as they become reestablished in the upper watershed.

11.4.3 Hatcheries

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

There are three hatcheries operating in the North Lewis Basin. The Lewis River Hatchery (since 1932) produces spring Chinook and coho for harvest as well as a sorting facility for all species trapped at Merwin Dam. The Lewis River Hatchery provides late coho eggs for the

Klickitat coho program and in some years spring Chinook pre-smolts for the Deep River program. The Lewis River Hatchery also provides spring Chinook and coho for the Fish First organization's net pen program. Speelyai Hatchery (since 1958) is located in Merwin Reservoir and is used for incubation and early rearing of spring Chinook, coho, and steelhead. Speelyai Hatchery also produces kokanee and rainbow trout for reservoir recreational fisheries. Merwin Hatchery (since 1983) produces early-timed winter and summer steelhead and rainbow trout. Merwin Hatchery also provides summer steelhead for the Elochoman program. These hatchery facilities and programs will be used in the near future to facilitate the reintroduction of spring Chinook, coho, and winter steelhead to the habitats in the Upper Lewis Basin

The Lewis River Hatchery spring Chinook and late coho programs are primarily derived from Cowlitz stocks, and the early coho program from Toutle stock. The early winter steelhead produced at Merwin Hatchery is a composite Elochoman, Chambers Creek, and Cowlitz steelhead, and the summer steelhead are Skamania stock. The main threats from hatchery released salmon are domestication of wild fish and ecological interactions between hatchery smolts and wild fall Chinook, chum, and coho in the lower river. 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 11-4. Lewis Basin hatchery production.

Hatchery	Release Location	Spring Chinook	Late Coho	Early Coho	Winter Steelhead	Summer Steelhead	Kokanee	Rainbow
Lewis R.	Lower Lewis	1,050,000	815,000	880,000				
Speelyai	Yale Res.						93,000	
	Swift Res.							400,000
Merwin	Lower Lewis				100,000	175,000		
	Elochoman					35,000		
	Swift Res.							400,000

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 Lewis 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). Regional hatchery measures identified in Volume I, Chapter 7 with potential applications at facilities within the Lewis subbasin are summarized in Table 11-5.

Table 11-5. Regional hatchery measures from Volume I, Chapter 7 with potential implementation actions in the Lewis Subbasin.

Measure	Description	Comments
H.M2,5,38	Integrated hatchery and wild program for reintroduced spring Chinook and early coho.	Assures fitness of the natural produced fish which will improve population productivity. Integrated programs would be developed specific to the Lewis populations in the BRAP procedure.
H.M30	Develop a late-timed winter steelhead broodstock to enhance the winter steelhead reintroduction program	Late-timed wild winter steelhead are the preferred stock to reintroduce above the Lewis River dams. The brood stock would be developed from wild winter steelhead entering the Merwin Trap.
H.M15, 22,32, 40	Juvenile release strategies to minimize interactions with naturally spawning fish.	Release strategies are aimed at reducing or avoiding interactions with wild steelhead, fall Chinook, coho, and chum by release timing and release location strategies.
H.M32,34,41	Mark hatchery steelhead, coho, and spring Chinook, with an adipose fin-clip for identification and selective harvest.	Marking hatchery fish allows for identification of hatchery fish in the natural spawning grounds and at collection facilities which enables accurate accounting of wild fish and sorting for the reintroduction program. Marking also enables selective fisheries to retain hatchery fish and release wild fish.
H.M24	Hatchery program utilized for supplementation and enhancement of lower Lewis chum populations.	The Lewis hatchery complex will be used for reintroduction of salmon and steelhead in the upper basin. Enhancement of chum in the lower North Lewis and East Fork Lewis could also be considered.
H.M8	Adaptively manage hatchery programs to further protect and enhance natural populations and improve operational efficiencies.	Appropriate research, monitoring, and evaluation programs along with guidance from regional hatchery evaluations will be utilized to improve the survival and contribution of hatchery fish, reduce impacts to natural fish, and increase benefits to natural fish.
H.M2,6	Evaluate the Lewis Salmon and Trout Hatcheries facility operations.	Both facilities would be evaluated in the BRAP process for potential hazards associated with barriers to fish passage and adequacy of screens.
H.M19, 29, 37	Hatcheries utilized for reintroduction of coho, spring Chinook, and winter steelhead into the upper Cowlitz basin.	Hatchery facilities and operations to accommodate the reintroduction effort; including rearing, collection, transport, marking, sorting, brood stock development, and M&E.

11.4.4 Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Lower North Fork Lewis salmon and steelhead are affected throughout their lifecycle by ecological interactions with non-native species, food web components, and predators. Interactions are similar for lower North Fork Lewis populations to those of most other subbasin salmonid populations. Ecological Interactions are addressed by regional strategies and measures identified in Volume 1.

11.4.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. 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 are similar for lower North Fork Lewis populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook than spring Chinook, steelhead, and coho. Estuary and mainstem effects on North Fork Lewis salmon populations are addressed by regional strategies and measures identified in Volume I and the Columbia Mainstem and Estuary Subbasin sections of Volume II.

11.4.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity have significantly altered watershed processes and reduced both the quality and quantity of habitat needed to sustain viable populations of salmon and steelhead. Although the hydropower system has the greatest negative impact on some lower North Fork populations, stream habitat conditions play a significant role in the health and viability of all salmon and steelhead populations.

Subwatersheds, reaches, and habitat attributes have been prioritized for protection and/or restoration based on the plan's biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Priority areas for habitat preservation and restoration are identified in Figure 11-4. A summary of the primary habitat limiting factors and threats are presented in Table 11-7. Habitat measures and related information are presented in Table 11-8. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 11-5. Reach- and subwatershed-scale limiting factors generated from the technical assessment are included in Table 11-6. Details on species-specific spatial priorities and limiting factors at the subbasin level may be found in Volume II of the Technical Foundation. A description of the methodology used to generate composite (multi-species) reach and subwatershed priorities can be found in the introduction to this volume of the recovery plan.

The areas with the greatest current or potential contribution to focal salmonid population health and productivity are listed below. Tier 1 and 2 reaches within these priority areas are included in the list. The habitat limiting factors, threats, and measures included in this chapter focus primarily on the priority areas and the Tier 1 and 2 reaches within them. Tier, 3, 4, and non-tiered reaches are considered secondary priority, but in many cases, these lower priority areas will also require restoration and preservation actions in order to achieve recovery objectives. Watershed process measures generally focus on the entire basin as opposed to being limited only to high priority areas because conditions in high priority areas are often influenced by cumulative watershed effects. High priority areas and reaches in the lower NF Lewis Basin include the following:

- Middle mainstem Lewis – Lewis 3-7
- Cedar Creek – Cedar 1a, 1b, 3, & 4.

The following paragraphs provide a brief overview of each of these priority areas, including species most affected, land-use threats, and the general type of measures that will be necessary for recovery. Additional detail can be found in the tables and figures that follow.

While reach level habitat conditions often result from local factors, they are also affected or shaped by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input and large woody debris recruitment are often affected by or result from upstream conditions and degraded watershed processes. Access to key reaches may also be affected by barriers that occur downstream of a reach. Accordingly, restoration of a priority reach may require action outside the targeted reach. The IWA analysis was used to identify potential upstream watershed areas that could influence reach level habitat attributes. EDT was used to allow a relative comparison of reaches and habitat attributes within a reach.

The most critical reaches in the middle mainstem Lewis lie between Ross Creek and Merwin Dam. These reaches are most important for chum, fall Chinook, and coho. Winter steelhead also utilize these reaches. The middle mainstem basin is largely in private land ownership with some areas of state forest land. Hydropower operations, agriculture, and rural development have the greatest impacts. The recovery emphasis is for preservation as well as restoration. Effective recovery measures in the middle mainstem will involve managing regulated flows from the hydropower system, addressing agricultural and rural/suburban development impacts to floodplains and riparian areas, and ensuring that land-use planning effectively protects habitat and watershed processes.

Cedar Creek reaches are most important for winter steelhead, though other species make limited use of these habitats. Lower Cedar Creek (mouth to Pup Creek) (Cedar Creek 1a) and the reach downstream of the Chelatchie Creek confluence (Cedar Creek 3) are the most critical. Forest practices on private commercial timber lands in the upper watershed have impacted sediment supply and hydrologic processes in Cedar Creek reaches. Agriculture and rural residential uses have impacted riparian areas and floodplains. Recovery measures will need to address agricultural impacts along stream corridors and forest practices in the upper basin.

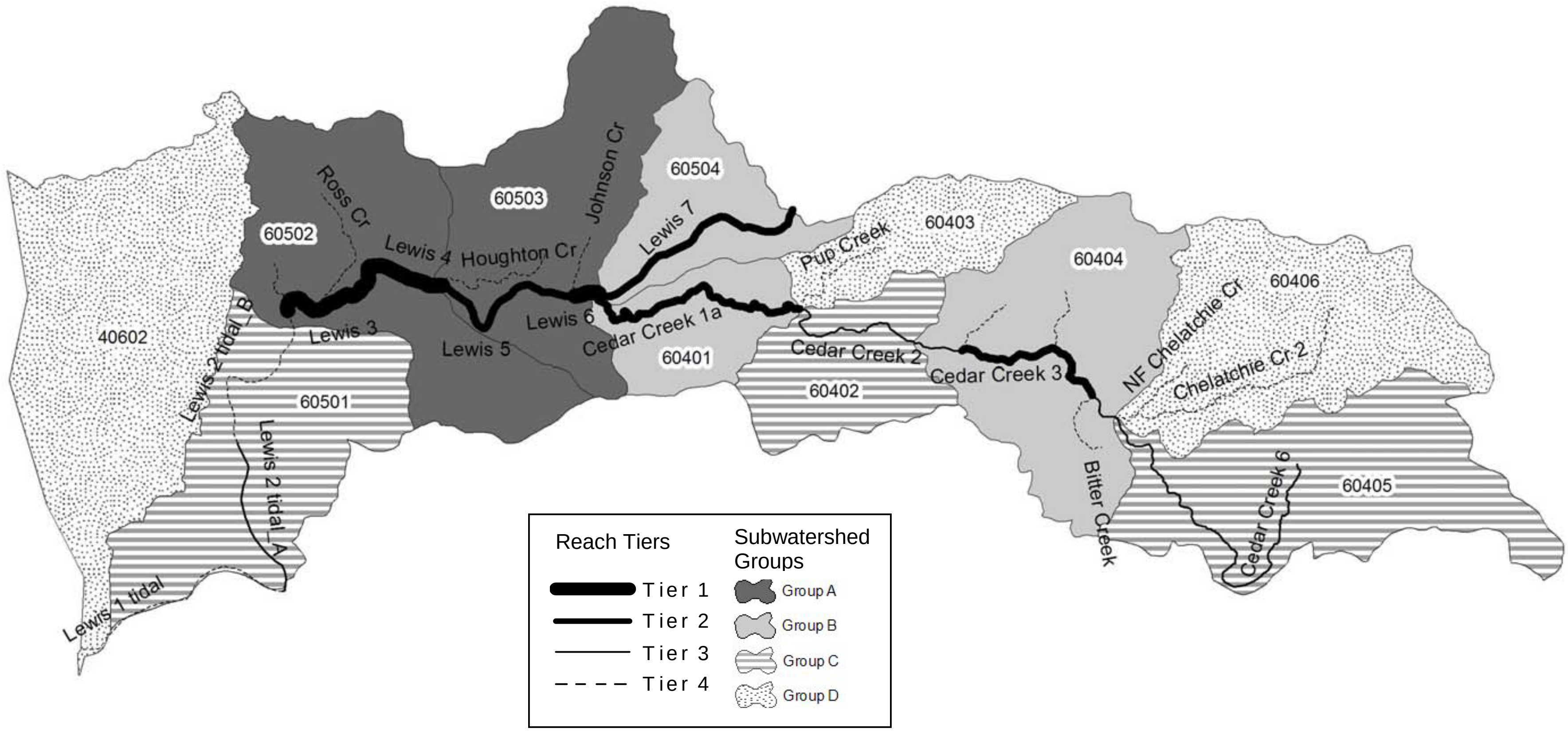


Figure 11-4. Reach tiers and subwatershed groups in the lower NF Lewis Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities 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.

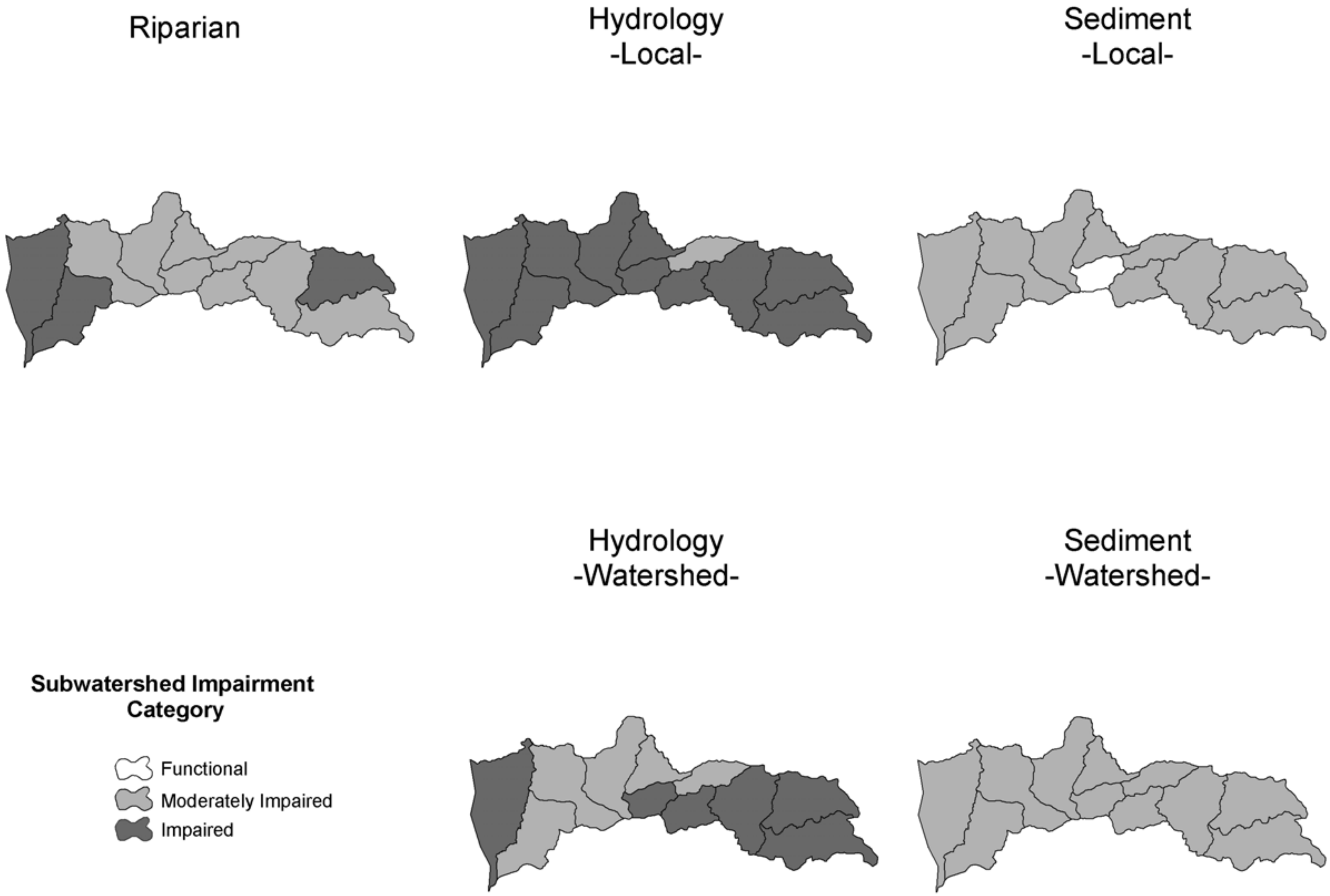


Figure 11-5. IWA subwatershed impairment ratings by category for the lower NF Lewis Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 11-6. 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-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) Hydrology	Watershed processes (local) Sediment	Watershed processes (local) Riparian	Watershed processes (watershed) Hydrology	Watershed processes (watershed) Sediment
A	60503	Cedar Creek 1a Houghton Cr Johnson Cr Lewis 5 Lewis 6	ChF	Lewis 6	Spawning Egg incubation Fry colonization	none	P	I	M	M	M	M
			StW	Cedar Creek 1a	Egg incubation 0-age active rearing 1-age active rearing	temperature	PR					
			Coho	Lewis 5 Lewis 6	Fry colonization 0-age active rearing 1-age active rearing Prespawning holding 0-age inactive Prespawning migrant	habitat diversity key habitat quantity	PR					
			Chum	Lewis 5 Lewis 6	Spawning Egg incubation Fry colonization Prespawning holding	none	P					
	60502	Lewis 2 tidal_B Lewis 3 Lewis 4 Robinson Cr Ross Cr	ChF	Lewis 3 Lewis 4	Egg incubation Fry colonization 0-age active rearing Prespawning holding	sediment	P	I	M	M	M	M
			StW	none								
			Coho	Lewis 3 Lewis 4	Egg incubation Fry colonization 0-age active rearing Prespawning migrant Prespawning holding	habitat diversity predation sediment key habitat quantity	PR					
			Chum	Lewis 4	Spawning Egg incubation Prespawning holding	none	P					
B	60504	Lewis 7	ChF StW Coho Chum	none none none none				I	M	M	M	M
	60404	Bitter Cr Brush Creek Cedar Creek 2 Cedar Creek 3 Cedar Creek 4 Cedar Creek 5 John Creek	StW	Cedar Creek 3 Cedar Creek 4	Egg incubation 0-age active rearing 0,1-age inactive 1-age active rearing	none	P	I	M	M	I	M
			Coho	none								
	60401	Cedar Creek 1a Cedar Creek 1b Grist Mill	StW	Cedar Creek 1a Cedar Creek 1b	Egg incubation 0-age active rearing 1-age active rearing	temperature	PR	I	F	M	I	M
			Coho	none								
C	60501	Lewis 1 tidal Lewis 2 tidal_A	All	none				I	M	I	M	M
	60405	Cedar Creek 6	StW	none				I	M	M	I	M
			Coho	none								
	60402	Cedar Creek 2	StW	none				I	M	M	I	M
			Coho	none								
D	60406	Chelatchie Cr 1 Chelatchie Cr 2 NF Chelatchie Cr	StW	none				I	M	I	I	M
			Coho	none								
	60403	Pup Creek	StW	none				M	M	M	M	M
			Coho	none								
	40602	Lewis 1 tidal	All	none				I	M	I	I	M

Table 11-7. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the middle mainstem (MM) and Cedar Creek (CC) portions of the lower NF Lewis Basin. Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors	MM	CC
Habitat connectivity		
Blockages to off-channel habitats	✓	
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)	✓	✓
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	✓	✓
Alterations to the temporal pattern of stream flow	✓	
Water quality		
Altered stream temperature regime	✓	✓
Bacteria		✓
Substrate and sediment		
Excessive fine sediment	✓	✓
Disrupted sediment transport processes (hydro)	✓	
Embedded substrates		✓

Threats	MM	CC
Agriculture/grazing		
Clearing of vegetation	✓	✓
Riparian grazing	✓	✓
Floodplain filling	✓	✓
Rural/suburban development		
Clearing of vegetation	✓	✓
Floodplain filling	✓	✓
Increased impervious surfaces	✓	✓
Increased drainage network	✓	
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	✓	✓
Clearing and snagging (historical)	✓	
Dredge and fill activities	✓	
Hydropower operations		
Flow manipulation	✓	
Changes to sediment transport dynamics	✓	
Changes to stream temperature regime	✓	

Table 11-8. Habitat measures in priority areas, with reference to limiting factors addressed, threats addressed, target species, and estimated time until benefits would be realized (time). Tier 1 and 2 reaches, or other areas of known priority, are listed under the location column for some measures (i.e., stream corridor measures). Reaches not included in the table (Tier, 3, 4, and non-tiered reaches) are considered secondary priority.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
1. Protect and restore floodplain function and channel migration processes ***A. Set back, breach, or remove artificial channel confinement structures***					
Middle mainstem Lewis Lewis 3-6 ***Cedar Creek*** Cedar Creek 3-4	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes	• Floodplain filling • Channel straightening • Artificial confinement	• All species	2-15 years	Great potential benefit due to improvements in many limiting factors. This passive restoration approach can allow channels to restore naturally once confinement structures are removed. There are challenges with implementation due to existing infrastructure already in place, private property, potential flood risk to property, and large expense.
2. Protect and restore off-channel and side-channel habitats ***A. Restore historical off-channel and side-channel habitats where they have been eliminated*** ***B. Provide access to blocked off-channel habitats*** ***C. Create new off-channel or side-channel habitats (i.e., spawning channels)***					
Middle mainstem Lewis Lewis 3-6 ***Cedar Creek*** Cedar Creek 3-4	• Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats • Altered habitat unit composition	• Floodplain filling • Channel straightening • Artificial confinement	• All species	2-15 years	Great potential benefit due to improvements in many limiting factors. This passive restoration approach can allow channels to restore naturally once confinement structures are removed. There are challenges with implementation due to existing infrastructure already in place, private property, potential flood risk to property, and large expense.
3. Protect and restore riparian function ***A. Reforest riparian zones*** ***B. Allow for the passive restoration of riparian vegetation*** ***C. Livestock exclusion fencing*** ***D. Invasive species eradication*** ***E. Hardwood-to-conifer conversion***					
Middle mainstem Lewis Lewis 3-6 ***Cedar Creek*** Cedar Creek 3-4	• Reduced stream canopy cover • Altered stream temperature regime	• Timber harvest – riparian harvests • Riparian grazing • Clearing of	• All species	20-100 years	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. Riparian

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
	• Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or noxious species	vegetation due to rural/suburban development and agriculture			protections on forest lands are provided for under current harvest policy. Riparian restoration projects are relatively inexpensive and are often supported by landowners. Whereas the specified stream reaches are the highest priority for riparian measures, riparian restoration and preservation should occur throughout the basin since riparian conditions affect downstream reaches. Use IWA riparian ratings to help identify restoration and preservation opportunities.
4. Protect and restore streambank stability ***A. Restore eroding streambanks***					
Cedar Creek Cedar Creek 3-4	• Reduced bank/soil stability • Excessive fine sediment • Embedded substrates	• Artificial confinement • Clearing of vegetation • Roads – riparian / floodplain impacts • Riparian grazing	• Winter steelhead • Coho	5-50 years	Most areas of bank instability in Cedar Creek reach 3 and 4 are related to confinement and grazing. Bio-engineered approaches that rely on structural as well as vegetative measures are the most appropriate. These projects have a high risk of failure if causative factors are not adequately addressed.
5. Protect and restore natural sediment supply processes ***A. Address forest road related sources*** ***B. Address timber harvest related sources*** ***C. Address agricultural sources*** ***D. Address developed land sources***					
Entire basin	• Excessive fine sediment • Embedded substrates	• Timber harvest – impacts to sediment supply • Forest roads – impacts to sediment supply • Agricultural practices – impacts to sediment supply	• All species	5-50 years	High potential benefit due to sediment effects on egg incubation and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs and forest land HCPs. Likelihood is moderate on agricultural lands due to incentive programs and outreach to landowners, but few sediment-focused regulatory requirements. Use IWA impairment ratings to identify restoration and preservation opportunities.
6. Protect and restore runoff processes ***A. Address forest road impacts*** ***B. Address timber harvest impacts*** ***C. Limit additional watershed imperviousness***					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
D. Manage stormwater runoff					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Timber harvest – impacts to runoff • Forest roads – impacts to runoff • Increased impervious surfaces • Increased drainage network (road ditches, storm drains) • Clearing of vegetation (development, agriculture)	• All species	5-50 years	High potential benefit due to flow effects on habitat formation, redd scour, and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs and forest land HCPs. There are challenges with implementation on developed lands due to continued increase in watershed imperviousness related to rural and suburban residential development. Use IWA impairment ratings to identify restoration and preservation opportunities.
7. Protect and restore instream flows ***A. Water rights closures*** ***B. Purchase or lease existing water rights*** ***C. Relinquishment of existing unused water rights*** ***D. Enforce water withdrawal regulations*** ***E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Water withdrawals	• All species	1-5 years	Instream flow management strategies for the Lower NF Lewis basin have been identified as part of Watershed Planning for WRIA 27 (LCFRB 2004). Strategies include water rights closures, setting of minimum flows, and drought management policies.
8. Protect and restore instream habitat complexity ***A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting*** ***B. Structurally modify stream channels to create suitable habitat types***					
Cedar Creek Cedar Creek 3-4	• Lack of stable instream woody debris • Altered habitat unit composition	• None (symptom-focused restoration strategy)	• Coho • Winter steelhead	2-10 years	Moderate potential benefit due to the high chance of failure. Failure is probable if habitat-forming processes are not also addressed. These projects are relatively expensive for the benefits accrued. Moderate to high likelihood of implementation given the lack of hardship imposed on landowners and the current level of acceptance of these type of projects.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
9. Protect and restore water quality ***A. Restore the natural stream temperature regime*** ***B. Reduce fecal coliform bacteria levels*** ***C. Reduce delivery of chemical contaminants to streams***					
Entire basin	• Altered stream temperature regime • Bacteria • Chemical contaminants (potential)	• Riparian harvests • Riparian grazing • Leaking septic systems • Application of pesticides, herbicides, and fertilizers	• All species	1-50 years	Primary emphasis for restoration should be placed on stream segments that are on the 2004 303(d) list.
10. Manage regulated stream flows to provide for critical components of the natural flow regime ***A. Provide adequate flows for specific life stage requirements (i.e., migration, summer rearing)*** ***B. Address geomorphic effects of hydro-regulation (channel-forming flows, sediment transport)***					
All mainstem Lewis reaches	• Alterations to the temporal pattern of stream flow • Altered stream temperature regime • Disrupted sediment transport processes (hydro)	• Hydropower operations – flow manipulation • Hydropower operations – changes to sediment transport • Hydropower operations – changes to stream temperature	• All species	1-5 years	Large potential benefit due to flow regulation and dam effects on habitat formation, stream temperatures, and fish movements. Adequate flow protections are being negotiated as part of Hydro re-licensing efforts conducted by PacifiCorp in consultation with the Federal Energy Regulatory Commission (FERC) and various stakeholders.
11. Protect and restore fish access to channel habitats ***A. Culverts and dams on various tributary streams***					
Colvin Creek ***Bitter Creek*** ***Other small tribs***	• Blockages to channel habitats	• Dams, culverts, in-stream structures	• Coho • Winter steelhead	Immediate	As many as 16 miles of potentially accessible habitat are blocked by culverts or other barriers (approximately 14 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.
12. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development ***A. Plan growth and development to avoid sensitive areas (e.g., wetlands, riparian zones, floodplains, unstable geology)*** ***B. Encourage the use of low-impact development methods and materials*** ***C. Apply mitigation measures to off-set potential impacts***					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	The mainstem basin and lower Cedar Creek basin are growing rapidly. The focus should be on management of land-use conversion and managing continued development in sensitive areas (e.g., wetlands, stream corridors, unstable slopes). Many critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary mechanisms need to be put in place to restore currently degraded habitats.
13. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection ***A. Purchase properties outright through fee acquisition and manage for resource protection*** ***B. Purchase easements to protect critical areas and to limit potentially harmful uses*** ***C. Lease properties or rights to protect resources for a limited period***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit. These programs are under-funded and have low landowner participation.

11.5 Program Gap and Sufficiency Analysis

The lower NF Lewis Basin (~102 sq mi) lies below Merwin Dam and is a mix of landuses, including rural residential, small scale agriculture, and forestry:

- The lower NF Lewis has approximately 35 square miles in forestry uses; 16 square miles of state land ownership; the predominant land manager is the Washington Department of Natural Resources and 19 square miles of small and industrial forest lands;
- Agriculture and rural residential uses occur in the valley bottom areas;
- The 2000 population in the NF Lewis was 14,300;
- Lands south of the NF Lewis River are in Clark County;
- Lands north of the NF Lewis River are in Cowlitz County;
- The largest population center in the basin is Woodland, which is situated near the confluence with the Columbia River;
- Other communities include Chelatchie and Amboy, both are located in the Cedar Creek drainage; and
- PacifiCorp and Cowlitz PUD control stream flows released through Merwin Dam.

Protection Programs

Protection programs in the lower NF Lewis Basin are implemented by a variety of agencies, organizations, and private interests. Protection programs in this analysis include those programs that protect habitat conditions or watershed functions through regulatory measures, through the acquisition outright or the purchase of easements, incentives or by applying standards to new development that protects resources by avoiding damaging impacts. Key programs implementing measures are identified below.

Federal Programs

- ***U.S. Army Corps of Engineers***
  - Regulatory Programs: U.S. Army Corps of Engineers administers the Section 10 (Rivers and Harbor Act) and Section 404 (Clean Water Act) permit processes. Section 10 requires approval of any activity in, above, or below a navigable river, which affects course, location, condition, or capacity of navigable waters. Section 404 requires prior approval of dredging, filling, grading, clearing, and bank hardening. In waters used by listed fish species, the permits are subject to ESA Section 7 consultation with NOAA Fisheries to ensure that any approved action is adequately protective of the ESA listed fish. [M.1A; M.2A; M.2B; M.8A; M.8B; M.11A]

- ***Federal Energy Regulatory Commission (FERC)***
  - Licensing of Hydroelectric Projects: PacifiCorp and the Cowlitz PUD operate hydroelectric facilities on the North Fork Lewis. The projects are currently undergoing relicensing pursuant to the federal Power Act using FERC's alternative licensing approach. Under this approach the utilities are working with federal agencies, local governments, tribes, community interests, and environmental organizations to develop a settlement agreement defining terms for a license. Topics affecting the lower North Fork Lewis include flows and habitat protection for ESA listed salmonids and other aquatic and terrestrial species. [M.9A; M.10A; M.10B; M.11A]

- ***NOAA Fisheries*:**
  - Hydroelectric Project Relicensing: Under the federal Power Act, NOAA Fisheries has substantive authority over license provisions relating to listed salmonids. The agency is actively engaged in the relicensing efforts for the Lewis hydroelectric projects. With regard to the lower North Fork Lewis, NOAA is pursuing flow and habitat measures to protect listed salmonids, specifically spawning and rearing fall chinook and chum salmon in the lower North Fork. [M.9A; M.10A; M.10B; M.11A]

State Programs

- ***Department of Natural Resources***
  - State Forest Land HCP:
    State forest lands are managed under the provisions of a Habitat Conservation Plan (HCP). The Habitat Conservation Plan has protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. [M.3A; M3B; M.5A; M.5B; M.6A; M.6B; M.9A]
  - State Forest Practices:
    Riparian areas and watershed functions on small- and industrial forest lands are protected under the State of Washington Forest Practices Rules, including the Forest and Fish Module. These rules provide for riparian buffers, harvest restrictions, sensitive area protections, and protective standards for new road construction. [M.3A; M3B; M.5A; M.5B; M.6A; M.6B; M.9A]

- ***Washington Department of Fish and Wildlife***
  - Hydraulics Project Approval (HPA): The Department administers the state Hydraulic Code. The purpose of this program is to protect stream conditions and habitat. The regulations apply to such activities as streambank protection, instream construction, culvert installation, channel changes or realignments, debris removal, and water diversion facilities. Those proposing such actions must obtain a Hydraulic Project Approval (HPA) permit. [M.1A; M.2A; M.2B; M.8A; M.8B; M.11A]
  - Habitat Program: The Department provides advice to local governments and landowners interested in measures to protect habitat values on their property. [M.1A; M.2A; M.2B; M.3A; M.4A; M.5D; M.6C; M.6D; M.8A; M.8B; M.9A; M.9B; M.9C; M.11A; M.12A; M.12B; M.12C]
  - Hydro Facility Relicensing: The Department is an active participant in the FERC relicensing of the PacifiCorp and Cowlitz PUD hydro facilities on the North Fork Lewis. The Department has worked to address protection of habitat in the lower North Fork affected by hydro operations. Issues include protection of downstream spawning and rearing habitat for fall Chinook, chum, and steelhead through flow measures, gravel augmentation, and large woody debris. [M.9A; M.10A; M.10B; M.11A]
- ***Washington Department of Ecology***

- Water Quality Program/Clean Water Act – Section 401 Certification
  FERC relicensing of the Lewis hydro projects requires the Department to issue a CWA Section 401 water quality certification. The Department of Ecology review and, where necessary, revise flow requirements for the protection of fish and their habitat. [M.9A; M.10A; M.10B]

- Water Resources Program/Water Rights: Department of Ecology, in consultation with the Department of Fish and Wildlife, has administrative closed selected areas within the lower North Fork Lewis watershed to further surface and groundwater withdraws (where groundwater is in continuity with surface water). Existing administrative closures by the Department of Ecology protect surface waters from further withdrawals. Formal rule-making would strengthen the closures. The extent of unauthorized surface water withdrawals is unknown, but could exacerbate summer low flows. [M.7A; M.7B; M.7C; M.7D]

- Water Resources Program/Watershed Planning: In cooperation with the Lower Columbia Fish Recovery Board, other state and federal agencies, tribes, local governments, and citizens, the Department funds and participates in a state authorized watershed planning process for Water Resource Inventory Area (WRIA) 27 pursuant to RCW 90.82. The goal of the plan is to ensure adequate water for people and fish. The planning process is dealing with water quantity and quality, stream flows and fish habitat. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.7A; M.7B; M.7C; M.7D; M.9A; M.9B; M.9C; M.12A]

➢ ***Washington Department of Transportation:***
- Highway maintenance program implements best management practices for the protection of habitat. [M.6C; M.9C; M.11A]

➢ ***Salmon Recovery Funding Board (SFRB)/ Lower Columbia Fish Recovery Board (LCFRB)***

- Washington Salmon Recovery Act (RCW 77.85): The SRFB and the LCFRB jointly administer a grant program that allocates federal Pacific Salmon Recovery Funds and State funds for habitat protection and restoration projects by state and local agencies, nonprofit organizations, and landowners. To date the SRFB provided approximately $100,000 to Clark County and other partners for the $1 million purchase of Eagle Island. [M.2A; M.2B; M.3A; M.3B; M.4A; M.8A; M.8B; M.9A; M.11A]

Local Government Programs

➢ ***Clark County*** (Lands south of the NF Lewis)
  - ESA Program: The County has established an Endangered Species Program to address ESA requirements and develop a comprehensive county strategy for salmon recovery. An ESA committee with representatives from federal and state agencies, tribes, citizens, the business community and environmental groups has been

established to advise the county as it works to bring its ordinances and programs into compliance with ESA requirements.

- Land Use:
  - ✓ The County is actively engaged in a comprehensive review and revision of its programs to better protect watershed processes and habitat and to secure ESA Section 4d assurances from NOAA Fisheries.
  - ✓ The County comprehensive sets policies calling for the protection of habitat for ESA listed salmon and other aquatic and terrestrial species.
  - ✓ Zoning that directs growth throughout the County and maintains low-density development in rural areas. The County has a designated Urban Growth Area pursuant to the Washington Growth Management Act (GMA). The UGA helps protect rural lands by directing high intensity uses to developed areas.
  - ✓ A Habitat Conservation Ordinance provides stream buffers and measures for the protection of important habitat, including ESA listed salmonids.
  - ✓ Wetland ordinance provides substantial protection. [M.12A; M.12B; M.12C]

- Stormwater Management:
  The County stormwater program, based on Best Available Science, is implementing an NPDES permit, including measures to protect water quality and reduce impacts on stream flows [M.6C; M.6D; M.9A; M.9C];

- Road Maintenance:
  Clark County Road Program utilizes Best Management Practices to guide their operations and is actively seeking programmatic ESA Section 4d assurances from NOAA Fisheries that these measures provide adequate protection for fish. [M.6C, M.6D; M.11A]

- Parks and County Facilities:
  - ✓ The County has an active Conservation Futures program to acquire and protect critical habitat. On the lower North Fork Lewis the County participated in efforts to acquire the 260-acre Eagle Island to protect critical chinook rearing habitat. [M.13A]
  - ✓ The County has not implemented a comprehensive parks and facilities management plan to protect habitat. [M.9C]

➢ ***Cowlitz County*** (Lands north of the NF Lewis)
- Land Use:
  - ✓ The comprehensive plan that applies to the non-federal lands, but contains no significant policies for the protection of watershed processes and stream habitat.
  - ✓ Zoning along State Highway 503 provides for one dwelling per 2 acres and one dwelling per 5 acres along non-county roads.
  - ✓ Cowlitz County has not adopted protective stream buffers.
  - ✓ Wetland buffers vary from 25’ to 200’ and are based upon soil type and wildlife utilization.

  - ✓ The County has not developed comprehensive ordinances for the protection of watershed processes or stream habitat conditions. [M.12A; M.12B; M.12C]
- Road Maintenance

The County has not developed or implemented a road maintenance program to protect habitat. [M.6C; M.6D; M.11A]

➢ ***City of Woodland***

- Land Use:
  - ✓ The City has a comprehensive plan conforming to the Growth Management Act.
  - ✓ Generally, urban land use zoning within the City limits and Urban Growth Boundary.
  - ✓ Critical Areas Ordinance primarily requires mitigation impacts. It does require preservation of the natural hydrology of drainage systems and protection of critical fish habitat through maintenance of stable channels, adequate low flows, and management of stormwater, erosion, and sedimentation. Buffers vary from 75' to 200' for riverine wetlands with values of fish and wildlife. No other stream buffer provisions for protection of riparian functions have been adopted.
  - ✓ The City has adopted the Shorelines Management Master Program for Cowlitz County. [M.12A; M.12B; M.12C]

- Stormwater Management: The City has adopted the Cowlitz County Shoreline Master Plan. The intent of the plan is to protect water quality, riparian, stream conditions through the regulation of shoreline development. No specific measures for the protection of ESA listed salmonids are included. [M.6C; M.6D; M.9C]

Community Programs

➢ ***PacifiCorp:*** In conjunction with DFW and Clark-Vancouver Parks, PacifiCorp participated in the acquisition of 260-acre Eagle Island. The island is important rearing habitat for fall Chinook [M.13A].

Restoration Programs

Restoration programs in the lower NF Lewis Basin are implemented by a variety of agencies, organizations, and private interests. Restoration programs are generally organized around agencies, organizations, and private interests that assess threats, develop solutions, and implement projects that are intended to improve habitat conditions or watershed functions. Programs implementing habitat restoration measures are identified below:

Federal Programs

➢ ***Federal Energy Regulatory Commission (FERC)***

- Licensing of Hydroelectric Projects: Under the FERC alternative licensing approach the PacifiCorp and the Cowlitz PUD are working with federal agencies, local governments, tribes, community interests, and environmental organizations to develop a settlement agreement defining terms for a license. Restoration topics affecting the lower North Fork Lewis include establishing and funding a habitat restoration fund for aquatic species, including those in the lower North Fork Lewis. [M.5D; M.8A; M.8B; M.9A; M.9C; M.10A; M.10B; M.11A; M.13A]

- ***NOAA Fisheries***
  - Hydroelectric Project Relicensing: Under the federal Power Act, NOAA Fisheries has substantive authority over license provisions relating to listed salmonids. The agency is actively engaged in the relicensing efforts for the Lewis hydroelectric projects. With regard to the lower North Fork Lewis, NOAA is pursuing habitat protection measures, gravel augmentation, and large woody debris. [M.5D; M.8A; M.8B; M.9A; M.9C; M.10A; M.10B; M.11A; M.13A]

State Programs

- ***Washington Department of Natural Resources***

  State Forest Land Habitat Conservation Plan (HCP): The Department manages state forest lands pursuant to a Habitat Conservation Plan (HCP). The HCP road maintenance and restoration objectives require barrier upgrades and road abandonment and/or other improvements. [[M.3A; M3B; M.5A; M.5B; M.6A; M.6B; M.9A; M.11A]

  - State Forest Practices Act:
    - ✓ Industrial forests within the lower NF Lewis Basin are governed by Forest and Fish regulations and have rigid schedules for maintaining and improving roads and removing barriers. Industrial landowners have 15 years to bring roads and barriers into compliance with regulations [M.5A; M.5B; M.6A; M.6B; M.9A; M.11A]
    - ✓ Small private forest owners are governed by Forest and Fish regulations; however their road and barrier maintenance and improvement programs are tied to state funding. In the State 2003-05 Biennial Budget, 2 million dollars was allocated statewide to support small private forest owners [M.5A; M.5B; M.6A; M.6B; M.9A; M.11A]

- ***Washington Department of Fish and Wildlife***
  - Habitat Program: The Department provides advice to local governments and landowners interested in measures to protect habitat values on their property. [M.1A; M.2A; M.2B; M.3A; M.4A; M.5D; M.6C; M.6D; M.8A; M.8B; M.9A; M.9B; M.9C; M.11A; M.12A; M.12B; M.12C]

- ***Washington Department of Ecology***
  - Water Resources Program/Watershed Planning:
    The planning process for WRIA 27 is dealing with water quantity and quality, stream flows and fish habitat. Potential restoration efforts address improving summer low flows

through conservation and acquisition of water rights. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.7A; M.7B; M.7C; M.7D; M.9A; M.9B; M.9C; M.12A]

- ***Washington Department of Transportation***

  - Barriers: WSDOT has improved several blockages associated with State Route 503 in the lower North Fork Lewis area. [M.6D; M.9C; M.11A]

- ***Salmon Recovery Funding Board (SFRB)/ Lower Columbia Fish Recovery Board (LCFRB)***

  - Washington Salmon Recovery Act (RCW 77.85): As noted under preservation programs above, the SRFB and the LCFRB jointly administer a grant program that allocates federal Pacific Salmon Recovery Funds and State funds for habitat protection and restoration projects by state and local agencies, nonprofit organizations, and landowners. To date the SRFB has provided over $975,000 for to Clark County and other non-profit groups in the area for riparian restoration and barrier removals in Cedar and Chelatchie Creeks. [M.2A; M.2B; M.3A; M.3B; M.4A; M.8A; M.8B; M.9A; M.11A]

- ***Conservation Commission/Clark Conservation District* (CCD)**

  - The CCD is active in the lower NF Lewis Basin. CCD works with agriculture interests to develop farm plans and implements the Conservation Enhancement Reserve Program. [M.3A; M.3C; M.4A; M.5C; M.9A; M.9B; M.9C]

Local Government Programs

- ***Clark County***
  - Clark County ESA Program: The Clark County ESA program encourages and recognizes citizen efforts to conserve and restore habitat for salmon through education and outreach activities.
  - Clark County Culvert Program: The County inventories and replaces priority barriers associated with its roads. [M.11A]

Community Programs

- ***Fish First***: a non-profit group actively performing restoration projects in the lower NF Lewis. Fish First works directly with landowners to develop relationships that facilitate the implementation of habitat projects in the Cedar and Chelatchie. The organization also conducts nutrient enhancement (carcass placement) projects. [M.3A; M.4A; M.8A; M.8B; M.9A; M.11A]

Gap Analysis

Forest-related Programs: Approximately 35% of the lower NF Lewis Basin is in commercial forest production. Accordingly, Washington Department of Natural Resource forestry programs and forest practice regulations play an important role in protecting and restoring watershed functions and habitat conditions to levels supporting recovery goals. Certainty of forestry-related protection and restoration programs is relatively high because programs are being implemented and, for the most part, fully funded. Program areas of concern include state funding for small commercial forest landowners and the continued potential for hydrologic impacts caused by past harvest practices. Monitoring of watershed processes and habitat conditions will be required to confirm the effectiveness of these measures.

Protection-related Programs: Clark County land use regulatory mechanisms provide significant protections throughout the lower NF Lewis Basin. Protection is further promoted through active public outreach and education efforts. This level of protection should be improved to levels supporting recovery with the completion and implementation of the County's current program review and revision. Cowlitz County land use regulatory mechanisms provide limited, basic protections. However, County programs lack effective provisions that commonly are used to proactively direct growth, protect streams and wetlands, and manage stormwater.

Restoration-related Programs: Relative to the hydroelectric facilities, actions to address downstream impacts are also important to salmon and steelhead recovery efforts. These include: monitoring and augmentation of gravel, where and when necessary; Augmentation of LWD; and assurance of flow regimes needed for downstream spawning and rearing.

Table 11-9. Actions to Address Gaps

Action #	Lead Agency	Proposed Action
LNFL.1	Cowlitz County	Develop and implement stormwater discharge controls to protect water quality and quantity and reduce localized stream flow impacts detrimental to fish —including peak and base flows
LNFL.2	Cowlitz County	Develop and implement controls to adequately protect riparian areas to maintain currently functional habitat as well as restored habitat needed habitat conditions around all rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Require mitigation, where necessary, to offset unavoidable damage to habitat conditions in riparian management areas
LNFL.3	Cowlitz County	Zoning and development standards to adequately protect wetlands, wetland buffers, and wetland function.
LNFL.4	Cowlitz County	Develop and implement controls to address erosion and sediment run-off during (and after) construction to prevent sediment and pollutant discharge to streams, wetlands and other water bodies
LNFL.5	Cowlitz County	Protect historic stream meander patterns and channel migration zones and avoid hardening stream banks and shorelines
LNFL.6	State of Washington (DNR)	Provide state funding for small forest owners in the lower NF Lewis Basin to a level sufficient to achieve the road and barrier improvements of Forest and Fish on a schedule parallel to private industrial forest owners
	State of Washington (Dept of Agriculture)	Develop and implement agricultural practices and regulations to protect riparian conditions and water quality

	State of Washington (DFW, Ecology)	Close tributaries to the lower NF Lewis to further withdrawal of surface water, including groundwater in connection with surface waters. Curtail unauthorized withdrawals.
LNFL7.	Forest Managers LCFRB, and DFW	Identify and sequence early action forest restoration projects that analysis indicates could provide significant benefits. In these cases, it may be appropriate to identify outside funding to initiate these early actions
LNFL.8	State of Washington, LCFRB, CC	Build institutional capacity for agencies and organizations to undertake protection and restoration projects
LNFL.9	LCFRB, DOE, DFW, NOAA, USFWS, ACOE, BPA	Increase available funding for projects that implement measures and addresses underlying threats
LNFL.10	PacifiCorp and Cowlitz PUD	Provide passage and collection facilities for adult and juvenile coho, steelhead, spring chinook populations to make use of habitats above Swift Reservoir. Monitor and mitigate LWD and sediment (gravel) transport impacts below Merwin Dam.
	WDFW, Department of Ecology, PacifiCorp and Cowlitz PUD	Develop and implement flow regimes that protect salmon and steelhead spawning and rearing below Merwin Dam
LNFL.11	PacifiCorp and Cowlitz PUD	Increase fish and wildlife habitat mitigation measures (upstream and downstream) of hydrosystem commensurate with recovery goals for populations affected by hydrosystem impacts
LNFL.12	Clark CD, Clark County, Cowlitz County, non profit fish recovery organizations.	Utilize a combination of public outreach/education, incentives, and authority to positively influence landowner behaviors toward land stewardship in practices not covered by land use regulations
LNFL.13	Clark County, Cowlitz County, City of Woodland	Apply land use code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
LNFL.14	WRIA 27/28 PU, DOE, DFW	Close the NF Lewis River to further surface water withdrawals,
LNFL.15	LCFRB, Clark County, Cowlitz County, DFW	Build institutional capacity for agencies and organizations to undertake additional protection and restoration projects, including noxious weed control
LNFL.16	SRFB,	Increase available funding for projects that implement measures and addresses underlying threats
LNFL.17	LCFRB, , WDFW, PacifiCorp	Address threats proactively by building agreement on priorities among the various program implementers
LNFW.18	FEMA	Update floodplain maps.

12 Lewis Subbasin – Upper North Fork Lewis

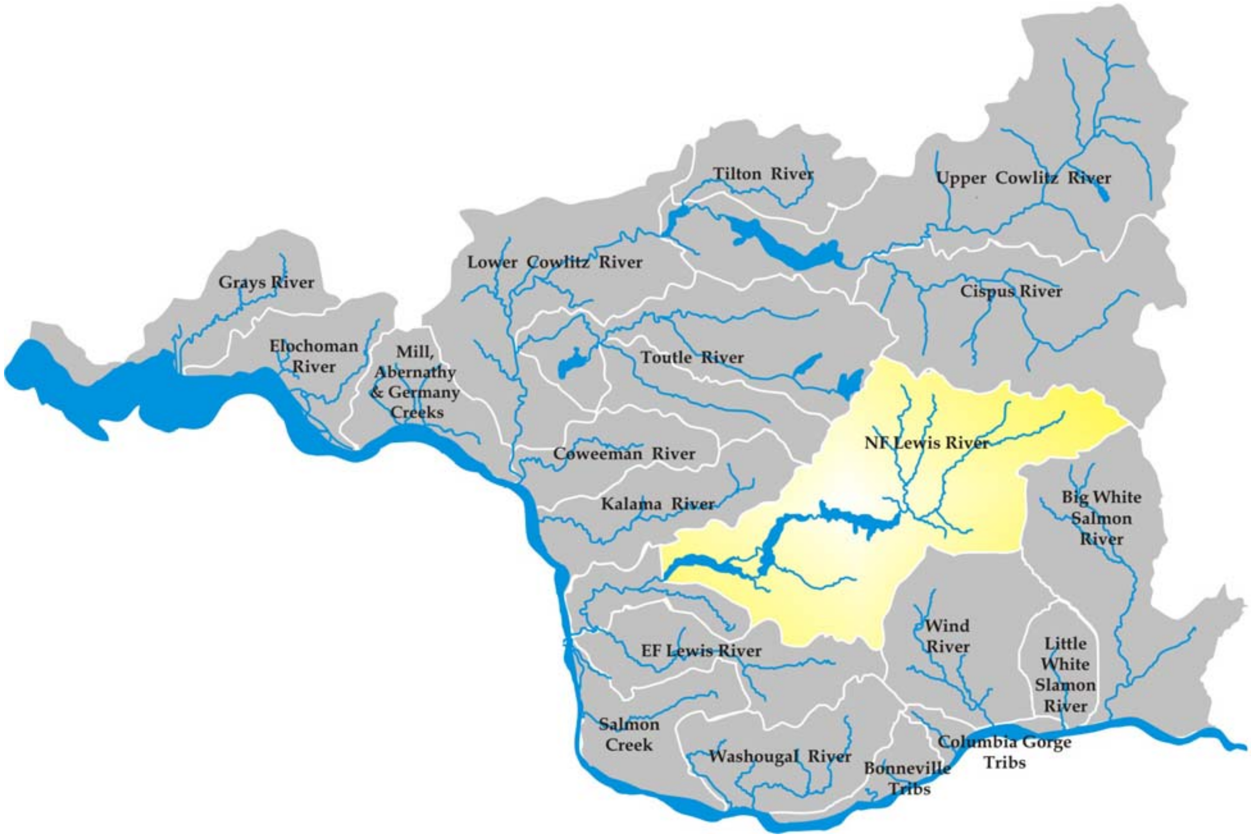


Figure 12-1. Location of the Upper North Fork Lewis River Basin within the Lower Columbia River Basin.

12.1 Basin Overview

The upper North Fork Lewis River basin comprises approximately 731 square miles, primarily in Skamania County. The lower portion of the basin including Merwin and Yale Reservoirs is in Clark and Cowlitz counties. The basin begins within the mainstem Lewis above Merwin Dam (RM 19.5). The basin contains three major reservoirs (Merwin, Yale, and Swift), and major tributaries include Pine Creek and the Muddy River. The basin is part of WRIA 27.

The upper North Fork Lewis Basin will play a key role in the recovery of salmon and steelhead. The basin has historically supported populations of spring Chinook, winter steelhead, and coho. Today, Chinook and steelhead are listed as threatened under the ESA. Coho salmon are a candidate for listing. Other fish species of interest are Pacific lamprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

Upper North Fork Lewis salmon and steelhead are affected by a variety of in-basin and out-of basin factors including stream, Columbia River mainstem, estuary, and ocean habitat conditions; harvest; hatcheries; and ecological relationships with other species. Analysis has demonstrated that recovery cannot be achieved by addressing only one limiting factor. Recovery will require action to reduce or eliminate all manageable factors or threats. The deterioration of habitat conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonids within the Columbia Basin. Direct harvest of listed salmon and steelhead is prohibited but sport and commercial fisheries focusing on hatchery fish and other healthy wild populations, primarily in the mainstem Columbia and ocean, incidentally affect ESA-listed

Lewis fish. Speelyai and Merwin hatcheries operate within the basin with the potential to both adversely affect wild salmon and steelhead populations and to assist in recovery efforts. Key ecological interactions of concern include effects of non-native species; nutrient inputs from salmon carcasses; and predation by species affected by development including Caspian terns, northern pikeminnow, seals, and sea lions. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the Upper North Fork Lewis Subbasin.

The bulk of the land lies within the Gifford Pinchot National Forest. Approximately 70% of the basin is national forest or national monument land, 11% is state land, and the remainder is private, most of it in private industrial forestland ownership. Recreation uses and residential development have increased in recent years. The majority of the basin is heavily forested, except for an area of approximately 30 square miles in the north part of the upper basin that was denuded by the 1980 eruption of Mount St. Helens. Stand replacement fires, which burned large portions of the basin between 1902 and 1952, have had lasting effects on basin hydrology, sediment transport, soil conditions, and riparian function. The largest of these was the Yacolt Burn in 1902. Subsequent fires followed in 1927 and 1929.

The three mainstem reservoirs inundate nearly 40 miles of historically productive habitat and block all anadromous access to the upper basin. Currently, tributaries to the reservoirs and the upper mainstem and its tributaries provide habitat for bull trout and potential habitat for anadromous fish, although these streams have been impacted by years of timber harvest activities.

Restoration of the reservoir reaches to historical conditions provides the greatest benefit to anadromous fish, however, the feasibility of such an effort is low. With the anticipated re-introduction of anadromous fish, attention should be focused on the most potentially productive habitats to which the fish will have access. The most important area is the Lewis mainstem upstream of Swift Reservoir. These reaches provide abundant potential spawning and rearing habitats. They are impacted most by past upper basin timber harvest and road building.

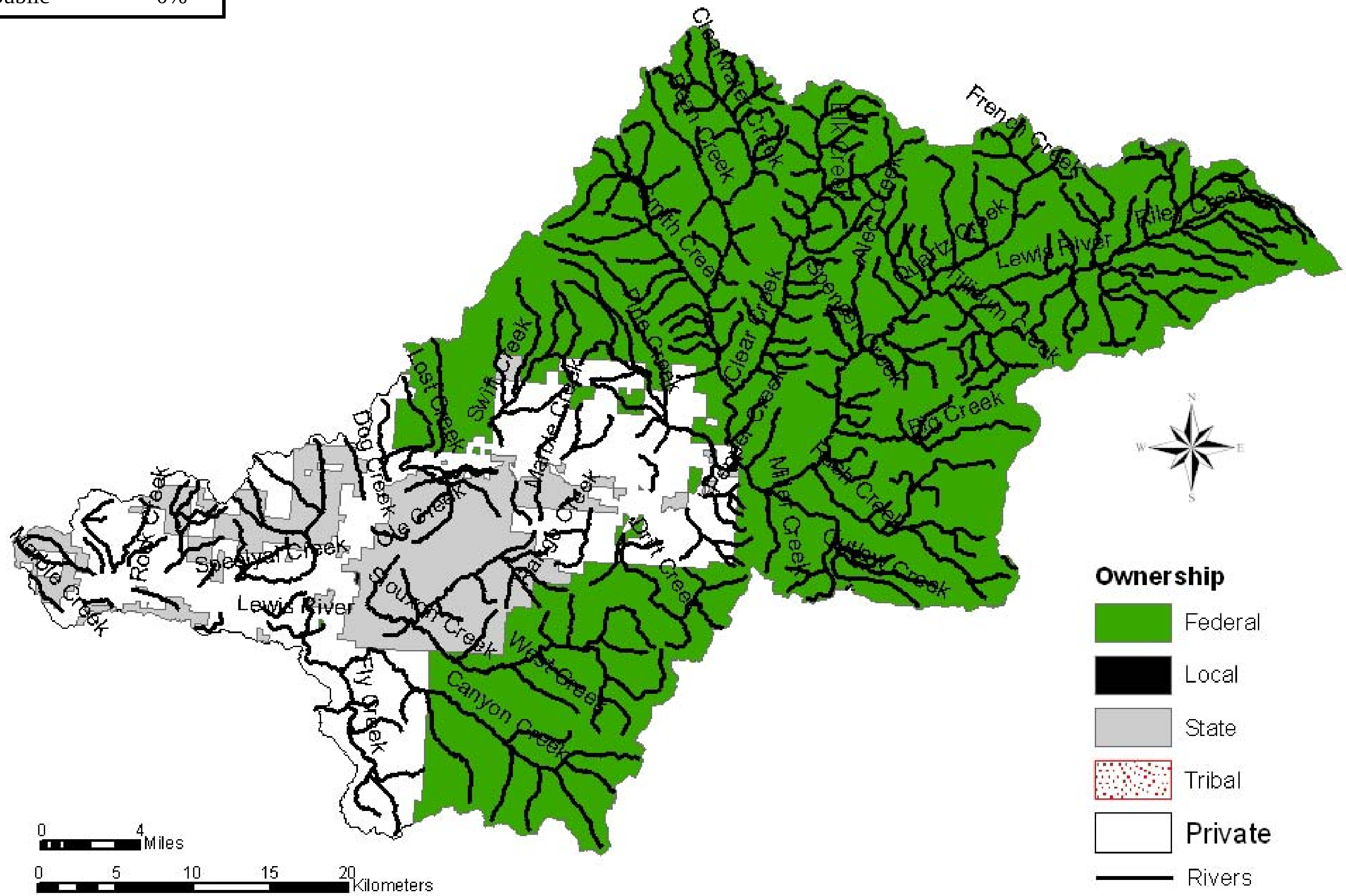
The next most important areas are the Muddy River system (including Clearwater Creek) and the Clear Creek system (tributary to lower Muddy Creek). Protecting existing production potential and restoring habitats in these areas would provide important benefits to anadromous populations. These streams have been impacted by timber harvests and road building as well as by mud and debris flows during the 1980 Mount St. Helens eruption.

The Pine Creek and Rush Creek basins currently support bull trout and also provide potential habitat for anadromous species. Improving conditions in these basins would yield important fish benefits, especially to the bull trout population. As with the Muddy Creek system, the Pine Creek basin was impacted by eruption impacts followed by intensive timber harvest. The upper Rush Creek basin has experienced intensive timber harvest and road building within the past two decades.

The population of the basin is small, with only small rural communities. There is very little development in the basin as most of the basin lies within the Gifford Pinchot National Forest. Only the areas surrounding the small communities of Yale, Woodland Park, and Cougar have any residential development or agriculture. The impact from these activities on aquatic and terrestrial habitats is relatively insignificant. The year 2000 population of the entire NF basin (including the lower NF Lewis) was approximately 14,300 persons (LCFRB 2001).

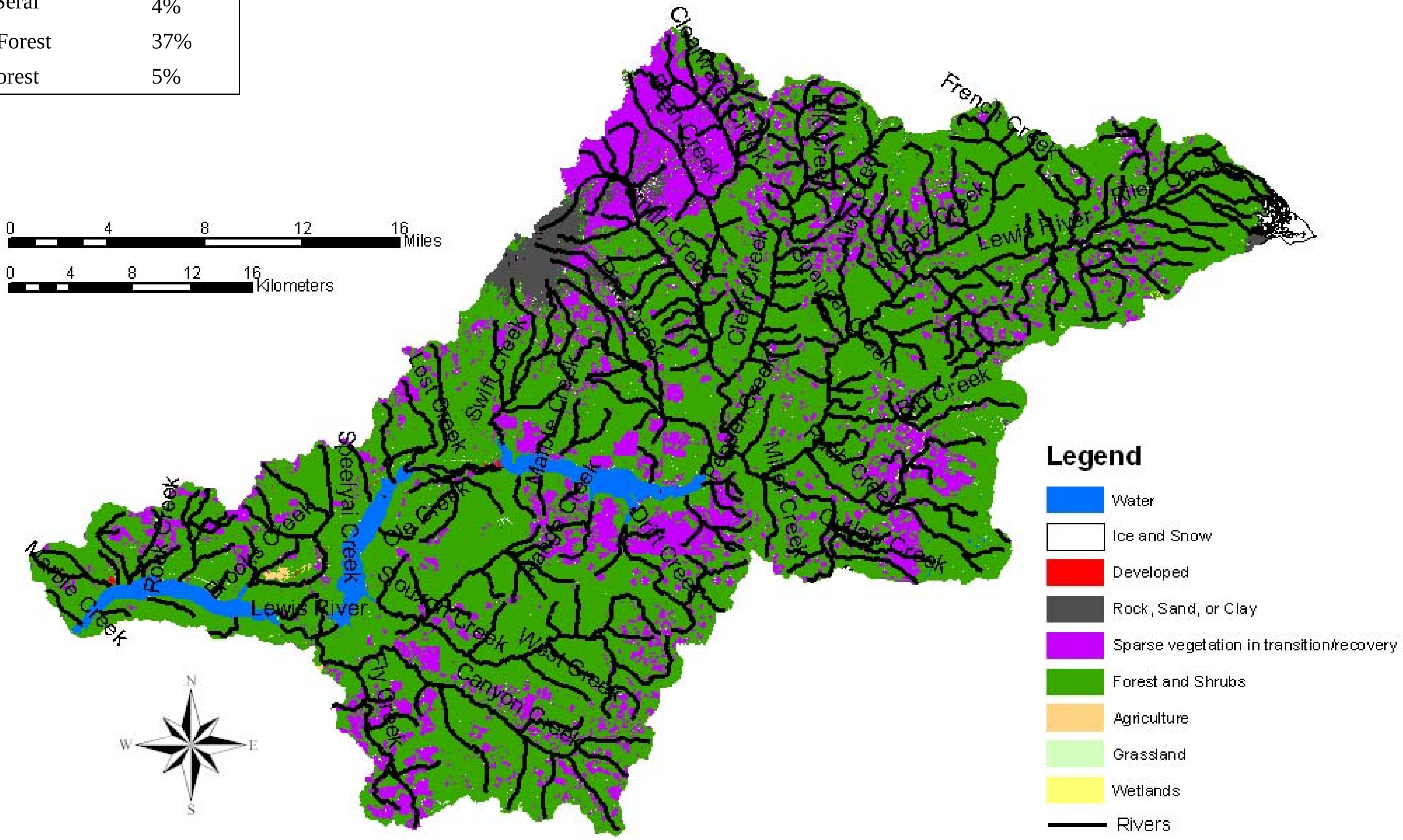
Land Ownership	
Federal	69%
Private	20%
State	11%
Other public	0%

Land Ownership



Vegetation Composition	
Late Seral	34%
Mid Seral	21%
Early Seral	4%
Other Forest	37%
Non Forest	5%

Land Use / Cover



12.2 Species of Interest

Focal salmonid species in the upper North Lewis River include spring Chinook, winter steelhead and coho. The current health or viability of the focal populations is very low for all, except low for winter steelhead. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Recovery goals call for restoring all winter steelhead and coho to a medium viability level, providing for a 75-95% chance of persistence over the next 100 years. Spring Chinook recovery goals call for a high level of viability. This level will provide for a 95% probability of population survival over 100 years.

Other species of interest in the upper Lewis include coastal cutthroat trout and Pacific lamprey. Regional objectives for these species are described in Volume I, Chapter 6. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for these other species. Cutthroat will benefit from improvements in stream habitat conditions for salmonids. Lamprey are also expected to benefit from habitat improvements in the estuary, Columbia River mainstem, and upper North Fork Lewis subbasin although specific spawning and rearing habitat requirements of lamprey are not well known.

Table 12-1. Current viability status of upper North Fork Lewis 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	Yes	Very Low	200-1,000	High	1,400-3,900
Winter steelhead	Threatened	Yes	Low	unknown	Medium	600-3,400
Coho	Candidate	Yes	Very Low	unknown	Medium	unkown

Spring Chinook- The historical North Lewis River adult population estimate is from 10,000-50,000 fish. Current natural spawning returns range from 200-1,000 and are almost entirely hatchery produced fish. Historical spawning was almost entirely in the upper Lewis basin which was blocked by Merwin Dam in 1931. Spring Chinook are expected to be reintroduced above the hydrosystem in the near future. The majority of upper Lewis spawning habitat is above Swift Reservoir in the main North Lewis, the Muddy River, Clearwater Creek, and Clear Creek. Spawning in the lower North Lewis occurs in the first 2 miles below Merwin dam and in Cedar Creek. Spawning occurs in late August and September. Juveniles rear in the Lewis basin for a full year before migrating to the Columbia in the spring.

Winter Steelhead – The historical North Lewis River adult population is estimated from 6,000-24,000 fish. Current natural spawning returns are presumed to be very low and are limited to habitat below Merwin Dam. Winter steelhead are expected be reintroduced to habitats upstream of the Lewis River hydrosystem in the near future, where the majority of winter steelhead habitat is available. The preferred stock for reintroduction is late-timed wild winter returning to the North Lewis and trapped at Merwin Dam. The majority of habitat in the upper Lewis is in the main North Lewis and tributaries upstream of Swift Dam. 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 Lewis Basin.

Coho – The historical North Lewis River adult population is estimated from 7,500-85,000 fish. Both early and late stocks were present historically, with early stock primarily spawning in the upper Lewis. Current returns are unknown but assumed be low and limited to the habitat downstream of Merwin Dam. Early coho are expected to be reintroduced to the habitat upstream of the hydrosystem in the near future. Coho spawning habitat in the upper Lewis is primarily above Swift Reservoir but is also present in tributaries to Yale and Merwin reservoirs. Early stock coho spawn from late October into November and late stock spawn from late November to March. Juvenile rearing occurs upstream and downstream of spawning areas. Reintroduced juvenile coho are expected to utilize the reservoir habitat to some extent during their freshwater rearing time. Juveniles rear for a full year in the Lewis basin before migrating as yearlings in the spring.

Bull Trout – There may have been both fluvial and resident bull trout populations in the North Lewis River historically. The current bull trout populations in Swift and Yale reservoirs are isolated because there is no upstream passage at the dams. Genetic samples show significant differences between these populations indicating there may have been biological separation prior to construction of Swift Dam in 1958. Current peak counts of spawners in Cougar Creek range from 0-40 fish, and Swift Reservoir spawning population estimates range from 100-900 fish. Spawning occurs primarily in Cougar Creek (Yale population), and in Pine and Rush creeks (Swift population).

Coastal Cutthroat – Coastal cutthroat abundance in the North Lewis River has not been quantified but the population is considered depressed. Anadromous cutthroat trout are present in in the North Fork Lewis and tributaries upstream to Merwin Dam, resident forms are present throughout the basin, and adfluvial forms are present in the reservoirs.

Pacific lamprey – Information on lamprey abundance is limited and does not exist for the North Lewis River population. Lamprey passage is blocked to the upper Lewis Basin.

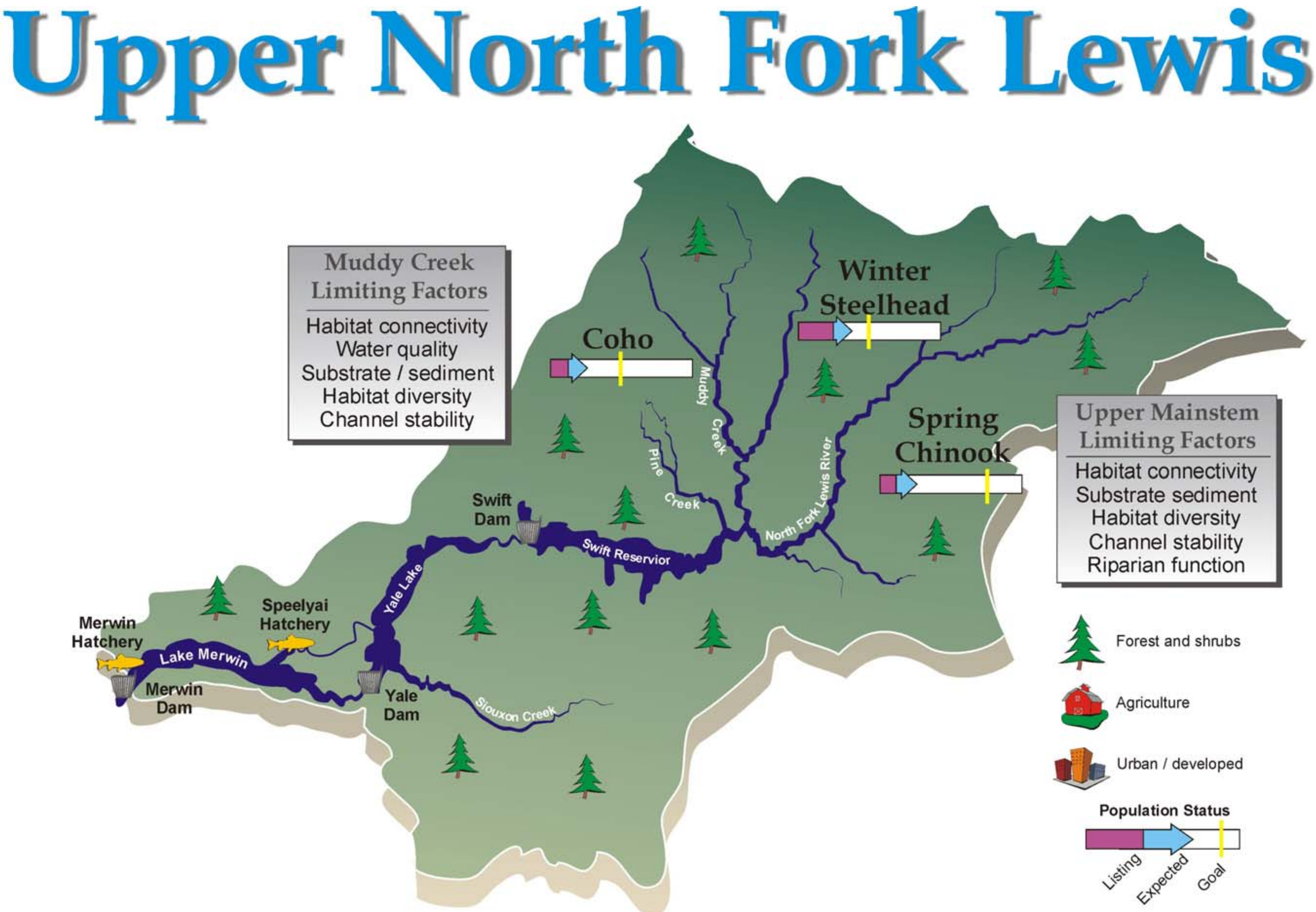


Figure 12-2. Summary of habitat limiting factors, popoulation status, expected population improvement trend with existing programs, and biological objectives depicted for the upper North Fork Lewis Basin.

12.3 Potentially Manageable Impacts

Stream habitat, estuary/mainstem habitat, harvest, hatchery and predation effects have all contributed to reduced salmonid productivity, numbers, and population viability in the upper North Fork Lewis Subbasin. The pie charts below represent the relative order of magnitude of quantifiable effects for each of these factors for each focal species. The preferred recovery scenario targets an equivalent reduction in each impact factor in proportion to the magnitude of the effect. Population-specific targets are discussed in further detail in Volume I, Chapter 6.

- Hydrosystem access and passage impacts are the most influential factor for each of the three upper North Fork Lewis populations. These populations are influenced by the impacts of Merwin, Yale, and Swift dams and reservoirs in the mainstem Lewis.
- Loss of tributary habitat quality and quantity is an important impact for all species, particularly for spring Chinook and winter steelhead.
- Harvest has moderate impacts on spring Chinook and coho, but its effects on winter steelhead are minor.
- Hatchery impacts include domestication of natural populations (most applicable to Chinook and coho) and ecological interactions which can impact all species to variable degrees. Hatcheries moderately impact all three species in the upper North Fork Lewis.
- Predation impacts of northern pikeminnow, Caspian terns, and marine mammals in the mainstem and estuary are moderate for winter and summer steelhead, but appear to be less important for coho, chum, and fall Chinook.

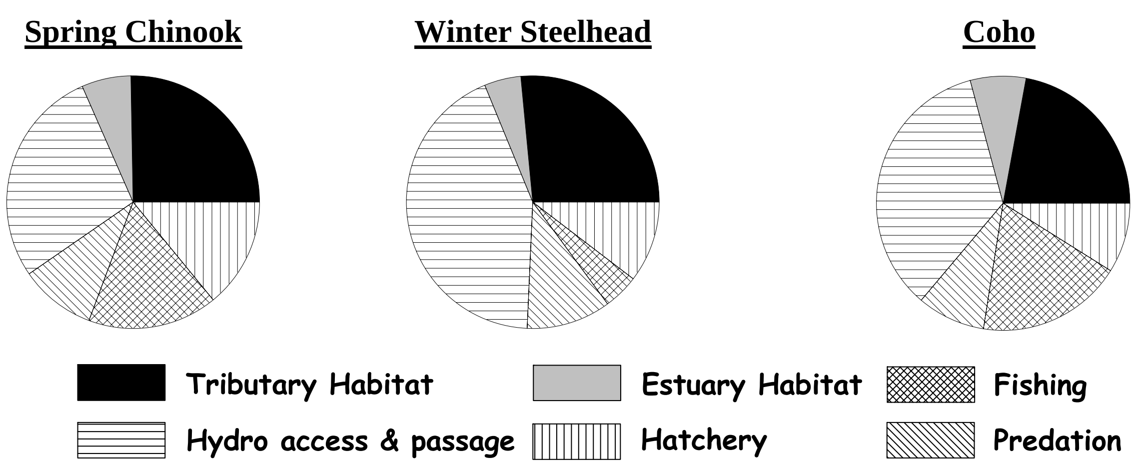


Figure 12-3. Relative contribution of potentially manageable impacts for upper North Fork Lewis populations.

12.4 Limiting Factors, Threats, and Measures

12.4.1 Hydropower Operation and Configuration

Merwin Dam (RM 20), built in 1931, blocks anadromous passage to the upper North Lewis watershed. Merwin Dam, along with Yale Dam (RM 35) and Swift 1 Dam (RM 45) form 39 miles of reservoir in the impounded upper Lewis Basin. Another small dam, Swift 2 diverts water from Swift 1 through a canal to a power generating facility. A program to reintroduce spring Chinook, coho and winter steelhead to the habitats of the upper North Lewis and provide passage for bull trout from Yale Reservoir to Swift Reservoir is likely to occur as part of an agreement for relicensing of the Lewis River hydrosystem. Successful reintroduction of Lewis spring Chinook is especially important for lower Columbia spring Chinook ESU recovery. A significant amount of habitat for North Lewis winter steelhead and coho is also located in the upper North Lewis watershed. The keys to successful reintroduction will be adequate passage of juveniles and adults to and from the upper watershed, hatchery supplementation, and habitat improvements. In addition, Upper Lewis anadromous species are affected by mainstem Columbia hydro operations and flow regimes which affect habitat in migration corridors and in the estuary. These factors are described in further detail in Volume I, Chapter 4. Mainstem hydro factors and threats are addressed by regional strategies and measures identified in Volume I, Chapter 7. Key regional strategies and measures applying to the upper North Lewis populations include:

Table 12-2. Regional hydropower measures from Volume I, Chapter 7 with significant application to the upper North Lewis Subbasin populations.

Measure	Description	Comments
D.S1	Restore access of key populations to blocked habitats in historically accessible subbasins or portions of subbasins where necessary to support region wide recovery.	Access to and from the habitats in the Upper North Fork Lewis River system is essential to meet biological objectives for spring Chinook, coho and winter steelhead. Adequate passage is a key element to achieving recovery objectives.
D.M1	Evaluate and actively implement anadromous fish reintroduction upstream of Cowlitz, Lewis, and White Salmon dams and facilities as part of dam relicensing processes.	Monitoring and evaluation pf juvenile collection efficiciency at Swift Dam will be necessary to meet recovery objectives. Fish management plans should clearly link adaptive management plans to needed juvenile passage efficiencies to meet population goals..

12.4.2 Harvest

Most harvest of wild North Lewis salmon and steelhead occurs incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. Mortality is very low for steelhead. North Lewis spring Chinook are harvested in ocean and Columbia River commercial and sport fisheries as well as in-basin sport fisheries. Wild spring Chinook impacts are limited by Columbia River and Lewis River fishery management provisions to retain marked hatchery fish and release unmarked wild fish. Harvest of North Lewis 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 Lewis Basin. Wild coho impacts are limited by fishery management provisions to retain marked hatchery fish and release unmarked wild fish. 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.

Measures 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. The regional measures 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 Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest measures that have significant application to the upper Lewis subbasin populations are summarized in the following table:

Table 12-3. Regional harvest measures from Volume I, Chapter 7 with significant application to the upper North Lewis Subbasin populations.

Measure	Description	Comments
F.M18	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	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.M19	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	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.M24	Maintain selective sport fisheries in Ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	Mass marking of lower Columbia River spring Chinook, 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.
F.M30	Develop a harvest plan for wild spring Chinook as populations are reestablished.	Adaptively manage harvest to respond to biological objectives for reintroduced Lewis River spring Chinook as they become reestablished in the upper watershed.

12.4.3 Hatcheries

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

There are three hatcheries operating in the North Lewis Basin. The Lewis River Hatchery (since 1932) produces spring Chinook and coho for harvest as well as a sorting facility for all species trapped at Merwin Dam. The Lewis River Hatchery provides late coho eggs for the Klickitat coho program and in some years spring Chinook pre-smolts for the Deep River program. The Lewis River Hatchery also provides spring Chinook and coho for the Fish First organization’s net pen program. Speelyai Hatchery (since 1958) is located in Merwin Reservoir and is used for incubation and early rearing of spring Chinook, coho, and steelhead. Speelyai Hatchery also produces kokanee and rainbow trout for reservoir recreational fisheries. Merwin Hatchery (since 1983) produces early-timed winter and summer steelhead and rainbow trout. Merwin Hatchery also provides summer steelhead for the Elochoman program. These hatchery facilities and programs will be used in the near future to facilitate the reintroduction of spring Chinook, coho, and winter steelhead to the habitats in the upper Lewis basin

The Lewis River Hatchery spring Chinook and late coho programs are primarily derived from Cowlitz stocks, and the early coho program from Toutle stock. The early winter steelhead produced at Merwin Hatchery is a composite Elochoman, Chambers Creek, and Cowlitz steelhead, and the summer steelhead are Skamania stock. The main threats from hatchery released salmon are domestication of wild fish and ecological interactions between hatchery smolts and wild fall Chinook, chum, and coho in the lower river. 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 12-4. Lewis Basin hatchery production.

Hatchery	Release Location	Spring Chinook	Late Coho	Early Coho	Winter Steelhead	Summer Steelhead	Kokanee	Rainbow
Lewis R.	Lower Lewis	1,050,000	815,000	880,000				
Speelyai	Yale Res.						93,000	
	Swift Res.							400,000
Merwin	Lower Lewis				100,000	175,000		
	Elochoman					35,000		
	Swift Res.							400,000

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 Lewis 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 Technical Foundation, Volume IV). Regional hatchery measures identified in Volume I, Chapter 7 with potential applications at facilities within the upper North Fork Lewis subbasin are summarized in Table 12-5.

Table 12-5. Regional hatchery measures from Volume I, Chapter 7 with potential implementation actions in the Upper North Fork Lewis Subbasin.

Measure	Description	Comments
H.M5,36	Integrated hatchery and wild program for reintroduced spring Chinook and early coho.	Assures fitness of the natural produced fish which will improve population productivity. Integrated programs would be developed specific to the Lewis populations in the BRAP procedure.
H.M30.	Develop a late-timed winter steelhead broodstock to enhance the winter steelhead reintroduction program.	Late-timed wild winter steelhead are the preferred stock to reintroduce above the Lewis River dams. The brood stock would be developed from wild winter steelhead entering the Merwin Trap.
H.M15, 22,32, 40	Juvenile release strategies to minimize interactions with naturally-spawning fish.	Release strategies are aimed at reducing or avoiding interactions with wild steelhead, fall Chinook, coho, and chum by release timing and release location strategies.
H.M32, 34,41	Mark hatchery steelhead, coho, and spring Chinook, with an adipose fin-clip for identification and selective harvest.	Marking hatchery fish allows for identification of hatchery fish in the natural spawning grounds and at collection facilities which enables accurate accounting of wild fish and sorting for the reintroduction program. Marking also enables selective fisheries to retain hatchery fish and release wild fish.
H.M8	Adaptively manage hatchery programs to further protect and enhance natural populations and improve operational efficiencies.	Appropriate research, monitoring, and evaluation programs along with guidance from regional hatchery evaluations will be utilized to improve the survival and contribution of hatchery fish, reduce impacts to natural fish, and increase benefits to natural fish.
H.M2	Evaluate the Lewis Salmon and Trout Hatcheries facility operations.	Both facilities would be evaluated in the BRAP process for potential hazards associated with barriers to fish passage and adequacy of screens.
H.M19, 29, 37	Hatcheries utilized for reintroduction of coho, spring Chinook, and winter steelhead into the upper Cowlitz Basin.	Hatchery facilities and operations to accommodate the reintroduction effort; including rearing, collection, transport, marking, sorting, brood stock development, and M&E.

12.4.4 Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Upper North Fork Lewis salmon and steelhead are affected throughout their lifecycle by ecological interactions with non-native species, food web components, and predators. Interactions are similar for upper North Fork Lewis populations to those of most other subbasin salmonid populations. Ecological Interactions are addressed by regional strategies and measures identified in Volume I.

12.4.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. 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 are similar for upper North Fork Lewis populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook than spring Chinook, steelhead, and coho. Estuary and mainstem effects on upper North Fork Lewis salmon and steelhead populations are addressed by regional strategies and measures identified in Volume I and the Columbia Mainstem and Estuary Subbasin sections of Volume II.

12.4.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity have significantly altered watershed processes and reduced both the quality and quantity of habitat needed to sustain viable populations of salmon and steelhead. Currently, there is no access to upper Lewis habitats and much of the habitat has been lost under the three mainstem reservoirs. Potentially productive habitats exist upstream of the reservoirs and in reservoir tributaries. Assuming fish passage is provided to upper basin reaches, the condition of stream habitat will have a large impact on the health and viability of salmon and steelhead.

Subwatersheds, reaches, and habitat attributes have been prioritized for protection and/or restoration based on the plan's biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Priority areas for habitat preservation and restoration are identified in Figure 12-4. A summary of the primary habitat limiting factors and threats are presented in Table 12-7. Habitat measures and related information are presented in Table 12-8. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 12-5. Reach- and subwatershed-scale limiting factors generated from the technical assessment are included in Table 12-6. Details on species-specific spatial priorities and limiting factors at the subbasin level may be found in Volume II of the Technical Foundation. A description of the methodology used to generate composite (multi-species) reach and subwatershed priorities can be found in the introduction to this volume of the recovery plan.

The areas with the greatest current or potential contribution to focal salmonid population health and productivity are listed below. Tier 1 and 2 reaches within these priority areas are included in the list. The habitat limiting factors, threats, and measures included in this chapter focus primarily on the priority areas and the Tier 1 and 2 reaches within them. Tier 3, 4, and non-tiered reaches are considered secondary priority, but in many cases, these lower priority areas will also require restoration and preservation actions in order to achieve recovery objectives. Watershed process measures generally focus on the entire basin as opposed to being limited only to high priority areas because conditions in high priority areas are often influenced by cumulative watershed effects. High priority areas and reaches in the upper North Fork Lewis basin include the following:

- Upper mainstem – Lewis 18-26
- Muddy Creek basin – Muddy R 1A; Clear Creek lower; Clear Creek; Clearwater Creek)
- Pine Creek – Pine Creek 1-6

The areas with the greatest current or potential production of bull trout in the upper North Fork Lewis Basin are the following:

- Pine Creek
- Rush Creek
- Cougar Creek (Yale Lake tributary)

The following paragraphs provide a brief overview of each of these priority areas, including species potentially affected, land-use threats, and the general type of measures that will be most effective. Additional detail can be found in the tables and figures that follow.

While reach level habitat conditions often result from local factors, they are also affected or shaped by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input, and large woody debris recruitment are often affected by or result from upstream conditions and degraded watershed processes. Access to key reaches may also be affected by barriers that occur downstream of a reach. Accordingly, restoration of a priority reach may require action outside the targeted reach. The IWA analysis was used to identify potential upstream watershed areas that could influence reach level habitat attributes. EDT was used to allow a relative comparison of reaches and habitat attributes within a reach.

Most of the potentially productive habitat in the upper Lewis is in the upper mainstem above Swift Reservoir. The contributing basin is almost entirely within the Gifford Pinchot National Forest. The major impacts stem from the effects of forest practices on watershed processes. These reaches have high restoration and preservation value. The most effective recovery measures will be preservation of existing functional conditions and targeted restoration of road impacts and riparian areas.

The Muddy Creek system includes the large tributaries Clear Creek and Clearwater Creek. This system, particularly the mainstem Muddy and Smith Creek, were heavily impacted by the 1980 Mount St. Helens eruption. Intensive post-eruption timber harvests and road building further impacted these streams. Historically, these reaches were most important for coho but also provided productive winter steelhead and spring chinook habitat.

The recovery emphasis in the Pine Creek system is preservation; therefore no limiting factors and threats are specified. Pine Creek is believed to have historically provided habitat primarily for winter steelhead. This system was impacted by the 1980 Mount St. Helens eruption but has recovered rapidly. Although there has been considerable timber harvest and roading in this system, including some riparian timber harvests, stream conditions are currently good for winter steelhead.

Bull trout will benefit from many of the same recovery measures identified for anadromous species, especially restoration and preservation of watershed processes on forested lands. Targeted riparian and stream channel restoration may benefit bull trout in reaches of Cougar, Pine, and Rush creeks.

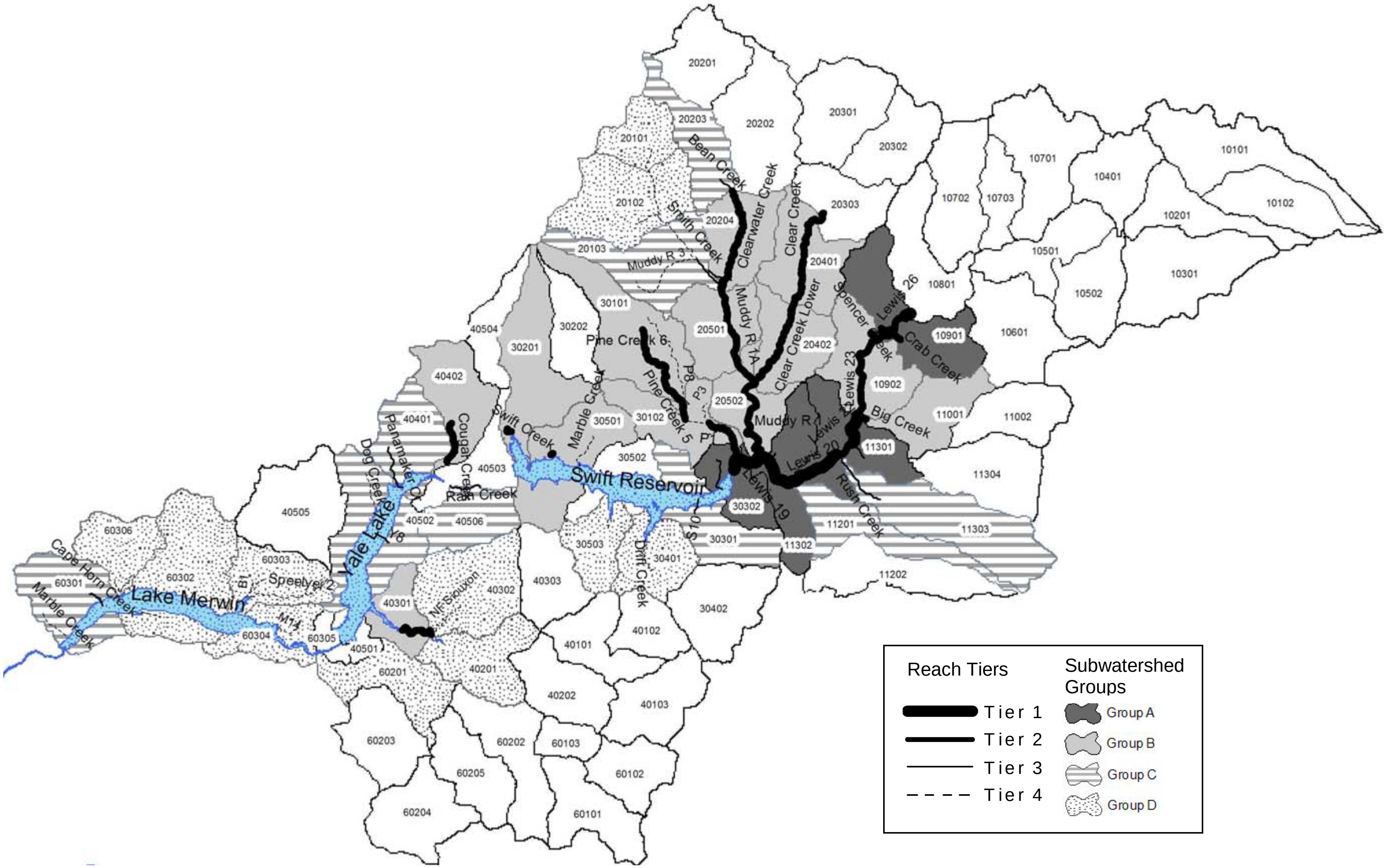


Figure 12-4. Reach tiers and subwatershed groups in the upper NF Lewis Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities 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.

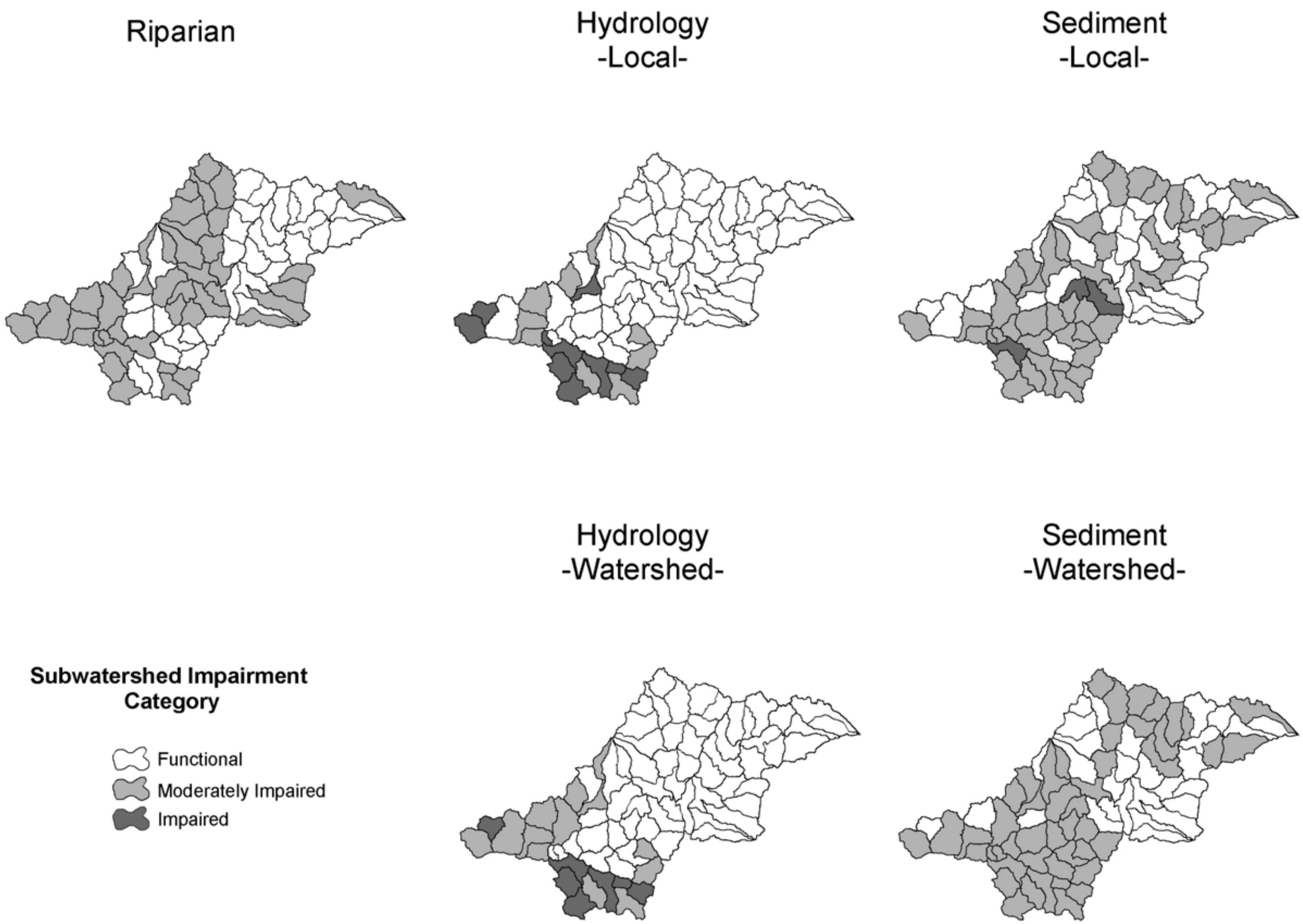


Figure 12-5. IWA subwatershed impairment ratings by category for the Upper NF Lewis Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 12-6. 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 subwatershed	Species present	High priority reaches by species	Critical life stages	High impact habitat factors	Restoration or preservation emphasis	Watershed processes (local) Hydrology	Watershed processes (local) Sediment	Watershed processes (local) Riparian	Watershed processes (watershed) Hydrology	Watershed processes (watershed) Sediment
A	10901	Chickoom Creek Crab Creek Cussed Hollow Lewis 24 Lewis 25 Lewis 26 Lewis 27	ChS	Lewis 25 Lewis 27	spawning egg incubation fry colonization summer rearing winter rearing adult holding	channel stability habitat diversity sediment key habitat quantity	PR	F	M	F	F	M
			Coho									
			StW	Crab Creek Lewis 24 Lewis 25 Lewis 26 Lewis 27 Cussed Hollow	spawning egg incubation fry colonization summer rearing	habitat diversity predation sediment food key habitat quantity	PR					
	11301	Lewis 20 Lewis 21 Lewis 22 Little Creek	ChS	Lewis 22	egg incubation fry colonization summer rearing	sediment	PR	F	M	F	F	F
			Coho									
			StW	Lewis 21 Lewis 22	egg incubation summer rearing	sediment	P					
	11302	Lewis 20 Pepper Creek	ChS	Lewis 20	egg incubation fry colonization summer rearing	sediment	PR	F	F	F	F	F
			Coho									
			StW									
	30302	Lewis 18 Lewis 19 Swift Campground Cr	ChS	Lewis 18 Lewis 19	egg incubation fry colonization summer rearing	habitat diversity predation competition (hatchery fish) sediment food key habitat quantity	PR	F	M	M	F	F
			Coho	Lewis 18	egg incubation summer rearing winter rearing	habitat diversity predation competition (hatchery fish) sediment food key habitat quantity	R					
			StW	Lewis 18 Lewis 19	summer rearing winter rearing	habitat diversity predation competition (hatchery fish) sediment food	PR					

Sub-watershed Group	Sub-watersheds	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	10902	Spencer Creek Lewis 23	ChS					F	F	F	F	F
			Coho	Lewis 23	spawning	habitat diversity	P					
			StW	Spencer Creek	fry colonization egg incubation summer rearing	sediment						
	11001	Big Creek Mid	Coho					F	M	F	F	F
			StW	Big Creek Mid	spawning egg incubation fry colonization summer rearing winter rearing	habitat diversity sediment key habitat quantity	P					
	20204	Clearwater Creek Clearwater Tribs	ChS					F	F	M	F	M
			Coho	Clearwater Creek	egg incubation fry colonization summer rearing winter rearing	habitat diversity temperature sediment food	R					
			StW									
	20401	Clear Creek Clear Creek Small Tribs	ChS					F	F	F	F	F
			Coho	Clear Creek Small Tribs	egg incubation fry colonization summer rearing winter rearing adult holding	sediment key habitat quantity	PR					
			StW									
	20402	Clear Creek Lower Clear Creek Small Tribs	ChS					F	F	F	F	F
			Coho	Clear Creek Lower	egg incubation summer rearing winter rearing	habitat diversity sediment food key habitat quantity	PR					
			StW									
	20501	Muddy R 1A	ChS					F	M	M	F	M
			Coho	Muddy R 1A	egg incubation summer rearing winter rearing	habitat diversity sediment	R					
			StW									
	20502	Muddy R 1 Muddy R 1A	ChS					F	F	M	F	F
			Coho	Muddy R 1 Muddy R 1A	egg incubation summer rearing winter rearing	habitat diversity temperature competition (hatchery fish) sediment food	R					
			StW									
	30101	P10 P8 Pine Creek 5 Pine Creek 6	ChS					F	F	M	F	F
			Coho									
			StW	Pine Creek 5 Pine Creek 6	spawning egg incubation fry colonization summer rearing winter rearing adult holding		P					
	30102	P1 P3 P7 Pine Creek 1 Pine Creek 2 Pine Creek 3 Pine Creek 4	ChS					F	M	M	F	M
			Coho									
			StW	Pine Creek 1 Pine Creek 2 Pine Creek 4	egg incubation fry colonization summer rearing winter rearing		P					
	30201	Swift Creek	ChS Coho StW					F	M	F	F	M
	30401	Drift Creek	All					F	M	M	F	M
	30501	Diamond Creek Diamond Creek Template Marble Creek	Coho	Diamond Creek	spawning egg incubation fry colonization summer rearing winter rearing adult holding	habitat diversity sediment	P	F	F	M	F	M
			StW									
	40301	Siouxon 1	All					F	M	M	F	M
	40402	Cougar Creek	All					F	M	F	F	M

Sub-watershed Group	Sub-watersheds	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	11201	Curly Creek	Coho StW					F	F	F	F	F
	11303	Rush Creek	All					F	F	M	F	F
	20103	Muddy R 2 Muddy R 3 Smith Creek	All					F	M	M	F	F
	20203	Bean Creek	Coho StW					F	F	M	F	F
	30301	S10	Coho					F	I	M	F	F
	40401	Panamaker Cr	Coho StW					M	M	M	M	M
	40502	Dog Creek Dog Creek Template Y8	Coho StW					F	M	M	M	
	40506	Ole Creek Rain Creek	Coho StW					F	F	F	F	F
	60301	Cape Horn Creek Marble Creek Marble Creek Templa	Coho StW					I	M	M	M	M
D	20101	Upper Smith Creek	All					F	F	M	F	F
	20102	Ape Canyon Creek Upper Smith Creek	All					F	F	M	F	F
	30401	Drift Creek	All					F	M	M	F	M
	30503	Range Creek Range Creek Templat	All					F	M	M	F	M
	40201	Siouxon 2	StW					F	M	M	F	M
	40302	NF Siouxon	Coho StW					F	M	F	F	M
	60201	Canyon Creek	All					I	I	M	I	M
	60302	Buncombe Hollow Creek	Coho StW					F	F	M	M	M
	60303	B1 Brooks Creek Speelyei 1 Speelyei 1 Template Speelyei 2	Coho StW					M	M	M	M	M
	60304	M14 M14 Template	Coho StW					M	M	M	M	M
	60306	Indian George Creek Jim Creek	Coho StW					I	F	M	I	F
	60501	Lewis 1 tidal Lewis 2 tidal	All					I	M	I	M	M
	60502	Lewis 3 Lewis 4	All					I	M	M	M	M
	60503	Lewis 5 Lewis 6	All					I	M	M	M	M
	60504	Lewis 7	All					I	M	M	M	M

Table 12-7. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the upper mainstem (UM) and Muddy Creek and tributaries (MC). Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors	UM	MC	Threats	UM	MC
Habitat connectivity			***Forest practices***		
Blockages to stream habitats due to structures	✓	✓	Timber harvests –sediment supply impacts	✓	✓
Habitat diversity			Riparian harvests (historical)	✓	✓
Lack of stable instream woody debris	✓	✓	Forest roads – impacts to sediment supply	✓	✓
Altered habitat unit composition		✓	Forest roads – riparian/floodplain impacts	✓	
Channel stability			***Hydropower operations***		
Bed and bank erosion	✓	✓	Passage obstructions (dams)	✓	✓
Mass wasting		✓			
Riparian function					
Reduced bank/soil stability	✓				
Reduced wood recruitment	✓				
Water quality					
Altered stream temperature regime		✓			
Excessive turbidity		✓			
Substrate and sediment					
Excessive fine sediment	✓	✓			

Table 12-8. Habitat measures in priority areas, with reference to limiting factors addressed, threats addressed, target species, and estimated time until benefits would be realized (time). Tier 1 and 2 reaches, or other areas of known priority, are listed under the location column for some measures (i.e., stream corridor measures). Reaches not included in the table (Tier 3, 4, and non-tiered reaches) are considered secondary priority.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
1. Protect and restore riparian function ***A. Reforest riparian zones*** ***B. Allow for the passive restoration of riparian vegetation***					
Upper mainstem Lewis Lewis 18-26 ***Muddy Creek & tribs*** Muddy Creek 1-1A, Clear Creek lower, Clear Creek, Clearwater Creek	• Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris	• Timber harvest – riparian harvests	• Winter steelhead • Coho • Spring Chinook	20-80 years	High potential benefit due to the many limiting factors that are addressed. Riparian impairment is related to the 1980 Mt. Saint Helens eruption and subsequent timber harvests. Recovery of riparian forests is occurring naturally. Riparian protections on forest lands are provided for under current harvest policy. Active reforestation should be considered low priority unless the benefit can be clearly demonstrated. Whereas the specified stream reaches are the highest priority for riparian measures, riparian restoration and preservation should occur throughout the basin since riparian conditions affect downstream reaches. Use IWA riparian ratings to help identify restoration and preservation opportunities.
2. Protect and restore natural sediment supply processes ***A. Address forest road related sources*** ***B. Address timber harvest related sources***					
Entire basin	• Excessive fine sediment • Excessive turbidity	• Timber harvest – impacts to sediment supply • Forest roads – impacts to sediment supply	• Winter steelhead • Coho • Spring Chinook • Bull trout	5-50 years	High potential benefit due to sediment effects on egg incubation and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. Use IWA impairment ratings to identify restoration and preservation opportunities.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
3. Protect and restore runoff processes ***A. Address forest road impacts*** ***B. Address timber harvest impacts***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Timber harvest – impacts to runoff • Forest roads – impacts to runoff	• Winter steelhead • Coho • Spring Chinook • Bull trout	5-50 years	High potential benefit due to flow effects on habitat formation, redd scour, and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs.
4. Protect and restore instream habitat complexity ***A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting*** ***B. Structurally modify stream channels to create suitable habitat types***					
Upper mainstem Lewis Lewis 18-26 ***Muddy Creek & tribs*** Muddy Creek 1-1A, Clear Creek lower, Clear Creek, Clearwater Creek	• Lack of stable instream woody debris • Altered habitat unit composition	• None (symptom-focused restoration strategy)	• winter steelhead • coho • spring Chinook	2-10 years	Moderate potential benefit due to the high chance of failure. Failure is probable if habitat-forming processes are not also addressed. These projects are relatively expensive for the benefits accrued. High likelihood of implementation given the USFS focus on stream restoration.
5. Protect and restore water quality ***A. Restore the natural stream temperature regime***					
Entire basin	• Altered stream temperature regime	• Riparian harvests	• All species	20-50 years	Primary emphasis for restoration should be placed on stream segments that are on the 2004 303(d) list.
6. Protect and restore instream flows ***A. Water rights closures*** ***B. Purchase or lease existing water rights*** ***C. Relinquishment of existing unused water rights*** ***D. Enforce water withdrawal regulations*** ***E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Water withdrawals	• All species	1-5 years	Instream flow management strategies for the Upper Lewis Basin have been identified as part of Watershed Planning for WRIA 27 (LCFRB 2004).

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
7. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development ***A. Plan growth and development to avoid sensitive areas (e.g., wetlands, riparian zones, floodplains, unstable geology)*** ***B. Encourage the use of low-impact development methods and materials*** ***C. Apply mitigation measures to off-set potential impacts***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	The focus should be on management of land-use conversion and managing continued development in sensitive areas (e.g., wetlands, stream corridors, unstable slopes). Many critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary mechanisms need to be put in place to restore currently degraded habitats.
8. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection ***A. Purchase properties outright through fee acquisition and manage for resource protection*** ***B. Purchase easements to protect critical areas and to limit potentially harmful uses*** ***C. Lease properties or rights to protect resources for a limited period***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit. These programs are under-funded and have low landowner participation.

12.5 Program Gap Analysis

The upper North Fork Lewis Basin (~731 square miles) is predominantly forest lands; its headwaters begin in the Gifford Pinchot National Forest before entering three hydroelectric reservoirs managed by PacifiCorp. The three reservoirs are Swift, Yale, and Merwin.

- Approximately 500 square miles of the basin lie within the Gifford Pinchot NF and divided into multiple management areas. These include the Mount St Helens Monument and Ranger District, Mt Adams Ranger District, Indian Heaven Wilderness, and the Mt Adams Wilderness.
- Lands surrounding Swift Reservoir are predominantly private industrial forest lands with some Department of Natural Resources managed state forests.
- Lands surrounding the Yale Reservoir are predominantly Department of Natural Resources managed state lands (~80 square miles), Mt St Helens National Monument, private small landowner and industrial forest lands, and private lands.
- Lands surrounding the Merwin Reservoir are a balanced mix of Department of Natural Resources lands, private small and industrial forest lands, and private lands that can be characterized as rural and residential;
- The portion of the upper North Fork Lewis basin above Yale Reservoir lies in Skamania County. Below this point, lands north of the river lie in Cowlitz County and lands south of the river lie in Clark County.
- PacifiCorp and Cowlitz PUD management of the three reservoirs is governed by a license issued by the Federal Energy Regulatory Commission. Programs implemented under the current license include flow, habitat, hatcheries, and water quality.

Protection Programs

In the upper North Fork Lewis basin, protection programs center forest management and the existing hydroelectric project. Habitat protection on the very small remaining area of private is provided through county land use programs. Protection programs in this analysis include those programs that protect habitat conditions or watershed functions through regulatory measures, acquisition sensitive habitat or protective easements, or by applying standards to new development that protects resources by avoiding damaging impacts. Key programs implementing protection measures are identified below.

Federal Programs

➢ ***U.S. Forest Service Gifford Pinchot National Forest***

- Forest Plan: The Gifford Pinchot NF Forest Plan provides high levels of protection for riparian areas and forest stands within the upper NF Lewis Basin. Protection efforts are subject to NOAA Fisheries and U.S. Fish and Wildlife Service ESA Section 7.
    - ✓ Riparian buffers in all areas of the Gifford Pinchot NF include at least 300' setbacks.
    - ✓ Designated matrix lands in the NF Lewis observe the forest-wide 'no clear cut' policy.
    - ✓ Some NF Lewis Gifford Pinchot lands fall in the Late Successional Reserves Program. Thinning occurs in the riparian areas to support healthier late successional stands.

- ✓ Congressional Reserve Areas (Mt St Helens National Volcanic Monument) in the NF Lewis are 'no touch' areas. This includes portions of the Muddy Fork watershed.
- ✓ Upper NF Lewis lands located within Wilderness Areas (Indian Heaven and Mt Adams) allow little human activity.
- ✓ Addresses measures: M.1B; M.2A; M.2B; M.3A; M.3B; M.5A

➢ ***Federal Energy Regulatory Commission (FERC)***

- Licensing of Hydroelectric Projects: PacifiCorp and the Cowlitz PUD operate hydroelectric facilities on the North Fork Lewis. Existing FERC licenses for these projects include habitat protection provisions. The projects are currently undergoing relicensing pursuant to the federal Power Act using FERC's alternative licensing approach. Under this approach the utilities are working with federal agencies, local governments, tribes, community interests, and environmental organizations to develop a settlement agreement defining terms for a license. Aquatic and terrestrial habitat protection is an issue under consideration in the relicensing discussions.

➢ ***NOAA Fisheries***

- Hydroelectric Project Relicensing: Under the federal Power Act, NOAA Fisheries has substantive authority over FERC license provisions relating to listed salmonids. The agency is actively engaged in the relicensing efforts for the Lewis hydroelectric projects. With regard to the upper North Fork Lewis, habitat protection is a key issues of interest to NOAA fisheries.

➢ ***U.S. Fish and Wildlife Service***

- Hydroelectric Project Relicensing: Under the federal Power Act, the U.S, Fish and Wildlife Service (USFWS) has substantive authority over FERC license provisions relating to bull trout in the upper North Fork Lewis. The agency is actively engaged in the relicensing efforts for the Lewis hydroelectric projects. With regard to the upper North Fork Lewis, key protection issue of interest to USFWS is bull trout habitat protection.

➢ ***U.S. Army Corps of Engineers***

- Regulatory Programs: U.S. Army Corps of Engineers administers the Section 10 (Rivers and Harbor Act) and Section 404 (Clean Water Act) permit processes. Section 10 requires approval of any activity in, above, or below a navigable river, which affects course, location, condition, or capacity of navigable waters. Section 404 requires prior approval of dredging, filling, grading, clearing, and bank hardening. In waters used by listed fish species, the permits are subject to ESA Section 7 consultation with NOAA Fisheries to ensure that any approved action is adequately protective of the ESA listed fish. [M.1A; M.4A; M.4B]

State Programs

➢ ***Department of Natural Resources***

- State Forest Land HCP: State forest lands are managed under the provisions of a Habitat Conservation Plan (HCP). The Habitat Conservation Plan has protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. [M.1B; M.2A; M.2B; M.3A; M.3B; M.5A]

- State Forest Practices: Riparian areas and watershed functions on small- and industrial forest lands are protected under the State of Washington Forest Practices Rules, including the Forest and Fish Module. These rules provide for riparian buffers, harvest restrictions, sensitive area protections, and protective standards for new road construction. [M.1B; M.2A; M.2B; M.3A, M.3B, M.5A]

➢ ***Washington Department of Fish and Wildlife***

- Hydraulics Project Approval (HPA): The Department administers the state Hydraulic Code. The purpose of this program is to protect stream conditions and habitat. The regulations apply to such activities as streambank protection, instream construction, culvert installation, channel changes or realignments, debris removal, and water diversion facilities. Those proposing such actions must obtain a Hydraulic Project Approval (HPA) permit. . [M.1A; M.4A; M.4B]

- Habitat Program: The Department provides advice to local governments and landowners interested in measures to protect habitat values on their property. [M.1A; M.4A; M.4B; M.5A; M.7A; M.7B; M.7C]

- Hydro Facility Relicensing: The Department is an active participant in the FERC relicensing of the PacifiCorp and Cowlitz PUD hydro facilities on the North Fork Lewis. Protection of aquatic and terrestrial habitat in the upper North Fork Lewis is a topic of interest to WDFW.

➢ ***Washington Department of Ecology***

- Water Quality Program/Clean Water Act – Section 401 Certification
FERC relicensing of the Lewis hydro projects requires the Department to issue a CWA Section 401 water quality certification. The Department of Ecology review and, where necessary, revise flow requirements for the protection of fish and their habitat. [M.3A; M.3B; M.5A]

- Water Resources Program/Water Rights: Department of Ecology, in consultation with the Department of Fish and Wildlife, has administrative closed selected areas within the North Fork Lewis watershed to further surface and groundwater withdraws (where groundwater is in continuity with surface water). Existing administrative closures by the Department of Ecology protect surface waters from further withdrawals. Formal rule-making would strengthen the closures. The extent of unauthorized surface water withdrawals is unknown, but given the low intensity of land uses is not expected to adverse impact stream flows. [M.6A; M.6B; M.6C; M.6D]

- Water Resources Program/Watershed Planning: In cooperation with the Lower Columbia Fish Recovery Board, other state and federal agencies, tribes, local governments, and citizens, the Department funds and participates in a state authorized watershed planning process for Water Resource Inventory Area (WRIA) 27 pursuant to RCW 90.82. The goal of the plan is to ensure adequate water for people and fish. The planning process is dealing with water quantity and quality, stream flows and fish habitat. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.5A; M.6A; M.6B; M.6C; M.6D; M.7A]

Local Government Programs

➢ ***Clark County*** (Lands south of the NF Lewis)

- ESA Program: The County has established an Endangered Species Program to address ESA requirements and develop a comprehensive county strategy for salmon recovery. An ESA committee with representatives from federal and state agencies, tribes, citizens, the business community and environmental groups has been established to advise the county as it works to bring its ordinances and programs into compliance with ESA requirements.
- Land Use:
  - ✓ The County is actively engaged in a comprehensive review and revision of its programs to better protect watershed processes and habitat and to secure ESA Section 4d assurances from NOAA Fisheries.
  - ✓ The County comprehensive sets policies calling for the protection of habitat for ESA listed salmon and other aquatic and terrestrial species.
  - ✓ Zoning that directs growth throughout the County and maintains low-density development in rural areas. The County has a designated Urban Growth Area pursuant to the Washington Growth Management Act (GMA). The UGA helps protect rural lands by directing high intensity uses to developed areas.
  - ✓ A Habitat Conservation Ordinance provides stream buffers and measures for the protection of important habitat, including ESA listed salmonids.
  - ✓ Addresses measures: [M.7A; M.7B; M.7C]
- Road Maintenance:
  Clark County Road Program utilizes Best Management Practices to guide their operations and is actively seeking programmatic ESA Section 4d assurances from NOAA Fisheries that these measures provide adequate protection for fish. [M.5A]

➢ ***Cowlitz County*** (Lands north of the NF Lewis)

- Land Use:
  - ✓ The comprehensive plan that applies to the non-federal lands, but contains no significant policies for the protection of watershed processes and stream habitat.
  - ✓ Zoning along State Highway 503 provides for one dwelling per 2 acres and one dwelling per 5 acres along non-county roads.
  - ✓ Cowlitz County has not adopted protective stream buffers.
  - ✓ Wetland buffers vary from 25' to 200' and are based upon soil type and wildlife utilization.
  - ✓ The County has not developed comprehensive ordinances for the protection of watershed processes or stream habitat conditions. [M.7A; M.7B; M.7C]
- Road Maintenance

The County has not developed or implemented a road maintenance program to protect habitat. [M.5A]

Community Programs

No active programs

<u>Restoration Programs</u>

Restoration programs in the upper NF Lewis Basin are conducted primarily by the U.S. Forest Service Gifford Pinchot National Forest, the Washington Department of Natural Resources on state forest lands and industrial and small forest land owners pursuant to the state forest practice rules. Restoration programs are generally organized around agencies, organizations, and private interests that assess threats, develop solutions, and implement projects that are intended to improve habitat conditions or watershed functions. Key programs implementing restoration measures are identified below:

Federal Programs

➢ ***U.S. Forest Service Gifford Pinchot National Forest:*** Restoration activities within the upper NF Lewis Basin are a high priority on the Gifford Pinchot NF. These efforts include placement of large wood, riparian thinning to improve stands, and road stabilization and decommissioning. The Muddy Fork and Pine Creek receive provide important bull trout habitat receive high priority for restoration. [M.1A; M.1B; M.2A; M.2B; M.3A; M.3B; M.5A]

➢ ***Federal Energy Regulatory Commission (FERC)***

- <u>Hydro Project Licensing:</u> Current FERC licenses for the hydroelectric projects operated by PacifiCorp and Cowlitz PUD contain habitat restoration provisions. Relicensing negotiations underway included the following habitat restoration topics:
  - ✓ Adult and juvenile passage for salmonids;
  - ✓ Reintroduction of spring Chinook, coho, and steelhead;
  - ✓ Habitat protection and improvement for salmon, steelhead, and bull trout; and
  - ✓ Flows in the bypass reach (former North Fork Lewis channel).

  Reintroduction and passage of spring chinook are essential for the recovery of the species in the lower Columbia ESU.

➢ ***NOAA Fisheries***

- <u>Hydroelectric Project Relicensing</u>: Under the federal Power Act, NOAA Fisheries has substantive authority over FERC license provisions relating to listed salmonids. The agency is actively engaged in the relicensing efforts for the Lewis hydroelectric projects. With regard to the upper North Fork Lewis, restoration of primary concern are:
  - ✓ Adult and juvenile passage for salmonids;
  - ✓ Reintroduction of spring Chinook, coho, and steelhead; and
  - ✓ Habitat protection and improvement.

- ***U.S. Fish and Wildlife Service***
  - Hydroelectric Project Relicensing: Under the federal Power Act, the U.S, Fish and Wildlife Service (USFWS) has substantive authority over FERC license provisions relating to bull trout in the upper North Fork Lewis. The agency is actively engaged in the relicensing efforts for the Lewis hydroelectric projects. With regard to the upper North Fork Lewis, key restoration issues for USFWS are protection.
    - ✓ Bull trout passage; and
    - ✓ Restoration of bull trout habitat.

State Programs

- ***Department of Natural Resources***

  - State Forest Land Habitat Conservation Plan (HCP): The Department manages state forest lands pursuant to a Habitat Conservation Plan (HCP). The HCP road maintenance and restoration objectives require barrier upgrades and road abandonment and/or other improvements. [M.1B; M.2A; M.2B; M.3A; M.3B; M.5A]

  - State Forest Practices Act:

    - Industrial forests within the lower NF Lewis Basin are governed by Forest and Fish regulations and have rigid schedules for maintaining and improving roads and removing barriers. Industrial landowners have 15 years to bring roads and barriers into compliance with regulations [M.1B; M.2A; M.2B; M.3A; M.3B; M.5A]

    - Small private forest owners are governed by Forest and Fish regulations; however their road and barrier maintenance and improvement programs are tied to state funding. In the State 2003-05 Biennial Budget, 2 million dollars was allocated statewide to support small private forest owners [M.1B; M.2A; M.2B; M.3A; M.3B; M.5A]

- ***Department of Fish and Wildlife***

  - Habitat Program: The Department provides advice and assistance to local governments and landowners interested in measures to restore habitat. [M.1A; M.4A; M.4B; M.5A; M.7A; M.7B; M.7C]

  - Hydro Facility Relicensing: The Department is an active participant in the FERC relicensing of the PacifiCorp and Cowlitz PUD hydro facilities on the North Fork Lewis. Upper North Fork restoration issues of interest to WDFW include:

    - ✓ Adult and juvenile passage for salmonids;
    - ✓ Reintroduction of spring Chinook, coho, and steelhead;
    - ✓ Habitat protection and improvement for salmon, steelhead, bull trout and other aquatic species;
    - ✓ Flows in the bypass reach (former North Fork Lewis channel); and
    - ✓ Restoration of habitat for terrestrial species.

- ***Department of Transportation***

- Barrier Removal Program:
  WSDOT has improved several blockages associated with State Route 503 project.

- Road Maintenance Program

WSDOT has an ESA Section 4(d) Road Maintenance Program. The Maintenance Program uses trained crews to primarily manage road-side vegetation, litter control, and maintenance of safety rest areas. [M.5A]

Gap Analysis

Forest-related Programs: Approximately 70% of the upper NF Lewis Basin is in the Gifford Pinchot NF. Forest Service management will provide a high level of watershed and habitat protection and restoration on these lands. Forestry programs and regulations applicable to state and private forest lands will play a substantial role in protecting and restoring watershed functions and habitat conditions at levels supporting recovery goals. Certainty of forestry-related protection and restoration programs is relatively high because programs are being implemented and, for the most part, fully funded. Program areas of concern include state funding for small commercial forest landowners and the continued potential for hydrologic impacts caused by past harvest practices. Monitoring of watershed processes and habitat conditions will be required to confirm the effectiveness of these measures.

Protection-related Programs: Clark, Skamania, and Cowlitz Counties' land use regulatory mechanisms provide varied protections throughout the upper NF Lewis Basin. Cowlitz County land use regulatory mechanisms provide some protections. However, Cowlitz County programs lack effective provisions that commonly are used to proactively direct growth, protect streams and wetlands, and manage stormwater. In addition, there are very limited protection mechanisms for agricultural practices relative to riparian areas and hydrologic impairment.

Restoration-related Programs: Relative to the hydroelectric facilities, upstream and downstream passage for coho, steelhead, and spring chinook are fundamental to access high-quality habitats upstream of the reservoirs. Recovery of Spring Chinook, in particular, hinges upon success of the PacifiCorp and Cowlitz PUD passage program. New FERC licenses will likely provide for additional habitat restoration.

Table 12-9. Program Actions to Address Gaps

Action #	Lead Agency	Proposed Action
U-NFL.1	Cowlitz County	Develop and implement controls to adequately protect riparian areas to maintain currently functional habitat as well as restored habitat needed

		habitat conditions around all rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Require mitigation, where necessary, to offset unavoidable damage to habitat conditions in riparian management areas
U-NFL.2	Cowlitz County, Skamania County	Zoning and development standards to adequately protect wetlands, wetland buffers, and wetland function.
U-NFL.3	Cowlitz County, Skamania County	Develop and implement controls to address erosion and sediment run-off during (and after) construction to prevent sediment and pollutant discharge to streams, wetlands and other water bodies
U-NFL.4	State of Washington (DNR)	Provide state funding for small forest owners in the upper NF Lewis Basin to a level sufficient to achieve the road and barrier improvements of Forest and Fish on a schedule parallel to private industrial forest owners
U-NFL.5	State of Washington (DFW, Ecology)	Close tributaries to the upper NF Lewis to further withdrawal of surface water, including groundwater in connection with surface waters. Curtail unauthorized withdrawals.
U-NFL.6	Forest Managers LCFRB, and DFW	Identify and sequence early action forest restoration projects that analysis indicates could provide significant benefits. In these cases, it may be appropriate to identify outside funding to initiate these early actions
U-NFL.7	State of Washington, LCFRB, CC	Build institutional capacity for agencies and organizations to undertake protection and restoration projects
U-NFL.8	LCFRB, DOE, DFW, NOAA, USFWS, ACOE, BPA	Increase available funding for projects that implement measures and addresses underlying threats
U-NFL.9	PacifiCorp and Cowlitz PUD	Provide passage and collection facilities for adult and juvenile coho, steelhead, spring chinook populations to make use of habitats above Swift Reservoir. Monitor and mitigate LWD and sediment (gravel) transport impacts below Merwin Dam.
U-NFL.10	PacifiCorp and Cowlitz PUD	Increase fish and wildlife habitat mitigation measures (upstream and downstream) commensurate with recovery goals for populations affected by hydrosystem impacts
U-NFL.11	Clark CD, Clark County, Cowlitz County, Skamania County, non profit fish recovery organizations.	Utilize a combination of public outreach/education, incentives, and authority to positively influence landowner behaviors toward land stewardship in practices not covered by land use regulations
U-NFL.12	Clark County, Cowlitz County, Skamania County	Apply land use code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
U-NFL.13	WRIA 27/28 PU, DOE, DFW	Close the upper NF Lewis River to further surface water withdrawals,
U-NFL.14	LCFRB, Clark County, Cowlitz County, Skamania County, DFW	Build institutional capacity for agencies and organizations to undertake additional protection and restoration projects, including noxious weed control
U-NFL.15	LCFRB, , WDFW, PacifiCorp	Address threats proactively by building agreement on priorities among the various program implementers
U-NFL.16	FEMA	Update Floodplain maps using Best Available Science

13 Lewis Subbasin – East Fork Lewis

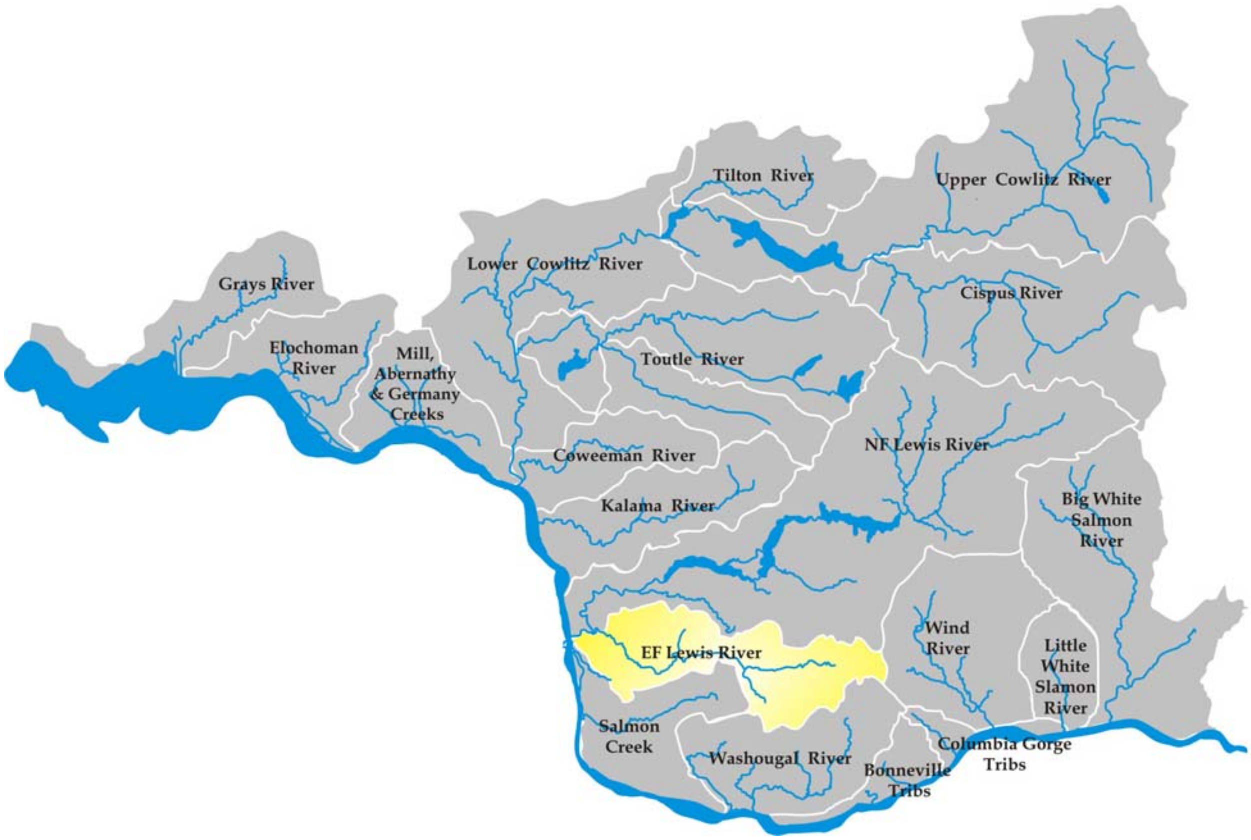


Figure 13-1. Location of the East Fork Lewis River Basin within the Lower Columbia River Basin.

13.1 Basin Overview

The East Fork Lewis River Basin comprises approximately 235 square miles, primarily in Clark County with the upper portion in Skamania County. The East Fork Lewis enters the North Fork Lewis at RM 3.5. The subbasin is part of WRIA 27.

The East Fork Lewis Basin will play a key role in the recovery of salmon and steelhead. The basin has historically supported populations of fall Chinook, summer and winter steelhead, chum, and coho. Today, Chinook, steelhead and chum are listed as threatened under the ESA. Coho salmon are a candidate for listing. Other fish species of interest are Pacific lamprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

East Fork Lewis salmon and steelhead are affected by a variety of in-basin and out-of basin factors including stream, Columbia River mainstem, estuary, and ocean habitat conditions; harvest; hatcheries; and ecological relationships with other species. Analysis has demonstrated that recovery cannot be achieved by addressing only one limiting factor. Recovery will require action to reduce or eliminate all manageable factors or threats. The deterioration of habitat conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonids within the Columbia Basin. Direct harvest of listed salmon and steelhead is prohibited but sport and commercial fisheries focusing on hatchery fish and other healthy wild populations, primarily in the mainstem Columbia and ocean, incidentally affect ESA-listed East Fork Lewis fish. Key ecological interactions of concern include effects of nonnative species; nutrient inputs from salmon carcasses; and predation by species affected by development including Caspian terns, northern pikeminnow, seals, and sea lions. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the East Fork Lewis Subbasin.

The bulk of the land is forested and a large percentage is managed as commercial forest. Agricultural and residential activities are found in valley bottom areas. Recreation uses and residential development have increased in recent years. Most of the land is private (63%), with about 20% of the basin area lying within the Gifford Pinchot National Forest. Stand replacement fires, which burned large portions of the basin between 1902 and 1952, have had lasting effects on basin hydrology, sediment transport, soil conditions, and riparian function. The largest of these fires was the Yacolt Burn in 1902. Subsequent fires followed in 1927 and 1929.

The East Fork Lewis has a high degree of watershed process impairment (sediment, flow) in the lower half of the basin. This portion suffers from a variety of land uses including agriculture, grazing, mining, rural residential development, and some timber harvest. The upper portion of the basin, much of which lies within the Gifford Pinchot National Forest is more intact. Past fires and forest harvest have degraded watershed processes and riparian areas in many subwatersheds, however, healthy conditions exist in headwater areas.

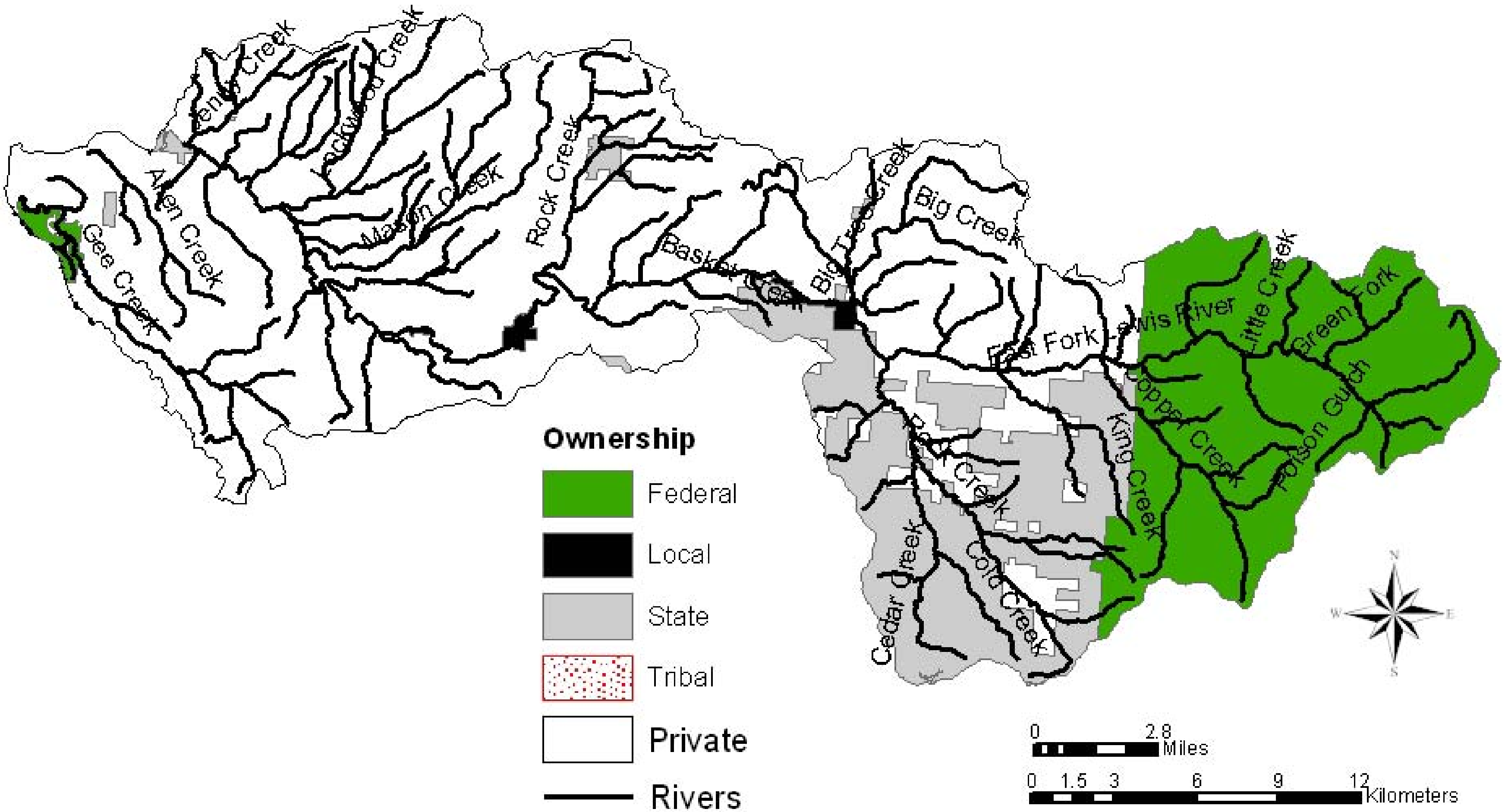
The most important areas in the basin from an aquatic habitat perspective are the mainstem reaches and the lower mainstem tributaries. The upper mainstem is critical for summer steelhead production. These spawning and rearing reaches currently support good numbers of naturally-produced steelhead, though much higher production could be achieved with recovery of impaired conditions. Upper basin timber harvest and road building have the greatest impact here. The middle mainstem provides the best potential for winter steelhead. This stock would also benefit from restoration measures focused on recovering watershed process impairments related to forest harvest.

The lower mainstem and lower mainstem tributaries represent important spawning and rearing sites for fall Chinook, chum, and coho. These areas currently suffer from loss of key habitat, low habitat diversity, and channel instability. These conditions are partly due to recent avulsions of the mainstem into stream-adjacent gravel pits. This area also suffers from artificial confinement projects and degraded riparian zones.

Rural residential development is widespread in the lower portion of the basin and is expected to increase. The population in the basin was approximately 24,400 persons in 2000 (LCFRB 2001). The population of the basin is expected to more than double by 2020. 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.

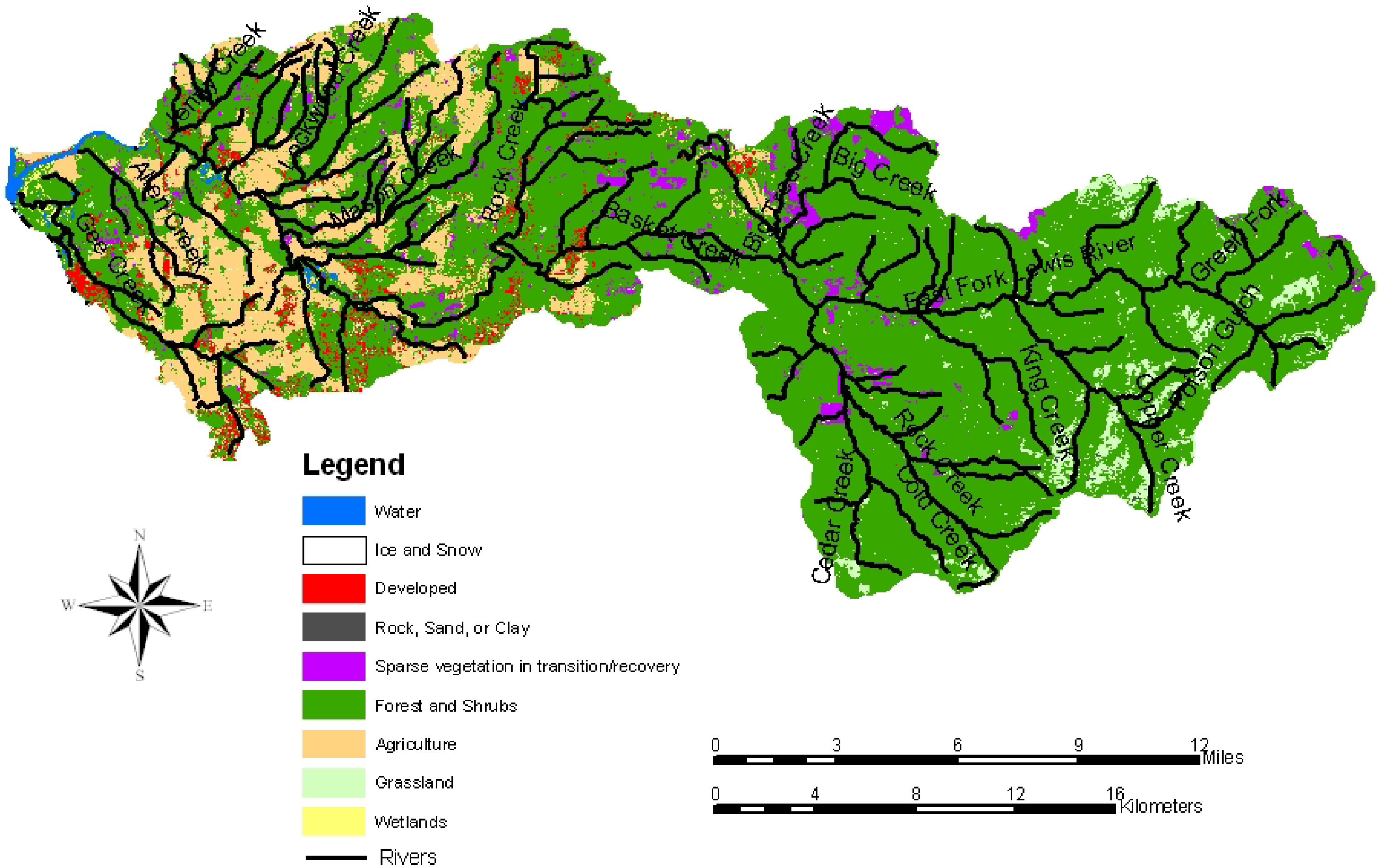
Land Ownership	
Private	63%
Federal	20%
State	16%
Other public	1%

Land Ownership



Vegetation Composition	
Late Seral	7%
Mid Seral	28%
Early Seral	3%
Other Forest	37%
Non Forest	25%

Land Use / Cover



13.2 Species of Interest

Focal salmonid species in the East Fork Lewis include fall Chinook, winter steelhead, summer steelhead, chum, and coho. The health or viability of these populations range from very low (chum) to medium (fall Chinook), except for coho, which is very low. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Recovery goals call for restoring all five populations to a high or very high viability level. This level will provide for a 95% or better probability of population survival over 100 years.

Other species of interest in the East Fork Lewis Subbasin include coastal cutthroat trout and Pacific lamprey. Regional objectives for these species are described in Volume I, Chapter 6. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for these other species. Cutthroat will benefit from improvements in stream habitat conditions for salmonids. Lamprey are also expected to benefit from habitat improvements in the estuary, Columbia River mainstem, and East Fork Lewis Subbasin although specific spawning and rearing habitat requirements of lamprey are not well known.

Table 13-1. Current viability status of East Fork Lewis 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	100-700	High+	1,900-3,900
Winter Steelhead	Threatened	Yes	Low-Med	100-300	High	600-1,300
Summer Steelhead	Threatened	Yes	Low-Med	100	High	200-400
Chum	Threatened	No	Very low	<100	High	1,100-71,000
Coho	Candidate	No	Low	Unknown	High	unknown

<u>*Fall Chinook*</u>– The historical East Fork Lewis River adult population is estimated from 4,000-30,000 fish. The current natural spawning number for tule fall Chinook ranges from 100-700 fish. There is no hatchery fall Chinook production. Natural spawning occurs primarily in six miles of the mainstem from Lewisville Park downstream to Daybreak Park. Spawning occurs primarily in October for the tule population, a later timed fall Chinook run spawns in November to January. Juvenile rearing occurs near and downstream of the spawning areas. Juveniles migrate from the East Fork Lewis in the spring and early summer of their first year.

<u>*Winter Steelhead*</u>– The historical East Fork Lewis adult population is estimated from 3,000-10,000 fish. Current natural spawning returns range from 100-300. In-breeding with Skamania Hatchery produced steelhead is possible, but likely low because of differences in spawn timing. Spawning occurs in the mainstem East Fork Lewis and tributaries. Access upstream of Sunset Falls was blocked until 1982 when the falls were “notched”. Spawning time is generally from early 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 East Fork Lewis.

<u>*Summer Steelhead*</u>– The historical East Fork Lewis adult population is estimated from 1,000-9,000 fish. Current natural spawning returns average about 100 fish. In-breeding with Skamania Hatchery produced steelhead is thought to be low because of differences in spawn timing and distribution. Spawning occurs throughout the basin, extending to the mainstem East Fork Lewis and tributaries upstream of Moulton Falls. Juvenile rearing occurs both downstream

and upstream of the spawning areas. Juveniles rear for a full year or more before migrating from the Lewis.

Chum– Historical adult populations produced from the Lewis Basin (including the mainstem, North, and East Lewis) are estimated from 120,000-300,000. Current natural spawning is estimated at less than 100 fish. Spawning occurs in the lower reaches of the mainstem, North Fork, East Fork, and in Cedar Creek. Natural spawning chum in the Lewis Basin are all naturally produced as no hatchery chum are released in the area. Juveniles rear in the lower reaches for a short period in the early spring and quickly migrate to the Columbia.

Coho– The historical East Fork Lewis adult population is estimated from 5,000-40,000, with the majority of returns late stock which spawn from late November to March. Some early stock coho were also historically present with spawning occurring primarily in early to mid-November. Current returns are unknown but assumed to be low. There is currently no hatchery coho released into the East Fork Lewis. Natural spawning occurs downstream of Lucia Falls (RM 21), particularly in Lockwood, Mason, and Rock creeks. Juveniles rear for a full year in the Lewis Basin before migrating as yearlings in the spring.

Coastal cutthroat– Coastal cutthroat abundance in the East Fork Lewis has not been quantified but the population is considered depressed. Anadromous cutthroat enter the East Fork Lewis from July-December and spawn from December through June. Most juveniles rear 2-4 years before migrating from their natal stream.

Pacific lamprey– Information on lamprey abundance is limited and does not exist for the East Fork Lewis population. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have declined in the East Fork Lewis basin also. 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 East Fork basin. Juveniles rear in freshwater up to six years before migrating to the ocean.

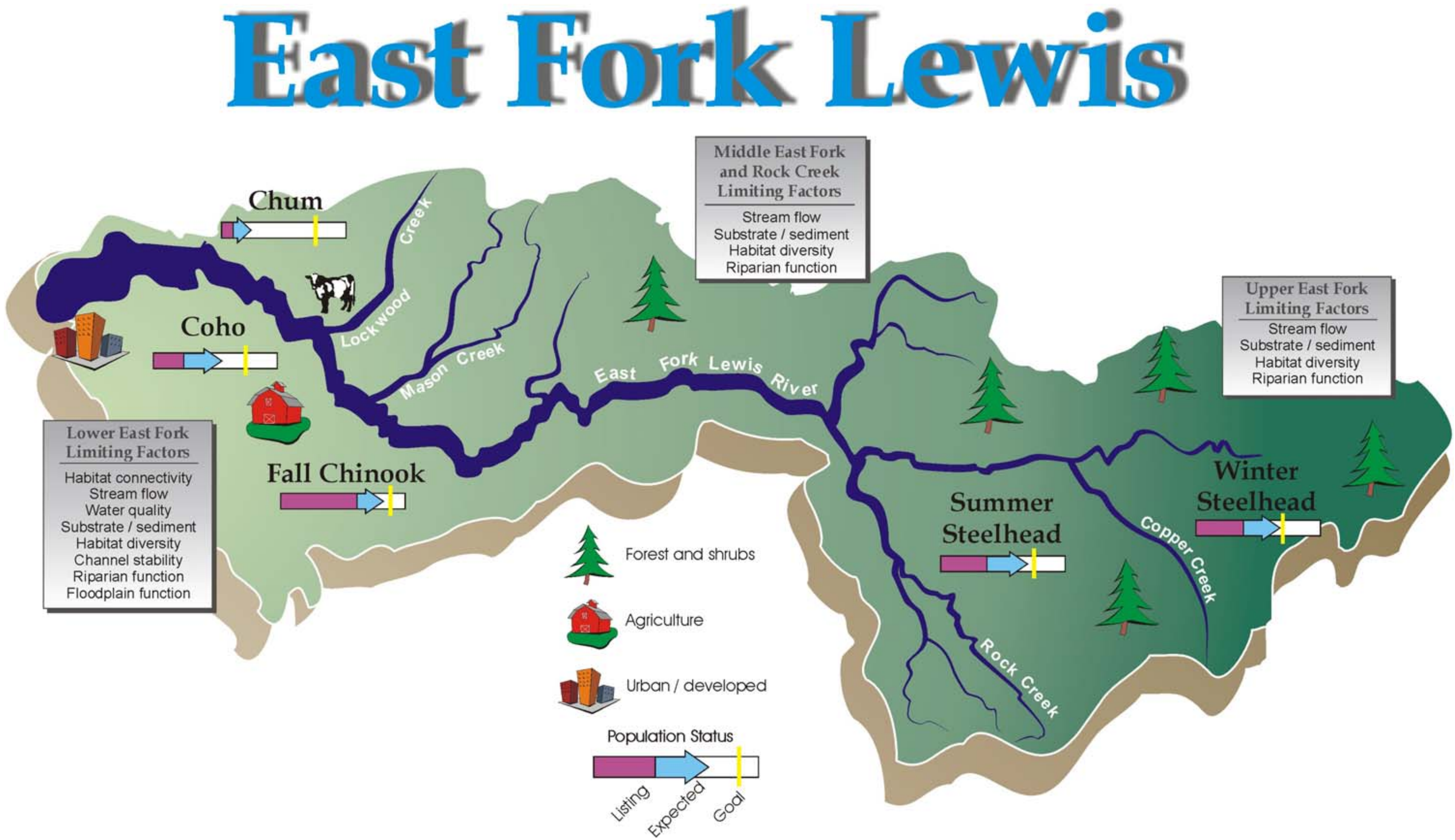


Figure 13-2. Summary of habitat limiting factors, population status, expected population improvement trend with existing programs and biological objectives depicted for the East Fork Lewis Basin.

13.3 Potentially Manageable Impacts

Stream habitat, estuary/mainstem habitat, harvest, hatchery and predation effects have all contributed to reduced salmonid productivity, numbers, and population viability in the Lewis subbasin. The pie charts below represent the relative order of magnitude of quantifiable effects for each of these factors for each focal species. The preferred recovery scenario targets an equivalent reduction in each impact factor in proportion to the magnitude of the effect. Population-specific targets are discussed in further detail in Volume I, Chapter 6.

- Loss of habitat quantity and quality has the highest relative impact on populations in the EF Lewis.
- Loss of estuary habitat quantity and quality has high relative impacts on chum and moderate impacts on fall Chinook and winter steelhead. Impacts to summer steelhead are minor.
- Harvest has relatively high impacts on fall Chinook, but impacts to chum, steelhead, and coho are relatively minor.
- Hatchery impacts are high to moderate for summer steelhead and coho, but are low for chum, fall Chinook, and winter steelhead.
- Impacts of predation are moderately important to winter and summer steelhead, coho and chum, but are relatively minor for fall Chinook.

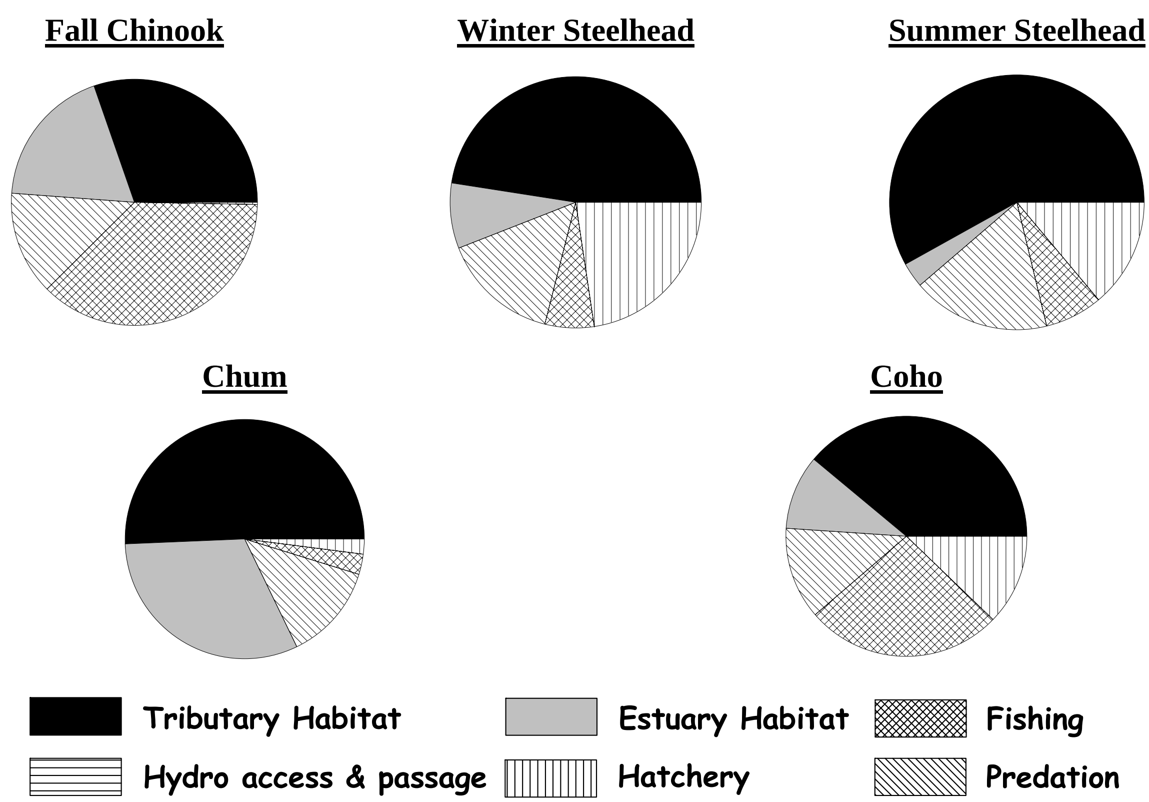


Figure 13-3. Relative contribution of potentially manageable impacts for East Fork Lewis populations.

13.4 Limiting Factors, Threats, and Measures

13.4.1 Hydropower Operation and Configuration

There are no hydro-electric dams in the East Fork Lewis Basin. However, East Fork Lewis species are affected by mainstem Columbia hydro operations and flow regimes which affect habitat in migration corridors and in the estuary. Lewis hydro operations affect both habitat and flow in the mainstem Lewis below the confluence of the East Fork Lewis. Mainstem hydro factors and threats are addressed by regional strategies and measures identified in Volume I.

13.4.2 Harvest

Most harvest of wild East Fork Lewis salmon and steelhead is incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. This mortality is very low for chum and steelhead, but can be significant for fall Chinook. East Fork Lewis fall Chinook are harvested in ocean and Columbia River commercial and sport fisheries as well as in-basin sport fisheries. Regional harvest is controlled by an ESA harvest limit associated with Coweeman natural fall Chinook. Retention of fall Chinook is prohibited in the East Fork Lewis sport fisheries. No harvest of chum occurs in ocean fisheries, there is no chum directed Columbia River commercial fisheries and retention of chum is prohibited in Columbia River and Lewis basin sport fisheries. Chum are impacted incidental to fisheries directed at coho and winter steelhead. Harvest of East Fork Lewis coho occurs in the ocean commercial and recreational fisheries off the Washington and Oregon coasts and Columbia River. There is no directed hatchery coho sport fishery in the East Fork Lewis. Wild coho impacts are limited by fishery management to retain marked hatchery fish and release unmarked wild fish. 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 marked hatchery fish and commercial fisheries cannot retain hatchery or wild steelhead.

Measures 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. The regional measures 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 Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is generally more applicable to steelhead while regional management is more applicable to salmon. Regional harvest measures with significant application to the East Fork Lewis subbasin populations are summarized in the following table:

Table 13-2. Regional harvest measures from Volume I, Chapter 7 with significant application to the East Fork Lewis Subbasin populations.

Measure	Description	Comments
F.M17	Monitor chum handle rate in tributary winter steelhead.	State agencies would include chum incidental handle assessments as part of their annual tributary sport fishery sampling plan.
F.M13	Develop a mass marking plan for hatchery tule Chinook for harvest management and for naturally-spawning escapement monitoring.	A regional marking program for tule fall Chinook would provide regional selective fishing options. This program would not affect sport harvest in the East Fork Lewis as there is no hatchery production in the basin.
F.M18	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	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.M19	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	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.M24	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	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.

13.4.3 Hatcheries

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

There are no hatcheries operating in the East Fork Lewis Basin. Skamania Hatchery winter and summer steelhead are released into the East Fork Lewis to provide harvest opportunity. Skamania Hatchery steelhead are a composite stock and are genetically different from the naturally-produced steelhead in the East Fork Lewis River. 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 13-3. East Fork Lewis Hatchery Production.

Hatchery	Release Location	Winter Steelhead	Summer Steelhead
Skamanaia	East Fork Lewis	90,000	30,000

Regional hatchery strategies and measures are focused on evaluating and reducing biological risks and increasing the benefits to natural populations. Regional hatchery measures identified in Volume I, Chapter 7 with specific applications within the East Fork Lewis Subbasin are summarized in the following table:

Table 13-4. Regional hatchery measures from Volume I, Chapter 7 with specific implementation actions in the East Fork Lewis Subbasin.

Measure	Description	Comments
H.M32	Juvenile release strategies to minimize interactions with naturally spawning fish.	Release strategies are aimed at reducing or avoiding interactions with wild steelhead, fall Chinook, coho by release timing and release location strategies.
H.M17,34,41	Mark hatchery steelhead, coho, fall Chinook with an adipose fin-clip for identification and selective harvest	Marking hatchery fish allows for identification of hatchery fish in the natural spawning grounds and at collection facilities which enables accurate accounting of wild fish. Marking also enables selective fisheries to retain hatchery fish and release wild fish.
H.M 24,36	Hatchery program utilized for supplementation and enhancement of wild chum and coho populations.	The Washougal hatchery is currently used for supplementation and risk management of lower gorge chum populations. This type of program could be considered to include more hatcheries and populations, including Lewis chum. Supplementation programs for East Fork Lewis natural coho could be developed with appropriate brood stock.
H.M8	Adaptively manage hatchery programs to further protect and enhance natural populations and improve operational efficiencies.	Appropriate research, monitoring, and evaluation programs along with guidance from regional hatchery evaluations will be utilized to improve the survival and contribution of hatchery fish, reduce impacts to natural fish, and increase benefits to natural fish.

13.4.4 Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. East Fork Lewis salmon and steelhead are affected throughout their lifecycle by ecological interactions with non-native species, food web components, and predators. Interactions are similar for East Fork Lewis populations to those of most other subbasin salmonid populations. Ecological Interactions are addressed by regional strategies and measures identified in Volume I.

13.4.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. 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 are similar for East Fork Lewis populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook than spring Chinook, steelhead, and coho. Estuary and mainstem effects on East Fork Lewis salmon and steelhead populations are addressed by regional strategies and measures identified in Volume I and the Columbia Mainstem and Estuary Subbasin sections of Volume II.

13.4.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity 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 East Fork

Lewis basin have the greatest impact on the health and viability of salmon and steelhead relative to the other limiting factors and threats discussed in this chapter.

Subwatersheds, reaches, and habitat attributes have been prioritized for protection and/or restoration based on the plan's biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Priority areas for habitat preservation and restoration are identified in Figure 13-4. A summary of the primary habitat limiting factors and threats are presented in Table 13-6. Habitat measures and related information are presented in Table 13-7. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 13-5. Reach- and subwatershed-scale limiting factors generated from the technical assessment are included in Table 13-5. Details on species-specific spatial priorities and limiting factors at the subbasin level may be found in Volume II of the Technical Foundation. A description of the methodology used to generate composite (multi-species) reach and subwatershed priorities can be found in the introduction to this volume of the recovery plan.

The areas with the greatest current or potential contribution to focal salmonid population health and productivity are listed below. Tier 1 and 2 reaches within these priority areas are included in the list. The habitat limiting factors, threats, and measures included in this chapter focus primarily on the priority areas and the Tier 1 and 2 reaches within them. Tier, 3, 4, and non-tiered reaches are considered secondary priority, but in many cases, these lower priority areas will also require restoration and preservation actions in order to achieve recovery objectives. Watershed process measures generally focus on the entire basin as opposed to being limited only to high priority areas because conditions in high priority areas are often influenced by cumulative watershed effects. High priority areas and reaches in the East Fork Lewis Basin include the following:

- Lower mainstem – EF Lewis 4-10
- Middle mainstem & Rock Creek – EF Lewis 12-13; Rock Creek 1-4
- Upper mainstem – EF Lewis 15-19C

The following paragraphs provide a brief overview of each of these priority areas, including species most affected, land-use threats, and the general type of measures that will be necessary for recovery. Additional detail can be found in the tables and figures that follow.

While reach level habitat conditions often result from local factors, they are also affected or shaped by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input, and large woody debris recruitment are often affected by or result from upstream conditions and degraded watershed processes. Access to key reaches may also be affected by barriers that occur downstream of a reach. Accordingly, restoration of a priority reach may require action outside the targeted reach. The IWA analysis was used to identify potential upstream watershed areas that could influence reach level habitat attributes. EDT was used to allow a relative comparison of reaches and habitat attributes within a reach.

The lower mainstem EF Lewis (EF Lewis 4-10) contains important spawning and rearing habitats for fall Chinook, chum, and coho. This mixed use area is heavily impacted by agriculture, rural residential development, and gravel mining. The recovery emphasis is for restoration and preservation measures. Effective restoration measures will involve riparian restoration, reductions in streambank erosion, re-connection of floodplains, and restoration of mining related impairments and future avulsion risks. Land-use planning/growth management is critical to make sure that expanding development and land-use conversions do not continue to impair habitat conditions or habitat-forming processes.

The middle mainstem EF Lewis (reach EF Lewis 12-13) and Rock Creek (Rock Creek 1-4) are most important for winter steelhead, although summer steelhead also utilize these reaches to some degree. There are agricultural and rural residential uses along these reaches but forestry impacts dominate. The recovery emphasis is for restoration and preservation. Effective restoration measures will include riparian restoration and restoration of watershed processes related to forest practices (i.e., forest road and timber harvest impacts). Emphasis should be placed on preserving functional sediment supply conditions in the Rock Creek basin.

Summer steelhead use the greatest proportion of upper EF Lewis reaches. Winter steelhead may utilize some of these reaches but they rarely make significant use of reaches above Sunset Falls (upstream end of reach EF Lewis 17). Nearly the entire upper basin is within the Gifford Pinchot National Forest and forestry impacts dominate. Past wildfires have had a lasting impact on channels. The recovery emphasis is for preservation and restoration. Effective restoration measures will include riparian restoration and watershed process restoration related to forest practices.

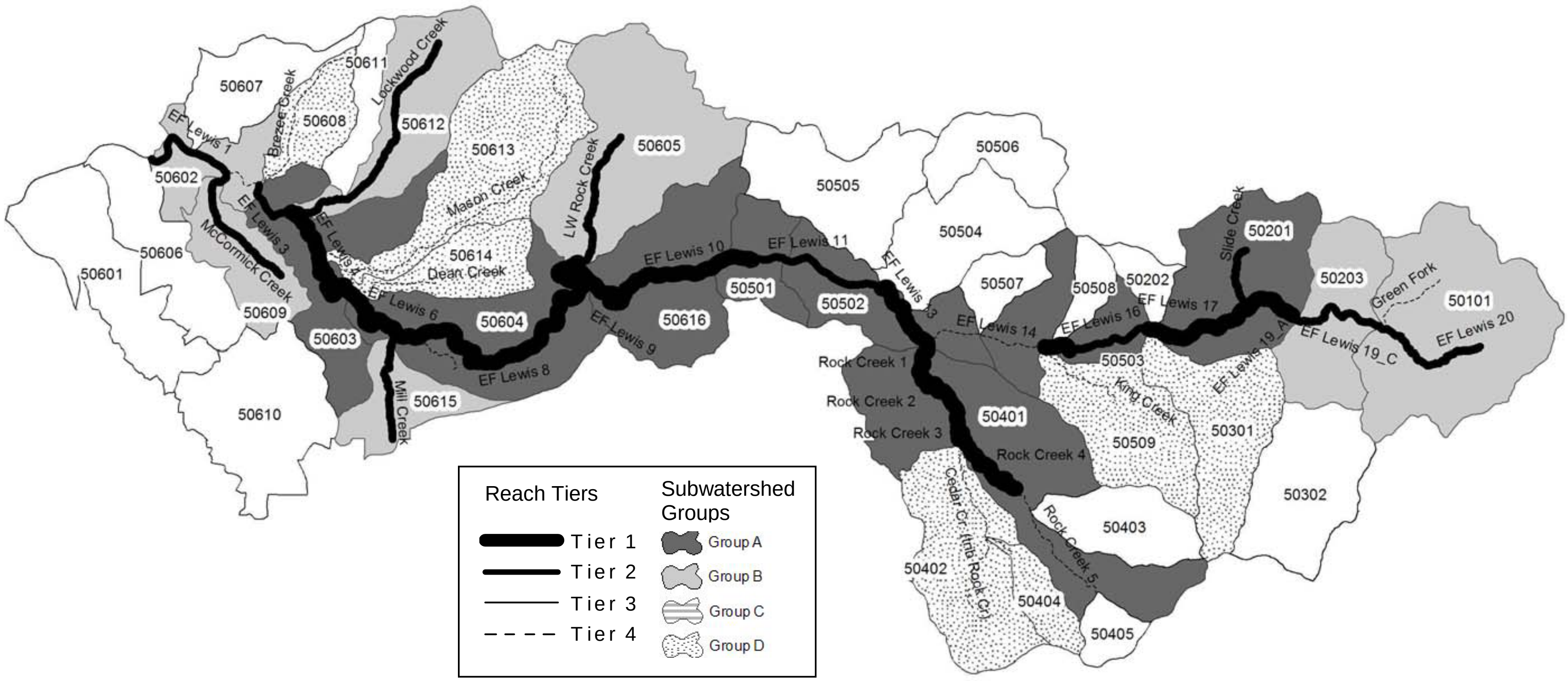


Figure 13-4. Reach tiers and subwatershed groups in the EF Lewis Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities at the 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.

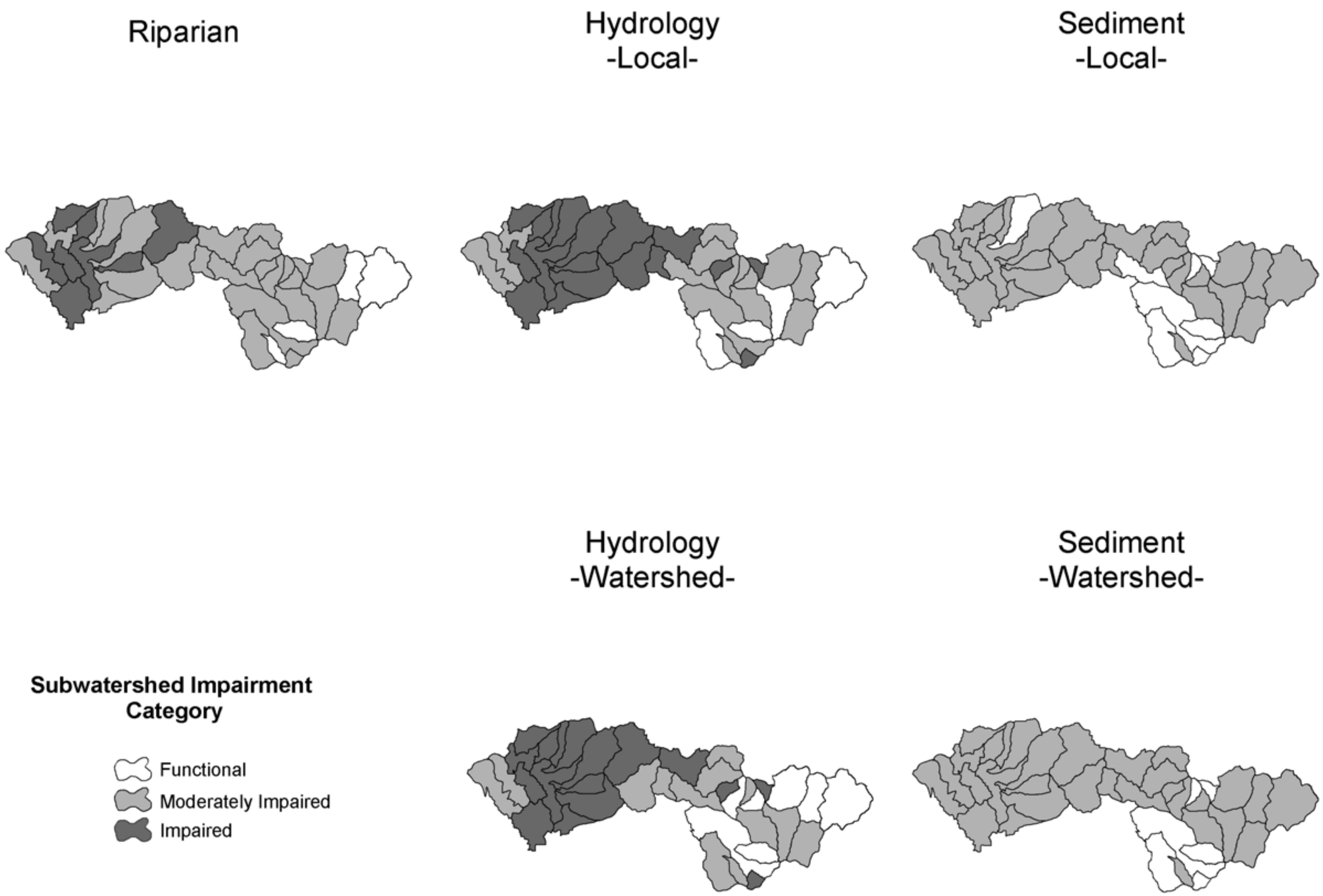


Figure 13-5. IWA subwatershed impairment ratings by category for the EF Lewis basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 13-5. 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-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): Hydrology	Watershed processes (local): Sediment	Watershed processes (local): Riparian	Watershed processes (watershed): Hydrology	Watershed processes (watershed): Sediment
A	50616	EF Lewis 10 EF Lewis 9 LW Rock Creek	ChF	EF Lewis 9	Spawning Egg incubation Fry colonization Prespawning holding	none	P	I	M	M	M	M
			StW	none								
			StS	none								
			Coho	EF Lewis 10	Spawning Egg incubation Fry colonization 0-age active rearing 0-age migrant 0-age inactive 1-age active rearing	habitat diversity key habitat quantity	R					
	50604	EF Lewis 5 EF Lewis 6 EF Lewis 7 EF Lewis 8 Manley Creek	ChF	EF Lewis 5 EF Lewis 6 EF Lewis 7	Egg incubation Fry colonization 0-age active rearing	temperature sediment key habitat quantity	PR	I	M	M	I	M
			Chum	EF Lewis 5 EF Lewis 6 EF Lewis 7 EF Lewis 8	Spawning Egg incubation Fry colonization Prespawning migrant Prespawning holding	habitat diversity sediment key habitat quantity	PR					
			StW	none								
			StS	none								
			Coho	EF Lewis 5 EF Lewis 6 EF Lewis 7 EF Lewis 8	Spawning Egg incubation Fry colonization 0-age active rearing 0-age inactive 1-age active rearing Prespawning migrant	channel stability habitat diversity sediment key habitat quantity	R					
	50603	EF Lewis 2 EF Lewis 3 EF Lewis 4 EF Lewis 5	ChF	EF Lewis 5	Spawning Egg incubation 0-age active rearing	temperature sediment key habitat quantity	PR	I	M	I	I	M
			Chum	EF Lewis 4 EF Lewis 5	Egg incubation Fry colonization Prespawning migrant Prespawning holding	habitat diversity sediment key habitat quantity	PR					
			StW	none								
			StS	none								
			Coho	EF Lewis 5	Egg incubation 0-age active rearing 0-age inactive	key habitat quantity	R					
	50503	EF Lewis 14 EF Lewis 15 EF Lewis 16 Horseshoe Falls	StW	none				M	M	M	F	M
			StS	EF Lewis 15	0-age active rearing 0,1-age inactive 1-age active rearing	habitat diversity flow	P					
	50502	EF Lewis 11 EF Lewis 12 EF Lewis 13 EF Lewis 14 Moulton Falls Rock Creek 1	StW	EF Lewis 12 EF Lewis 13 Rock Creek 1	Egg incubation 0-age active rearing 0,1-age inactive 1-age active rearing	habitat diversity flow sediment	P	M	F	M	M	M
			StS	none								
	50501	EF Lewis 10 EF Lewis 11 Lucia Falls	ChF	none				I	M	M	M	M
			StW	none								
			StS	none								
			Coho	EF Lewis 10	Spawning Egg incubation Fry colonization 0-age active rearing 0-age migrant 0-age inactive 1-age active rearing	habitat diversity key habitat quantity	R					
	50401	Rock Creek 1 Rock Creek 2 Rock Creek 3 Rock Creek 4 Rock Creek 5	StW	Rock Creek 1 Rock Creek 2 Rock Creek 3 Rock Creek 4	Spawning Egg incubation Fry colonization 0-age active rearing 0,1-age inactive 1-age active rearing Prespawning holding	habitat diversity flow sediment key habitat quantity	PR	M	F	M	F	F
	50201	EF Lewis 17 EF Lewis 18 EF Lewis 19_A Slide Creek Sunset Falls	StS	EF Lewis 17 EF Lewis 18 EF Lewis 19_A	Egg incubation Fry colonization 0-age active rearing 0,1-age inactive 1-age active rearing	habitat diversity flow	PR	M	M	M	F	M

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	50612	Lockwood Creek	Chum	none				I	F	M	I	M
			StW	none								
			Coho	none								
	50615	Mill Creek	Chum	none				I	M	M	I	M
			Coho	none								
	50609	McCormick Creek	Chum	none				I	M	I	I	M
			StW	none								
			Coho	none								
	50605	LW Rock Creek	StW	none				I	M	I	I	M
			Coho	none								
	50602	EF Lewis 1 EF Lewis 2	ChF	none				M	M	M	I	M
			Chum	none								
			StW	none								
			StS	none								
			Coho	none								
	50203	EF Lewis 19_B EF Lewis 19_C	StS	none				M	M	F	F	M
	50101	EF Lewis 20 Green Fork	StS	none				F	M	F	F	M
D	50614	Dean Creek	Chum	none				I	M	I	I	M
			StW	none								
			Coho	none								
	50613	Mason Creek	Chum	none				I	M	M	I	M
			StW	none								
			Coho	none								
	50608	Brezee Creek	Chum	none				I	M	I	I	M
			StW	none								
			Coho	none								
	50509	King Creek	StW	none				M	M	M	M	M
	50404	Cold Creek	StW	none				M	M	F	M	M
	50402	Cedar Cr. (trib Rock Cr)	StW	none				F	F	M	M	F
	50301	Copper Creek	StS	none				F	M	M	M	M

Table 13-6. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the lower mainstem (LM), middle mainstem + Rock Creek (MR), and upper mainstem (UM) portions of the EF Lewis basin. Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors				Threats			
	LM	MR	UM		LM	MR	UM
Habitat connectivity				***Agriculture/grazing***			
Blockages to off-channel habitats	✓			Clearing of vegetation	✓		
Habitat diversity				Riparian grazing	✓		
Lack of stable instream woody debris	✓	✓	✓	Floodplain filling	✓		
Altered habitat unit composition	✓	✓	✓	***Rural/suburban development***			
Loss of off-channel and/or side-channel habitats	✓			Clearing of vegetation	✓		
Channel stability				Floodplain filling	✓		
Bed and bank erosion	✓			Increased impervious surfaces	✓		
Channel down-cutting (incision)	✓			Increased drainage network	✓		
Riparian function				Roads – riparian / floodplain impacts	✓		
Reduced stream canopy cover	✓	✓		Leaking septic systems	✓		
Reduced bank/soil stability	✓	✓	✓	***Forest practices***			
Exotic and/or noxious species	✓			Timber harvests –sediment supply impacts		✓	✓
Reduced wood recruitment	✓	✓	✓	Timber harvests – impacts to runoff		✓	✓
Floodplain function				Riparian harvests (historical)		✓	✓
Altered nutrient exchange processes	✓			Forest roads – impacts to sediment supply		✓	✓
Reduced flood flow dampening	✓			Forest roads – impacts to runoff		✓	✓
Restricted channel migration	✓			Forest roads – riparian/floodplain impacts			✓
Disrupted hyporheic processes	✓			Catastrophic wildfire (historical)			✓
Stream flow				Splash-dam logging (historical)		✓	✓
Altered magnitude, duration, or rate of change	✓	✓	✓	***Channel manipulations***			
Water quality				Bank hardening	✓		
Altered stream temperature regime	✓			Channel straightening	✓		
Excessive turbidity	✓			Artificial confinement	✓		
Bacteria	✓			Clearing and snagging (historical)			✓
Substrate and sediment				***Mining***			
Lack of adequate spawning substrate			✓	Clearing of vegetation	✓		
Excessive fine sediment	✓	✓	✓	Channel and/or floodplain substrate removal	✓		
Embedded substrates	✓	✓	✓	Floodplain filling	✓		
				Increased water surface area	✓		

Table 13-7. Habitat measures in priority areas, with reference to limiting factors addressed, threats addressed, target species, and estimated time until benefits would be realized (time). Tier 1 and 2 reaches, or other areas of known priority, are listed under the location column for some measures (i.e., stream corridor measures). Reaches not included in the table (Tier, 3, 4, and non-tiered reaches) are considered secondary priority.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
1. Protect and restore floodplain function and channel migration processes ***A. Set back, breach, or remove artificial channel confinement structures***					
Lower mainstem EF Lewis 4 – EF Lewis 10	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes	• Floodplain filling • Channel straightening • Artificial confinement	• Chum • Coho • Fall Chinook	2-15 years	Great potential benefit due to improvements in many limiting factors. This passive restoration approach can allow channels to restore naturally once confinement structures are removed. There are challenges with implementation on private lands due to existing infrastructure already in place, potential flood risk to property, and large expense. Opportunities exist in areas of public ownership in these reaches.
2. Protect and restore off-channel and side-channel habitats ***A. Restore historical off-channel and side-channel habitats where they have been eliminated*** ***B. Provide access to blocked off-channel habitats*** ***C. Create new off-channel or side-channel habitats (i.e., spawning channels)***					
Lower mainstem EF Lewis 4 – EF Lewis 10	• Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats • Altered habitat unit composition	• Floodplain filling • Channel straightening • Artificial confinement	• Chum • Coho	2-15 years	Good potential benefit especially for chum, which have lost a significant portion of historically available off-channel habitat for spawning. Potential benefit is limited by moderate probability of success with creation of new habitats. There are challenges with implementation on private lands due to existing infrastructure already in place, potential flood risk to property, and large expense. Opportunities exist in areas of public ownership in these reaches.
3. Protect and restore riparian function ***A. Reforest riparian zones*** ***B. Allow for the passive restoration of riparian vegetation*** ***C. Livestock exclusion fencing*** ***D. Invasive species eradication*** ***E. Hardwood-to-conifer conversion***					
Lower mainstem	• Reduced stream canopy	• Timber harvest –	• All	20-100	High potential benefit due to the many

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
EF Lewis 4 – EF Lewis 10 ***Middle mainstem*** EF Lewis 12-13 ***Rock Creek*** Rock Creek 1-4 ***Upper mainstem*** EF Lewis 15-19	cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or noxious species	riparian harvests • Riparian grazing • Clearing of vegetation due to rural/suburban development, agriculture, and mining	species	years	limiting factors that are addressed. Riparian impairment is related to most land-uses and is a concern throughout the basin. Riparian protections on forest lands are provided for under current harvest policy. Riparian restoration projects are relatively inexpensive and are often supported by landowners. Whereas the specified stream reaches are the highest priority for riparian measures, riparian restoration and preservation should occur throughout the basin since riparian conditions affect downstream reaches. Use IWA riparian ratings to help identify restoration and preservation opportunities. Significant riparian restoration efforts are currently underway by Clark County along the lower mainstem.
4. Restore channel and floodplain areas damaged as a result of streamside gravel mining and reduce risks of future impairment due to these activities ***A. Prevent high temperature water and turbidity from entering streams*** ***B. Prevent fish stranding in processing areas*** ***C. Stabilize surface mining sites to prevent erosion*** ***D. Reduce the risk of gravel pond capture, while providing for natural channel migration processes*** ***E. Restore channel morphology where streams have avulsed into mining areas***					
Lower mainstem EF Lewis 4 – 6	• Loss of off-channel and/or side channel habitats • Altered habitat unit composition • Bed and bank erosion • Channel down-cutting (incision) • Altered stream temperature regime • Excessive turbidity • Restricted channel migration	• Channel and/or floodplain substrate removal • Floodplain filling • Increased water surface area	• Chum • Dall Chinook • Coho	10-50 years	The two main areas of concern are the Ridgefield Pits (RM 8), which the mainstem avulsed into in 1996, and the Stordahl & Sons ponds (near Dean Creek confluence), which create a risk of future channel avulsion and temperature concerns. Restoration measures need to focus on restoring currently degraded channel conditions as well as reducing the risk of future degradation.
5. Protect and restore streambank stability ***A. Restore eroding streambanks***					
Lower mainstem EF Lewis 4 - 10	• Reduced bank/soil stability • Excessive fine sediment • Excessive turbidity • Embedded substrates	• Artificial confinement • Clearing of vegetation	• Chum • Dall Chinook • Coho	5-50 years	Most areas of bank instability are located between river mile 7 and 12. Bio-engineered approaches that rely on structural as well as vegetative measures are the most appropriate.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
		• Roads – riparian / floodplain impacts • Riparian grazing			These projects have a high risk of failure if causative factors are not adequately addressed.
6. Protect and restore natural sediment supply processes ***A. Address forest road related sources*** ***B. Address timber harvest related sources*** ***C. Address agricultural sources***					
Entire basin	• Excessive fine sediment • Excessive turbidity • Embedded substrates	• Agricultural practices – impacts to sediment supply • Forest roads – impacts to sediment supply • Timber harvest – impacts to sediment supply	• All species	5-50 years	High potential benefit due to sediment effects on egg incubation and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. Likelihood is moderate on agricultural lands due to incentive programs and outreach to landowners, but few sediment-focused regulatory requirements. Use IWA impairment ratings to identify restoration and preservation opportunities.
7. Protect and restore runoff processes ***A. Address forest road impacts*** ***B. Address timber harvest impacts*** ***C. Limit additional watershed imperviousness*** ***D. Manage stormwater runoff***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Timber harvest – impacts to runoff • Forest roads – impacts to runoff • Increased impervious surfaces • Increased drainage network (road ditches, storm drains) • Clearing of vegetation (development, agriculture)	• All species	5-50 years	High potential benefit due to flow effects on habitat formation, redd scour, and early rearing. Improvements are expected on timber lands due to requirements under the FPRs, the USFS Northwest Forest Plan, and forest land HCPs. There are challenges with implementation on developed lands due to continued increase in watershed imperviousness related to rural and suburban residential development. Use IWA impairment ratings to identify restoration and preservation opportunities.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
8. Protect and restore instream flows ***A. Water rights closures*** ***B. Purchase or lease existing water rights*** ***C. Relinquishment of existing unused water rights*** ***D. Enforce water withdrawal regulations*** ***E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Water withdrawals	• All species	1-5 years	Instream flow management strategies for the EF Lewis Basin have been identified as part of Watershed Planning for WRIA 27 (LCFRB 2004). Strategies include water rights closures, setting of minimum flows, and drought management policies.
9. Protect and restore instream habitat complexity ***A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting*** ***B. Structurally modify stream channels to create suitable habitat types***					
Middle mainstem EF Lewis 12-13 ***Rock Creek*** Rock Creek 1-4 ***Upper mainstem*** EF Lewis 15-19	• Lack of stable instream woody debris • Altered habitat unit composition	• None (symptom-focused restoration strategy)	• Coho • Winter steelhead • Summer steelhead	2-10 years	Moderate potential benefit due to the high chance of failure. Failure is probable if habitat-forming processes are not also addressed. These projects are relatively expensive for the benefits accrued. Moderate to high likelihood of implementation given the lack of hardship imposed on landowners and the current level of acceptance of these type of projects.
10. Protect and restore water quality ***A. Restore the natural stream temperature regime*** ***B. Reduce fecal coliform bacteria levels*** ***C. Reduce delivery of chemical contaminants to streams***					
Entire basin	• Altered stream temperature regime • Bacteria • Chemical contaminants (potential)	• Riparian harvests • Riparian grazing • Leaking septic systems • Application of pesticides, herbicides, and fertilizers	• All species	1-50 years	Primary emphasis for restoration should be placed on stream segments that are listed on the 2004 303(d) list.
11. Protect and restore fish access to channel habitats ***A. Culvert, dam, and various other barriers on tributary streams***					
McCormick Creek ***Brezee Creek & tribs***	• Blockages to channel habitats	• Dams, culverts, in-stream structures	• Coho • Winter	Immediate	As many as 30 miles of potentially accessible habitat are blocked by culverts or other

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
Lockwood Creek & tribs ***Mason Creek*** ***Basket Creek*** ***Other small tribs***			Steelhead • Summer steelhead		barriers. The blocked habitat is believed to be marginal in the majority of cases and no individual barriers in themselves account for a significant portion of blocked miles (there are 23 barriers total). Passage restoration projects should focus only on cases where it can be demonstrated that there is good potential benefit and reasonable project costs.
12. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development ***A. Plan growth and development to avoid sensitive areas (e.g., wetlands, riparian zones, floodplains, unstable geology)*** ***B. Encourage the use of low-impact development methods and materials*** ***C. Apply mitigation measures to off-set potential impacts***					
Privately owned portions of the basin	***Preservation Measure –*** addresses many potential limiting factors and threats		• All species	5-50 years	The lower portion of the basin is growing rapidly. The focus should be on management of land-use conversion and managing continued development in sensitive areas (e.g., wetlands, stream corridors, unstable slopes). Many critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary mechanisms need to be put in place to restore currently degraded habitats.
13. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection ***A. Purchase properties outright through fee acquisition and manage for resource protection*** ***B. Purchase easements to protect critical areas and to limit potentially harmful uses*** ***C. Lease properties or rights to protect resources for a limited period***					
Privately owned portions of the basin	***Preservation Measure –*** addresses many potential limiting factors and threats		• All species	5-50 years	Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit. These programs are under-funded and have low landowner participation.

13.5 Program Gap Analysis

The East Fork Lewis Basin (~235 sq mi) is located in Skamania and Clark Counties. The EF Lewis headwaters are in the Gifford Pinchot NF, it flows through Department of Natural Resources forest lands, through small- and industrial forest lands, through agricultural and rural residential lands and, finally through the cities of LaCenter and Ridgefield prior to meeting the North Fork Lewis at River Mile 3.5.

- The EF Lewis has approximately 43 square miles within the Gifford Pinchot National Forest.
- Department of Natural Resources forest lands comprise approximately 35 square miles.
- Small- and industrial forest lands include approximately 23 square miles.
- The Skamania County area within the East Fork Lewis watershed fall within the Gifford Pinchot National Forest. The remainder of the basin lies in Clark County
- Agriculture and rural residential uses occur on the valley floor in lower basin.
- The 2000 population in the EF Lewis was 24,400, it is expected to more than double by the year 2020.

<u>Protection Programs</u>

In the East Fork Lewis basin, protection programs center primarily on forest management and forest practice rules in the upper reaches and on local land use controls in the lower reaches. Protection programs in this analysis include those programs that protect habitat conditions or watershed functions through regulatory measures, acquisition sensitive habitat or protective easements, incentives or by applying standards to new development that protects resources by avoiding damaging impacts. Key programs implementing protection measures are identified below.

Federal Programs

- ***U.S. Forest Service Gifford Pinchot National Forest***
  - <u>Forest Plan</u>: The Gifford Pinchot NF Forest Plan provides high levels of protection for riparian areas and forest stands within the upper NF Lewis Basin. Protection efforts are subject to NOAA Fisheries and U.S. Fish and Wildlife Service ESA Section 7.
    - ✓ Riparian buffers in all areas of the Gifford Pinchot NF include at least 300' setbacks.
    - ✓ Designated matrix lands in the EF Lewis observe the forest-wide 'no clear cut' policy.
    - ✓ Some EF Lewis Gifford Pinchot lands fall in the Late Successional Reserves Program. Thinning occurs in the riparian areas to support healthier late successional stands.
    - ✓ Congressional Reserve Areas (Mt St Helens National Volcanic Monument) in the EF Lewis are 'no touch' areas.
    - ✓ Upper portions of the watershed lands are located within Wilderness Areas allow little human activity.
    - ✓ Addresses measures: [M.3A; M.3B; M.6A; M.6B; M.7A; M.7B; M.10A]

- ***NOAA Fisheries***

  - Habitat Conservation Plan (HCP): Under Section 10 of the ESA, NOAA Fisheries has approved an HPC to minimize and mitigate the impact of gravel mining operations by Storedahl in the lower EF Lewis. The plan specifies restoration actions, schedules, funding and monitoring that would trigger adaptive management as need. Specific conservation measures address water quality (turbidity and temperature); water quantity (donation of water rights to the state trust), avulsion potential; riparian, wetland and valley-bottom revegetation; and ultimate inclusion in the EF Lewis River greenbelt with a conservation easement and endorsement to ensure its management as fish and wildlife habitat in perpetuity. [M.1A; M.3A; M.3D; M.4; M.5A; M.8B; M.10A; M.13.B]

- ***U.S. Army Corps of Engineers***

  - Regulatory Programs: U.S. Army Corps of Engineers administers the Section 10 (Rivers and Harbor Act) and Section 404 (Clean Water Act) permit processes. Section 10 requires approval of any activity in, above, or below a navigable river, which affects course, location, condition, or capacity of navigable waters. Section 404 requires prior approval of dredging, filling, grading, clearing, and bank hardening. In waters used by listed fish species, the permits are subject to ESA Section 7 consultation with NOAA Fisheries to ensure that any approved action is adequately protective of the ESA listed fish. [M.1A; M.2A; M.2B; M.2C; M.5A; M.9A; M.9B]

State Programs

- ***Department of Natural Resources***

  - State Forest Land HCP: State forest lands are managed under the provisions of a Habitat Conservation Plan (HCP). The Habitat Conservation Plan has protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. [M.3A; M.3B; M.6A; M.6B; M.7A; M.7B]

  - State Forest Practices: Riparian areas and watershed functions on small- and industrial forest lands are protected under the State of Washington Forest Practices Rules, including the Forest and Fish Module. These rules provide for riparian buffers, harvest restrictions, sensitive area protections, and protective standards for new road construction. [M.3A; M.3B; M.6A; M.6B; M.7A; M.7B]

- ***Washington Department of Fish and Wildlife***

  - Hydraulics Project Approval (HPA): The Department administers the state Hydraulic Code. The purpose of this program is to protect stream conditions and habitat. The regulations apply to such activities as streambank protection, instream construction, culvert installation, channel changes or realignments, debris removal, and water diversion facilities. Those proposing such actions must obtain a Hydraulic Project Approval (HPA) permit. [M.1A; M.2A; M.2B; M.2C; M.5A; M.9A; M.9B]

- Habitat Program: The Department provides advice to local governments and landowners interested in measures to protect habitat values on their property. [M.1A; M.2A; M.2B; M.3A; M.5A; M.7C; M.7D; M.9A; M.9B; M.10A; M.11A; M.12A; M.12.B; M.12C]

➢ ***Washington Department of Ecology***

- Water Resources Program/Water Rights: Department of Ecology, in consultation with the Department of Fish and Wildlife, has administratively closed selected areas within the North Fork Lewis watershed to further surface and groundwater withdraws (where groundwater is in continuity with surface water). Existing administrative closures by the Department of Ecology protect surface waters from further withdrawals. Formal rule-making would strengthen the closures. The extent of unauthorized surface water withdrawals is unknown, but may have the potential to adversely impact low summer stream flows. Currently, there are approximately 58 cfs of water rights in the EF Lewis. It is unknown how much of this volume is being utilized for beneficial uses. This compares to an average August low flow of 83 cfs. [M.8A; M.8B; M.8C; M.8D]

- Water Resources Program/Watershed Planning: In cooperation with the Lower Columbia Fish Recovery Board, other state and federal agencies, tribes, local governments, and citizens, the Department funds and participates in a state authorized watershed planning process for Water Resource Inventory Area (WRIA) 27 pursuant to RCW 90.82. The goal of the plan is to ensure adequate water for people and fish. The planning process is dealing with water quantity and quality, stream flows and fish habitat. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.7C; M.7D; M.8A; M.8B; M.8C; M.8D; M.10A; M.10B; M.10C]

Local Government Programs

➢ ***Clark County*** (Lands south of the NF Lewis)

- ESA Program: The County has established an Endangered Species Program to address ESA requirements and develop a comprehensive county strategy for salmon recovery. An ESA committee with representatives from federal and state agencies, tribes, citizens, the business community and environmental groups has been established to advise the county as it works to bring its ordinances and programs into compliance with ESA requirements.

- Land Use:
  - The County is actively engaged in a comprehensive review and revision of its programs to better protect watershed processes and habitat and to secure ESA Section 4d assurances from NOAA Fisheries.
  - The County comprehensive plan sets policies calling for the protection of habitat for ESA listed salmon and other aquatic and terrestrial species.
  - Zoning that directs growth throughout the County [M.12] and maintains low-density development in rural areas. The County has a designated Urban Growth

Area pursuant to the Washington Growth Management Act (GMA). The UGA helps protect rural lands by directing high intensity uses to developed areas.
  - A Habitat Conservation Ordinance provides stream buffers and measures for the protection of important habitat, including ESA listed salmonids. [M.7A; M.7B; M.7C]

- Road Maintenance:
  Clark County Road Program utilizes Best Management Practices to guide their operations and is actively seeking programmatic ESA Section 4d assurances from NOAA Fisheries that these measures provide adequate protection for fish. [M.7C; M.7D; M.11A]

- Stormwater Management:
  The County stormwater program, based on Best Available Science, is implementing an NPDES permit, including measures to protect water quality and reduce impacts on stream flows. [M.7C; M.7D; M.10C]

- Parks and County Facilities:
  The County has an active Conservation Futures program to acquire and protect critical habitat. The Clark-Vancouver Parks program has acquired 1200 acres of wetlands near LaCenter. [M.13A]

➢ ***Skamania County***
- Comprehensive Planning and Zoning: Since all basin lands within Skamania County are federal, County land use programs do not apply.

➢ ***Cities***
- Comprehensive Planning and Land Use Zoning: Cities within the East Fork Lewis Basin have adopted comprehensive plans and zoning ordinances that afford limited protection of watershed processes and habitat conditions. These programs relate minimally to measures M.12A, M.12B, and M.12C. Specifically:
  - ✓ The City of Battleground has a comprehensive plan with a critical areas ordinance and zoning. Battleground's ordinances lack wetland/stream protections.
  - ✓ Yacolt has critical areas designated on their zoning ordinance. Yacolt's ordinances lack wetland/stream protections.
  - ✓ LaCenter has a comprehensive plan with a critical areas ordinance and zoning.

Community Programs

No community actions at this time.

Restoration Programs

Restoration programs in the East Fork Lewis Basin are conducted primarily by the U.S. Forest Service Gifford Pinchot National Forest, the Washington Department of Natural Resources on state forest lands and industrial and small forest land owners pursuant to the state forest practice rules. Restoration programs are generally organized around agencies, organizations, and private interests that assess threats, develop solutions, and implement projects that are intended to improve habitat conditions or watershed functions. Key programs implementing restoration measures are identified below:

Federal Programs

- ***U.S. Forest Service Gifford Pinchot National Forest:*** Restoration activities within the upper East Fork Lewis Basin are a high priority on the Gifford Pinchot NF. These efforts include placement of large wood, riparian thinning to improve stands, and road stabilization and decommissioning. [M.3A; M.3B; M.6A; M.6B; M.7A; M.7B; M.11A]

State Programs

- ***Department of Natural Resources***
  - State Forest Land Habitat Conservation Plan (HCP): The Department manages state forest lands pursuant to a Habitat Conservation Plan (HCP). The HCP road maintenance and restoration objectives require barrier upgrades and road abandonment and/or other improvements. [M.3A; M.3B; M.6A; M.6B; M.7A; M.7B; M.11A]
  - State Forest Practices Act:
    - ✓ Industrial forests within the lower NF Lewis Basin are governed by Forest and Fish regulations and have rigid schedules for maintaining and improving roads and removing barriers. Industrial landowners have 15 years to bring roads and barriers into compliance with regulations [M.3A; M.3B; M.6A; M.6B; M.7A; M.7B; M.11A]
    - ✓ Small private forest owners are governed by Forest and Fish regulations; however their road and barrier maintenance and improvement programs are tied to state funding. In the State 2003-05 Biennial Budget, 2 million dollars was allocated statewide to support small private forest owners [M.3A; M.3B; M.6A; M.6B; M.7A; M.7B; M.11A]
- ***Department of Fish and Wildlife***
  - Habitat Program: The Department provides advice and assistance to local governments and landowners interested in measures to restore habitat. [M.1A; M.2A; M.2B; M.3A; M.5A; M.7C; M.7D; M.9A; M.9B; M.10A; M.11A; M.12A; M.12.B; M.12C]
- ***Salmon Recovery Funding Board (SFRB)/ Lower Columbia Fish Recovery Board (LCFRB)***
  - Washington Salmon Recovery Act (RCW 77.85): The SRFB and the LCFRB jointly administer a habitat restoration grant program that allocates federal Pacific Salmon Recovery Funds and State dollars for habitat protection and restoration projects by state

and local agencies, nonprofit organizations, and landowners. To date the program has funded six projects in the EF Lewis totally more that $600,000.

- ✓ Vancouver Clark Parks restored lands in the EF Lewis Basin. One project on Lockwood Creek includes restoration of 4,000' of the EF Lewis and replacing four undersized culverts. [M.3A; M.3D; M.5A; M.9A; M.9B; M.11A]
- ✓ Fish and Wildlife and Vancouver-Clark Parks sponsored restoration of approximately 22 acres of floodplain wetlands; [M.1A; M.2A; M.2B]

Local Government Programs

- ➢ ***Clark Conservation District Program*** works directly with agriculture interests in the EF Lewis in their Farm Plan Program and Conservation Reserve Enhancement Program. Clark Conservation District is active in the EF Lewis; [M.3A; M.3B; M.3C; M.5A; M.6C; M.10A; M.10B]

Community Programs

- ➢ ***Friends of East Fork*** is a non-profit entity that is developing a strategic plan for the EF Lewis. The reach-level assessment will identify and evaluate the feasibility of potential restoration projects. [M.3A; M.5A; M.9A; M.9B]

- ➢ ***Fish First*** is a non-profit entity that initiates restoration projects primarily in the NF Lewis Basin. Fish First participated EF Lewis restoration as demonstrated by two projects, Price Dairy restoration and the Lockwood Creek Culvert Removal projects. [M.3A; M.5A; M.9A; M.9B]

Gap Analysis

Forest-related Programs: Given that over half the EF Lewis Basin is comprised of forest lands, forestry programs play a substantial role in protecting and restoring watershed functions and habitat conditions at levels supporting recovery goals. Certainty of forestry-related protection and restoration programs is relatively high because programs are being implemented and, for the most part, fully funded. Program areas of concern include state funding for small commercial forest landowners and the continued potential for hydrologic impacts caused by past harvest practices. Monitoring of watershed processes and habitat conditions will be required to confirm the effectiveness of these measures.

Agricultural-related Programs: Best Management Practices, incentives, and regulations for agricultural practices need to be developed to ensure protection of watershed processes and habitat conditions.

Protection-related Programs: Protection programs in the mid- to lower- areas of the EF Lewis are fundamental to achieving recovery goals. Population growth in Southwest Washington will exert tremendous pressures in these areas over the next 20 to 50 years. In general, county land use protections are likely to become sufficient over the next couple of years. Cities will need to update their critical area ordinances and use Best Available Science to ensure adequate protection of habitat and watershed processes. Regulations pertaining to resource use or processing should be enhanced to protect habitat and watershed processes. Outright purchase of habitat lands in the EF Lewis is occurring. Clark Vancouver Parks and others have acquired significant properties. Protection of instream flows should receive greater attention within the next year as WRIA 27/28 Planning Units make their recommendations to DOE for new protections. Program areas of concern include consistent land use protections across agencies, conversion of rural or resource lands to more intensive uses, unregulated activities, and the protection of instream flows.

Restoration-related Programs: The EF Lewis has received significant attention from restoration-focused programs and there is reason to believe these efforts will continue. In general, the various restoration efforts have addressed all measures at some level. Program areas of concern include magnitude of efforts and corresponding funding to support those efforts at a level necessary to achieve recovery goals. Relative to other program categories, restoration is likely to have the most significant resource needs because of impacts that haven't been fully addressed, new threats that protection mechanisms may not address, and the cumulative impacts caused by population growth over time.

Table 13-8. Actions to Address Gaps

Action #	Lead Agency	Proposed Action
EF.1	Battleground, Yacolt, LaCenter	Develop and implement controls to adequately protect riparian areas to maintain currently functional habitat as well as restored habitat needed habitat conditions around all rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Require mitigation, where necessary, to offset unavoidable damage to habitat conditions in riparian management areas
EF.2	Battleground, Yacolt, LaCenter	Zoning and development standards to adequately protect wetlands, wetland buffers, and wetland function.
EF.3	Battleground, Yacolt, LaCenter, Clark County	Develop and implement controls to address erosion and sediment run-off during (and after) construction to prevent sediment and pollutant discharge to streams, wetlands and other water bodies
EF.4	State of Washington	Provide state funding for small forest owners in the EF Lewis Basin to a level sufficient to achieve the road and barrier improvements of Forest and Fish on a schedule parallel to private industrial forest owners
EF.5	Forest Managers LCFRB, and DFW	Identify early action forest-wide restoration projects that analysis indicates could provide significant benefits. In these cases, it may be appropriate to identify outside funding to initiate these early actions
EF.6	Restoration Agencies and Organizations	Coordinate barrier removal projects to ensure they are conducted in a logical sequence that will generate maximum benefits for fish in the highest priority subbasins
EF.7	Clark County, Cities, and State Agencies	Utilize a combination of public outreach/education, incentives, and authority to positively influence landowner behaviors toward land stewardship
EF.8	NOAA Fisheries, USFWS	Ensure implementation of the Stordahl Mine HCP, as approved or amended, including all conservation measures and adaptive management requirements
EF.9	Clark County, Cities, State of Washington	Apply land use code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
EF.10	WRIA 27/28 PU, DOE, and DFW	Close the EF Lewis to further surface water withdrawals, including groundwater in connectivity with surface waters
EF.11	Clark County, Cities, DOE, DFW, CLT	Increase summer low-flow conditions in the EF Lewis through the purchase of existing water rights and land use actions (e.g., wetland restoration and re-connecting side-channels) and enforcement against illegal withdrawals
EF.12	Clark County, Cities, DOE, DFW, CLT	Decrease the frequency and duration of peak-flow events on the EF Lewis by reducing impervious surfaces, controlling stormwater and re-connecting riparian wetlands
EF.13	Clark County, Cities, CCD, Friends of EF, Fish First, and LCFRB	Build support for the acquisition of conservation easements, long-term leases, and fee-simple purchase through outreach and increased project funding for non-profit organizations like the Columbia Land Trust or the Nature Conservancy
EF.14	State of Washington, LCFRB, CC	Build institutional capacity for agencies and organizations to undertake protection and restoration projects
EF.15	LCFRB, DOE, DFW, NOAA, USFWS, ACOE, SRFB	Increase available funding for projects that implement measures and addresses underlying threats.
EF.16	LCFRB	Address threats proactively by building agreement on priorities among the various program implementers
EF.17	CC	Increase capacity of agencies like Clark Conservation District to perform outreach and design/implement farm plans, restoration projects, education, compliance, etc.
EF.18	CC, WDA, GSRO	Develop agricultural practices that protect watershed processes and habitat conditions.
EF.19	FEMA	Update Floodplain Maps

14 Lower Columbia Mainstem Subbasin – Salmon Creek

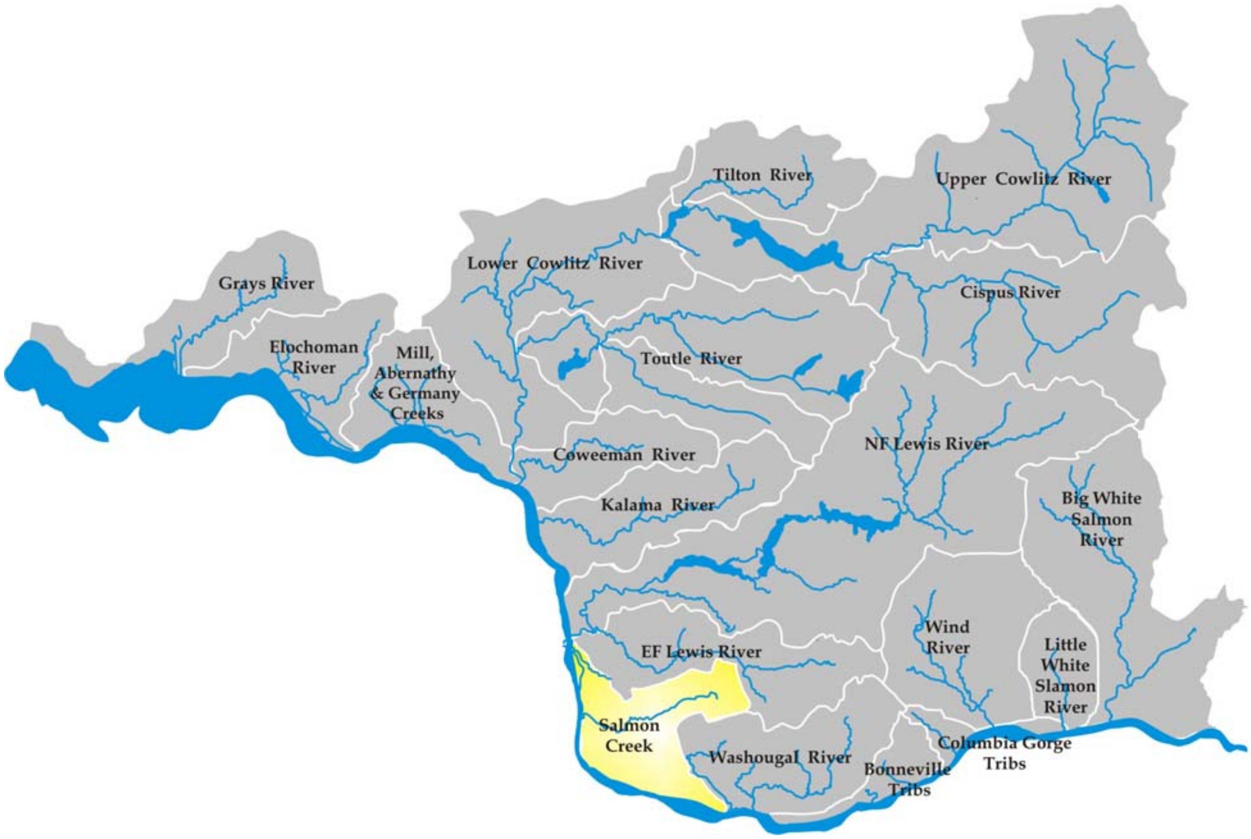


Figure 14-1. Location of the Salmon Creek Basin within the Lower Columbia River Basin.

14.1 Basin Overview

The Salmon Creek Basin comprises approximately 85 square miles in Clark County. Salmon Creek is the largest tributary to the Lake River basin. The creek enters the Columbia near Vancouver, Washington. The basin is part of WRIA 28.

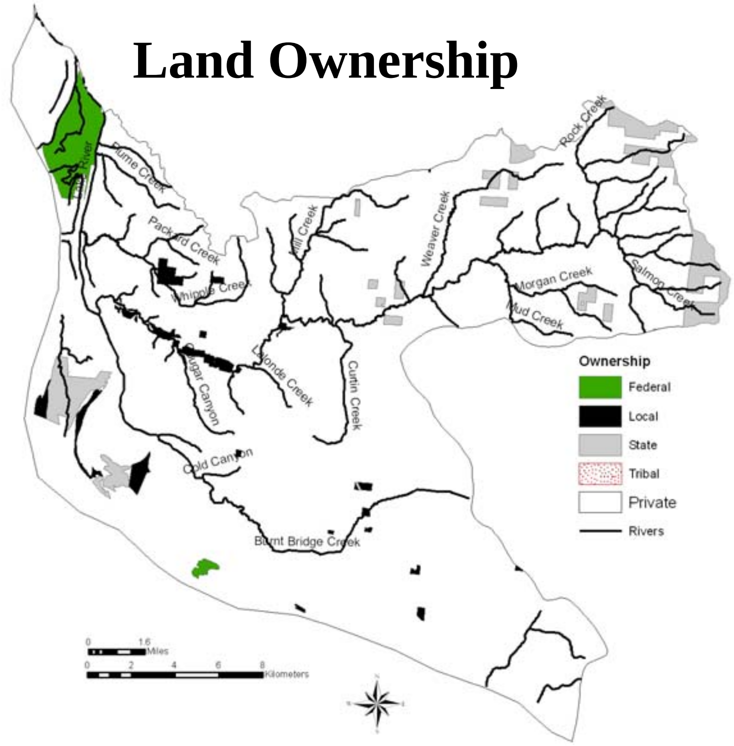
The Salmon Creek Basin will play key role in the recovery of salmon and steelhead. The subbasin has historically supported populations of fall Chinook, winter steelhead, chum, and coho. Today, Chinook, steelhead and chum are listed as threatened under the ESA. Coho salmon are a candidate for listing. Other fish species of interest are Pacific lamprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

Salmon Creek salmon and steelhead are affected by a variety of in-basin and out-of basin factors including stream, Columbia River mainstem, estuary, and ocean habitat conditions; harvest; hatcheries; and ecological relationships with other species. Analysis has demonstrated that recovery cannot be achieved by addressing only one limiting factor. Recovery will require action to reduce or eliminate all manageable factors or threats. The deterioration of habitat conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonids within the Columbia Basin. Direct harvest of listed salmon and steelhead is prohibited but sport and commercial fisheries focusing on hatchery fish and other healthy wild populations, primarily in the mainstem Columbia and ocean, incidentally affect ESA-listed Salmon Creek fish. Key ecological interactions of concern include effects of nonnative species; nutrient inputs from salmon carcasses; and predation by species affected by development including Caspian terns, northern pikeminnow, seals, and sea lions. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the Salmon Creek Subbasin.

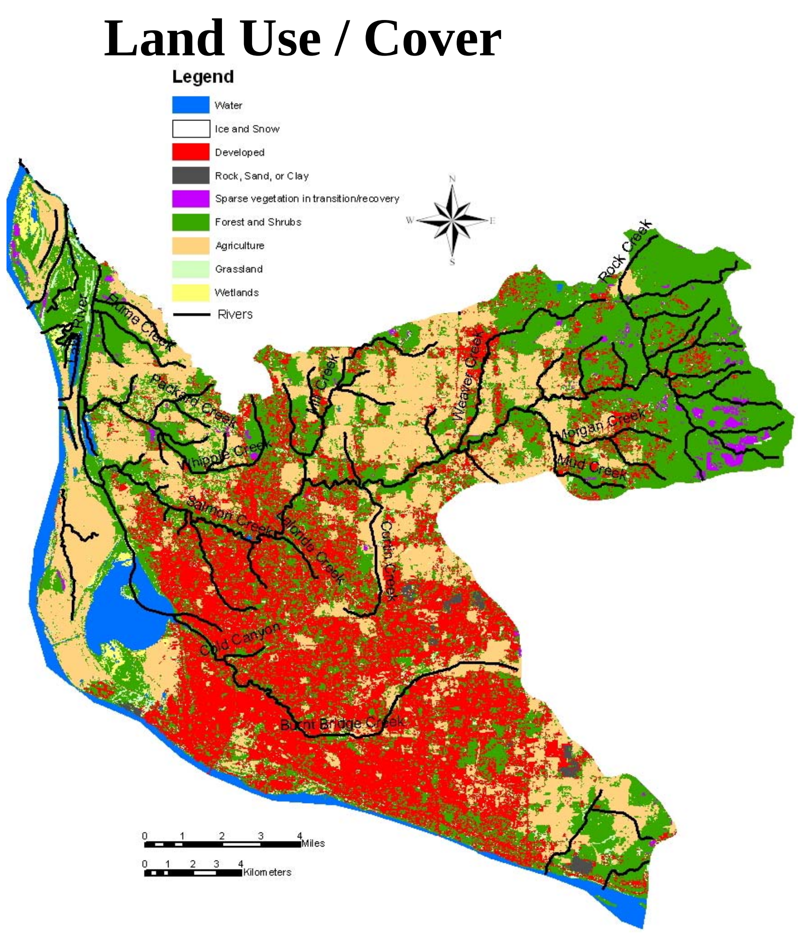
Land use in the Salmon Creek/Lake River basin is predominately urban and rural development, with nearly the entire Burnt Bridge Creek watershed lying within the Vancouver metropolitan area. Historical wetlands and floodplains have been converted to residential, commercial, industrial, and agricultural uses. The upper reaches of the Salmon Creek basin have been impacted by forestry, agriculture, and rural residential development.

Continued population growth is of primary concern in this basin. Major urban centers in the basin are Vancouver, Orchards, Salmon Creek, Battle Ground, and Ridgefield. The year 2000 population, estimated at 252,000 persons is expected to increase to 519,000 by year 2020 (LCFRB 2001). Population growth will result in the continued 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 critical habitats and the conditions that create and support them.

Land Ownership	
Private	89%
Federal	4%
State	4%
Other public	3%



Vegetation Composition	
Late Seral	0%
Mid Seral	6%
Early Seral	1%
Other Forest	19%
Non Forest	71%



14.2 Species of Interest

Focal salmonid species in the Salmon Creek basin include coho, winter steelhead, and chum. Fall Chinook are considered part of the East Fork Lewis population. The current health or viability is low for winter steelhead and very low for chum and coho. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). For Salmon Creek populations, the objective is to stabilize the populations to no less than the current viability level. The low viability level for winter steelhead provides for a 40-74% probability of persistence over 100 years, and the very low viability level for chum and coho provides for a 0-40% probability of persistence over 100 years.

Other species of interest in Salmon Creek include coastal cutthroat trout and Pacific lamprey. Regional objectives for these species are described in Volume I, Chapter 6. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for these other species. Cutthroat will benefit from improvements in stream habitat conditions for salmonids. Lamprey are expected to benefit from habitat improvements in the estuary, Columbia River, and mainstem, and in the Salmon subbasin, although specific spawning and rearing habitat requirements for lamprey are not well known.

Table 14-1. Current viability status of Salmon 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**
Winter Steelhead	Threatened	Yes	Low	<100	Low	600-1,200
Chum	Threatened	No	Very low	<100	Very low	1,100-4,200
Coho	Candidate	No	Very low	unknown	Very low	unknown

Winter Steelhead– The historical Salmon Creek adult population is estimated from 500-8,000 fish. Current natural spawning returns are less than 100 fish. Skamania Hatchery winter steelhead are released into Salmon Creek for harvest opportunity In-breeding between wild and hatchery winter steelhead is possible, but likely low because of differences in spawn timing. Spawning occurs throughout the Salmon Creek basin, the lower reaches of Gee Creek, Whipple Creek, and Burnt Bridge Creek Spawning time is generally from early 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 Salmon Creek.

Chum– the historical Salmon Creek adult population is estimated from 10,000-90,000 fish. Current natural spawning is estimated at less than 100 fish. Spawning occured in the lower reaches of the mainstem Salmon Creek, Gee Creek, Whipple Creek, and Burnt Bridge Creek North Fork, East Fork, and in Cedar Creek. Spawning occurs from late November through December. Juveniles rear in the lower reaches for a short period in the early spring and quickly migrate to the Columbia.

Coho– The historical Salmon Creek adult population is estimated from 6,000-35,000, with both early and late stock coho produced. Current returns are unknown, but presumed to be very low. Early stock coho spawn in early to mid-November and late stock from late November to March. There is currently no hatchery coho released into Salmon Creek. Natural spawning can occur though out the Salmon Creek basin, but principally in the upper mainstem Salmon Creek, and Morgan, Rock, Mill, and Weaver creeks. Potential for coho spawning also exists in nearby streams, including Burnt Bridge and Whipple creeks. Juveniles rear for a full year in the Salmon Creek basin before migrating as yearlings in the spring.

Coastal Cutthroat– Coastal cutthroat abundance in Salmon Creek has not been quantified but the population is considered depressed. Both andromous and resident form of cutthroat ar present in the basin. Anadromous cutthroat enter Salmon Creek from July-December and spawn from December through June. Most juveniles rear 2-4 years before migrating from their natal stream.

Pacific lamprey– Information on lamprey abundance is limited and does not exist for the Salmon Creek population. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have declined in the Salmon Creek basin also. Adult lamprey return from the ocean to spawn in the spring and summer. Juveniles rear in freshwater up to seven years before migrating to the ocean.

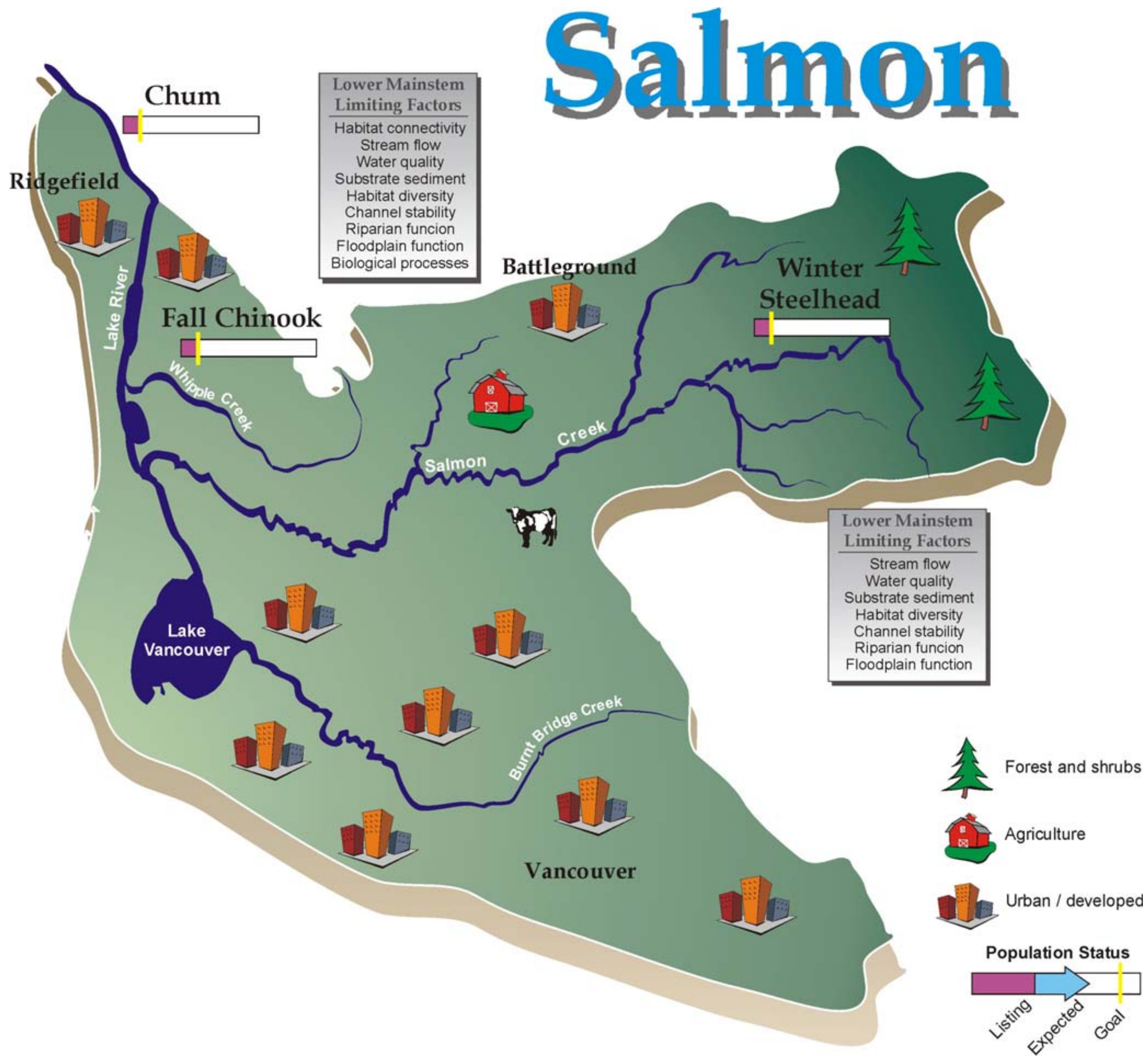


Figure 14-2. Summary of habitat limiting factors, population status, expected population improvement trend with existing programs and biological objectives depicted for the Salmon Creek Basin.

14.3 Potentially Manageable Impacts

Stream habitat, estuary/mainstem habitat, harvest, hatchery and predation effects have all contributed to reduced salmonid productivity, numbers, and population viability in the Salmon Creek subbasin. The pie charts below represent the relative order of magnitude of quantifiable effects for each of these factors for each focal species. The preferred recovery scenario targets an equivalent reduction in each impact factor in proportion to the magnitude of the effect. Population-specific targets are discussed in further detail in Volume I, Chapter 6.

- Loss of tributary habitat quality and quantity is an important impact for all species. Loss of estuary habitat quality and quantity is also important to chum. Harvest has a large relative impact on fall Chinook and moderate impacts on coho and winter and summer steelhead. Harvest effects on chum are minimal.

- Harvest is a significant issue for coho, but not so for both chum and winter steelhead.
- Hatchery impacts are moderate for winter steelhead and coho, but are non-existent for chum.
- Predation is moderately important to all three species.

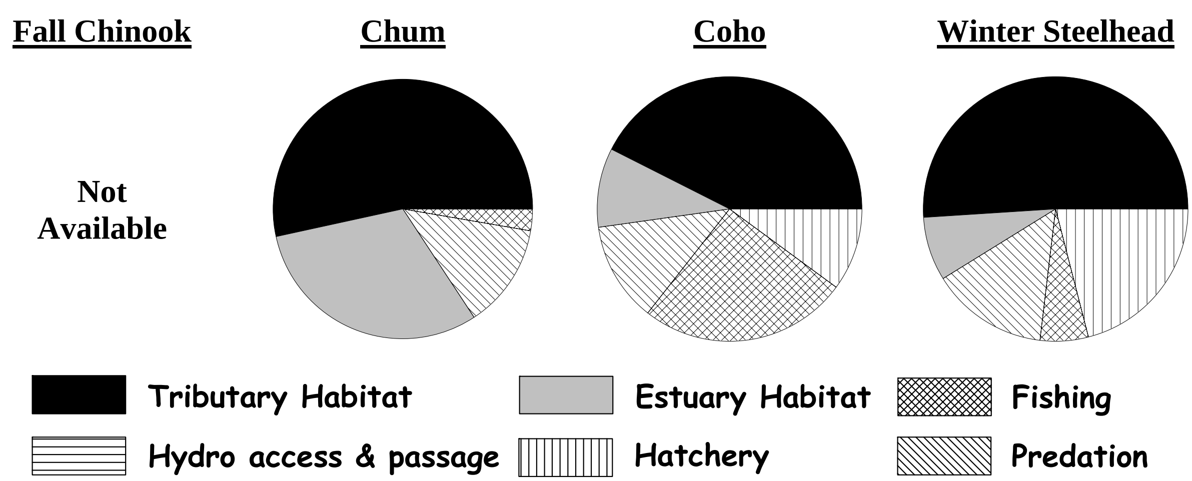


Figure 14-3. Relative contribution of potentially manageable impacts for Salmon Creek populations.

14.4 Limiting Factors, Threats, and Measures

14.4.1 Hydropower Operation and Configuration

There are no hydro-electric dams in the Salmon Creek Basin. However, Salmon Creek species are affected by mainstem Columbia hydro operations and flow regimes which affect habitat in migration corridors and in the estuary. Mainstem hydro factors and threats are addressed by regional strategies and measures identified in Volume I.

14.4.2 Harvest

Most harvest of wild Salmon Creek salmon and steelhead occurs incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. This mortality is very low for chum and steelhead, and relatively low for coho. No harvest of chum occurs in ocean fisheries, there is no chum directed Columbia River commercial fisheries and retention of chum is prohibited in Columbia River and Salmon Creek sport fisheries. Some chum can be impacted incidental to fisheries directed at coho and winter steelhead. Harvest of Salmon Creek coho occurs in the ocean commercial and recreational fisheries off the Washington and Oregon coasts and Columbia River. There is no salmon directed sport fishery in Salmon Creek. Wild coho impacts are limited by fishery management to retain fin-marked hatchery fish and release unmarked wild fish. 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 fish and commercial fisheries cannot retain hatchery or wild steelhead.

Measures 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. The regional measures 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 Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is generally more applicable to steelhead while regional management is more applicable to salmon. Regional harvest measures with significant application to the Salmon Creek Subbasin populations are summarized in the following table:

Table 14-2. Regional harvest measures from Volume I, Chapter 7 with significant application to the Salmon Creek Subbasin populations.

Measure	Description	Comments
F.M17	Monitor chum handle rate in tributary winter steelhead.	State agencies would include chum incidental handle assessments as part of their annual tributary sport fishery sampling plan.
F.M18	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	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.M19	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	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.M24	Maintain selective sport fisheries in Ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	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.

14.4.3 Hatcheries

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

There are no hatcheries operating in the Salmon Creek Basin. Skamania Hatchery winter steelhead are released into lower Salmon Creek to provide harvest opportunity. Skamania Hatchery steelhead are a composite stock and are genetically different from the naturally produced steelhead in Salmon Creek. 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 14-3. Salmon Creek hatchery Production.

Hatchery	Release Location	Winter Steelhead
Skamanaia	Salmon Creek	20,000

Regional hatchery strategies and measures are focused on evaluating and reducing biological risks and increasing the benefits to natural populations. Regional hatchery measures identified in Volume I, Chapter 7 with specific applications within the Salmon Creek Subbasin are summarized in the following table:

Table 14-4. Regional hatchery measures from Volume I, Chapter 7 with specific implementation actions in the Salmon Creek Subbasin.

Measure	Description	Comments
H.M32	Juvenile release strategies to minimize interactions with naturally spawning fish.	Release strategies are aimed at reducing or avoiding interactions with wild steelhead, fall Chinook, coho by release timing and release location strategies.
H.M34	Mark hatchery steelhead.	Marking hatchery fish allows for identification of hatchery fish in the natural spawning grounds and at collection facilities which enables accurate accounting of wild fish. Marking also enables selective fisheries to retain hatchery fish and release wild fish.

14.4.4 Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Salmon Creek salmon and steelhead are affected throughout their lifecycle by ecological interactions with non native species, food web components, and predators. Interactions are similar for Salmon Creek populations to those of most other subbasin salmonid populations. Ecological Interactions are addressed by regional strategies and measures identified in Volume I.

14.4.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. 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 are similar for Salmon Creek populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook than spring Chinook, steelhead, and coho. Estuary and mainstem effects on Salmon Creek salmon and steelhead populations are addressed by regional strategies and measures identified in Volume I and the Columbia Mainstem and Estuary Subbasin sections of Volume II.

14.4.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity 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 Salmon River basin have the greatest impact on the health and viability of salmon and steelhead relative to the other limiting factors and threats discussed in this chapter.

Subwatersheds, reaches, and habitat attributes have been prioritized for protection and/or restoration based on the plan's biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Priority areas for habitat preservation and restoration are identified in Figure 14-4. A summary of the primary habitat limiting factors and threats are presented in Table 14-6. Habitat measures and related information are presented in Table 14-7. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 14-5. Reach- and subwatershed-scale limiting factors generated from the technical assessment are included in Table 14-5. Details on species-specific spatial priorities and limiting factors at the subbasin level may be found in Volume II of the Technical

Foundation. A description of the methodology used to generate composite (multi-species) reach and subwatershed priorities can be found in the introduction to this volume of the recovery plan.

The Salmon Creek basin contains no Tier 1 or 2 reaches, which reflects that Salmon Creek salmonid populations are not expected to be recovered to a high level of viability for recovery planning purposes. It is important for recovery planning, however, that these populations do not decline further, which will be a challenging objective considering the continued intensive development of this basin. The areas with the greatest current or potential contribution to focal salmonid population health and productivity are listed below.

- Lower mainstem Salmon & tributaries – Salmon 12-16; Suds 1-2
- Upper mainstem Salmon & tributaries – Salmon 20-32; Morgan 1; Rock 1, 5, 7

The following paragraphs provide a brief overview of each of these priority areas, including species most affected, land-use threats, and the general type of measures that will be necessary for recovery. Additional detail can be found in the tables and figures that follow.

While reach level habitat conditions often result from local factors, they are also affected or shaped by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input and large woody debris recruitment are often affected by or result from upstream conditions and degraded watershed processes. Access to key reaches may also be affected by barriers that occur downstream of a reach. Accordingly, restoration of a priority reach may require action outside the targeted reach. The IWA analysis was used to identify potential upstream watershed areas that could influence reach level habitat attributes. EDT was used to allow a relative comparison of reaches and habitat attributes within a reach.

The lower mainstem Salmon Creek reaches with the greatest potential production are located in the vicinity of Salmon Creek County Park, near the I-5 crossing. These reaches historically provided productive habitats for fall Chinook, chum, coho, and winter steelhead. This area is heavily impacted by urban and rural development in the expanding Vancouver metropolitan area. Effective recovery measures will involve land-use planning that adequately protects habitat-forming processes in sensitive areas (wetlands, floodplains, riparian corridors). Restoration of riparian areas along these and upstream reaches will also yield important benefits.

A few potentially productive reaches for coho and winter steelhead are located on the mainstem between the Hwy 503 crossing and Salmon Falls. Rock Creek and other, smaller, tributaries (e.g., Morgan Creek) also contain potentially productive habitats for coho. These reaches are heavily impacted by agricultural uses and rural residential development. As with the lower basin, the upper basin is expected to continue to develop rapidly. In light of the continued growth, there needs to be emphasis on land-use planning that provides adequate protections to sensitive areas. In addition, riparian and floodplain restoration that targets impacts related to grazing and rural development will yield important benefits to salmonid habitat.

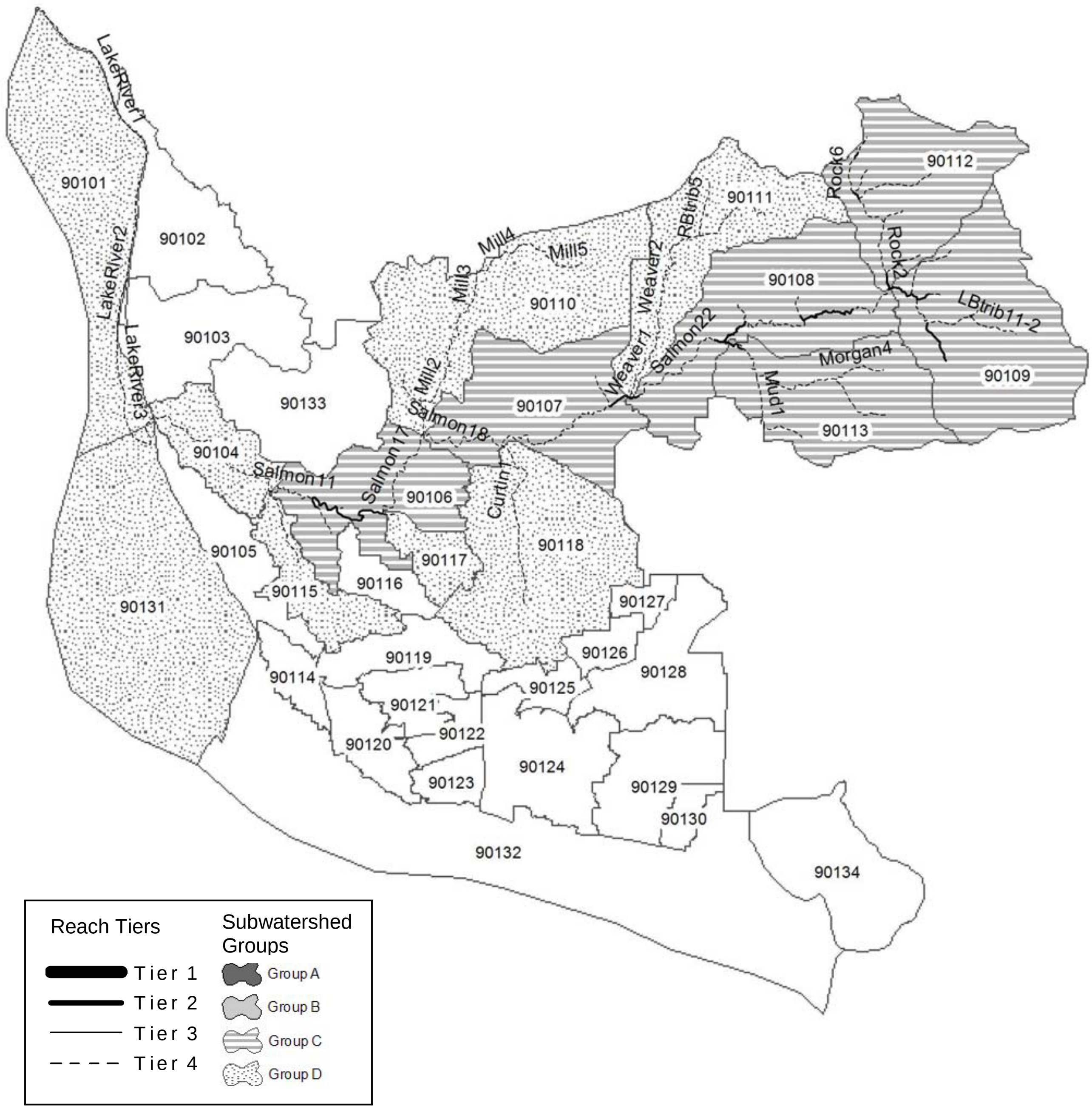


Figure 14-4. Reach tiers and subwatershed groups in the Salmon Creek Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities at 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.

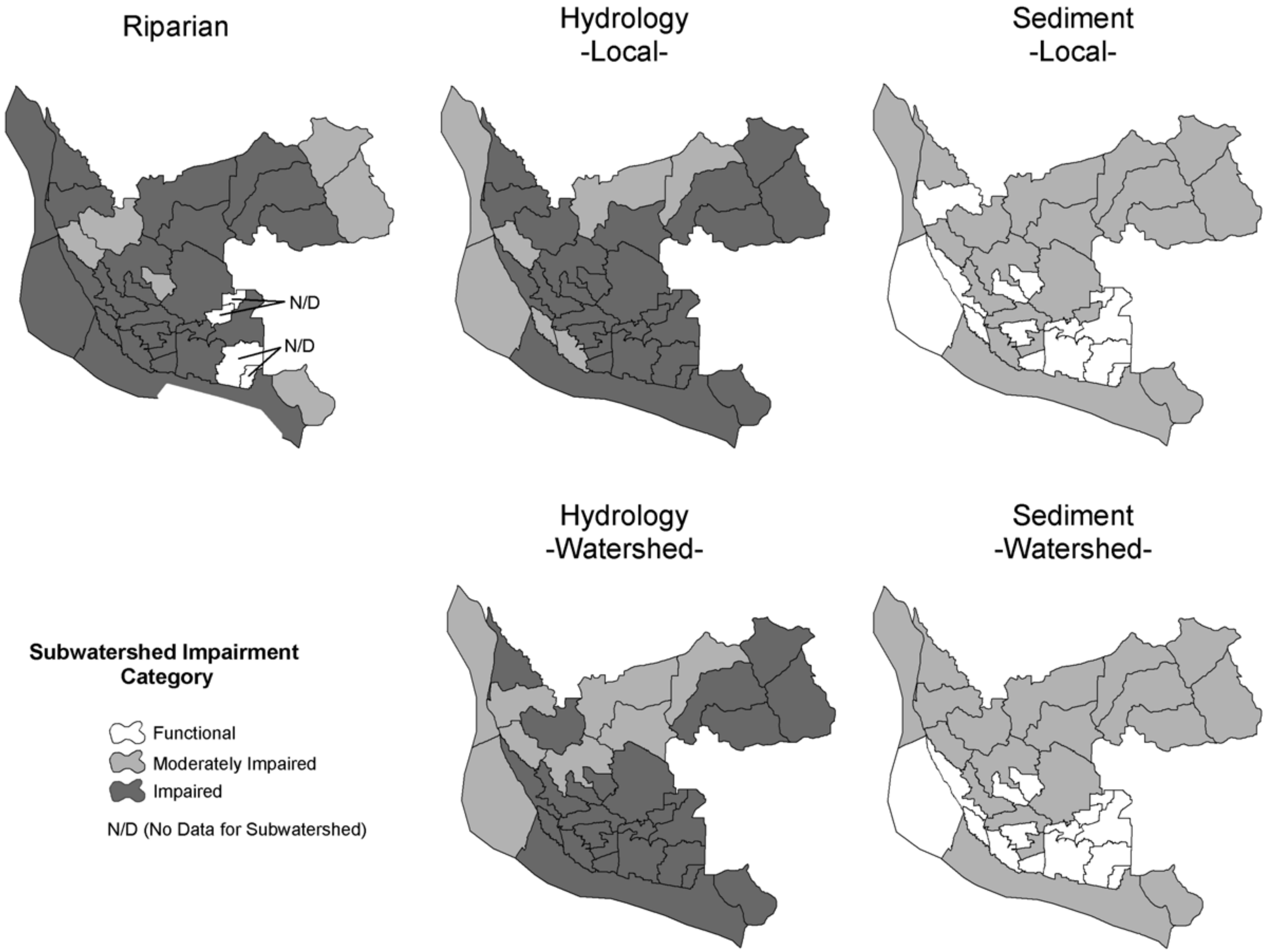


Figure 14-5. IWA subwatershed impairment ratings by category for the Salmon Creek Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 14-5. 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-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) Hydrology	Watershed processes (local) Sediment	Watershed processes (local) Riparian	Watershed processes (watershed) Hydrology	Watershed processes (watershed) Sediment
C	90113	BakerCr1_(LBtrib3-1) BakerCr2_(LBtrib3-2) BakerCr3_(LBtrib3-3) Fishway1 Morgan1 Morgan2 Morgan3_A Morgan3_B Morgan4 Mud1 Mud2 SideChannel1	StW	none				I	M	I	I	M
			Coho	Morgan1 SideChannel1	egg incubation summer rearing winter rearing adult holding	channel stability temperature flow sediment key habitat quantity	R					
	90112	LBtrib5 LBtrib7-1 LBtrib8-1 LBtrib9 Rock1 Rock2 Rock3 Rock4 Rock5 Rock6 Rock7 Rock8 RockCulv1	StW	none				I	M	M	I	M
			Coho	Rock1 Rock5 Rock7	egg incubation fry colonization summer rearing winter rearing	channel stability habitat diversity flow sediment food key habitat quantity	R					
	90109	LBtrib11-1 LBtrib11-2 LittleSalmon1 RBtrib11-1 RBtrib11-2 RBtrib11Culv1 RBtrib12-1 RBtrib12-2 Salmon28 Salmon29 Salmon30 Salmon31 Salmon32	StW	Salmon28 Salmon29 Salmon31 Salmon32	egg incubation fry colonization summer rearing winter rearing	habitat diversity sediment	PR	I	M	M	I	M
			Coho	LBtrib11-1 RBtrib11-1 Salmon29 Salmon31	spawning egg incubation fry colonization summer rearing winter rearing juvenile migrant (age-0)	channel stability habitat diversity sediment key habitat quantity	PR					
	90108	Salmon21 Salmon23 Salmon24 Salmon26 RBtrib9-1 Salmon25 Salmon27 RBtrib8 Salmon22 RBtrib9-2 RBtrib9Dam	StW	Salmon21 Salmon23	egg incubation fry colonization summer rearing	sediment	R	I	M	I	I	M
			Coho	Salmon21 Salmon23 Salmon24 Salmon26 RBtrib9-1	egg incubation fry colonization summer rearing winter rearing	habitat diversity sediment	R					
	90107	Salmon20 Salmon18 Salmon19 RBtrib4	StW	Salmon20	egg incubation summer rearing winter rearing	habitat diversity sediment	R	I	M	I	M	M
			Coho	Salmon20	egg incubation summer rearing winter rearing	habitat diversity sediment	R					
	90106	Klineline1 KlinelineChannel1 (SCPC1) Lalonde1 LalondeCulv1 Salmon11 Salmon12 Salmon13 Salmon14_A Salmon14_B Salmon14_C Salmon15(falls) Salmon16 Salmon17 Suds1 Suds2 Suds3 Suds4 Suds5 Suds6 SudsCulv1 SudsCulv2 SudsCulv3 SudsCulv4 SudsCulv5 TenneyCr(LBtrib1)	ChF	Salmon14_A Salmon14_B Salmon14_C Salmon16	spawning egg incubation fry colonization adult holding	channel stability habitat diversity sediment key habitat quantity	R	I	M	I	M	M
			Chum	Salmon13 Salmon14_A Salmon14_B Salmon16	spawning egg incubation fry colonization adult migrant adult holding	habitat diversity sediment harassment key habitat quantity	R					
			StW	Salmon13 Salmon14_A Salmon14_B Salmon14_C Salmon16	egg incubation fry colonization summer rearing	habitat diversity temperature predation flow sediment	R					
			Coho	Lalonde1 Salmon12 Salmon13 Salmon14_A Salmon14_B Salmon16 Suds1 Suds2	spawning egg incubation fry colonization summer rearing winter rearing juvenile migrant (age-0) juvenile migrant (age-1)	channel stability habitat diversity predation flow sediment	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
D	90131	Salmon1	All	none				M	F	I	M	F
	90118	Curtin1 Curtin2 CurtinCulv	Coho	none				I	M	I	I	M
	90117	Lalonde2	Coho	none				I	F	M	I	F
	90115	CougarCanyon1 CougarCanyon2 NW119thCulv	Coho	none				I	M	I	I	M
	90111	RBtrib5	StW	none				M	M	I	M	M
		Weaver1 Weaver2 Weaver3 WeaverCulv1	Coho	none								
	90110	Dam1	StW	none				M	M	I	M	M
		Mill1 Mill2 Mill3 Mill4 Mill5 RBtrib2-1 (MillCr) Reservoir1	Coho	none								
	90104	Salmon2 Salmon3 Salmon4 Salmon5 Salmon6 Salmon7 Salmon8 Salmon9 Salmon10	All	none				M	M	M	M	M
	90101	LakeRiver1	All	none				M	M	I	M	M
		LakeRiver2	Chum	none								
		LakeRiver3	StW	none								

Table 14-6. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the lower Salmon mainstem (LM) and upper mainstem Salmon & tributaries (UM). Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors			Threats		
	LM	UM		LM	UM
Habitat connectivity			***Agriculture/grazing***		
Blockages to off-channel habitats	✓		Clearing of vegetation	✓	✓
Habitat diversity			Riparian grazing	✓	✓
Lack of stable instream woody debris	✓	✓	Floodplain filling	✓	✓
Altered habitat unit composition	✓	✓	***Urban/suburban/rural development***		
Loss of off-channel and/or side-channel habitats	✓		Clearing of vegetation	✓	✓
Channel stability			Floodplain filling	✓	✓
Bed and bank erosion	✓	✓	Increased impervious surfaces	✓	✓
Channel down-cutting (incision)	✓	✓	Increased drainage network	✓	✓
Riparian function			Roads – riparian/floodplain impacts	✓	✓
Reduced stream canopy cover	✓	✓	Leaking septic systems	✓	✓
Reduced bank/soil stability	✓	✓	***Channel manipulations***		
Exotic and/or noxious species	✓	✓	Bank hardening	✓	✓
Reduced wood recruitment	✓	✓	Channel straightening	✓	✓
Floodplain function			Artificial confinement	✓	✓
Altered nutrient exchange processes	✓	✓	Dredge and fill activities	✓	
Reduced flood flow dampening	✓	✓	***Mining***		
Restricted channel migration	✓	✓	Clearing of vegetation	✓	
Disrupted hyporheic processes	✓	✓	Channel and/or floodplain substrate removal	✓	
Stream flow			Floodplain filling	✓	
Altered magnitude, duration, or rate of change	✓	✓	Increased water surface area	✓	
Water quality			***Recreation***		
Altered stream temperature regime	✓	✓	River recreation (harassment)	✓	
Excessive turbidity	✓	✓			
Bacteria	✓	✓			
Reduced dissolved oxygen concentrations	✓				
Substrate and sediment					
Lack of adequate spawning substrate	✓				
Excessive fine sediment	✓	✓			
Embedded substrates	✓	✓			
Biological processes					
Harassment	✓				

Table 14-7. Habitat measures in priority areas, with reference to limiting factors addressed, threats addressed, target species, and estimated time until benefits would be realized (time). Tier 1 and 2 reaches, or other areas of known priority, are listed under the location column for some measures (i.e., stream corridor measures). Reaches not included in the table (Tier 3, 4, and non-tiered reaches) are considered secondary priority.

Priority Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
1. Protect and restore floodplain function and channel migration processes ***A. Set back, breach, or remove artificial channel confinement structures***					
Lower mainstem Salmon 12-16 ***Upper mainstem*** Salmon 20-32	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes • Channel incision	• Floodplain filling • Channel straightening • Artificial confinement	• Chum • Coho • Fall Chinook	2-15 years	Good potential benefit due to improvements in many limiting factors. This passive restoration approach can allow channels to restore naturally once confinement structures are removed. There are challenges with implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense. Opportunities exist in a few areas of public ownership in these reaches.
2. Protect and restore off-channel and side-channel habitats ***A. Restore historical off-channel and side-channel habitats where they have been eliminated*** ***B. Provide access to blocked off-channel habitats*** ***C. Create new off-channel or side-channel habitats (i.e. spawning channels)***					
Lower mainstem Salmon 12-16 ***Upper mainstem*** Salmon 20-32	• Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats • Altered habitat unit composition	• Floodplain filling • Channel straightening • Artificial confinement	• Chum • Coho	2-15 years	Good potential benefit especially for chum, which have lost a significant portion of historically available off-channel habitat for spawning. Potential benefit is limited by moderate probability of success with creation of new habitats. There are challenges with implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense. Opportunities exist in a few areas of public ownership in these reaches.
3. Protect and restore riparian function ***A. Reforest riparian zones*** ***B. Allow for the passive restoration of riparian vegetation*** ***C. Livestock exclusion fencing*** ***D. Invasive species eradication*** ***E. Hardwood-to-conifer conversion***					

Priority Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
Lower mainstem & tribs Salmon 12-16; Suds 1-2 ***Upper mainstem & tribs*** Salmon 20-32; Morgan 1; Rock 1, 5, 7	• Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or noxious species • Bacteria • Reduced DO concentration	• Riparian grazing • Clearing of vegetation due to development, agriculture, and mining	• All species	20-100 years	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. Riparian protections on forest lands are provided for under current harvest policy. Riparian restoration projects are relatively inexpensive and are often supported by landowners. Whereas the specified stream reaches are the highest priority for riparian measures, riparian restoration and preservation should occur throughout the basin since riparian conditions affect downstream reaches. Use IWA riparian ratings to help identify restoration and preservation opportunities.
4. Restore channel and floodplain areas damaged as a result of streamside gravel mining and reduce risks of future impairment due to these activities ***A. Stabilize surface mining sites to prevent erosion*** ***B. Restore channel morphology where streams have avulsed into mining areas***					
Lower mainstem Salmon 13-14	• Loss of off-channel and/or side channel habitats • Altered habitat unit composition • Bed and bank erosion • Channel down-cutting (incision) • Altered stream temperature regime • Excessive turbidity • Restricted channel migration	• Channel and/or floodplain substrate removal • Floodplain filling • Increased water surface area	• Chum • Fall Chinook • Coho	10-50 years	The main area of concern is between I-5 and Highway 99, where the mainstem avulsed into streamside gravel mining ponds in 1996. An upstream migrating headcut has resulted from this avulsion. Restoration measures need to focus on restoring currently degraded channel conditions as well as reducing the risk of future degradation.
5. Protect and restore streambank stability ***A. Restore eroding streambanks***					
Lower mainstem Salmon 13-14 ***Upper mainstem & tribs*** Salmon 24, 26; Morgan 1; Rock 5	• Reduced bank/soil stability • Excessive fine sediment • Embedded substrates • Excessive turbidity	• Artificial confinement • Clearing of vegetation • Roads – riparian / floodplain impacts • Riparian grazing • Mining impacts	• All species	5-25 years	There are areas of bank instability just upstream of I-5 due to avulsion into streamside gravel pits. The upstream reaches in the mainstem, Morgan, and Rock creeks have bank instability associated with roads and riparian livestock grazing. Restoration measures should include livestock exclusion fencing and bio-engineered approaches that rely on structural as well as vegetative

Priority Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
					measures.
6. Protect and restore natural sediment supply processes ***A. Address agricultural sources*** ***B. Address developed land sources***					
Entire basin	• Excessive fine sediment • Excessive turbidity • Embedded substrates	• Agricultural practices – impacts to sediment supply • Urban and rural development – impacts to sediment supply	• All species	5-50 years	High potential benefit due to sediment effects on egg incubation and early rearing. There are challenges with implementation on agricultural lands due to few sediment-focused regulatory requirements for agricultural lands. Use IWA impairment ratings to identify restoration and preservation opportunities.
7. Protect and restore runoff processes ***A. Limit additional watershed imperviousness*** ***B. Manage stormwater runoff***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Increased impervious surfaces • Increased drainage network (road ditches, storm drains) • Clearing of vegetation (development, agriculture)	• All species	5-50 years	High potential benefit due to flow effects on habitat formation, redd scour, and early rearing. There are challenges with addressing runoff issues on developed lands due to continued increase in watershed imperviousness related to development and lack of adequate mitigation. Use IWA impairment ratings to identify restoration and preservation opportunities.
8. Protect and restore instream flows ***A. Water rights closures*** ***B. Purchase or lease existing water rights*** ***C. Relinquishment of existing unused water rights*** ***D. Enforce water withdrawal regulations*** ***E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Water withdrawals	• All species	1-5 years	Instream flow management strategies for the Salmon Creek basin have been identified as part of Watershed Planning for WRIA 28 (LCFRB 2004). Strategies include water rights closures, setting of minimum flows, and drought management policies.
9. Protect and restore water quality ***A. Restore the natural stream temperature regime***					

Priority Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
B. Reduce fecal coliform bacteria levels ***C. Reduce turbidity sources*** ***D. Restore dissolved oxygen concentrations***					
Entire basin	• Altered stream temperature regime • Bacteria • Excessive turbidity • Reduced DO concentration	• Riparian grazing • Leaking septic systems • Clearing of vegetation (development, agriculture)	• All species	1-50 years	Primary emphasis for restoration should be placed on stream segments that are listed on the 2004 303(d) list.
10. Protect and restore instream habitat complexity ***B. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting*** ***C. Structurally modify stream channels to create suitable habitat types***					
Lower mainstem & tribs Salmon 12-16; Suds 1-2 ***Upper mainstem & tribs*** Salmon 20-32; Morgan 1; Rock 1, 5, 7	• Lack of stable instream woody debris • Altered habitat unit composition	• None (symptom-focused restoration strategy)	• coho • winter steelhead	2-10 years	Moderate potential benefit due to the high chance of failure. Failure is probable if habitat-forming processes are not also addressed. These projects are relatively expensive for the benefits accrued. Moderate to high likelihood of implementation given the lack of hardship imposed on landowners and the current level of acceptance of these type of projects.
11. Protect and restore sensitive areas through recreation management ***A. Limit intensive recreational use where there is harassment potential*** ***B. Actively rehabilitate areas damaged by intensive recreational use***					
Lower mainstem Salmon 12-16	• Harassment	• River recreation	• chum • fall Chinook	immediate	Human activity in and around the stream in the vicinity of Salmon Creek County Park has the potential to disrupt spawning, egg incubation, and early rearing of chum and fall Chinook. Outreach programs (primarily through signage) may assist in educating park goers about areas to avoid during sensitive times.
12. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development ***A. Plan growth and development to avoid sensitive areas (e.g. wetlands, riparian zones, floodplains, unstable geology)*** ***B. Encourage the use of low-impact development methods and materials*** ***C. Apply mitigation measures to off-set potential impacts***					
Entire basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	This basin is experiencing rapid development. The focus should be on management of land-use conversion and managing continued development in sensitive areas (e.g.,

Priority Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
					wetlands, stream corridors, unstable slopes). Many critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary mechanisms need to be put in place to restore currently degraded habitats.
13. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection ***A. Purchase properties outright through fee acquisition and manage for resource protection*** ***B. Purchase easements to protect critical areas and to limit potentially harmful uses*** ***C. Lease properties or rights to protect resources for a limited period***					
Entire basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit. These programs are under-funded and have low landowner participation.

14.5 Program Gap and Sufficiency Analysis

The Salmon Creek Basin (~150 sq mi) is located entirely in Clark County:

- The Department of Natural Resources has approximately 10 square miles of public forest in the uppermost reaches of the Salmon Creek Basin;
- Small- and industrial private forests represent approximately 10 square miles of the Basin;
- The predominant land uses in the Salmon Creek Basin are urban, suburban, residential, and agriculture;
- Burnt Bridge Creek lies within urban Vancouver;
- Clark County has regulatory authority for areas outside of the Vancouver City limits;
- The City of Battleground is partially within the Salmon Creek Watershed;
- The City of Brush Prairie is within the Salmon Creek Watershed;
- Other emerging population centers within the Salmon Creek Basin include Orchards, Salmon Creek, and Ridgefield;
- The 2000 population of the Basin was 252,000 and is projected to grow to an estimated 519,000 by the year 2020.

<u>Protection Programs</u>

Protection programs in the Salmon Creek Basin are implemented by a variety of agencies, organizations, and private interests. Protection programs in this analysis include those programs that protect habitat conditions or watershed functions through regulatory measures, through the acquisition outright or the purchase of easements, or by applying standards to new development that protects resources by avoiding damaging impacts. Example programs implementing measures are identified below.

Federal Program

- ***U.S. Army Corps of Engineers***
  - <u>Regulatory Programs:</u> U.S. Army Corps of Engineers administers the Section 10 (Rivers and Harbor Act) and Section 404 (Clean Water Act) permit processes. Section 10 requires approval of any activity in, above, or below a navigable river, which affects course, location, condition, or capacity of navigable waters. Section 404 requires prior approval of dredging, filling, grading, clearing, and bank hardening. In waters used by listed fish species, the permits are subject to ESA Section 7 consultation with NOAA Fisheries to ensure that any approved action is adequately protective of the ESA listed fish. [M.1A; M.2A; M.2B; M.2C; M.4; M.5A; M.10B; M.10C]

State Programs

- ***Department of Natural Resources***
  - <u>State Forest Land HCP</u>: State forest lands are managed under the provisions of a Habitat Conservation Plan (HCP). The Habitat Conservation Plan has protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules [M.3A; M.3B; M.9A; M.9C]

- State Forest Practices: Riparian areas and watershed functions on small- and industrial forest lands are protected under the State of Washington Forest Practices Rules, including the Forest and Fish Module. These rules provide for riparian buffers, harvest restrictions, sensitive area protections, and protective standards for new road construction. [M.3A; M.3B; M.9A; M.9A]

➢ ***Washington Department of Fish and Wildlife***

- Hydraulics Project Approval (HPA): The Department administers the state Hydraulic Code. The purpose of this program is to protect stream conditions and habitat. The regulations apply to such activities as streambank protection, instream construction, culvert installation, channel changes or realignments, debris removal, and water diversion facilities. Those proposing such actions must obtain a Hydraulic Project Approval (HPA) permit. [M.1A; M.2A; M.2B; M.10B; M.10C]

- Habitat Program: The Department provides advice to local governments and landowners interested in measures to protect habitat values on their property. [M.1A; M.2A; M.2B; M.3A; M.4; M.5A; M.6B; M.8A; M.8B; M.8C; M.8D; M.9A; M.9B; M.9C; M.10B; M.10C; M.11A; M.11B; M.12A; M.12B; M.12C]

➢ ***Washington Department of Ecology***

- Water Quality Program/Clean Water Act – Section 401 Certification
FERC relicensing of the Lewis hydro projects requires the Department to issue a CWA Section 401 water quality certification. The Department of Ecology review and, where necessary, revise flow requirements for the protection of fish and their habitat. [M.9A; M.9B; M.9C]

- Water Resources Program/Water Rights: Department of Ecology, in consultation with the Department of Fish and Wildlife, has administrative closed selected areas within the Salmon Creek watershed to further surface and groundwater withdraws (where groundwater is in continuity with surface water). Existing administrative closures by the Department of Ecology protect surface waters from further withdrawals. Formal rule-making would strengthen the closures. The extent of unauthorized surface water withdrawals is unknown, but could exacerbate summer low flows. [M.8A; M.8B; M.8C; M.8D]

- Water Resources Program/Watershed Planning: In cooperation with the Lower Columbia Fish Recovery Board, other state and federal agencies, tribes, local governments, and citizens, the Department funds and participates in a state authorized watershed planning process for Water Resource Inventory Area (WRIA) 27 pursuant to RCW 90.82. The goal of the plan is to ensure adequate water for people and fish. The planning process is dealing with water quantity and quality, stream flows and fish habitat. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.7A; M.7B; M.8A; M.8B; M.8C; M.8D; M.9A; M.9B; M.9C; M.9D; M.12A]

➢ ***Department of Ecology and the Department of Fish and Wildlife***

- There are many administrative closures relating to surface water withdrawals in the Basin; [M.8A; M.8B; M.8C; M.8D]

➢ ***Washington Department of Transportation***

- Highway maintenance program implements best management practices for the protection of habitat. [M.7A; M.7B]

Local Government Programs

o ***Clark County***

- ESA Program: The County has established an Endangered Species Program to address ESA requirements and develop a comprehensive county strategy for salmon recovery. An ESA committee with representatives from federal and state agencies, tribes, citizens, the business community and environmental groups has been established to advise the county as it works to bring its ordinances and programs into compliance with ESA requirements.

- Land Use:
  - ✓ The County is actively engaged in a comprehensive review and revision of its programs to better protect watershed processes and habitat and to secure ESA Section 4d assurances from NOAA Fisheries.
  - ✓ The County comprehensive sets policies calling for the protection of habitat for ESA listed salmon and other aquatic and terrestrial species.
  - ✓ Zoning that directs growth throughout the County and maintains low-density development in rural areas. The County has a designated Urban Growth Area pursuant to the Washington Growth Management Act (GMA). The UGA helps protect rural lands by directing high intensity uses to developed areas.
  - ✓ A Habitat Conservation Ordinance provides stream buffers and measures for the protection of important habitat, including ESA listed salmonids.
  - ✓ Wetland ordinance provides substantial protection. [M.12A; M.12B; M.12C]
  - ✓ Other protection programs include conservation futures and Conservation REET which provides for the acquisition of sensitive habitat areas; [M.13A; M.13B; M.13C]
- Stormwater Management:
  The County stormwater program, based on Best Available Science, is implementing an NPDES permit, including measures to protect water quality and reduce impacts on stream flows [M.7A; M.7B; M.9A; M.9C; M.9D]

- Road Maintenance:
  Clark County Road Program utilizes Best Management Practices to guide their operations and is actively seeking programmatic ESA Section 4d assurances from NOAA Fisheries that these measures provide adequate protection for fish. [M.7A; M.7B]

- Parks and County Facilities:

- ✓ The County has an active Conservation Futures program to acquire and protect critical habitat. [M.13A; M.13B]
- ✓ The County has not implemented a comprehensive parks and facilities management plan to protect habitat.

➢ ***Clark Conservation District and NRCS*** is active in the Salmon Creek Basin, including Salmon Creek and Burnt Bridge Creek. CCD works with agriculture interests to develop farm plans and acquires short-term easements to implement Conservation Enhancement Reserve Program [M.1A; M.2A; M.2B; M.2C; M.3A; M.3C; M.5A; M.6A; M.9A; M.9B; M.9C; M.9D]

Community Programs

Restoration Programs

Restoration programs in the Salmon Creek Basin are implemented by a variety of agencies, organizations, and private interests. Major programs implementing protection measures are identified below:

State Programs

➢ ***Washington Department of Natural Resources***

State Forest Land Habitat Conservation Plan (HCP): The Department manages state forest lands pursuant to a Habitat Conservation Plan (HCP). The HCP road maintenance and restoration objectives require barrier upgrades and road abandonment and/or other improvements. [M.3A; M.3B; M.9A; M.9C]

- State Forest Practices Act:
  - ✓ Industrial forests within the basin are governed by Forest and Fish regulations and have rigid schedules for maintaining and improving roads and removing barriers. Industrial landowners have 15 years to bring roads and barriers into compliance with regulations [M.3A; M.3B; M.9A; M.9C]
  - ✓ Small private forest owners are governed by Forest and Fish regulations; however their road and barrier maintenance and improvement programs are tied to state funding. In the State 2003-05 Biennial Budget, 2 million dollars was allocated statewide to support small private forest owners [M.3A; M.3B; M.9A; M.9C]

➢ ***Washington Department of Fish and Wildlife***

- Habitat Program: The Department provides advice to local governments and landowners interested in measures to protect habitat values on their property. [M.1A; M.2A; M.2B; M.3A; M.4; M.5A; M.6B; M.8A; M.8B; M.8C; M.8D; M.9A; M.9B; M.9C; M.10B; M.10C; M.11A; M.11B; M.12A; M.12B; M.12C]

➢ ***Washington Department of Ecology***

- Water Resources Program/Watershed Planning:

The planning process for WRIA 27 is dealing with water quantity and quality, stream flows and fish habitat. Potential restoration efforts address improving summer low flows through conservation and acquisition of water rights. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.8A; M.8B; M.8C; M.8D; M.9A; M.9B; M.9C; M.9D; M.12A]

- ***Washington Department of Transportation***

  - Barriers: WSDOT has improved several blockages associated with State Route 500 in the Salmon Creek area.

- ***Salmon Recovery Funding Board (SFRB)/ Lower Columbia Fish Recovery Board (LCFRB)***

  - Washington Salmon Recovery Act (RCW 77.85): As noted under preservation programs above, the SRFB and the LCFRB jointly administer a grant program that allocates federal Pacific Salmon Recovery Funds and State funds for habitat protection and restoration projects by state and local agencies, nonprofit organizations, and landowners. To date the SRFB has not funded projects in this basin. [M.1A; M.2A; M.2B; M.3A; M.3B; M.5A; M.9A; M.9C; M.10B; M.10C]

- ***Conservation Commission/Clark Conservation District* (CCD)**

  - The CCD is active within the basin. CCD works with agriculture interests to develop farm plans and implements the Conservation Enhancement Reserve Program. [M.1A; M.2A; M.2B; M.2C; M.3A; M.3C; M.5A; M.6A; M.9A; M.9B; M.9C; M.9D]

Local Government Programs

- ***Clark County***

  - Clark County ESA Program: The Clark County ESA program encourages and recognizes citizen efforts to conserve and restore habitat for salmon through education and outreach activities.
  - Clark County Culvert Program: The County inventories and replaces priority barriers associated with its roads.

Community Programs

- ***Clark Public Utility*** is active in the Salmon Creek Watershed; restoration projects focus on stabilizing streambanks to reduce erosion and improve water quality; Clark Public Utilities also has an extensive water quality monitoring program; [M.3A; M.5A; M.8C; M.9A; M.9C]

Gap Analysis

Forest-related Programs: In the Salmon Creek Basin, forestry programs have a relatively minor, but important role in protecting and restoring watershed functions and habitat conditions consistent with recovery goals. This is because these programs apply to only a fraction of the basin. Certainty of forestry-related protection and restoration programs is relatively high because programs are being implemented and, for the most part, fully funded.

Protection-related Programs: Clark County and the City of Vancouver land use regulatory mechanisms provide significant protections throughout the Salmon Creek Basin. The City of Battleground land use regulatory mechanisms provide some protections; however, the City's programs lack effective provisions that commonly are used to proactively direct growth, protect streams and wetlands, and manage stormwater. These protection mechanisms will be extremely important to direct population growth away from critical areas and to slow the conversion of commercial forests and agriculture to more intensive uses, such as suburban and residential uses. In addition, as in all lower Columbia subbasins, there are very limited protection mechanisms for agricultural practices relative to riparian areas and hydrologic impairment.

Restoration-related Programs: The Salmon Creek Basin has received good attention from restoration-focused programs and there is reason to believe these efforts will continue. Restoration activities are especially important in the Salmon Creek Basin because of the wholesale changes to watersheds that have occurred as a result of urban growth and development. It is a foregone conclusion that the Basin will experience additional population growth over the next 20 years. While effective regulatory programs will be fundamental to protect critical areas, they will not entirely offset impacts associated with growth. Restoration activities will be necessary to address the cumulative impacts from additional imperviousness, riparian degradation and water quality.

Table 14-8. Program Actions to Address Gaps

Action #	Lead Agency	Proposed Action
SALMON.1	Battleground, Brush Prairie, Orchards	Develop and implement stormwater discharge controls to protect water quality and quantity and reduce localized stream flow impacts detrimental to fish —including peak and base flows
SALMON.2	Battleground, Brush Prairie, Orchards	Develop and implement controls to adequately protect riparian areas to maintain currently functional habitat as well as restored habitat needed habitat conditions around all rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Require mitigation, where necessary, to offset unavoidable damage to habitat conditions in riparian management areas
SALMON.3	Battleground, Brush Prairie, Orchards	Zoning and development standards to adequately protect wetlands, wetland buffers, and wetland function.
SALMON.4	Clark County, City of Vancouver, Battleground, Brush Prairie, Orchards	Develop and implement controls to address erosion and sediment run-off during (and after) construction to prevent sediment and pollutant discharge to streams, wetlands and other water bodies
SALMON.5	Clark County, City of Vancouver, Battleground, Brush Prairie Orchards	Protect historic stream meander patterns and channel migration zones and avoid hardening stream banks and shorelines
SALMON6	Battleground, Brush Prairie, Orchards	Development and implement controls and development standards to adequately protect wetlands, wetland buffers, and wetland function
SALMON.7	State of Washington (Dept of Agriculture)	Develop and implement agricultural practices and regulations to protect riparian conditions and water quality
SALMON.8	State of Washington (DFW, Ecology)	Close tributaries to the Salmon Creek Basin to further withdrawal of surface water, including groundwater in connection with surface waters. Curtail unauthorized withdrawals.
SALMON.9	State of Washington, LCFRB, CC	Build institutional capacity for agencies and organizations to undertake protection and restoration projects
SALMON.10	LCFRB, DOE, DFW, NOAA, USFWS, ACOE, BPA	Increase available funding for projects that implement measures and addresses underlying threats, including noxious weed control
SALMON.12	Clark CD, Clark County, Vancouver.	Utilize a combination of public outreach/education, incentives, and authority to positively influence landowner behaviors toward land stewardship in practices not covered by land use regulations
SALMON.13	Clark County, Vancouver, Battleground, Brush Prairie, Orchards	Apply land use code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
SALMON.14	FEMA	Update floodplain maps using Best Available Science

15 Washougal River Subbasin

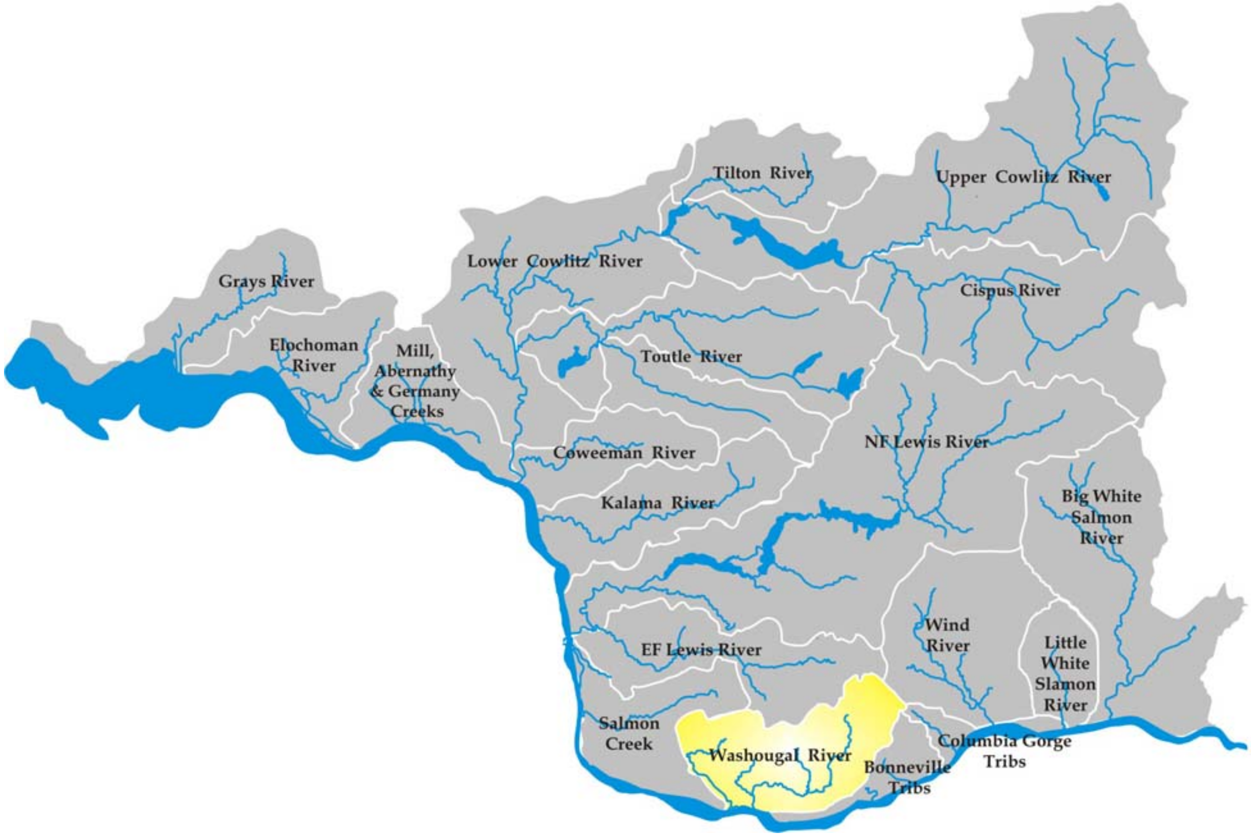


Figure 15-1. Location of the Washougal Subbasin within the Lower Columbia River Basin.

15.1 Basin Overview

The Washougal River Subbasin comprises approximately 240 square miles, two-thirds of which is located in Skamania County and one-third in Clark County. The river enters the Columbia at RM 121, near the town of Camas, Washington. Principal tributaries include the West Fork, Little Washougal River, and Lacamas Creek. The subbasin is part of WRIA 28.

The Washougal Subbasin will play a key role in the recovery of salmon and steelhead. The subbasin has historically supported populations of fall Chinook, summer and winter steelhead, chum, and coho. Today, Chinook, steelhead and chum are listed as threatened under the ESA. Coho salmon are a candidate for listing. The health or viability of these populations is currently low to moderate, except for coho, which is very low. Recovery goals call for restoring Chinook, steelhead, and chum population to a high or better viability level. This level will provide for a 95% or better probability of populations survival over 100 years. Coho will be restored to a moderate level of viability or a 75 to 95% probability of persistence over 100 years. Other fish species of interest are Pacific lamprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

Washougal salmon and steelhead are affected by a variety of in-basin and out-of basin factors including stream, Columbia River mainstem, estuary, and ocean habitat conditions; harvest; hatcheries; and ecological relationships with other species. Analysis has demonstrated that recovery cannot be achieved by addressing only one limiting factor. Recovery will require action to reduce or eliminate all manageable factors or threats. The deterioration of habitat conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonids within the Columbia Basin. Direct harvest of listed salmon and steelhead is prohibited but sport and commercial fisheries focusing on hatchery fish and other healthy wild populations, primarily in the mainstem Columbia and ocean, incidentally affect ESA-listed Washougal fish. Skamania and Washougal hatcheries operate within the basin with the potential to both adversely affect wild salmon and steelhead populations and to assist in recovery efforts. Key ecological interactions of concern include effects of nonnative species; nutrient inputs from salmon carcasses; and predation by species affected by development including Caspian terns, northern pikeminnow, seals, and sea lions. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the Washougal Subbasin.

Nearly all of the lands in upper portions of the Washougal Subbasin (upper mainstem and upper reaches of the West Fork, Little Washougal, and Dougan Creek) are forested. Stream habitat in these areas is particularly important for summer steelhead spawning. However, watershed processes in the upper areas of subbasin also affect salmon and steelhead habitat in the lower areas of the basin through influence on flows, water temperature, and sediment transport. Principal landowners in the upper subbasin are the U.S. Forest Service, the Washington Department of Natural Resources, and industrial forest companies. Landscape conditions in some of these areas are largely intact. Federal and state forest management plans and state forest practice regulations are expected to protect and restore watershed processes and habitat conditions in this area in the intermediate and long-term (10–100 years). Additional active restoration efforts will help to achieve improved habitat conditions in the near-term.

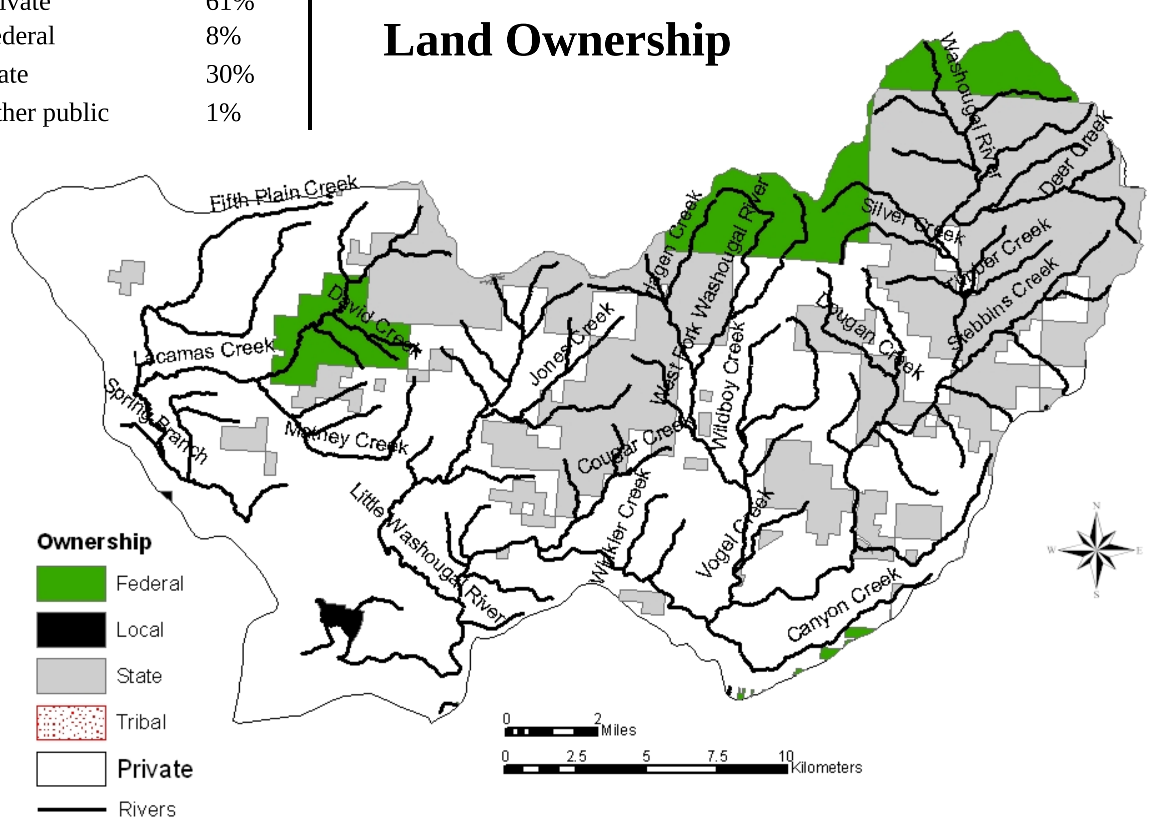
The middle portion of the subbasin (middle mainstem and the lower reaches of the West Fork and Little Washougal) is a mixed-use area comprised largely of rural residential development, small scale or noncommercial agriculture, and non-industrial forestlands. These areas are important for summer and winter steelhead spawning and rearing, chum spawning, and Chinook spawning and rearing. Watershed functions and habitat conditions have been altered by clearing of riparian zones, filling of wetland areas, isolation of side channel habitat, bank hardening, increased sediment inputs, and stormwater runoff. Degraded watershed processes in the middle subbasin impact habitat conditions in the lower subbasin.

The lower area of the subbasin is characterized by industrial, urban, and suburban land uses. Watershed functions and habitat conditions have been significantly compromised by these high intensity uses. Although some riparian areas in the lower reaches near the mouth have been protected through public ownership, destruction of riparian habitat, bank hardening, increased stormwater runoff, and channelization are major limiting factors. Lacamas Creek, the lowest tributary, has been dammed to provide water for industrial use. The reservoir and the creek’s heavily altered upper watershed have resulted in increased temperatures and decreased water quality. The lower subbasin is particularly important for chum spawning. It is also important for steelhead and Chinook rearing.

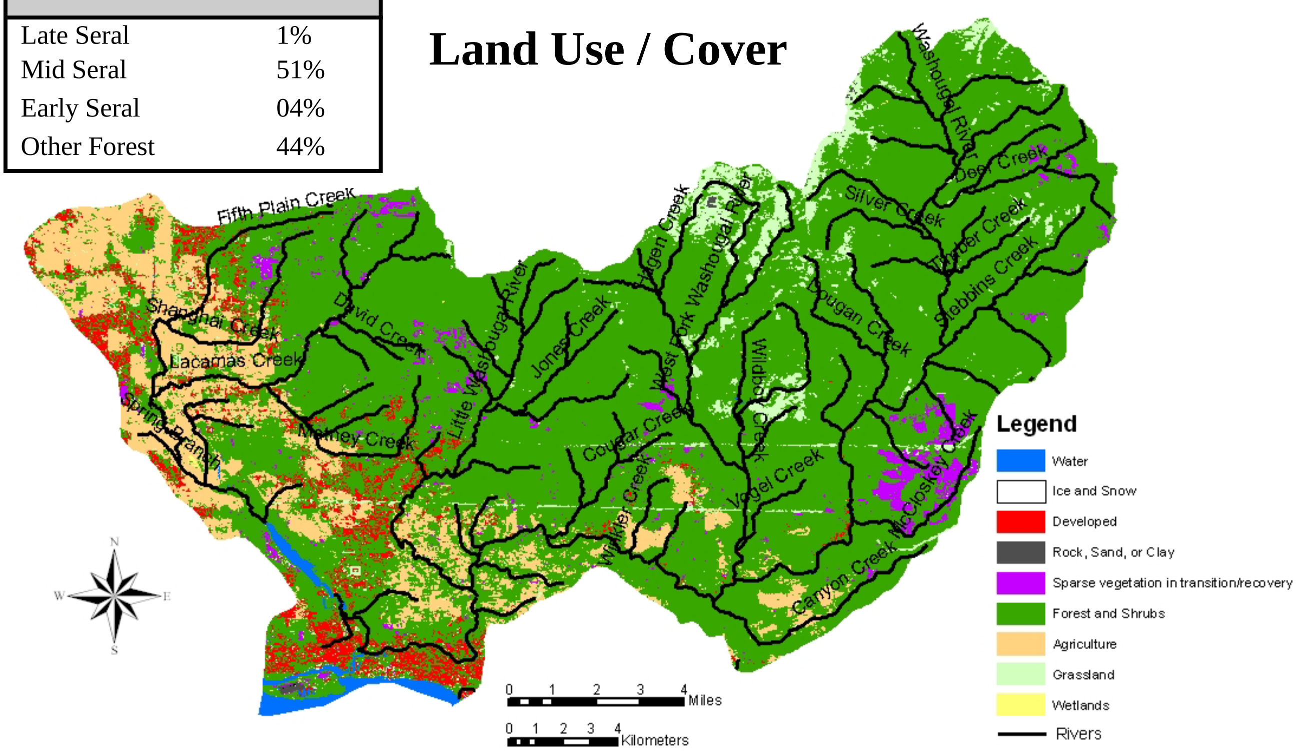
Between 2000 and 2020, human population in the Washougal Subbasin is expected to increase from 36,600 to 92,800 (LCFRB 2001). These substantial population increases reflect the eastward expansion of the Vancouver metropolitan area. Most development is expected to occur in the Lacamas, Little Washougal, and lower mainstem basins. This growth will place increased pressure on the middle mainstem of the Washougal and the Little Washougal watershed. Conversions of forest and agricultural lands to residential use within stream valley bottom areas have the potential to seriously degrade watershed processes and habitat conditions.

Current Clark and Skamania County land use regulations will provide moderate habitat protection. Clark County is pursuing an ESA Section 4(d) limit by developing additional protective measures. Both counties will need to adopt measures to protect watershed processes and habitat from degradation resulting from land use conversions. Land use regulations for the cities of Camas and Washougal provide only limited protection and will require strengthening. While improved land use regulation can make a significant contribution to habitat protection, it will not and, in all likelihood, cannot effectively prevent any further deterioration of habitat conditions. Seemingly minor unregulated activities such as application of fertilizers and pesticides and removal of riparian vegetation can cause incremental deterioration of habitat conditions. These impacts must be addressed through public information and outreach efforts that promote appropriate practices and landowner incentive programs. A closure of the basin to further surface water withdrawals has also been proposed based on low and high flow targets identified in Watershed planning efforts. However, existing withdrawals in two tributaries of the Little Washougal significantly reduce available flow during low flow periods. Active efforts to restore riparian habitat, side channels, and instream conditions will be required to compensate for development in the lower and middle portion of the subbasin that will likely preclude the full restoration of watershed processes.

Land Ownership	
Private	61%
Federal	8%
State	30%
Other public	1%



Vegetation Composition	
Late Seral	1%
Mid Seral	51%
Early Seral	04%
Other Forest	44%



15.2 Species of Interest

Focal salmonid species in the Washougal Basin include fall Chinook, winter steelhead, summer steelhead, chum, and coho. The health or viability of these populations is currently low to medium, except for coho, which is very low. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Other species of interest in the Washougal Subbasin include coastal cutthroat trout and Pacific lamprey. Regional objectives for these species are described in Volume I, Chapter 6. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for these other species. Cutthroat will benefit from improvements in stream habitat conditions for salmonids. Lamprey are also expected to benefit from habitat improvements in the estuary, Columbia River mainstem, and Washougal subbasin although specific spawning and rearing habitat requirements of lamprey are not well known.

Table 15-1. Current viability status of Washougal 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+	2,000-4,500	High	4,000-5,800
Winter Steelhead	Threatened	Yes	Low+	100-800	Medium	600-1,000
Summer Steelhead	Threatened	Yes	Low+	100-200	High+	500-900
Chum	Threatened	No	Low	<1,000	High+	1,100-9,400
Coho	Candidate	Yes	Very Low	unknown	Medium	unknown

Fall Chinook– The historical Washougal adult population is estimated from 3,000-9,000 fish. The current natural spawning number is 2,000-4,500, but the majority of the returns are hatchery fall Chinook released as juveniles from the Washougal Hatchery. Natural spawning occurs primarily in four miles of the mainstem Washougal from Salmon Falls Bridge (RM 15) to the Fish and Wildlife access area. A ladder was constructed at Salmon Falls in the late 1950s providing spawning access up to Dougan Falls (RM 21). Spawning upstream of Salmon Falls can be significant in years with early fall rain. Juvenile rearing occurs near and downstream of the spawning areas. Juveniles migrate from the Washougal in the spring and early summer of their first year.

Winter Steelhead– The historical Washougal adult population is estimated from 2,000-9,500 fish. Current natural spawning returns range from 100-800 fish. In-breeding with Skamania Hatchery produced steelhead is thought to be low because of differences in spawn timing. Spawning occurs primarily in the mainstem Washougal upstream to Dougan Falls, the Little Washougal, North Fork Washougal and tributaries. Spawning time is early 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 Washougal

Summer Steelhead– The historical Washougal adult population is estimated from 2,000-8,000 fish. Current natural spawning returns range from 100-200 fish. In-breeding with Skamania Hatchery produced steelhead is thought to be low because of differences in spawn timing. Spawning occurs throughout the Washougal Basin, extending to the mainstem Washougal and tributaries upstream of Dougan Falls, the Little Washougal, and the North Fork Washougal. Spawn timing is generally from early 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 Washougal.

Chum– The historical Washougal adult population is estimated from 25,000-40,000. Current natural spawning is less than 100 fish in the Washougal and less than 1,000 fish in the Washougal area, including the mainstem Columbia and tributaries near I-205 Bridge. Spawning occurs in the lower reaches of the mainstem Washougal, Little Washougal, and Lacamas Creek. A potentially related population spawns in the mainstem Columbia and tributaries near the I-205 Bridge. Spawning occurs from late November through December. Natural spawning chum in the Washougal are all naturally produced as no hatchery chum are released in the area. Juveniles rear in the lower reaches for a short period in the early spring and quickly migrate to the Columbia.

Coho– The historical Washougal adult population is estimated from 5,000-35,000, with the majority of returns late stock which spawn from late November to March. Some early stock coho were also historically present with spawning occurring primarily in early to mid November. Current returns are unknown but assumed to be very low. A number of hatchery produced fish spawn naturally. Natural spawning can occur in most areas of the basin upstream to Dougan Falls, but the principal spawning area is the Little Washougal River. Juvenile rearing occurs upstream and downstream of spawning areas. Juveniles rear for a full year in the Washougal Basin before migrating as yearlings in the spring.

Coastal cutthroat– Coastal cutthroat abundance in the Washougal has not been quantified but the population is considered depressed. Cutthroat trout have been observed throughout the basin upstream to Dougan Falls and in Lacamas Lake. Anadromous, fluvial, and resident forms of cutthroat trout are found in the basin. Anadromous cutthroat enter the Washougal 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 1999.

Pacific lamprey.– Information on lamprey abundance is limited and does not exist for the Washougal basin population. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have declined in the Washougal Basin also. 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 Washougal Basin. Juveniles rear in freshwater up to seven years before migrating to the ocean.

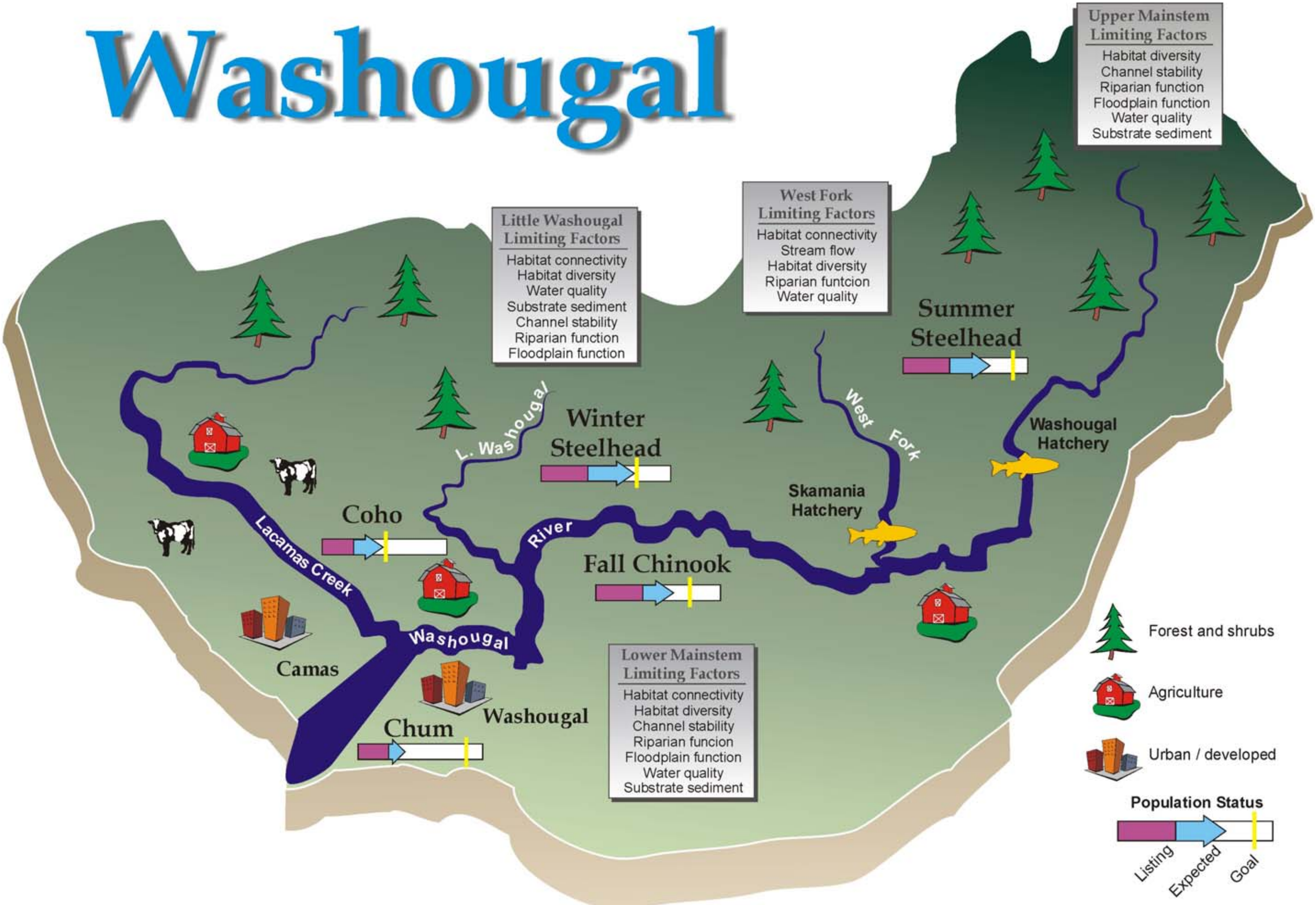


Figure 15-2. Summary of habitat limiting factors, population status, expected population improvement trend with existing programs, and biological objectives depicted for the Washougal Subbasin.

15.3 Potentially Manageable Impacts

Stream habitat, estuary/mainstem habitat, harvest, hatchery and predation effects have all contributed to reduced salmonid productivity, numbers, and population viability in the Washougal subbasin. The pie charts below represent the relative order of magnitude of quantifiable effects for each of these factors for each focal species. The preferred recovery scenario targets an equivalent reduction in each impact factor in proportion to the magnitude of the effect. Population-specific targets are discussed in further detail in Volume I, Chapter 6.

- Loss of tributary habitat quality and quantity is an important impact for all species, particularly for chum and steelhead. Loss of estuary habitat quality and quantity is also important, particularly for chum.
- Harvest has a large relative impact on fall Chinook and moderate impacts on coho. Harvest effects on winter and summer steelhead and chum are minimal.
- Hatchery impacts include domestication of natural populations (most applicable to Chinook and coho) and ecological interactions which can impact all species to variable degrees.
- Predation impacts of northern pikeminnow, Caspian terns, and marine mammals in the mainstem and estuary are moderate for winter and summer steelhead, but appear to be less important for coho, chum, and fall Chinook.
- Hydrosystem access and passage impacts are relatively minor for all species.

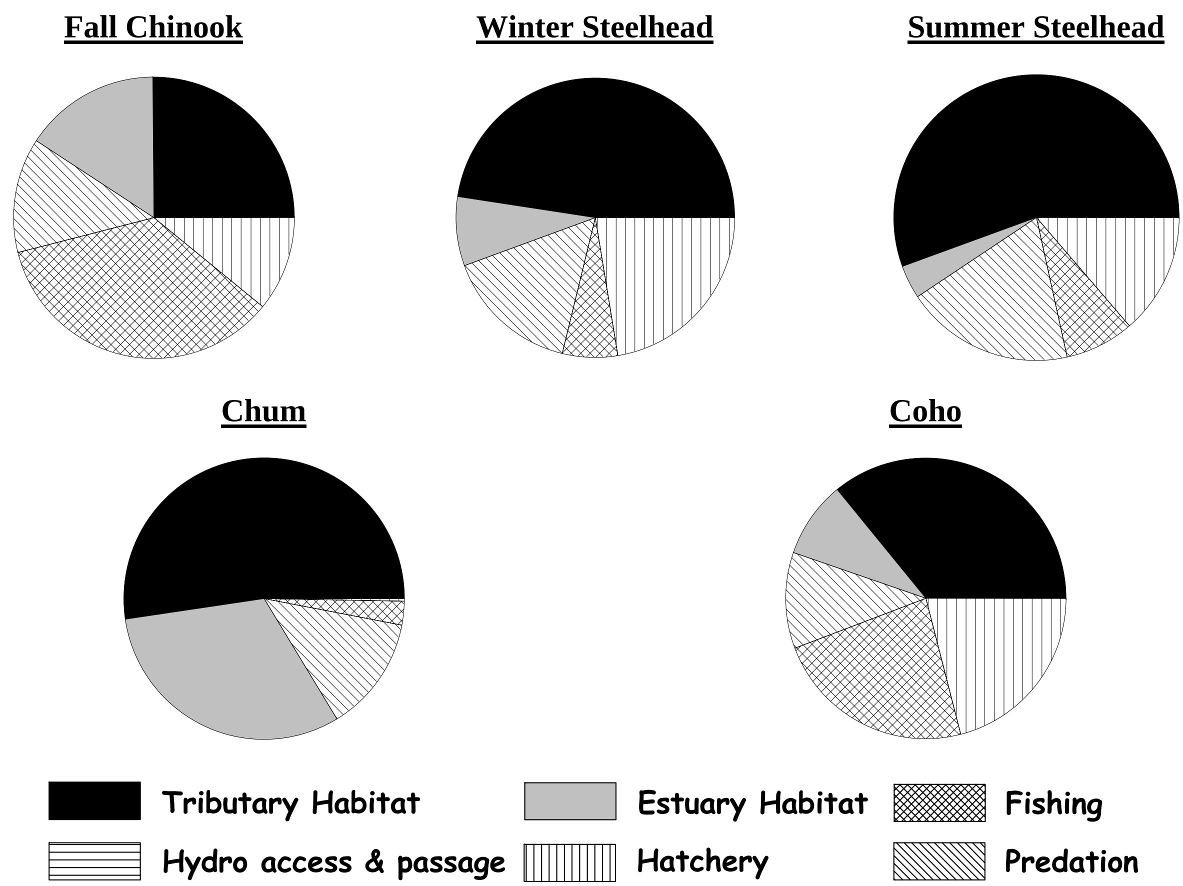


Figure 15-3. Relative contribution of potentially manageable impacts for Washougal populations.

15.4 Limiting Factors, Threats, and Measures

15.4.1 Hydropower Operation and Configuration

There are no hydro-electric dams in the Washougal River Basin. However, Washougal species are affected by mainstem Columbia hydro operations and flow regimes which affect habitat in migration corridors and in the estuary. These factors are described in further detail in Volume I, Chapter 4. Mainstem hydro factors and threats are addressed by regional strategies and measures identified in Volume I, Chapter 7.

15.4.2 Harvest

Most harvest of wild Washougal salmon and steelhead is incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. Harvest mortality is very low for chum and steelhead, but is more significant for fall Chinook. Washougal fall Chinook are harvested in ocean and Columbia River commercial and sport fisheries as well as in-basin sport fisheries. Harvest is controlled by an ESA harvest limit associated with Coweeman natural fall Chinook. No harvest of chum occurs in ocean fisheries, there are no directed Columbia River or Washougal Basin chum fisheries and retention of chum is prohibited in Columbia River and Washougal sport fisheries. Chum are impacted incidental to fisheries directed at coho and winter steelhead. Harvest of Washougal 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 Washougal Basin. Wild coho impacts are limited by fishery management to retain marked hatchery fish and release unmarked wild fish. 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.

Measures 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. The regional measures 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 Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest measures with significant application to Washougal Subbasin populations are summarized in the following table:

Table 15-2. Regional harvest measures from Volume I, Chapter 7 with significant application to Washougal Subbasin populations.

Measure	Description	Comments
F.M17	Monitor chum handle rate in winter steelhead and late coho tributary sport fisheries.	State agencies would include chum incidental handle assessments as part of their annual tributary sport fishery sampling plan.
F.M13	Develop a mass marking plan for hatchery tule Chinook for tributary harvest management and for naturally-spawning escapement monitoring.	Provides the opportunity to implement selective tributary sport fishing regulations in the Washougal 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.M18	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	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.M19	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	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.M24	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	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.

15.4.3 Hatcheries

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

There are two hatcheries operating in the Washougal Basin. Skamania Hatchery (since 1956) produces winter and summer steelhead for harvest opportunity. The Skamania Hatchery produced steelhead are released into several lower Columbia basins as well as the Washougal. Skamania Hatchery steelhead are a composite stock and are genetically different from the naturally-produced steelhead in the Washougal. 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 Washougal Hatchery (since 1958) produces fall Chinook for harvest opportunity and coho for harvest and for transfer to the Klickitat River as per an agreement with the Columbia River treaty Indian tribes. The Washougal Hatchery is also utilized for a chum enhancement program to assist in the rebuilding of the lower Gorge chum populations. The main hatchery threats are domestication of natural fall Chinook and coho and potential ecological interactions between hatchery and natural juvenile salmon.

Table 15-3. Washougal Basin hatchery production.

Hatchery	Release Location	Fall Chinook	Coho	Chum	Winter Steelhead	Summer Steelhead
Washougal	Washougal	4,000,000	500,000			
	Other basins		2,500,000	100,000		
Skamania	Washougal				60,000	60,000
	Other basins				130,000	224,000

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 Washougal 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 Technical Foundation, Volume IV). Regional hatchery measures identified in Volume I, Chapter 7 with potential applications at facilities within the Washougal subbasin are summarized in Table 15-4.

Table 15-4. Regional hatchery measures from Volume I, Chapter 7 with potential implementation actions in the Washougal Subbasin.

Measure	Description	Comments
H.M2 H.M13 H.M38	Integrated hatchery and wild program for fall Chinook. Evaluate potential for integration of a late stock coho program.	Assures fitness of the natural produced fish which will improve population productivity. Integrated programs would be developed specific to the Washougal populations in the BRAP procedure. Coho program integration opportunity may be limited by legal obligations to rear coho for release in the Klickitat River.
H.M14	Use only local broodstock in the fall Chinook hatchery program.	This measure will preclude transfer of outside basin stock into the Washougal hatchery program. This will enable a hatchery and wild integrated program to be developed with fall Chinook that are ecologically adapted to the Washougal Basin.
H.M15 H.M32 H.M40	Juvenile release strategies to minimize interactions with naturally-spawning fish.	Release strategies are aimed at reducing or avoiding interactions with wild steelhead, fall Chinook, coho by release timing and release location strategies.
H.M7 H.M17 H.M34 H.M41	Mark hatchery steelhead, coho, fall Chinook with an adipose fin-clip for identification and selective harvest.	Marking hatchery fish allows for identification of hatchery fish in the natural spawning grounds and at collection facilities which enables accurate accounting of wild fish. Marking also enables selective fisheries to retain hatchery fish and release wild fish.
H.M24 H.M36	Hatchery program utilized for supplementation and enhancement of wild chum and coho populations.	The Washougal Hatchery is currently used for supplementation and risk management of lower Gorge chum populations. This program could be potentially expanded to include more areas and populations. Supplementation programs for Washougal natural coho could be developed with appropriate brood stock in the Washougal Hatchery.
H.M8	Adaptively manage hatchery programs to further protect and enhance natural populations and improve operational efficiencies.	Appropriate research, monitoring, and evaluation programs along with guidance from regional hatchery evaluations will be utilized to improve the survival and contribution of hatchery fish, reduce impacts to natural fish, and increase benefits to natural fish.
H.M2 H.M6	Evaluate Washougal and Skamania hatcheries facility operations.	Evaluate Washougal and Skamania hatcheries facility operations.

15.4.4 Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Washougal salmon and steelhead are affected throughout their lifecycle by ecological interactions with non-native species, food web components, and predators. Interactions are similar for Washougal populations to those of most other subbasin salmonid populations. These interactions are described in further detail in Volume I, Chapter 4. Ecological Interactions are addressed by regional strategies and measures identified in Volume I, Chapter 7.

15.4.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. 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 are similar for Washougal populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook than spring Chinook, steelhead, and coho. These interactions are described in further detail in Volume I, Chapter 4. Estuary and mainstem effects on Washougal salmon and steelhead populations are addressed by regional strategies and measures identified in Volume I, Chapter 7 and the Columbia Mainstem and Estuary Subbasin sections of this chapter.

15.4.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity 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 Washougal Subbasin have the greatest impact on the health and viability of salmon and steelhead relative to the other limiting factor and threats discussed in this chapter.

Subwatersheds, reaches, and habitat attributes have been prioritized for protection and/or restoration based on the plan’s biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Priority areas for habitat protection and restoration are shown in Figure 15-4. A summary of the primary habitat limiting factors and threats are presented in Table 15-6. Habitat strategies and measures and related information are presented in Table 15-7. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 15-5. Reach- and subwatershed-scale limiting factors generated from the technical assessment are included in Table 15-5. Details on species-specific spatial priorities and limiting factors at the subbasin level may be found in Volume II of the Technical Foundation. A description of the methodology used to generate composite (multi-species) reach and subwatershed priorities can be found in the introduction to this volume of the recovery plan.

The areas with the greatest current or potential contribution to focal salmonid population health and productivity are listed below. Tier 1 and 2 reaches within these priority areas are included in the list. The habitat limiting factors, threats, and measures included in this chapter focus primarily on the priority areas and the Tier 1 and 2 reaches within them. Tier, 3, 4, and non-tiered reaches are considered secondary priority, but in many cases, these lower priority areas will also require restoration and preservation actions in order to achieve recovery objectives. Watershed process measures generally focus on the entire basin as opposed to being limited only to high priority areas because conditions in high priority areas are often influenced by cumulative watershed effects. High priority areas and reaches in the Washougal Basin include the following:

- Lower mainstem Washougal - Washougal reach 1-tidal to Washougal reach 3
- Middle mainstem Washougal – Washougal 4 - 9
- Upper mainstem Washougal - Washougal 11 - 17
- West Fork Washougal – WF Washougal 1-3; Wildboy Creek 1; Texas Creek
- Little Washougal - Little Washougal 1A-1B, 2-3

The following paragraphs provide a brief overview of each of these priority areas, including species most affected, land-use threats, and the general type of measures that will be necessary for recovery. Additional detail can be found in the tables and figures that follow.

While reach level habitat conditions often result from local factors, they are also affected or shaped by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input and large woody debris recruitment are often affected by or result from upstream conditions and degraded watershed processes. Access to key reaches may also be affected by barriers that occur downstream of a reach. Accordingly, restoration of a priority reach may require action outside the targeted reach. The IWA analysis was used to identify potential upstream watershed areas that could influence reach level habitat attributes. EDT was used to allow a relative comparison of reaches and habitat attributes within a reach.

Urban and suburban development in the lower Washougal mainstem has significantly altered and degraded watershed processes and habitat conditions. These areas are critically important for chum and fall Chinook spawning and fry colonization. The restoration and protection of the Washougal reach flowing through the town of Washougal provides high potential for fall Chinook. The tidally influenced reaches are the most important for chum. Riparian and floodplain functions are degraded in these areas due to streamside development and channelization features associated with residential/urban development, agriculture, and roadways. Needed habitat measures in the lower mainstem will involve protection of remaining functional habitat, riparian restoration, re-establishing connections between the stream channel and floodplain areas, storm water controls, and measures that address the potential impacts from expanding urban and suburban development around Washougal and Camas.

The middle mainstem is important for fall Chinook and coho spawning, incubation, and fry colonization. It is also used by steelhead for rearing. As the human population continues to grow in Clark County, this mixed-use area of rural residents and small farms and woodlands is likely to experience conversion to more intensive residential use. Riparian areas have been degraded through streamside development and roads. Sediments, lack of habitat diversity, and temperature are the most significant limiting factors in this area. County land use protections will be necessary to protect habitat in these areas should lands be converted from forest to residential.

Upper mainstem reaches are important summer and winter rearing areas for summer steelhead. The habitat conditions and watershed processes associated with these reaches are influenced primarily by actions on public and private timberland. While these lands have relatively intact landscape conditions, sediment supply processes are thought to be moderately impaired due to the prevalence of forest roads on unstable slopes. The potential for effective passive restoration is high through upgrading or obliterating roads and improving drainage systems. Policies to enable such actions are underway on private, state, and federal forest lands. Restoration of riparian function is also important. Preservation of existing functional conditions is the primary emphasis on these lands. Forest management policy currently being implemented by the USFS and WA DNR, as well as forest practice regulations for private lands, are expected to provide continuing protections of watershed processes.

The West Fork Washougal is important for summer steelhead spawning and rearing. Winter steelhead also make limited use of these reaches. Most of the basin is in private or state forestland with a small amount of crop and pasture land in the lower portion of the basin. Portions of the headwaters (i.e., Hagen Creek basin) have intact forest conditions, while most other areas have been extensively harvested and heavily roaded. Effective habitat measures in the West Fork will involve watershed process restoration and preservation associated with forest practices, much of which is addressed in current forest practices policy and regulations. An additional habitat concern in the West Fork Basin is a dam on Wildboy Creek, which blocks several miles of potentially productive habitat.

The Little Washougal Basin provides important habitat for winter steelhead adult holding, spawning, and rearing. Most other species (especially coho) also use these reaches. The basin is mixed use and is comprised mostly of private and state forest land with agricultural uses and rural residential development within the lower river valley. The City of Camas water withdrawals from Jones and Boulder creeks create an increased risk of critically low summer flows. Effective habitat measures in the Little Washougal will involve riparian restoration, re-establishing connections between the stream channel and floodplains, growth management, water withdrawal management, and watershed process restoration and preservation on forest lands.

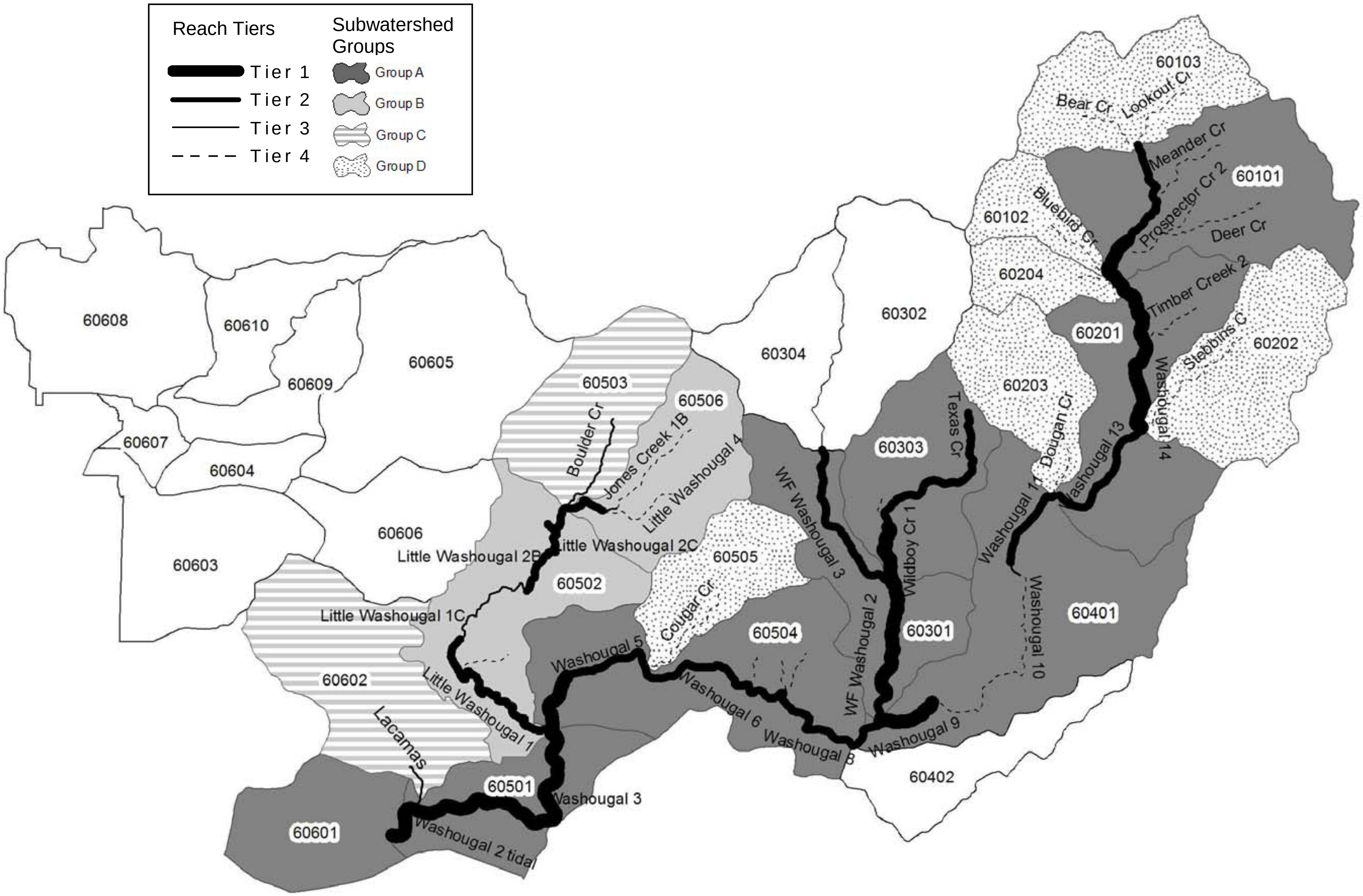


Figure 15-4. Reach tiers and subwatershed groups in the Washougal River Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities 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.

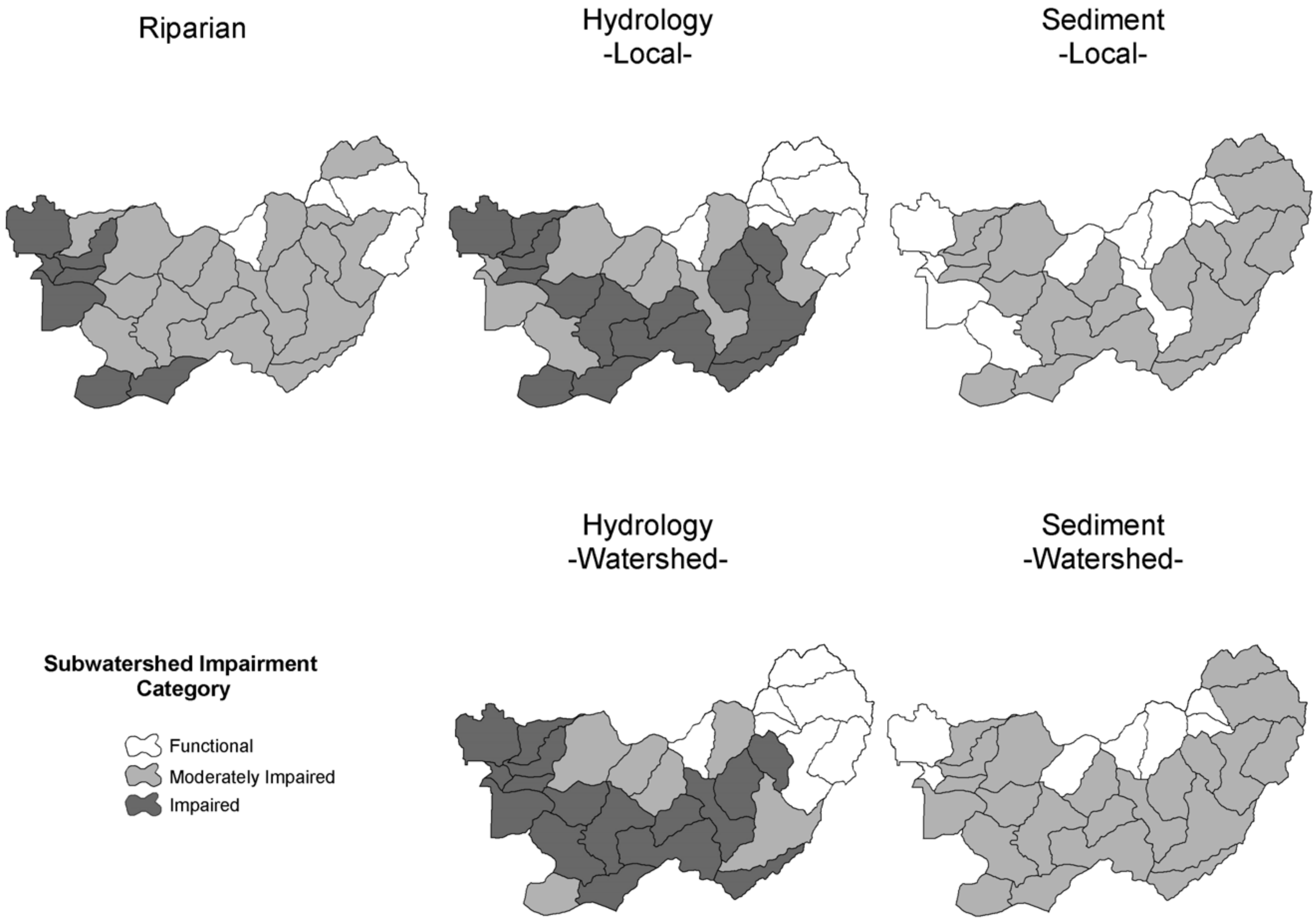


Figure 15-5. IWA subwatershed impairment ratings by category for the Washougal Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 15-5. 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) Hydrology	Watershed processes (local) Sediment	Watershed processes (local) Riparian	Watershed processes (watershed) Hydrology	Watershed processes (watershed) Sediment
A	60101	Deer Cr Meander Cr Prospector Cr 1 Prospector Cr 2 Prospector Creek 1B Prospector Creek Culv1 Washougal 16 Washougal 17 Washougal 18 Washougal 19	StS	Washougal 16 Washougal 17	summer rearing winter rearing	habitat diversiy flow	P	F	M	F	F	M
			Coho									
	60201	Dougan Falls Timber Cr Timber Creek 2 Timber Creek Culv1 Washougal 12 Washougal 13 Washougal 14 Washougal 15	StS	Washougal 14 Washougal 15	summer rearing winter rearing	habitat diversiy flow	P	M	M	M	F	M
			Coho									
	60301	WF Washougal 1 WF Washougal 1B WF Washougal 2 WF Washougal 3 WF Washougal Falls1 WF Washougal Weir	StS	WF Washougal 1B WF Washougal 2	egg incubation summer rearing winter rearing	habitat diversiy temperature flow sediment pathogens	PR	M	F	M	I	M
			StW	WF Washougal 1	egg incubation fry colonization summer rearing	temperature sediment	R					
	60303	Texas Cr Wildboy Cr 1 Wildboy Cr 2	StS	Wildboy Cr 1	egg incubation summer rearing winter rearing	none	P	I	M	M	I	M
	60501	Washougal 1 tidal Washougal 2 tidal Washougal 3	StS					I	M	I	I	M
			Chum	Washougal 1 tidal Washougal 2 tidal	spawning egg incubation fry colonization adult holding	none	R					
			ChF	Washougal 3	spawning egg incubation fry colonization	sediment	PR					
			StW									
			Coho	Washougal 3	egg incubation summer rearing winter rearing	habitat diversity temperature sediment	R					
	60601	Washougal 1 tidal	StS					I	M	I	M	M
			Chum	Washougal 1 tidal	spawning egg incubation fry colonization adult holding	none	R					
			ChF									
			StW									
			Coho									
	60401	Salmon Falls Washougal 10 Washougal 10A Washougal 11 Washougal 9 Washougal Falls1	StS					I	M	M	M	M
			ChF	Washougal 9	spawning egg incubation fry colonization	sediment	P					
			StW									
			Coho	Washougal 9	egg incubation summer rearing winter rearing	habitat diversity temperature sediment	R					
	60504	RB trib 1A RB trib 1B RB trib 1C RB trib 2 RB trib1 Barrier 1 Washougal 4 Washougal 5 Washougal 6 Washougal 7 Washougal 8 Winkler Cr	StS					I	M	M	I	M
			ChF	Washougal 4	spawning egg incubation fry colonization	none	PR					
			StW	Washougal 5	egg incubation fry colonization summer rearing winter rearing	none	R					
			Coho	Washougal 4 Washougal 8	egg incubation fry colonization summer rearing winter rearing	channel stability habitat diversity sediment	R					

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	60502	LB tribA (28.0211)	StS					I	M	M	I	M
		Little Washougal 1 Little Washougal 1B Little Washougal 1C Little Washougal 2 Little Washougal 2 Culv1 Little Washougal 2B	StW	Little Washougal 1 Little Washougal 1B Little Washougal 2 Little Washougal 2B Little Washougal 2C Little Washougal 2D	egg incubation fry colonization summer rearing winter rearing adult holding	temperature sediment key habitat quantity	PR					
		Little Washougal 2C Little Washougal 2D Little Washougal 2E Little Washougal Culv1 Little Washougal Culv2	Coho	Little Washougal 2C Little Washougal 2E	egg incubation fry colonization summer rearing winter rearing	channel stability habitat diversity temperature sediment key habitat quantity	R					
	60506	Jones Cr Jones Creek 1B Jones Creek Culv1 Little Washougal 3	StW	Little Washougal 3	egg incubation fry colonization summer rearing winter rearing	none	PR	M	M	M	M	M
		Little Washougal 4	Coho									
C	60503	Boulder Cr	StW					M	F	M	M	F
		Boulder Creek 1B Boulder Creek 1C Boulder Creek Culv1 Boulder Creek Falls1	Coho									
	60602	Lacamas	StW					M	F	M	I	M
			Coho									
D	60102	Bluebird Cr	StS					F	F	F	F	F
			Coho									
	60103	Bear Cr Degraded Lookout Cr Washougal 20	StS					F	M	M	F	M
	60202	Stebbins C	StS					F	M	F	F	M
	60203	Dougan Cr Dougan Creek 1B Dougan Creek Culv1	StS					I	M	M	I	M
	60204	Silver Cr	StS					F	F	M	F	F
	60505	Cougar Cr	StW					I	M	M	I	M

Table 15-6. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the lower mainstem (LM), middle mainstem (MM), upper mainstem (UM), West Fork (WF), and Little Washougal (LW) portions of the Washougal Subbasin. 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	WF	LW
Habitat connectivity					
Blockages to off-channel habitats	✓				
Blockages to stream habitats due to structures				✓	
Habitat diversity					
Lack of stable instream woody debris	✓	✓	✓	✓	✓
Altered habitat unit composition	✓	✓	✓	✓	✓
Loss of off-channel 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	✓	✓	✓	✓	✓
Excessive turbidity	✓				
Bacteria					✓
Substrate and sediment					
Lack of adequate spawning substrate	✓	✓	✓		
Excessive fine sediment	✓	✓		✓	✓

Threats	LM	MM	UM	WF	LW
Agriculture/grazing					
Clearing of vegetation	✓	✓			✓
Riparian grazing	✓	✓			✓
Floodplain filling	✓	✓			✓
Urban and rural development					
Clearing of vegetation	✓	✓			✓
Floodplain filling	✓	✓			✓
Increased impervious surfaces	✓	✓			✓
Increased drainage network	✓	✓			✓
Roads – riparian/floodplain impacts	✓	✓			✓
Leaking septic systems					✓
Forest practices					
Timber harvests: sediment supply impacts	✓	✓	✓	✓	✓
Timber harvests: impacts to runoff	✓	✓		✓	✓
Riparian harvests			✓	✓	✓
Forest roads: impacts to sediment supply	✓	✓	✓	✓	✓
Forest roads: impacts to runoff	✓	✓		✓	✓
Forest roads: riparian/floodplain impacts				✓	✓
Catastrophic wildfire (historical)			✓	✓	✓
Splash-dam logging (historical)		✓	✓		
Channel manipulations					
Bank hardening	✓	✓			✓
Channel straightening	✓	✓			✓
Artificial confinement	✓	✓			✓
Passage obstruction (dams)				✓	
Water withdrawals					
Livestock, irrigation, or municipal uses	✓	✓			✓

Table 15-7. Habitat measures in priority areas, with reference to limiting factors addressed, threats addressed, target species, and estimated time until benefits would be realized (time). Tier 1 and 2 reaches, or other areas of known priority, are listed under the location column for some measures (i.e., stream corridor measures). Reaches not included in the table (Tier 3, 4, and non-tiered reaches) are considered secondary priority.

Priority Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
1. Protect and restore floodplain function and channel migration processes ***A. Set back, breach, or remove artificial channel confinement structures***					
Lower mainstem Washougal 1 tidal, 2 tidal, 3 ***Little Washougal*** Little Washougal 1 ***Middle mainstem*** Washougal 4-9	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes	• Floodplain filling • Channel straightening • Artificial confinement	• chum • Coho • Winter steelhead	2-15 years	High potential benefit due to improvements in many limiting factors. This passive restoration approach can allow channel to restore naturally once confinement structures are removed. There are challenges with implementation due to existing infrastructure already in place, private property, potential flood risk to property, large expense, and no regulatory mechanisms in place for this type of restoration.
2. Protect and restore off-channel and side-channel habitats ***A. Restore historical off-channel and side-channel habitats where they have been eliminated*** ***B. Provide access to blocked off-channel habitats*** ***C. Create new off-channel or side-channel habitats (i.e. spawning channels)***					
Lower mainstem Washougal 1 tidal, 2 tidal, 3 ***Little Washougal*** Little Washougal 1 ***Middle mainstem*** Washougal 4-9	• Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats • Altered habitat unit composition	• Artificial confinement • Channel straightening • Floodplain filling	• Chum • Coho	2-15 years	Good potential benefit especially for chum, which have lost a significant portion of historically available off-channel habitat for spawning. Potential benefit is limited by moderate probability of success with creation of new habitats. There are challenges with implementation due to existing infrastructure already in place, private property, and large expense. No regulatory mechanisms in place for this type of restoration.
3. Protect and restore riparian function ***A. Reforest riparian zones*** ***B. Allow for the passive restoration of riparian vegetation*** ***C. Livestock exclusion fencing*** ***D. Invasive species eradication*** ***E. Hardwood-to-conifer conversion***					
Lower mainstem Washougal 1 tidal, 2 tidal, 3 ***Little Washougal*** Little Washougal 1, 2C	• Reduced stream canopy cover • Altered stream temperature regime	• Timber harvest – riparian harvests • Riparian grazing • Clearing of	• chum • Coho • Winter steelhead	20-100 years	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. Riparian protections on forest lands are provided for under current

Priority Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
WF Washougal WF Washougal, Wildboy 1 ***Upper mainstem*** Washougal 14-17 ***Middle mainstem*** Washougal 4-9	• Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or noxious species	vegetation due to urban and agricultural uses	• Summer steelhead		harvest policy. Riparian restoration projects are relatively inexpensive and are often supported by landowners. The specified stream reaches are the highest priority for riparian measures, however, riparian restoration and preservation should occur throughout the basin since riparian conditions affect downstream reaches. Use IWA riparian ratings to help identify restoration and preservation opportunities.
4. Protect and restore fish access to channel habitats ***A. Wildboy Creek Dam*** ***B. Culvert barriers throughout basin***					
Wildboy Creek Wildboy Creek Dam ***Culvert barriers throughout basin***	• Blockages to channel habitat	• Passage obstruction	• Summer steelhead	2-5 years	Moderate potential benefit because of marginal habitat available above blockage. There are challenges with implementation due to no regulatory mechanism to require passage and large expense.
5. Protect and restore natural sediment supply processes ***A. Address forest road related sources*** ***B. Address timber harvest related sources*** ***C. Address agricultural sources***					
Entire basin	• Excessive fine sediment • Excessive turbidity • Embedded substrates	• Timber harvest – impacts to sediment supply • Forest roads – impacts to sediment supply • Agricultural practices – impacts to sediment supply	• All species	5-50 years	High potential benefit due to sediment effects on egg incubation and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. There are challenges with implementation on agricultural lands due to few sediment-focused regulatory requirements for agricultural lands. Use IWA impairment ratings to identify restoration and preservation opportunities.
6. Protect and restore runoff processes ***A. Address forest road impacts*** ***B. Address timber harvest impacts*** ***C. Limit additional watershed imperviousness*** ***D. Manage stormwater runoff***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Timber harvest – impacts to runoff • Forest roads –	• All species	5-50 years	High potential benefit due to flow effects on habitat formation, redd scour, and early rearing. Improvements are expected on timber lands due

Priority Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
		impacts to runoff • Increased impervious surfaces • Increased drainage network (road ditches, storm drains) • Clearing of vegetation			to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. There are challenges associated with addressing runoff issues on developed lands due to continued increase in watershed imperviousness related to development and lack of adequate mitigation. Use IWA impairment ratings to identify restoration and preservation opportunities.
7. Protect and restore instream flows ***A. Water rights closures*** ***B. Purchase or lease existing water rights*** ***C. Relinquishment of existing unused water rights*** ***D. Enforce water withdrawal regulations*** ***E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption***					
Entire basin – with emphasis on Jones and Boulder creeks (Little Washougal Basin)	• Stream flow – altered magnitude, duration, or rate of change of flows	• Diversions/ withdrawals (for livestock, irrigation, or municipal uses)	• All species	Immediate	Instream flow management strategies for the Washougal River basin have been identified as part of Watershed Planning for WRIA 28 (LCFRB 2004). Particular concerns exist with City of Camas municipal withdrawals on Jones and Boulder creeks, tributaries to the Little Washougal River. The presence of illegal water withdrawals may be contributing to low flow problems in some areas. Increased monitoring and enforcement is needed to prevent illegal withdrawals.
8. Protect and restore instream habitat complexity ***A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting*** ***B. Structurally modify stream channels to create suitable habitat types***					
Lower mainstem Washougal 3 ***Little Washougal*** Little Washougal 1, 2C ***WF Washougal*** WF Washougal, Wildboy Cr 1 ***Upper maisntem*** Washougal 14-17 ***Middle mainstem***	• Lack of stable instream woody debris • Altered habitat unit composition	• None (symptom-focused restoration strategy)	• coho • winter steelhead • summer steelhead	2-10 years	Moderate potential benefit due to the high chance of failure. Failure is probable if habitat-forming processes are not also addressed. These projects are relatively expensive for the benefits accrued. Moderate likelihood given the lack of hardship imposed on landowners and the current level of acceptance of these type of projects.

Priority Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
Washougal 4-9					
9. Protect and restore water quality ***A. Restore the natural stream temperature regime*** ***B. Reduce fecal coliform bacteria levels*** ***C. Reduce turbidity sources***					
Entire basin	• Altered stream temperature regime • Bacteria • Excessive turbidity	• Riparian harvests • Riparian grazing • Leaking septic systems	• All species	1-50 years	Primary emphasis for restoration should be placed on stream segments that are listed on the 2004 303(d) list.
10. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development ***A. Plan growth and development to avoid sensitive areas (e.g., wetlands, riparian zones, floodplains, unstable geology)*** ***B. Encourage the use of low-impact development methods and materials*** ***C. Apply mitigation measures to off-set potential impacts***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	Especially important in the heavy growth areas surrounding the Washougal and Camas urban areas. The focus should be on management of land-use conversion and continued development in sensitive areas (e.g., wetlands, stream corridors, unstable slopes). Many critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary mechanisms need to be put in place to restore currently degraded habitats.
11. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection ***A. Purchase properties outright through fee acquisition and manage for resource protection*** ***B. Purchase easements to protect critical areas and to limit potentially harmful uses*** ***C. Lease properties or rights to protect resources for a limited period***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit where other protection measures such as incentives and regulation do not provide adequate protection These programs are under-funded and have low landowner participation.

15.5 Program Gap Analysis

The Washougal Basin's (~240 square miles) headwaters begin in the Gifford Pinchot NF and flow through substantial public and private forestlands; the forests transition to agricultural, residential, and rural lands; gradually these lands give way to suburban and urbanizing uses.

- Approximately 8% or about 19 square miles of the 240 square mile Washougal Basin falls within the Gifford Pinchot National Forest.
- Approximately 72 square miles are public forestlands managed by the Department of Natural Resources.
- Small- and industrial forest lands comprise approximately 12 square miles in the Washougal Basin.
- Current population of the Washougal Basin is approximately 36,600; it is expected to increase to approximately 92,800 by the year 2020.

Protection Programs

Federal Programs

➢ ***U.S. Forest Service Gifford Pinchot National Forest***

- Forest Plan: The Gifford Pinchot NF Forest Plan provides high levels of protection for riparian areas and forest stands within the Washougal Basin. Protection efforts are subject to NOAA Fisheries and U.S. Fish and Wildlife Service ESA Section 7.
  - ✓ Riparian buffers in all areas of the Gifford Pinchot NF include at least 300' setbacks.
  - ✓ Matrix designated lands (~5 sq mi) observe the forest-wide 'no clear cut' policy;
  - ✓ Approximately (14 sq mi) of Administratively Withdrawn Areas are located in the Washougal Basin headwaters.
  - ✓ Gifford Pinchot NF restoration activities within the basin are a low priority forest-wide and restoration needs are low to modest. [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.9A; M.9B]

➢ ***U.S. Army Corps of Engineers***

- Regulatory Programs: U.S. Army Corps of Engineers administers the Section 10 (Rivers and Harbor Act) and Section 404 (Clean Water Act) permit processes. Section 10 requires approval of any activity in, above, or below a navigable river, which affects course, location, condition, or capacity of navigable waters. Section 404 requires prior approval of dredging, filling, grading, clearing, and bank hardening. In waters used by listed fish species, the permits are subject to ESA Section 7 consultation with NOAA Fisheries to ensure that any approved action is adequately protective of the ESA listed fish. [M.1A; M.2A; M.2B; M.2C; M.4A; M.4B; M.8A; M.8B]

State Programs

- ***Department of Natural Resources***

  - State Forest Land HCP: State forestlands are managed under the provisions of a Habitat Conservation Plan (HCP). The Habitat Conservation Plan has protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. [M.3A; M.3B; M.5A, M.9A; M.9C]
  - State Forest Practices: Riparian areas and watershed functions on small- and industrial forest lands are protected under the State of Washington Forest Practices Rules, including the Forest and Fish Module. These rules provide for riparian buffers, harvest restrictions, sensitive area protections, and protective standards for new road construction. [M.3A, M.3B, M.5A; M.9A; M.9C]

- ***Washington Department of Fish and Wildlife***

  - Hydraulics Project Approval (HPA): The Department administers the state Hydraulic Code. The purpose of this program is to protect stream conditions and habitat. The regulations apply to such activities as streambank protection, instream construction, culvert installation, channel changes or realignments, debris removal, and water diversion facilities. Those proposing such actions must obtain a Hydraulic Project Approval (HPA) permit. [M.1A; M.2A; M.2B; M.2C; M.4A; M.4B; M.8A; M.8B]

  - Habitat Program: The Department provides advice to local governments and landowners interested in measures to protect habitat values on their property. [M.1A; M.2A; M.2B; M.2C; M.4A; M.4B; M.8A; M.8B; M.10A; M.10B; M.10C]

- ***Washington Department of Ecology***

  - Water Resources Program/Water Rights: Department of Ecology, in consultation with the Department of Fish and Wildlife, has administratively closed selected areas within the North Fork Lewis watershed to further surface and groundwater withdraws (where groundwater is in continuity with surface water). Existing administrative closures by the Department of Ecology protect surface waters from further withdrawals. Formal rule-making would strengthen the closures. The extent of unauthorized surface water withdrawals is unknown, but may have the potential to adversely impact low summer stream flows. [M.7A; M.7B; M.7C; M.7D]

  - Water Resources Program/Watershed Planning: In cooperation with the Lower Columbia Fish Recovery Board, other state and federal agencies, tribes, local governments, and citizens, the Department funds and participates in a state authorized watershed planning process for Water Resource Inventory Area (WRIA) 27 pursuant to RCW 90.82. The goal of the plan is to ensure adequate water for people and fish. The planning process is dealing with water quantity and quality, stream flows and fish habitat. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. M.7A; M.7B; M.7C; M.7D; M.7E; M.9A; M.9B; M.9C; M.10A]

- ***Salmon Recovery Funding Board (SFRB)/ Lower Columbia Fish Recovery Board (LCFRB)***
  - Washington Salmon Recovery Act (RCW 77.85): The SRFB and the LCFRB jointly administer a habitat restoration grant program that allocates federal Pacific Salmon Recovery Funds and State dollars for habitat protection and restoration projects by state and local agencies, nonprofit organizations, and landowners. [M.1A; M.2A; M.2B; M.2C; M.3A; M.4B; M.8A; M.8B; M.9A; M.9B; M.9C; M.11A; M.11B]

- ***Conservation Commission/ Clark Conservation District*** provides technical assistance and incentives (e.g., Conservation Reserve and Enhancement Program) to encourage agricultural landowners to protect riparian areas and stream habitat. The Conservation District has been involved in the lower Washougal basin. These programs could help address measure M.1A; M.2A; M.2B; M.2C; M.3A; M.4B; M.8A; M.8B; M.9A; M.9C]

Local Government Programs

- ***Clark County***
  - ESA Program: The County has established an Endangered Species Program to address ESA requirements and develop a comprehensive county strategy for salmon recovery. An ESA committee with representatives from federal and state agencies, tribes, citizens, the business community and environmental groups has been established to advise the county as it works to bring its ordinances and programs into compliance with ESA requirements.

  - Comprehensive Planning and Land Use Regulation:
    - ✓ The County is actively engaged in a comprehensive review and revision of its programs to better protect watershed processes and habitat and to secure ESA Section 4d assurances from NOAA Fisheries.
    - ✓ The County comprehensive sets policies calling for the protection of habitat for ESA listed salmon and other aquatic and terrestrial species.
    - ✓ Zoning that directs growth throughout the County [M.12] and maintains low-density development in rural areas. The County has a designated Urban Growth Area pursuant to the Washington Growth Management Act (GMA). The UGA helps protect rural lands by directing high intensity uses to developed areas.
    - ✓ A Habitat Conservation Ordinance provides stream buffers and measures for the protection of important habitat, including ESA listed salmonids. Addresses measures: [M.10A; M.10B; M.10C]

  - Road Maintenance:
    Clark County Road Program utilizes Best Management Practices to guide their operations and is actively seeking programmatic ESA Section 4d assurances from NOAA Fisheries that these measures provide adequate protection for fish. [M.4B]

  - Stormwater Management:

The County stormwater program, based on Best Available Science, is implementing an NPDES permit, including measures to protect water quality and reduce impacts on stream flows. [M.6C, M.9C]

- **Skamania County**
  - Comprehensive Planning and Land Use Regulation: [M.10A; M.10B; M.10C]

Skamania County is required by state law to have a critical areas ordinance. It is not otherwise required to plan in accordance with the Washington Growth Management Act (GMA). The County's land use controls provide only fair protection of watershed processes and habitat. Wetland and stream setbacks range from 25 to 200 feet depending on the class designation. The County shoreline management ordinance provisions for the Washougal protect the shorelines from substantial development or extensive timber harvest within a 200-foot buffer.

  - Road and Parks Programs: The County Road and Parks and Recreation programs have implemented management practices to deal with environmental issues. [M.4B]

- ***City of Washougal*** has a comprehensive plan with a critical areas ordinance and zoning. The Cities land use measures provide limited protection of habitat and watershed conditions. Effective protection measures within the City are important to support Chum and Fall Chinook recovery. [M.10A; M.10B; M.10C]

- ***City of Camas*** has a comprehensive plan with a critical areas ordinance and zoning. The Cities land use measures provide limited protection of habitat and watershed conditions. Effective protection measures within the City are important to support Chum and Fall Chinook recovery. [M.10A; M.10B; M.10C]

- ***City of Vancouver*** has comprehensive land use programs with high levels of protection for critical areas and zoning to direct growth into appropriate areas within their jurisdictions. These regulations pertain to only a small area of the LaCamas Creek watershed. M.10A; M.10B; M.10C]

Community Programs

- ***Columbia Land Trust*** is a nonprofit organization whose mission is to preserve and restore unique landscapes, natural areas, and sensitive habitats. The Trust has participated in several land acquisition efforts in the Washougal including Schoolhouse Creek and Slough Creek. [M.11A; M.11B]

Restoration Programs

A limited number of agencies and organizations have programs that initiate restoration and/or management activities in the urban and suburban lands in the lower Washougal Basin.

Federal Programs

- ***U.S. Forest Service Gifford Pinchot National Forest:*** Restoration activities within the upper Washougal Basin are a low priority on the Gifford Pinchot NF, but needs are modest. [M.3A, M.3B, M.4A, M.5A; M.9A; M.9C]

State Programs

- ***Department of Natural Resources***

  - State Forest Land Habitat Conservation Plan (HCP): The Department manages state forest lands pursuant to a Habitat Conservation Plan (HCP). The HCP road maintenance and restoration objectives require barrier upgrades and road abandonment and/or other improvements. [M.3A, M.3B, M.4A, M.5A; M.9A; M.9C]

  - State Forest Practices Act:
    - ✓ Industrial forests within the lower NF Lewis Basin are governed by Forest and Fish regulations and have rigid schedules for maintaining and improving roads and removing barriers. Industrial landowners have 15 years to bring roads and barriers into compliance with regulations [M.3A, M.3B, M.4A, M.5A; M.9A; M.9C]
    - ✓ Small private forest owners are governed by Forest and Fish regulations; however their road and barrier maintenance and improvement programs are tied to state funding. In the State 2003-05 Biennial Budget, 2 million dollars was allocated statewide to support small private forest owners [M.3A, M.3B, M.4A, M.5A; M.9A; M.9C]

- ***Department of Fish and Wildlife***

  - Habitat Program: The Department provides advice and assistance to local governments and landowners interested in measures to restore habitat. [M.1A; M.2A; M.2B; M.2C; M.4A; M.4B; M.8A; M.8B]

- ***Department of Transportation***

  - Road Maintenance Program

WSDOT has an ESA Section 4(d) Road Maintenance Program. The Maintenance Program uses trained crews to primarily manage roadside vegetation, litter control, and maintenance of safety rest areas associated with SR 14. [M.4A]

  - Barrier Replacement Program

In partnership with the County WSDOT has provided over $50,000 in funding for county culvert assessment, design and engineering. [M.6C; M.9A; M.9C]

- ***Salmon Recovery Funding Board (SFRB)/ Lower Columbia Fish Recovery Board (LCFRB)***

Washington Salmon Recovery Act (RCW 77.85): The SRFB and the LCFRB jointly administer a habitat restoration grant program that allocates federal Pacific Salmon Recovery Funds and State dollars for habitat protection and restoration projects by state and local agencies, nonprofit organizations, and landowners. To date the SRFB has award over $600,000 for projects. [M.1A; M.2A; M.2B; M.2C; M.3A; M.4B; M.8A; M.8B; M.9A; M.9B; M.9C; M.11A; M.11B]

- ***Conservation Commission/ Clark Conservation District*** provides technical assistance and incentives (e.g., Conservation Reserve and Enhancement Program) to encourage agricultural landowners to restore riparian areas and stream habitat. The Conservation District has been involved in the lower Washougal basin. These programs could help address measure M.1A; M.2A; M.2B; M.2C; M.3A; M.4B; M.8A; M.8B; M.9A; M.9C

Local Government Programs

- ***Clark County***
  - Clark County ESA Program: The Clark County ESA program encourages and recognizes citizen efforts to conserve and restore habitat for salmon through education and outreach activities.
  - Clark County Culvert Program: The County inventories and replaces priority barriers associated with its roads. The program has replaced barriers in the Washougal basin, such as the culvert at Coyote Creek where it intersects the Washougal Highway. [M.4A]
  - Noxious Weed Control Board: The Board has three primary programs that address weed control in the lower Cowlitz Basin; [M.3D]
    - ✓ Public education to prevent the spread of noxious weeds;
    - ✓ Survey County lands to assess emerging issues; and
    - ✓ Enforcement of noxious weed control

    A primary focus of the Board has been the control of Japanese Knotweed in Washougal riparian areas.

- ***Skamania County***
  - Public Works Program:
    The County inventoried culverts on county roads and is replacing and/or upgrading barrier culverts. The replaced a culvert on Schoolhouse Creek to facilitate the restoration of salmon and steelhead habitat. [M.4A]
  - Noxious Weed Control Board: The Board has three primary programs that address weed control in the lower Cowlitz Basin; [M.3D]
    - ✓ Public education to prevent the spread of noxious weeds;
    - ✓ Survey County lands to assess emerging issues; and
    - ✓ Enforcement of noxious weed control.

    A primary focus of the Board has been the control of Japanese Knotweed in Washougal riparian areas.

Community Programs

- ***Columbia Land Trust*** is a nonprofit organization whose mission is to preserve and restore unique landscapes, natural areas, and sensitive habitats. The Trust has participated in several land acquisition efforts in the Washougal including Schoolhouse Creek and Slough Creek. [M.11A; M.11B]
- ***Lower Columbia Fish Enhancement Group*** is one of many nonprofit enhancement groups authorized by state law. The group focuses on various riparian, instream restoration, and nutrient enhancement projects. Projects in the Washougal Basin include: [M.1A; M.2A; M.2B; M.3A; M.4B; M.8A; M.8B]
  - Larson Creek Fish Passage project;
  - Schoolhouse Creek; and
  - Little Washougal Restoration efforts.

- ***Clark Skamania Fly Fishers*** is another nonprofit restoration group working with the Lower Columbia Fish Enhancement Group on the Schoolhouse Creek and other projects. [M.1A; M.2A; M.2B; M.3A; M.4B; M.8A; M.8B]

- ***Lower Columbia River Estuary Partnership*** provides guidance and funding to implement habitat restoration activities in the estuary. The organization is considering whether to fund chum habitat work in the lower Washougal Basin. [M.1A; M.2A; M.2B; M.2C; M.3A]

Gap Analysis

Forest-related Programs: Nearly 50 percent of the Washougal basin in public and private forest use. Accordingly, forestry programs play a large role in restoring watershed functions and habitat conditions at levels supporting recovery goals. This is because these programs apply to approximately half of the basin. Certainty of forestry-related protection and restoration programs is relatively high because programs are being implemented and, for the most part, fully funded. Program areas of concern include state funding for small commercial forest landowners and the continued potential for hydrologic impacts caused by past harvest practices. Monitoring of watershed processes and habitat conditions will be required to confirm the effectiveness of these measures. The Gifford Pinchot NF's Forest Plan identifies restoration in the Washougal Basin as a low priority relative to other basins.

Agricultural-related Programs: Best Management Practices, incentives, and regulations for agricultural practices need to be developed to ensure protection of watershed processes and habitat conditions.

Protection-related Programs: Protection of watershed processes and habitat in the urban, suburban, residential, and agricultural areas of the Washougal basin are fundamental to achieving recovery goals. Population growth in Southwest Washington will exert tremendous pressures in these areas over the next 20 to 50 years. Land use programs vary significantly among Camas, Washougal, Vancouver, Clark County and Skamania County. They also offer varying levels of watershed and habitat protection from limited to significant. Overall, land use programs throughout the basin need to be revised and updated based on recent habitat surveys and modeling and best available science. Potential for greater consistency exists as comprehensive plans are updated. Protection of instream flows should receive greater attention within the next year as WRIA 27/28 Planning Units make their recommendations to DOE for new protections. Program areas of concern include inconsistent land use protections, unregulated landowner activities, and existing water rights held by the City of Camas in Jones and Boulder Creeks.

Restoration-related Programs: The Washougal Basin has received good attention from restoration-focused programs and there is reason to believe these efforts will continue. Program areas of concern include the magnitude of efforts and corresponding funding to support those efforts at a level necessary to achieve recovery goals. Relative to other program categories, restoration is likely to have the most significant resource needs because of impacts that haven't been fully addressed, new threats that protection mechanisms may not address, and the cumulative impacts caused by population growth over time.

Proposed Actions

Table 15-8. Actions to Address Gaps

Action #	Lead Agency	Proposed Action
WASH.1	State of Washington	Provide state funding for small forest owners in the Washougal Basin to a level sufficient to achieve the road and barrier improvements of Forest and Fish on a schedule parallel to private industrial forest owners
WASH.2	Forest Managers LCFRB, and DFW	Identify early action forest-wide restoration projects that analysis indicates could provide significant benefits. In these cases, it may be appropriate to identify outside funding to initiate these early actions
WASH.3	Restoration Agencies and Organizations	Coordinate barrier removal projects to ensure they are conducted in a logical sequence that will generate maximum benefits for fish in the highest priority subwatersheds (e.g., Wildboy Dam)
WASH.4	City of Washougal, Skamania County	Protect historic stream meander patterns and channel migration zones and avoid hardening stream banks and shorelines
WASH.5	City of Washougal	Develop and implement controls to adequately protect riparian areas to maintain currently functional habitat as well as restored habitat needed habitat conditions around all rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Require mitigation, where necessary, to offset unavoidable damage to habitat conditions in riparian management areas
WASH.6	City of Washougal	Zoning and development standards to adequately protect wetlands, wetland buffers, and wetland function.
WASH.7	Vancouver, Washougal, Camas, Skamania County and Clark County	Develop and implement controls to address erosion and sediment run-off during (and after) construction to prevent sediment and pollutant discharge to streams, wetlands and other water bodies
WASH.8	Skamania and Clark Counties, Cities, and State Agencies	Utilize a combination of public outreach/education, incentives, and authority to positively influence landowner behaviors toward land stewardship in practices not covered by land use regulations
WASH.9	Clark County, Skamania county Cities, State of Washington	Apply land use code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
WASH.10	WRIA 27/28 PU, DOE, and DFW	Close the Washougal to further surface water withdrawals, including groundwater in connectivity with surface waters
WASH.11	City of Camas, DOE, WRIA 27/28 PU	Work with DOE to develop new municipal water supplies and relinquish existing water rights in Jones and Boulder Creek
WASH.12	Clark County, Cities, DOE, DFW, CLT	Increase summer low-flow conditions in the Washougal Basin through the purchase of existing water rights and land use actions (e.g., wetland

		restoration and re-connecting side-channels)
WASH.13	Clark County, Cities, DOE, DFW, CLT	Decrease the frequency and duration of peak-flow events on the Washougal by reducing impervious surfaces, controlling stormwater and re-connecting riparian wetlands
WASH.14	Clark County, Cities, CCD, CLT and LCFRB	Build support for the acquisition of conservation easements, long-term leases, and fee-simple purchase through outreach and increased project funding for non-profit organizations like the Columbia Land Trust or the Nature Conservancy
WASH.15	State of Washington, LCFRB, CC, Weed Boards	Build institutional capacity for agencies and organizations to undertake additional protection and restoration projects, including noxious weed control
WASH.16	LCFRB, DOE, DFW, NOAA, USFWS, ACOE	Increase available funding for projects that implement measures and addresses underlying threats.
WASH.17	LCFRB and Program Managers	Address threats proactively by building agreement on priorities among the various program implementers
WASH.18	CC	Increase capacity of agencies like Clark Conservation District to perform outreach, design/implement farm plans, restoration projects, education, and compliance, etc.
WASH.19	CC, WDA, GSRO	Develop agricultural practices that protect watershed processes and habitat conditions.
WASH.20	FEMA	Update floodplain maps using Best Available Science

16 Lower Columbia Mainstem Subbasin – Bonneville Tributaries

Figure 16-1. Location of the Bonneville Tributaries Basin within the Lower Columbia River Basin.

16.1 Basin Overview

Streams in the Bonneville Tributaries Basin originate on the steep valley walls of the Columbia River Gorge and flow south through Columbia River floodplain terraces before entering the Columbia River. Most of the streams are high gradient and spawning habitat is only available in the lowest reaches. Hamilton Creek has the largest channel length at over 8 miles.

The Bonneville Tributaries Basin will play a key role in the recovery of salmon and steelhead. The basin has historically supported populations of fall Chinook, winter steelhead, chum, and coho. Today, Chinook, steelhead, and chum are listed as threatened under the ESA. Coho salmon are a candidate for listing. Other fish species of interest are Pacific lamprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

Bonneville tributaries salmon and steelhead are affected by a variety of in-basin and out-of-basin factors including stream, Columbia River mainstem, estuary, and ocean habitat conditions; harvest; hatcheries; and ecological relationships with other species. Analysis has demonstrated that recovery cannot be achieved by addressing only one limiting factor. Recovery will require action to reduce or eliminate all manageable factors or threats. The deterioration of habitat conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonids within the Columbia Basin. Direct harvest of listed salmon and steelhead is prohibited but sport and commercial fisheries focusing on hatchery fish and other healthy wild populations, primarily in the mainstem Columbia and ocean, incidentally affect ESA-listed Bonneville tributary fish. Key ecological interactions of concern include effects of non-native species; nutrient inputs from salmon carcasses; and predation by species affected by development including Caspian terns, northern pikeminnow, seals, and sea lions. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the Bonneville Tributary Subbasin.

The Bonneville Tributary watersheds are mostly forested, with a higher degree of residential and agricultural development in the western portion, especially near the town of Washougal. The eastern portion of the basin lies within the Columbia River Gorge National Scenic Area, where land use and development is limited; however, rural residential and industrial uses are located along the Columbia on the lower reaches of some streams.

All species, but particularly chum, are impacted by riparian and floodplain impacts to the lower reaches of these tributaries just prior to their confluence with the Columbia River. Of particular concern are dikes and transportation corridor crossings that prevent the streams' access to floodplains and disrupt natural sediment transport processes. Lower Hamilton Creek, which is affected by development in North Bonneville and by the Highway 14 and railroad crossing, has some of the most productive existing habitat as well as good potential benefit from restoration.

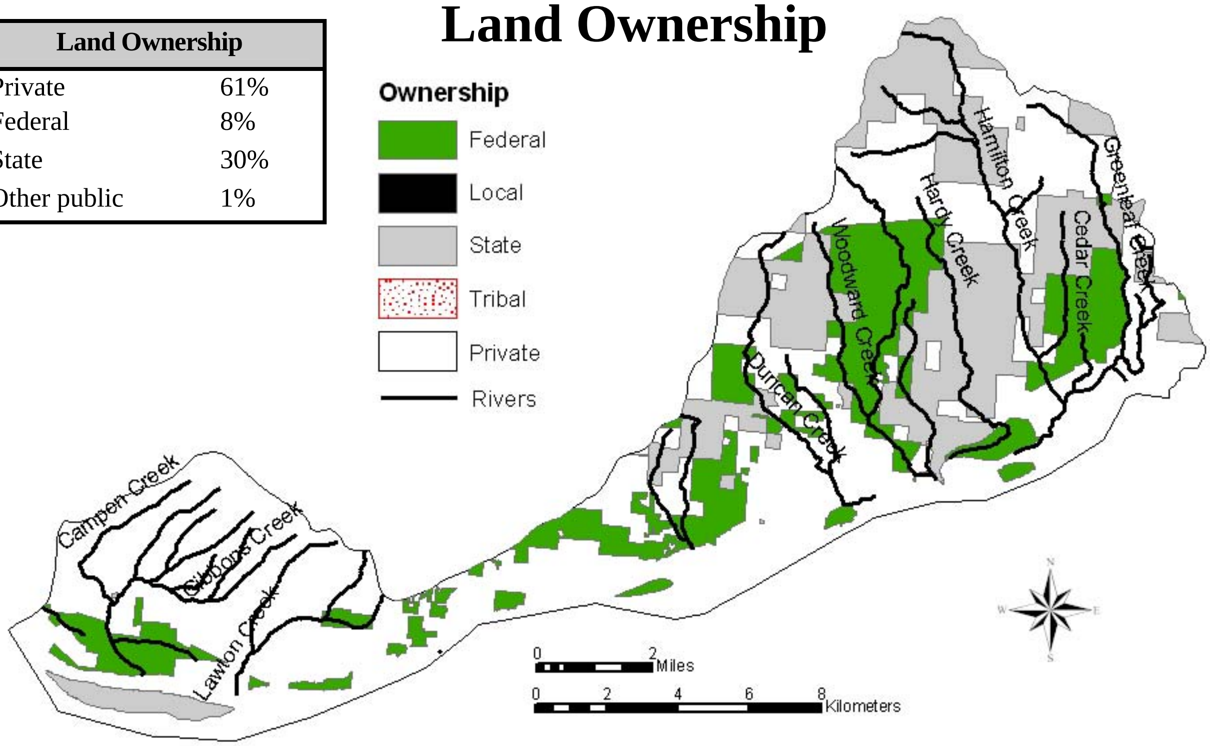
Upper Hamilton Creek is a key area for winter steelhead production. The relatively healthy conditions in this basin should at the least be maintained and ideally improved. This basin currently has a high percentage of forest in mid-seral (64%) and early-seral (10%) stages, indicating the potential for improved conditions if these forests can be protected from future intense timber harvest and road building.

Lower Gibbons Creek also has restoration potential where an artificial channel now courses through the Steigerwald National Wildlife Refuge. Reconnecting off-channel habitats in this reach would open up new habitats that could increase salmonid productivity.

There is a considerable amount of urban development in the western portion of this basin including the expanding suburban development around the town of Washougal. The only population center in the eastern portion of the basin is the town of North Bonneville, situated on the Columbia River just west of Bonneville Dam. The year 2000 population is estimated at approximately 7,000 persons, and is expected to increase to 10,500 by 2020. Most of this growth will occur in the western portion of the basin. Growth in the eastern portion of the basin is naturally limited by topography and legally limited by the Columbia Gorge National Scenic Area.

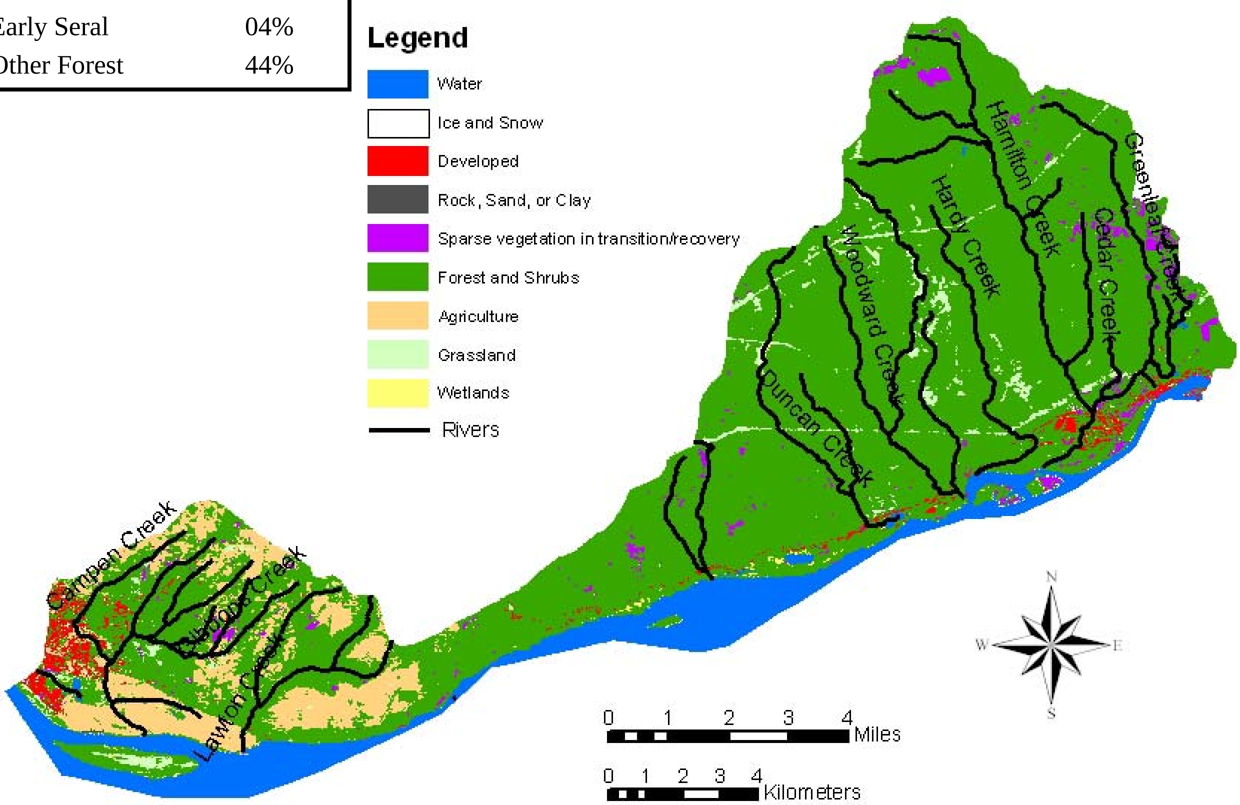
Land Ownership	
Private	61%
Federal	8%
State	30%
Other public	1%

Land Ownership



Vegetation Composition	
Late Seral	1%
Mid Seral	51%
Early Seral	04%
Other Forest	44%

Land Use / Cover



16.2 Species of Interest

Focal salmonid species in the Bonneville tributaries include fall Chinook, winter steelhead, chum, and coho. The health or viability of these populations is currently low, except for chum, which is above medium. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Recovery goals call for restoring fall Chinook to a medium viability level, providing for a 75-95% chance of persistence over 100 years. Winter steelhead and coho recovery goals call for a high level of viability, providing a 95% probability of persistence over 100 years, and chum recovery goals are to exceed a high level of viability, calling for greater than 95% probability of persistence over 100 years.

Other species of interest in the Bonneville tributaries include coastal cutthroat trout and Pacific lamprey. Regional objectives for these species are described in Volume I, Chapter 6. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for these other species. Cutthroat will benefit from improvements in stream habitat conditions for salmonids. Lamprey are expected to benefit from habitat improvements in the estuary, Columbia River, and mainstem, and in the Bonneville tributaries, although specific spawning and rearing habitat requirements for lamprey are not well known.

Table 16-1. Current viability status of Bonneville tributary populations and the biological objective status that is necessary to meet the recovery criteria for the Gorge strata and the lower Columbia ESU.

	ESA	Hatchery	Current		Objective	
Species	**Status**	**Component**	**Viability**	**Numbers**	**Viability**	**Numbers**
Fall Chinook	Threatened	No	Low	100	Med	1,400-2,800
Winter Steelhead	Threatened	No	Low+	200-300	High	200-300
Chum	Threatened	No	Med+	1,000-6,000	High+	2,600-3,100
Coho	Candidate	No	Low	<100	High	unknown

Fall Chinook– The historical Bonneville tributary adult population is estimated from 300-3,000 fish. The current natural spawning number in the tributaries is about 100 fish. However, there are significant numbers of upriver bright stock fall Chinook (not part of the lower Columbia ESU) that spawn in the mainstem Columbia near the Bonneville tributaries. Natural spawning occurs primarily in the lower reaches of Hamilton and Hardy creeks. Access in the early fall is dependent on mainstem Columbia and tributary flow conditions. Spawning time in the tributaries peaks in October. Juvenile rearing occurs near and downstream of the spawning areas. Juveniles migrate from the Bonneville tributaries in the spring and early summer of their first year.

Winter Steelhead– The historical Bonneville adult population is estimated from 600-4,000 fish. Current natural spawning returns are 200-300 fish. Spawning occurs primarily in the lower 2 miles of Hamilton Creek. Spawning time is early 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 Bonneville tributaries.

Chum– The historical Bonneville tributary adult population is estimated from 9,000-40,000. Current natural spawning returns range from 1,000-6,000, including tributary and mainstem Columbia spawning. Spawning occurs in the lower 1.0 miles of Hardy and Hamilton creeks, Hamilton Slough, Duncan Creek, and in the mainstem Columbia near Ives and Pierce islands. Spawning occurs from late November through December. Natural spawning chum in the Bonneville tributaries are all naturally produced as no hatchery chum are released in the area. Juveniles rear in the lower reaches for a short period in the early spring and quickly migrate to the Columbia.

Coho– The historical Bonneville tributary adult population is estimated from 300-13,000, with both early and late stock coho produced. Current natural spawning returns are presumed to be 100 fish or less. There is no hatchery production in the Bonneville tributaries. Natural spawning can occur in Hamilton, Greenleaf, Hardy, Woodard, Duncan, Gibbons and Lawton creeks. Early coho spawning occurs from mid October to mid-November and late coho from mid-Novenber to March. Juvenile rearing occurs upstream and downstream of spawning areas. Juveniles rear for a full year in the Bonneville tributaries before migrating as yearlings in the spring.

Coastal cutthroat– Coastal cutthroat abundance in the Bonneville tributaries has not been quantified but the population is considered depressed. Anadromous and resident forms of cutthroat trout are present in the Bonneville tributaries. Anadromous cutthroat enter the Bonneville tributaries from July-December and spawn from December through June. Most juveniles rear 2-4 years before migrating from their natal stream.

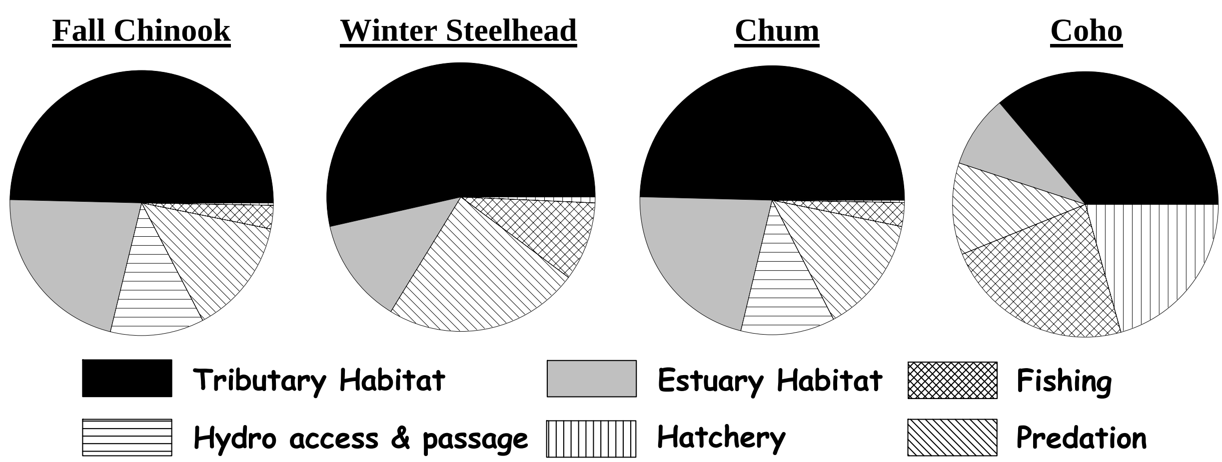
Pacific lamprey.– Information on lamprey abundance is limited and does not exist for the Bonneville tributary populations. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have declined in the Bonneville tributaries also. Adult lamprey return from the ocean to spawn in the spring and summer. Juveniles rear in freshwater up to 6 years before migrating to the ocean.

Figure 16-2. Summary of habitat limiting factors, population status, expected population improvement trend with existing programs, and biological objectives depicted for the Bonneville Tributaries Basin.

16.3 Potentially Manageable Impacts

Stream habitat, estuary/mainstem habitat, harvest, hatchery and predation effects have all contributed to reduced salmonid productivity, numbers, and population viability in the Bonneville Tributaries Subbasin. The pie charts below represent the relative order of magnitude of quantifiable effects for each of these factors for each focal species. The preferred recovery scenario targets an equivalent reduction in each impact factor in proportion to the magnitude of the effect. Population-specific targets are discussed in further detail in Volume I, Chapter 6.

- Loss of tributary habitat quality and quantity is an important impact for all species. Loss of estuary habitat quality and quantity is most important to chum of the four species.
- Harvest has moderate impacts on coho and winter steelhead, but is relatively low for chum and fall Chinook.
- Hatchery impacts are substantial for coho but are minimal for winter steelhead, chum, and fall Chinook.
- Predation impacts are moderate for winter steelhead, but are less important for the other three species.
- Hydrosystem access and passage impacts appear to be relatively important for chum and fall Chinook.



16-3. Relative contribution of potentially manageable impacts for Bonneville tributary populations.

16.4 Limiting Factors, Threats, and Measures

16.4.1 Hydropower Operation and Configuration

There are no hydro-electric dams in the Bonneville tributaries. However, Bonneville tributary species are affected by mainstem Columbia hydro operations and flow regimes which affect habitat in migration corridors and in the estuary. Mainstem hydro factors and threats are addressed by regional strategies and measures identified in Volume I.

16.4.2 Harvest

Most harvest of Bonneville tributary wild salmon and steelhead occurs incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. This mortality is very low for chum and steelhead, but is more significant for fall Chinook. Bonneville tributary fall Chinook are harvested in ocean and Columbia River commercial and sport fisheries as well as in-basin sport fisheries. Harvest is controlled by an ESA harvest limit associated with Coweeman natural fall Chinook. No harvest of chum occurs in ocean fisheries. There are no directed Columbia River commercial chum fisheries and retention of chum is prohibited in Columbia River and tributary sport fisheries. Some chum can be impacted incidental to fisheries directed at coho and winter steelhead. Harvest of Bonneville tributary coho occurs in the ocean commercial and recreational fisheries off the Washington and Oregon coasts and Columbia River. There are no salmon fisheries in the Bonneville tributaries. Wild coho impacts are limited by fishery management to retain fin-marked hatchery fish and release unmarked wild fish. 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.

Measures 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. The regional measures 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 Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest measures with significant application to the Bonneville tributary subbasin populations are summarized in the following table:

Table 16-2. Regional harvest measures from Volume I, Chapter 7 with significant application to the Bonneville tributary populations.

Measure	Description	Comments
F.M19	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	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.M24	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	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.

16.4.3 Hatcheries

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

There are no hatcheries operating in the Bonneville tributaries. A chum enhancement program for Bonneville tributary and mainstem Columbia natural chum populations is implemented using the Washougal Hatchery facility. The program objectives include supplementation of chum in Duncan Creek as part of a rebuilding program and a risk reduction program for the mainstem Columbia, Hamilton and Hardy creek chum populations. There have been small numbers of hatchery winter steelhead planted into Hamilton Creek in the past, but there are no current releases. The main threats from hatchery released 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 steelhead.

Table 16-3. Bonneville tributary hatchery production.

Hatchery	Release Location	Chum
Washougal	Bonneville tributaries and Columbia	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 Washougal 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 Technical Foundation, Volume IV). Regional hatchery measures identified in Volume I, Chapter 7 with potential applications at facilities within the Bonneville Tributaries Subbasin are summarized in Table 7.

Table 16-4. Regional hatchery measures from Volume I, Chapter 7 with potential implementation actions in the Bonneville Subbasin.

Measure	Description	Comments
H.M 24, 26	Hatchery program utilized for supplementation and enhancement of wild chum and coho populations.	The Washougal Hatchery is currently used for supplementation and risk management of lower Gorge chum populations. This program could be potentially expanded to include more areas and populations. Supplementation programs for Washougal natural coho could be developed with appropriate brood stock in the Washougal Hatchery.
H.M8	Adaptively manage hatchery programs to further protect and enhance natural populations and improve operational efficiencies.	Appropriate research, monitoring, and evaluation programs along with guidance from regional hatchery evaluations will be utilized to improve the survival and contribution of hatchery fish, reduce impacts to natural fish, and increase benefits to natural fish.

16.4.4 Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Bonneville tributary salmon and steelhead are affected throughout their lifecycle by ecological interactions with non-native species, food web components, and predators. Interactions are similar for Bonneville tributary populations to those of most other subbasin salmonid populations. Ecological Interactions are addressed by regional strategies and measures identified in Volume I.

16.4.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. 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 are similar for Bonneville tributary populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook than spring Chinook, steelhead, and coho. These estuary and mainstem effects on Bonneville tributary salmon and steelhead populations are addressed by regional strategies and measures identified in Volume I and the Columbia Mainstem and Estuary Subbasin sections of Volume II.

16.4.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity 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 Bonneville Tributaries Basin have the greatest impact on the health and viability of salmon and steelhead relative to the other limiting factors and threats discussed in this chapter.

Subwatersheds, reaches, and habitat attributes have been prioritized for protection and/or restoration based on the plan's biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Priority areas for habitat preservation and restoration are identified in Figure 16-4. A summary of the primary habitat limiting factors and threats are presented in Table 16-6. Habitat measures and related information are presented in Table 16-7. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 16-5. Reach- and subwatershed-scale limiting factors generated from the technical assessment are included in Table 16-5. Details on species-specific spatial priorities and limiting factors at the subbasin level may be found in Volume II of the Technical Foundation. A description of the methodology used to generate composite (multi-species) reach and subwatershed priorities can be found in the introduction to this volume of the recovery plan.

The areas with the greatest current or potential contribution to focal salmonid population health and productivity are listed below. Tier 1 and 2 reaches within these priority areas are included in the list. The habitat limiting factors, threats, and measures included in this chapter focus primarily on the priority areas and the Tier 1 and 2 reaches within them. Tier, 3, 4, and non-tiered reaches are considered secondary priority, but in many cases, these lower priority areas will also require restoration and preservation actions in order to achieve recovery objectives. Watershed process measures generally focus on the entire basin as opposed to being limited only to high priority areas because conditions in high priority areas are often influenced by cumulative watershed effects. High priority areas and reaches in the Bonneville Tributaries Basin include the following:

- Lower Hamilton Creek – Hamilton 1A, 2; Hamilton Springs
- Upper Hamilton and Greenleaf Creeks – Hamilton 4; Greenleaf 1-3
- Hardy and Duncan Creeks – Duncan 1-2; Duncan Springs; Lake Outlet; Hardy 2-3
- Gibbons & Lawton Creeks – no reach priorities specified

The following paragraphs provide a brief overview of each of these areas, including species most affected, land-use threats, and the general type of measures that will be necessary for recovery. Additional detail can be found in the tables and figures that follow.

While reach level habitat conditions often result from local factors, they are also affected or shaped by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input and large woody debris recruitment are often affected by or result from upstream conditions and degraded watershed processes. Access to key reaches may also be affected by barriers that occur downstream of a reach. Accordingly, restoration of a priority reach may require action outside the targeted reach. The IWA analysis was used to identify potential upstream watershed areas that could influence reach level habitat attributes. EDT was used to allow a relative comparison of reaches and habitat attributes within a reach.

Lower Hamilton Creek contains potentially good spawning habitat but conditions have been impacted by development around the town of North Bonneville and by the Hwy 14 crossing. The artificially created Hamilton Springs spawning channel provides important chum spawning habitat. Effective recovery measures here will include riparian and floodplain restoration, in particular addressing channel confinement adjacent to N. Bonneville and associated with the Hwy 14 crossing. Addressing upstream sediment inputs will also help these reaches to recover.

Upper Hamilton and upper Greenleaf creeks contain good quality habitat for winter steelhead and coho. Above reach Hamilton 4, the gradient increases dramatically with several large falls that cannot be ascended. Reach Hamilton 4 currently supports a significant portion of the production for these populations. Preservation is the primary recovery emphasis for these areas, although restoration of sediment supply conditions will also provide important benefits.

Most of the good spawning habitat in Duncan Creek is located just above Duncan Lake. This area is most important for chum and coho although it is also used by fall Chinook and winter steelhead. Access to spawning areas in Duncan Creek has recently been improved by the construction of a dam that lowers lake levels during salmonid migration periods. Hardy reach 2 and 3 contain the greatest potential in Hardy Creek. Recovery measures in these areas will primarily involve floodplain and riparian restoration.

Gibbons and Lawton creeks were not evaluated using the EDT model and therefore specific reach and limiting factor priorities have not been developed for these streams. Although these streams do not support significant abundance of anadromous salmonids, they nevertheless contain some potentially productive habitat that is in need of restoration and preservation. These streams are threatened primarily by expanding development from the town of Washougal. Effective recovery measures will entail floodplain reconnection, riparian reforestation, and land-use planning that is adequate to protect habitat-forming processes in sensitive areas (i.e., wetlands, riparian areas, floodplains).

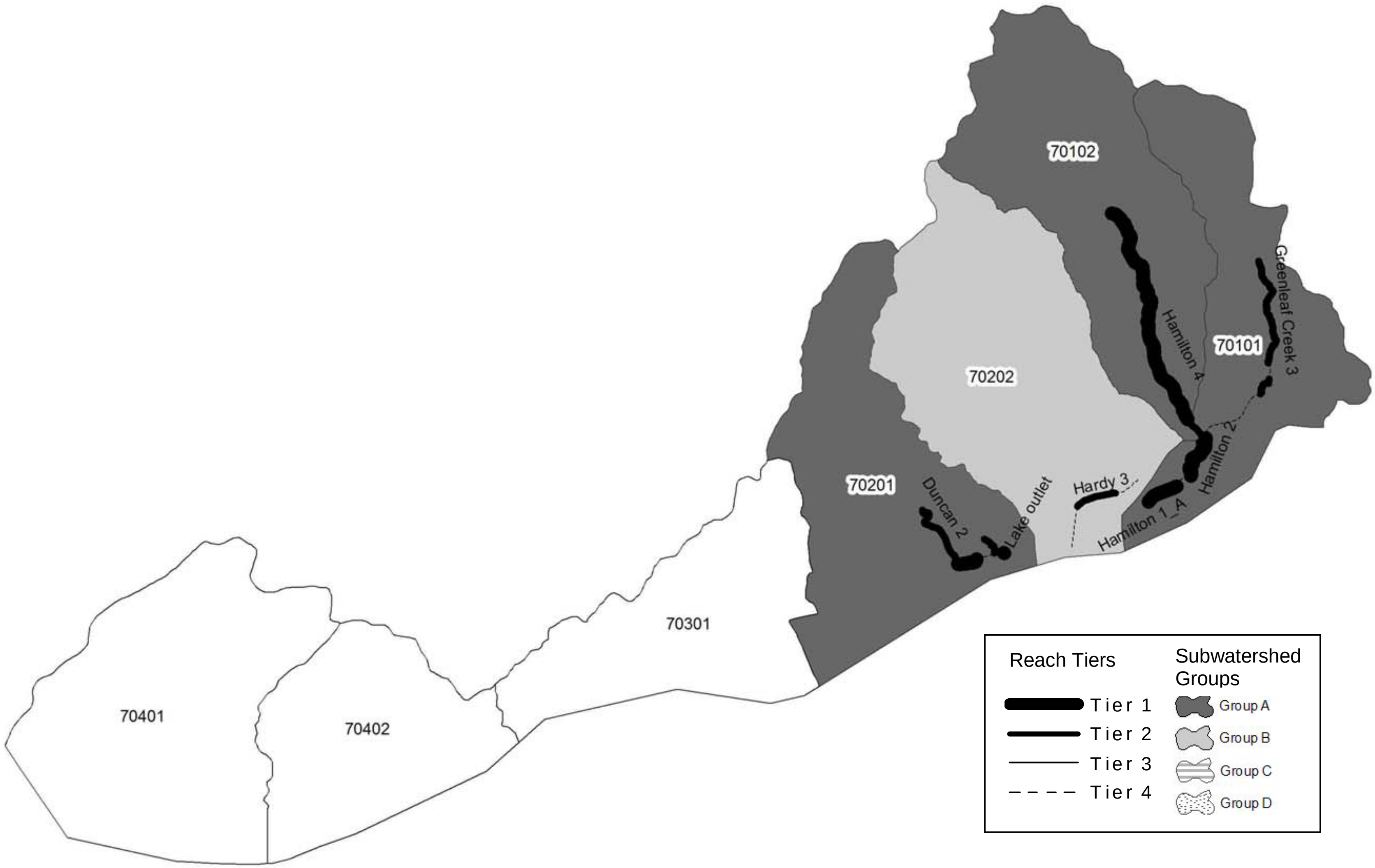


Figure 16-4. Reach tiers and subwatershed groups in the Bonneville Tributaries Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities 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.

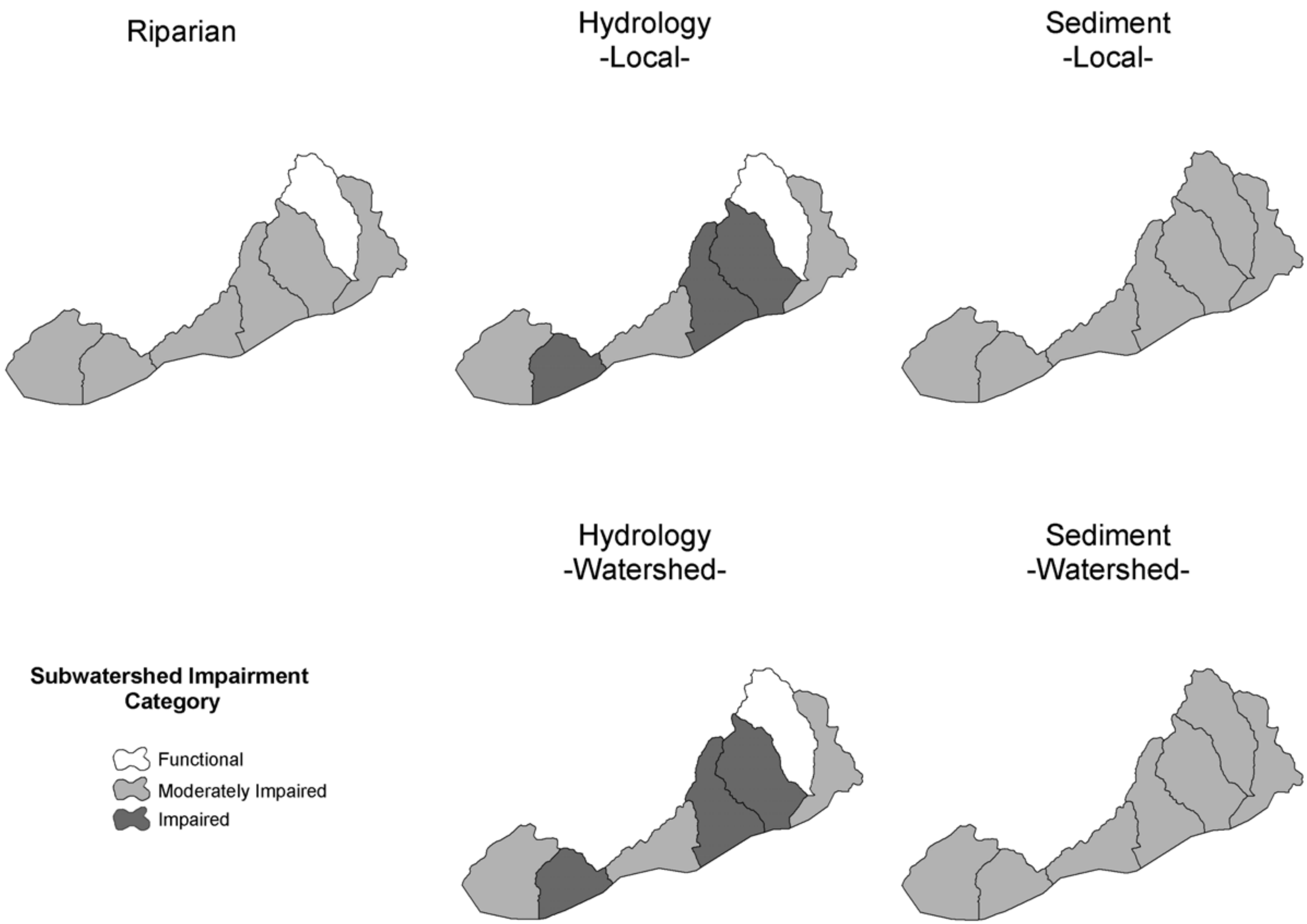


Figure 16-5. IWA subwatershed impairment ratings by category for the Bonneville Tributaries Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 16-5. 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-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): Hydrology	Watershed processes (local): Sediment	Watershed processes (local): Riparian	Watershed processes (watershed): Hydrology	Watershed processes (watershed): Sediment
A	70101	Hamilton 2 Hamilton 1_A Greenleaf Creek 1 Greenleaf Creek 3 Hamilton 3 Hamilton 1_B Greenleaf Creek 2 Greenleaf outlet Greenleaf Slough	ChF	Hamilton 1_A	Spawning Egg incubation Adult holding	temperature sediment key habitat quantity	PR	M	M	M	M	M
			Chum	Hamilton 2 Hamilton 1_A	Spawning Egg incubation Fry colonization Adult holding	habitat diversity harassment key habitat quantity	P					
			StW	none								
			Coho	Hamilton 2	Egg incubation Fry colonization Summer rearing	habitat diversity temperature flow sediment key habitat quantity	R					
	70201	Lake outlet Duncan 1 Duncan 2 Duncan Springs Duncan Lake Duncan Dam	ChF	none				I	M	M	I	M
			Chum	Lake outlet	Fry colonization Adult migrant	none	P					
			StW	none								
			Coho	Duncan 1	Egg incubation Summer rearing Winter rearing	sediment	R					
	70102	Hamilton 4	StW	Hamilton 4	Spawning Egg incubation Fry colonization Adult holding	sediment key habitat quantity	P	F	M	F	F	M
			Coho	none								
B	70202	Hardy 2 Hardy 3 Hardy 1 Slough Hardy 4 Hardy 5	Chum	none				I	M	M	I	M
			StW	none								
			Coho	none								

Table 16-6. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the lower Hamilton Creek (LH), upper Hamilton & Greenleaf Creek (UH), Duncan & Hardy Creeks (DU), and Gibbons & Lawton Creek (GI). Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors	LH	UH	DU	GI
Habitat connectivity				
Blockages to off-channel habitats	✓		✓	✓
Habitat diversity				
Lack of stable instream woody debris	✓	✓	✓	✓
Altered habitat unit composition	✓	✓	✓	✓
Loss of off-channel and/or 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, or rate of chng	✓		✓	✓
Water quality				
Altered stream temperature regime	✓	✓	✓	✓
Bacteria				✓
Substrate and sediment				
Excessive fine sediment	✓	✓	✓	✓
Embedded substrates	✓	✓	✓	✓

Threats	LH	UH	DU	GI
Agriculture/grazing				
Clearing of vegetation				✓
Riparian grazing				✓
Floodplain filling				✓
Urban & rural development				
Clearing of vegetation	✓		✓	✓
Floodplain filling	✓	✓	✓	✓
Increased impervious surfaces				✓
Increased drainage network				✓
Roads – riparian/floodplain impacts	✓		✓	✓
Leaking septic systems				✓
Forest practices				
Timber harvests –sediment supply impacts	✓	✓	✓	
Timber harvests – impacts to runoff	✓		✓	
Riparian harvests		✓		
Forest roads – impacts to sediment supply	✓	✓	✓	
Forest roads – impacts to runoff	✓		✓	
Channel manipulations				
Bank hardening	✓			✓
Channel straightening	✓	✓	✓	✓
Artificial confinement	✓	✓	✓	✓
Dredge and fill activities	✓	✓		

Table 16-7. Habitat measures in priority areas, with reference to limiting factors addressed, threats addressed, target species, and estimated time until benefits would be realized (time). Tier 1 and 2 reaches, or other areas of known priority, are listed under the location column for some measures (i.e., stream corridor measures). Reaches not included in the table (Tier 3, 4, and non-tiered reaches) are considered secondary priority.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
1. Protect and restore floodplain function and channel migration processes ***A. Set back, breach, or remove artificial channel confinement structures***					
Lower Hamilton Hamilton 1A-2 ***Upper Hamilton*** Hamilton 4 (lower portion) ***Hardy & Duncan*** Hardy 2-3; Duncan 1 ***Gibbons & Lawton*** Lower Gibbons; lower Lawton	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes • Channel incision	• Floodplain filling • Channel straightening • Artificial confinement	• All species	2-15 years	Great potential benefit due to improvements in many limiting factors. This passive restoration approach can allow channels to restore naturally once confinement structures are removed. There are challenges with implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense.
2. Protect and restore off-channel and side-channel habitats ***A. Restore historical off-channel and side-channel habitats where they have been eliminated*** ***B. Provide access to blocked off-channel habitats*** ***C. Create new off-channel or side-channel habitats (i.e. spawning channels)***					
Lower Hamilton Hamilton 1A-2 ***Upper Hamilton*** Hamilton 4 (lower portion) ***Hardy & Duncan*** Hardy 2-3; Duncan 1 ***Gibbons & Lawton*** Lower Gibbons; lower Lawton	• Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats • Altered habitat unit composition	• Floodplain filling • Channel straightening • Artificial confinement	• chum • Coho	2-15 years	Good potential benefit especially for chum, which have lost a significant portion of historically available off-channel habitat for spawning. Potential benefit is limited by moderate probability of success with creation of new habitats. There are challenges with implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense.
3. Protect and restore riparian function ***A. Reforest riparian zones*** ***B. Allow for the passive restoration of riparian vegetation***					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
C. Livestock exclusion fencing ***D. Invasive species eradication*** ***E. Hardwood-to-conifer conversion***					
Lower Hamilton Hamilton 1A-2 ***Upper Hamilton*** Hamilton 4 ***Hardy & Duncan*** Hardy 2-3; Duncan 1-2 ***Gibbons & Lawton*** Gibbons, Lawton, and Campen creeks	• Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or noxious species	• Riparian grazing • Clearing of vegetation due to rural/suburban development and agriculture	• All species	20-100 years	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. Riparian protections on forest lands are provided for under current harvest policy. Riparian restoration projects are relatively inexpensive and are often supported by landowners. Whereas the specified stream reaches are the highest priority for riparian measures, riparian restoration and preservation should occur throughout the basin since riparian conditions affect downstream reaches. Use IWA riparian ratings to help identify restoration and preservation opportunities.
4. Protect and restore natural sediment supply processes ***A. Address forest road related sources*** ***B. Address timber harvest related sources*** ***C. Address agricultural sources*** ***D. Address developed land sources***					
Entire basin	• Excessive fine sediment • Embedded substrates	• Timber harvest – impacts to sediment supply • Forest roads – impacts to sediment supply • Agricultural practices – impacts to sediment supply	• All species	5-50 years	High potential benefit due to sediment effects on egg incubation and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. There are challenges with implementation on agricultural lands due to few sediment-focused regulatory requirements for agricultural lands. Use IWA impairment ratings to identify restoration and preservation opportunities.
5. Protect and restore runoff processes ***A. Address forest road impacts*** ***B. Address timber harvest impacts***					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
C. Limit additional watershed imperviousness ***D. Manage stormwater runoff***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Timber harvest – impacts to runoff • Forest roads – impacts to runoff • Increased impervious surfaces • Increased drainage network (road ditches, storm drains) • Clearing of vegetation	• All species	5-50 years	High potential benefit due to flow effects on habitat formation, redd scour, and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. There are challenges associated with addressing runoff issues on developed lands due to continued increase in watershed imperviousness related to development and lack of adequate mitigation. Use IWA impairment ratings to identify restoration and preservation opportunities.
6. Protect and restore instream flows ***A. Water rights closures*** ***B. Purchase or lease existing water rights*** ***C. Relinquishment of existing unused water rights*** ***D. Enforce water withdrawal regulations*** ***E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Water withdrawals	• All species	1-5 years	Instream flow management strategies for the Bonneville Tributaries basin have been identified as part of Watershed Planning for WRIA 28 (LCFRB 2004).
7. Protect and restore water quality ***A. Restore the natural stream temperature regime*** ***B. Reduce fecal coliform bacteria levels***					
Entire basin	• Altered stream temperature regime • Bacteria	• Riparian harvests • Riparian grazing • Leaking septic systems	• All species	1-50 years	Primary emphasis for restoration should be placed on stream segments that are listed on the 2004 303(d) list.
8. Protect and restore instream habitat complexity ***A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting*** ***B. Structurally modify stream channels to create suitable habitat types***					
Lower Hamilton	• Lack of stable instream	• None (symptom-	• Coho	2-10 years	Moderate potential benefit due to the high

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
Hamilton 1A-2 ***Upper Hamilton*** Hamilton 4 ***Hardy & Duncan*** Hardy 2-3; Duncan 1-2 ***Gibbons & Lawton*** Gibbons, Lawton, and Campen creeks	woody debris • Altered habitat unit composition	focused restoration strategy)	• Qinter steelhead		chance of failure. Failure is probable if habitat-forming processes are not also addressed. These projects are relatively expensive for the benefits accrued. Moderate to high likelihood of implementation given the lack of hardship imposed on landowners and the current level of acceptance of these type of projects.
9. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development ***A. Plan growth and development to avoid sensitive areas (e.g. wetlands, riparian zones, floodplains, unstable geology)*** ***B. Encourage the use of low-impact development methods and materials*** ***C. Apply mitigation measures to off-set potential impacts***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	The western portion of the basin is developing rapidly. The eastern portion is protected in large part by the Columbia Gorge National Scenic Area. The focus should be on management of land-use conversion and managing continued development in sensitive areas (e.g., wetlands, stream corridors, unstable slopes). Many critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary mechanisms need to be put in place to restore currently degraded habitats.
10. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection ***A. Purchase properties outright through fee acquisition and manage for resource protection*** ***B. Purchase easements to protect critical areas and to limit potentially harmful uses*** ***C. Lease properties or rights to protect resources for a limited period***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit. These programs are under-funded and have low landowner participation.

16.5 Program Gap Analysis

The Bonneville Tributaries Basin (~100 sq mi) is located in Clark and Skamania Counties and the Columbia River Gorge National Scenic Area. The Bonneville Tributaries Basin streams originate on the steep valley walls of the Columbia River Gorge and flow south through Columbia River floodplain terraces before entering the Columbia River. The major streams, from west to east, are Gibbons, Lawton, Duncan, Woodward, Hardy, and Hamilton Creeks. Hamilton Creek has the largest channel length at over 8 miles.

- Columbia River Gorge National Scenic Area lands are estimated at 15 square miles.
- Department of Natural Resources timber lands are estimated at 12 square miles.
- Beacon Rock State Park encompasses an estimated 8 square miles.
- Industrial forest lands are estimated at 8 square miles.
- Small commercial forest land acreage is estimated to be 2 square miles.
- Overall the Bonneville tributaries subbasin is lightly populated. The highest population concentration is found in the Gibbons and Lawton watersheds, the closest to the Camas/Washougal area.

<u>Protection Programs</u>

Protection programs in this analysis include programs that protect habitat conditions or watershed functions through management policies and programs, regulatory measures, incentives, and acquisition of sensitive habitat or protective easements. Major programs implementing protection measures are identified below.

Federal Programs

- ***U.S. Forest Service-Columbia Gorge Commission – Columbia River Gorge National Scenic Area***
  - The purpose of the National Scenic Area Act is to protect and provide for the enhancement of the scenic, cultural, recreational and natural resources of the Gorge; and to protect and support the economy of the Columbia River Gorge area by encouraging growth to occur in existing urban areas and by allowing future economic development. All proposed development and land use changes are reviewed to determine if they are consistent with the Act and the implementing land-use ordinances. The Act authorized the Forest Service to acquire and exchange lands in the Special Management Area to achieve the purposes of the Act if the owners wish to sell or exchange their lands; [M.9A; M.9B; M.9C; M.10A]

- ***U.S. Army Corps of Engineers***
  - Administers the Section 10 (Rivers and Harbor Act) and Section 404 (Clean Water Act) permit processes. Section 10 requires approval of any activity in, above, or below a navigable river, which affects course, location, condition, or capacity of navigable waters. Section 404 requires prior approval of dredging, filling, grading, clearing, and bank hardening. In waters used by listed fish species, the permits are subject to ESA Section 7 consultation with NOAA Fisheries to ensure that any approved action is adequately protective of the fish. [M.1A; M.2A; M.2B; M.4D; M.8A; M.8B]

- ***U.S. Fish and Wildlife Service***

  - The USFWS manages three refuges in the Bonneville Tributaries Subbasin. These are the Steigerwald, Franz Lake, and Pierce. These refuges encompass wetlands and floodplain areas near the Columbia River. Two Bonneville tributaries flow through these refuge areas: Gibbons Creek and Hardy Creek. Gibbons Creek is largely contained within an artificial channel and water control structures in the Stiegerwald Refuge. USFWS is working with the Corps of Engineers to develop restoration options. Riparian habitat and channel conditions for Hardy are well protected within the Pierce Refuge. [M.1A; M.2A; M.2B; M.2C; M.3A; M.7A]

State Programs

- ***Department of Natural Resources***

  - State Forest Land Habitat Conservation Plan (HCP):
    State forest lands are managed under the provisions of a HCP. The HCP protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. [M.3A; M.3B; M.4A; M.4B; M.5A; M.5B; M.7A]
  - State Forest Practice Rules:
    Riparian areas and watershed functions on small- and industrial forest lands are protected under the State of Washington Forest Practices Rules, including the Forest and Fish Module. These rules provide for riparian buffers, harvest restrictions, sensitive area protections, and protective standards for new road construction to manage sedimentation, runoff, and slope failure. [M.3A; M.3B; M.4A; M.4B; M.5A; M.5B; M.7A]

- ***Department of Fish and Wildlife***

  - Hydraulics Project Approval (HPA): The Department administers the state Hydraulic Code. The purpose of this program is to protect stream conditions and habitat. The regulations apply to such activities as streambank protection, instream construction, culvert installation, channel changes or realignments, debris removal, and water diversion facilities. Those proposing such actions must obtain a Hydraulic Project Approval (HPA) permit. [M.1A; M.2A; M.2B; M.3A; M.7A; M.8A; M.8B;

  - Habitat Program: The Department provides advice to local governments and landowners interested in measures to protect habitat values on their property. [M.1A; M.2A; M.2B; M.3A; M.4C; M.5C; M.5D; M.6A; M.6B; M.6C; M.6D; M.7A; M.7B; M.8A; M.8B; M.9A; M.9B; M.9C; M.9D]

- ***Department of Ecology***

  - Water Resources Program/Water Rights: Department of Ecology, in consultation with the Department of Fish and Wildlife, has administrative closed selected areas within the Coweeman Basin to surface and groundwater withdraws (where groundwater is in continuity with surface water). Existing administrative closures by the Department of Ecology protect surface waters from further withdrawals. Formal rule-making would strengthen the closures. The extent of unauthorized surface water withdrawals is unknown, but could exacerbate summer low flows. [M.7A, M.7B, M.7C, M.7D]

- Water Resources Program/Watershed Planning: In cooperation with the Lower Columbia Fish Recovery Board, other state and federal agencies, tribes, local governments, and citizens, the Department funds and participates in a state authorized watershed planning process for Water Resource Inventory Area (WRIA) 28 pursuant to RCW 90.82. The goal of the plan is to ensure adequate water for people and fish. The planning process is dealing with water quantity and quality, stream flows and fish habitat. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.6A; M.6B; M.6C; M.6D; M.6E; M.7A; M.7B; M.9A]

➢ ***Washington Parks and Recreation Commission – Beacon Rock State Park:*** Beacon Rock State Park encompasses nearly all the Hardy Creek watershed above the USFWS Pierce Refuge. Watershed conditions and habitat conditions receive a high level of protection within the park. [M.3A; M.3B; M.3D; M.5C; M.7A; M.7B]

Local Government Protection Programs

➢ ***Clark County:***

- ESA Program: The County has established an Endangered Species Program to address ESA requirements and develop a comprehensive county strategy for salmon recovery. An ESA committee with representatives from federal and state agencies, tribes, citizens, the business community and environmental groups has been established to advise the county as it works to bring its ordinances and programs into compliance with ESA requirements.

- Land Use: [M.9A; M.9B; M.9C]
  - The County is actively engaged in a comprehensive review and revision of its programs to better protect watershed processes and habitat and to secure ESA Section 4d assurances from NOAA Fisheries.
  - The County comprehensive sets policies calling for the protection of habitat for ESA listed salmon and other aquatic and terrestrial species.
  - Zoning includes special provisions implementing the stringent environmental and land use standards of the Columbia Gorge National Scenic Area. A Habitat Conservation Ordinance provides stream buffers and measures for the protection of important habitat, including ESA listed salmonids.

- Road Maintenance:
  Clark County Road Program utilizes Best Management Practices to guide their operations and is actively seeking programmatic ESA Section 4d assurances from NOAA Fisheries that these measures provide adequate protection for fish.

➢ ***Skamania County***

- Land Use: [M.9A; M.9B; M.9C]

Skamania County has adopted special land use and environmental regulations implementing the Columbia River Gorge National Scenic Area Act. These measures provide a high level of protection to watershed processes and stream habitat in the Bonneville Tributaries Subbasin.

Community Plans

No active programs.

Restoration Programs

Restoration programs in the Bonneville Tributaries Basin are implemented by a variety of agencies, organizations, and private interests. Major programs implementing protection measures are identified below:

Federal Programs

- ***U.S. Forest Service Columbia River Gorge National Scenic Area***
  The USFS conducts stream and habitat restoration projects within the National Scenic Area. [M.9A; M.9B; M.9C; M.10A]

- ***U.S. Fish and Wildlife Service***
  The USFWS has conducted chum spawning improvements on Hardy Creek and is working with the Corps of Engineers to make channel improvements to Gibbons Creek. [M.2C]

State Programs

- ***Department of Natural Resources***

  - State Forest Land Habitat Conservation Plan (HCP): The Department manages state forest lands pursuant to a Habitat Conservation Plan (HCP). The HCP road maintenance and restoration objectives require barrier upgrades and road abandonment and/or other improvements. [M.3A; M.3B; M.4A; M.4B; M.5A; M.5B; M.7A]

  - State Forest Practices Act:

    - ✓ Industrial forests within the lower NF Lewis Basin are governed by Forest and Fish regulations and have rigid schedules for maintaining and improving roads and removing barriers. Industrial landowners have 15 years to bring roads and barriers into compliance with regulations [M.3A; M.3B; M.4A; M.4B; M.5A; M.5B; M.7A]
    - ✓ Small private forest owners are governed by Forest and Fish regulations; however their road and barrier maintenance and improvement programs are tied to state funding. In the State 2003-05 Biennial Budget, 2 million dollars was allocated statewide to support small private forest owners [M.3A; M.3B; M.4A; M.4B; M.5A; M.5B; M.7A].

- ***Department of Fish and Wildlife***

  - Habitat Program: The Department provides advice and assistance to local governments and landowners interested in measures to restore habitat. [M.1A; M.2A; M.2B; M.3A; M.4C; M.5C; M.5D; M.6A; M.6B; M.6C; M.6D; M.7A; M.7B; M.8A; M.8B; M.9A; M.9B; M.9C; M.9D]

- ***Department of Transportation***

  - Road Maintenance Program

  WSDOT has an ESA Section 4(d) Road Maintenance Program. The Maintenance Program uses trained crews to primarily manage roadside vegetation, litter control, and maintenance of safety rest areas associated with SR 14.

- ***Salmon Recovery Funding Board (SRFB)/ Lower Columbia Fish Recover Board (LCFRB)***

  - Washington Salmon Recovery Act (RCW 77.85): The SRFB and the LCFRB jointly administer a grant program that allocates federal Pacific Salmon Recovery Funds and State funds for habitat protection and restoration projects by state and local agencies, nonprofit organizations, and landowners. To date the SRFB has awarded over $375,000 in grants for restoration activities including the replacement of the Duncan Creek Dam and off channel chum rearing habitat restoration. [M.1A; M.2A; M.2B; M.3A; M.7A; M.7B; M.8A; M.8B; M.10A; M.10B]

Local Government Programs

- ***Clark and Skamania County Noxious Weed Control Boards*** has three primary programs that address weed control in the Bonneville Tributaries Basin. [M.3D]
  - ✓ Public education to prevent the spread of noxious weeds;
  - ✓ Survey of the County to assess emerging issues; and
  - ✓ Enforcement of noxious weed control

Both Boards are focusing on the control of highly invasive Japanese Knotweed in riparian areas.

Community Restoration Programs

- ***Lower Columbia Fish Enhancement Group*** is one of many nonprofit enhancement groups authorized by state law. The group focuses on various riparian, instream restoration, and nutrient enhancement projects. The group is pursuing restoration projects in the Bonneville Tributaries Subbasin. [M.1A; M.2A; M.2B; M.3A; M.4B; M.8A; M.8B]

- ***Skamania Landing Homeowners Association*** has volunteered time and resources to enhancing the Duncan Creek area including the replacement of the Duncan Creek Dam and the development of several off channel chum rearing sites. [M.2C]

Gap Analysis

Forest-related Programs: In the Bonneville Tributaries Basin, forestry programs play an important role in protecting and restoring watershed functions and habitat conditions at levels supporting recovery goals. Certainty of forestry-related protection and restoration programs is relatively high because programs are being implemented and, for the most part, fully funded. Program areas of concern include the continued potential for hydrologic impacts caused by past harvest practices. Monitoring of watershed processes and habitat conditions will be required to confirm the effectiveness of these measures.

Protection-related Programs: Watershed process and habitat conditions in the Bonneville Tributaries Basin are well protected through Clark and Skamania Counties' land use controls and the Columbia River Gorge National Scenic Area Act.

Restoration-related Programs: Forest related improvements to the Bonneville Tributaries Basin will accrue over time as a result of improved forest management practices that are already in place. Although several significant projects have occurred (Duncan Creek Access) in the Bonneville Tributaries Basin, there are few agencies and organizations actively working to restore impaired habitat. For example, the Clark and Underwood Conservation Districts are not active in this Basin. Efforts to generate interest and build the capacity of organizations in the Bonneville Tributaries Basin are critical. Significant transportation-related issues in the lower mainstems of the Bonneville Tributaries (e.g., Hamilton Creek) are outstanding restoration needs.

Table 16-8. Program Actions to Address Gaps

Action #	Lead Agency	Proposed Action
BONTRIB.1	Skamania County, N. Bonneville	Develop and implement controls to adequately protect riparian areas to maintain currently functional and restored habitat around rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Require mitigation, where necessary, to offset unavoidable damage to habitat conditions in riparian management areas
BONTRIB.2	Skamania County; N. Bonneville	Development and implement controls to protect historic stream meander patterns and channel migration zones and avoid hardening stream banks and shorelines
BONTRIB.3	Skamania County, N. Bonneville	Development and implement controls and development standards to adequately protect wetlands, wetland buffers, and wetland function.
BONTRIB.4	Clark County, Skamania County, N. Bonneville	Develop and implement controls to address erosion and sediment run-off during (and after) construction to prevent sediment and pollutant discharge to streams, wetlands and other water bodies
BONTRIB.5	Clark County, Skamania County, N. Bonneville	Apply land use and resource protection code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
BONTRIB.6	LCFRB, WDNR. WSDOT, Counties, private property owners.	Develop and implement a coordinated and strategic barrier removal program based on watershed fish priorities and ensuring an effective and efficient sequencing of barrier removal work.
BONTRIB.7	Clark County, Skamania County, N. Bonneville	Utilize a combination of public outreach/education and, incentives, and to promote (1) stewardship practices for protecting habitat and water quality and (2) landowner support of and participation in habitat

		restoration efforts.
BONTRIB.8	State of Washington (DOE, DFW)	Close the Bonneville Tributaries Basin to further surface water withdrawals, including groundwater in connectivity with surface waters; curtail unauthorized withdrawals
BONTRIB.9	LCFRB, WDFW, Clark County, Skamania County, Clark CD, Underwood CD, LCFEG	Build capacity (e.g. technical and administrative skills, personnel and fiscal resources) needed to allow agencies and organizations to undertake protection and restoration projects, including noxious weed control in a reasonable period time.
BONTRIB.10	SRFB, BPA, NOAA, USFWS, DOE, ACOE	Increase available funding for projects that implement measures and address underlying threats
BONTRIB.11	Clark CD	Expand landowner incentive (e.g. CREP) and education plans to promote further habitat protection and restoration.
BONTRIB.12	LCFRB, Clark CD, Clark County, Skamania County	Address threats proactively by building agreement on priorities among the various program implementers
BONTRIB.13	FEMA	Update floodplain maps using Best Available Science

17 Wind River Subbasin

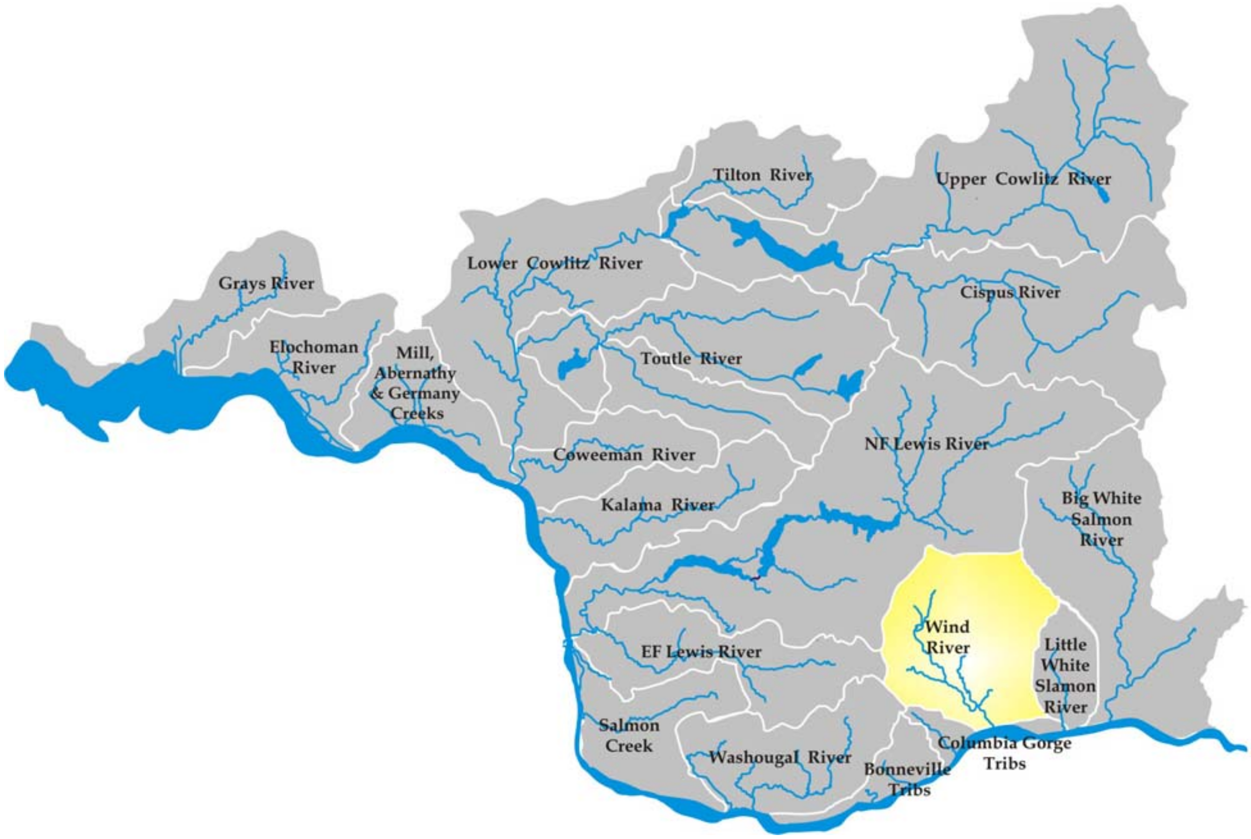


Figure 17-1. Location of the Wind River Subbasin within the Lower Columbia River Basin.

17.1 Basin Overview

The Wind River Subbasin comprises approximately 224 square miles in Skamania County. The river enters the Columbia near the town of Carson, Washington. Principal tributaries include Trout, Panther, and Brush creeks. The subbasin is part of WRIA 29.

The Wind Subbasin will play a key role in the recovery of salmon and steelhead. The subbasin has historically supported populations of fall Chinook, winter and summer steelhead, chum, and coho. Today, Chinook, steelhead and chum are listed as threatened under the ESA. Coho salmon are a candidate for listing. Other fish species of interest are Pacific lamprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

Wind salmon and steelhead are affected by a variety of in-basin and out-of basin factors including stream, Columbia River mainstem, estuary, and ocean habitat conditions; harvest; hatcheries; and ecological relationships with other species. Analysis has demonstrated that recovery cannot be achieved by addressing only one limiting factor. Recovery will require action to reduce or eliminate all manageable factors or threats. The deterioration of habitat conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonids within the Columbia Basin. Direct harvest of listed salmon and steelhead is prohibited but sport and commercial fisheries focusing on hatchery fish and other healthy wild populations, primarily in the mainstem Columbia and ocean, incidentally affect ESA-listed Wind fish. Key ecological interactions of concern include effects of nonnative species; nutrient inputs from salmon carcasses; and predation by species affected by development including Caspian terns, northern pikeminnow, seals, and sea lions. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the Wind Subbasin.

The Wind Subbasin is 93% forested. Non-forested lands include alpine meadows in the upper northeast basin and areas of development in lower elevation, privately-owned areas. Approximately 9.6% of the land is private, while almost all of the remainder lies within the Gifford Pinchot National Forest. Forestry land uses dominate the subbasin. The percentage of the forest in late-successional forest stages has decreased from 83,500 acres to 31,800 acres since pre-settlement times. This change is attributed to timber harvest and forest fires (USFS 1996).

The assessments illustrate the overwhelming importance of the lower mainstem and Panther Canyon reaches for summer steelhead parr rearing. While these reaches are affected by sediment and flow regime impairments originating in upstream subwatersheds, they have healthy local watershed conditions and are well-protected from riparian impacts due to the steepness of the canyons and lack of near-stream roadways. Recovery efforts should ensure that no further degradation of these important reaches occurs.

The next most important area for summer steelhead in the subbasin is the middle Wind mainstem between Stabler and Panther Creek. These alluvial reaches provide potentially abundant spawning and rearing areas but are heavily impacted by a variety of habitat impairments. Past timber harvest, splash dam logging, stream-adjacent roadways, residential development, and flood control levees have served to create unstable conditions with low habitat diversity and high fine sediment loading.

The importance of the mainstem Wind for steelhead and resident fish underscores the importance of retaining or recovering subbasin-wide land cover conditions that affect these key downstream reaches. Due to a large amount of public land in the subbasin, many subwatersheds support functioning watershed process conditions that should be maintained. These actions, combined with vegetation recovery and road removal in impaired subwatersheds, will greatly benefit fish and wildlife populations.

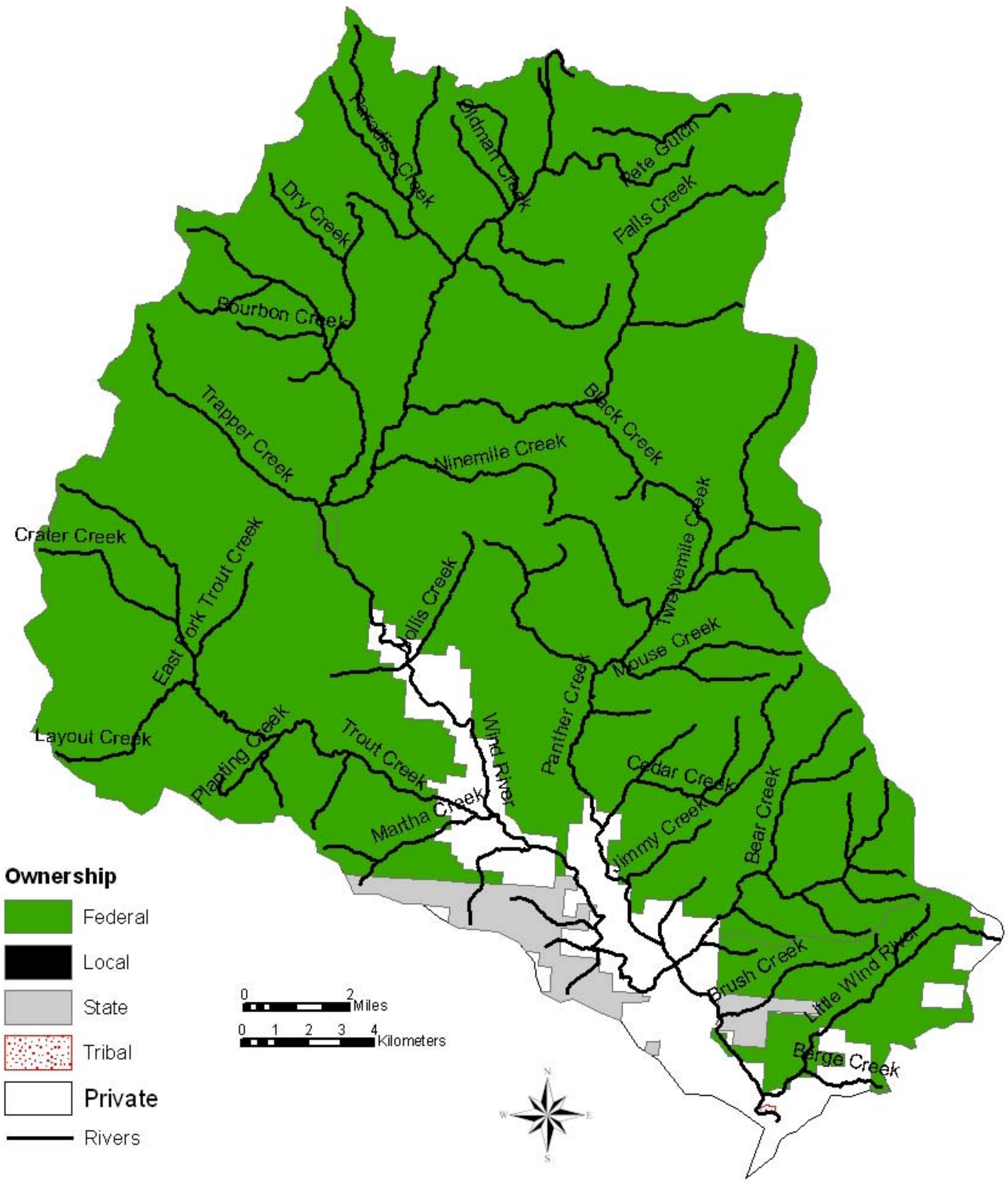
Canyon reaches in Trout Creek (upstream of Hemlock Lake) and lower Panther Creek are important for steelhead rearing. Degraded sediment and flow conditions in these reaches result from watershed process impairments in upstream basins. Contributing factors include high road densities and young vegetation in portions of the Trout Creek and Panther Creek basins. At the least, additional road building and intensive timber harvest in these areas should be avoided.

Although recovery efforts in the middle and upper basin will yield the greatest benefit to most species, targeting local conditions in the lower river could provide important benefits to winter steelhead and fall Chinook, which typically do not ascend Shipherd Falls at river mile 2. Restoration of chum is unlikely because of the effects of Bonneville Dam and Pool.

The largest population centers are the towns of Carson and Stabler. Carson draws its water supply from Bear Creek, a Wind River tributary. The year 2000 population of the subbasin was estimated at 2,096 persons and is expected to increase to 3,077 by 2020 (Greenberg and Callahan 2002). Population growth in the basin is not expected to be a major factor affecting salmon and steelhead habitat in the next 20 years.

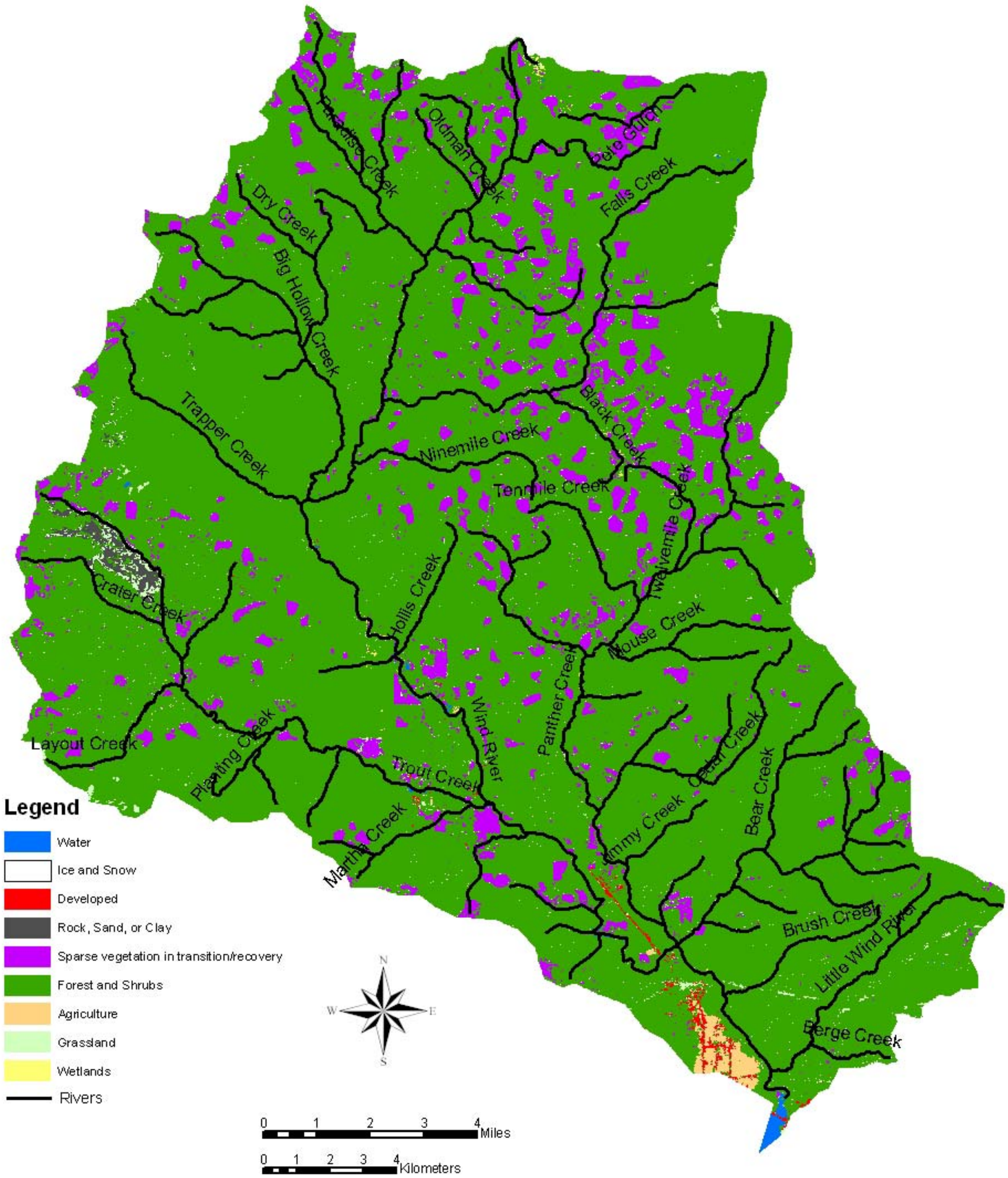
Land Ownership	
Federal	89%
Private	11%
State	0%
Other public	0%

Land Ownership



Vegetation Composition	
Late Seral	25%
Mid Seral	41%
Early Seral	26%
Other Forest	0%
Non Forest	8%

Land Use / Cover



17.2 Species of Interest

Focal salmonid species in the Wind Subbasin include summer steelhead, winter steelhead fall Chinook, chum, and coho. The health or viability of these populations is currently very low for chum, low for fall Chinook, coho, and winter steelhead, and above medium for summer steelhead. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Recovery goals call for restoring summer steelhead to above high viability level, providing for greater than 95% chance of persistence over 100 years, restoring coho to a high viability level, providing for a 95% probability of persistence over 100 years, restoring chum to a medium level of viability, providing for a 75-94% probability of persistence over 100 years, and maintaining fall Chinook and winter steelhead at low viability levels, providing for a 40-74% probability of persistence over 100 years.

Other species of interest in the Wind River include coastal cutthroat trout and Pacific lamprey. Regional objectives for these species are described in Volume I, Chapter 6. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for these other species. Cutthroat will benefit from improvements in stream habitat conditions for salmonids. Lamprey are expected to benefit from habitat improvements in the estuary, Columbia River, and mainstem, and in the Wind Subbasin, although specific spawning and rearing habitat requirements for lamprey are not well known.

Table 17-1. Current viability status of Wind populations and the biological objective status that is necessary to meet the recovery criteria for the Gorge strata and the lower Columbia ESU.

	ESA	Hatchery	Current		Objective	
Species	Status	Component	Viability	Numbers	Viability	Numbers
Fall Chinook	Threatened	No	Low	0-400	Low	1,400-2,400
Winter Steelhead	Threatened	No	Low+	100	Low+	100
Summer Steelhead	Threatened	No	Med+	100-800	High+	1,200-1,900
Chum	Threatened	No	Very Low	<100	Med	<100-1,100
Coho	Candidate	No	Low	200-300	High	unknown

Fall Chinook– The historical Wind River adult tule fall Chinook population is estimated from 2,500-3,500 fish. The current natural spawning number in the tributaries is 0 to 400 fish. However, there are significant numbers of upriver bright (URB) stock fall Chinook (not part of the lower Columbia ESU) that spawn in the lower Wind River. The URB spawners originated from strays produced at Little White Salmon and Bonneville hatcheries. There are also stray tule fall Chinook from Spring Creek Hatchery that spawn in the Wind. Natural spawning occurs primarily in the lower mainstem Wind downstream of Shipperd Falls (RM 2). The tule fall Chinook spawning time is from mid-September to early October. Juvenile rearing occurs near and downstream of the spawning areas. Juveniles migrate from the Bonneville tributaries in the spring and early summer of their first year.

Winter Steelhead– The historical Wind River adult population is estimated at 300-2,500 fish. Current natural spawning returns are about 100 fish. Shipperd Falls was a historical block to winter steelhead until 1956 when a fish ladder was constructed. Spawning occurs in the mainstem to RM 11 and in Trout Creek. Spawning time is early 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 Wind River basin.

Summer Steelhead– The historical Wind River adult population is estimated at 2,000-5,000 fish. Current natural spawning returns range from 100-800 fish. Summer steelhead spawning occurs throughout the Wind Basin including the mainstem Wind, the Little Wind, and Panther, Bear, Trout, Trapper, Dry, and Paradise creeks. Spawning time is early March through May. Juvenile rearing occurs both downstream and upstream of the spawning areas. Juveniles rear for a full year or more before migrating from the Wind River basin.

Chum– The historical Wind River adult population is estimated at 25,000-30,000. Current natural spawning returns are assumed to be very low, since the chum count at Bonneville Dam is typically less than 100 fish. Spawning occurs in the lower reaches below Shipperd Falls, with the majority of historical spawning area now inundated by Bonneville Reservoir. Spawning occurs from late November through December. Natural spawning chum in the Wind are all naturally produced as no hatchery chum are released in the area. Juveniles rear in the lower reaches for a short period in the early spring and quickly migrate to the Columbia.

Coho– The historical Wind and upper Gorge tributary adult early coho population is estimated at 1,000-10,000. Current natural spawning returns are low at about 200-300 fish. There is no coho hatchery production in the Wind River, however significant hatchery coho programs exist nearby in the Little White Salmon and the Klickitat rivers. Spawning occurs primarily in the lower Wind and tributaries, including the Little Wind River. Early coho spawning occurs from mid October to mid-November. Juvenile rearing occurs upstream and downstream of spawning areas. Juveniles rear for a full year in the Wind Basin before migrating as yearlings in the spring.

Coastal cutthroat.– Coastal cutthroat abundance in Wind River has not been quantified but the population is considered depressed. Anadromous and resident forms of cutthroat trout are present in the Wind Subbasin. Anadromous cutthroat enter the Wind River from July-December and spawn from December through June. Most juveniles rear 2-4 years before migrating from their natal stream.

Pacific lamprey.– Information on lamprey abundance is limited and does not exist for the Wind River population. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have declined in the Wind River also. Adult lamprey return from the ocean to spawn in the spring and summer. Juveniles rear in freshwater up to seven years before migrating to the ocean.

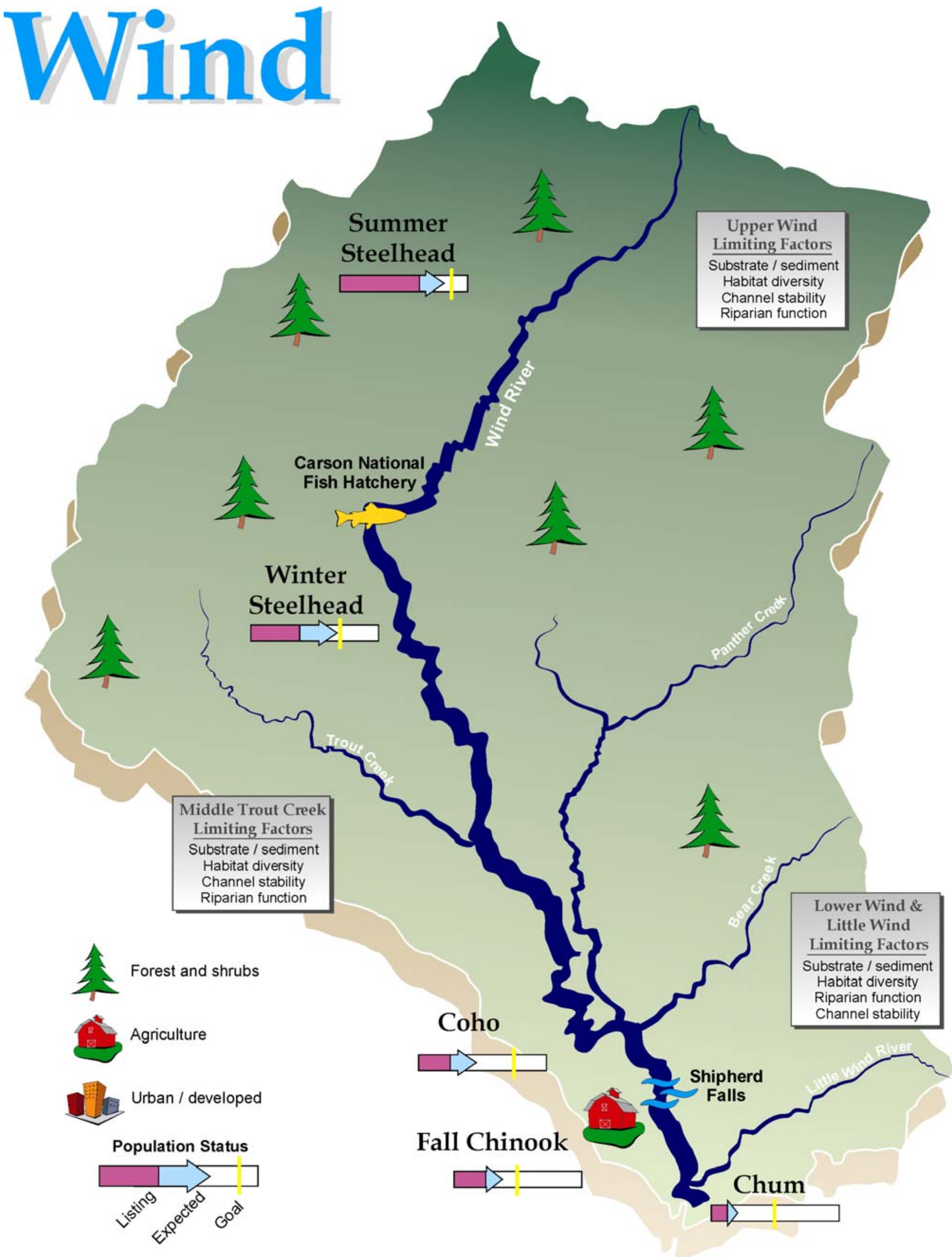


Figure 17-2. Summary of habitat limiting factors, population status, expected population improvement trend with existing programs and biological objectives depicted for the Wind Subbasin.

17.3 Potentially Manageable Impacts

Stream habitat, estuary/mainstem habitat, harvest, hatchery and predation effects have all contributed to reduced salmonid productivity, numbers, and population viability in the Wind Subbasin. The pie charts below represent the relative order of magnitude of quantifiable effects for each of these factors for each focal species. The preferred recovery scenario targets an equivalent reduction in each impact factor in proportion to the magnitude of the effect. Population-specific targets are discussed in further detail in Volume I, Chapter 6.

- Loss of tributary habitat quantity and quality is an important relative impact on all species, while estuary habitat impacts appear to be of lesser importance.
- The impact of hydrosystem access and passage is one of the more important factors for chum and fall Chinook. Hydrosystem effects on chum are substantial enough to minimize the relative importance of all other potentially manageable impact factors.
- Harvest has relatively high impacts on fall Chinook, while harvest impacts to steelhead and coho are moderate. The relative impact of harvest on chum is minor.
- Hatchery impacts are relatively moderate for coho and summer steelhead. Hatchery impacts on chum, fall Chinook, and winter steelhead are low.

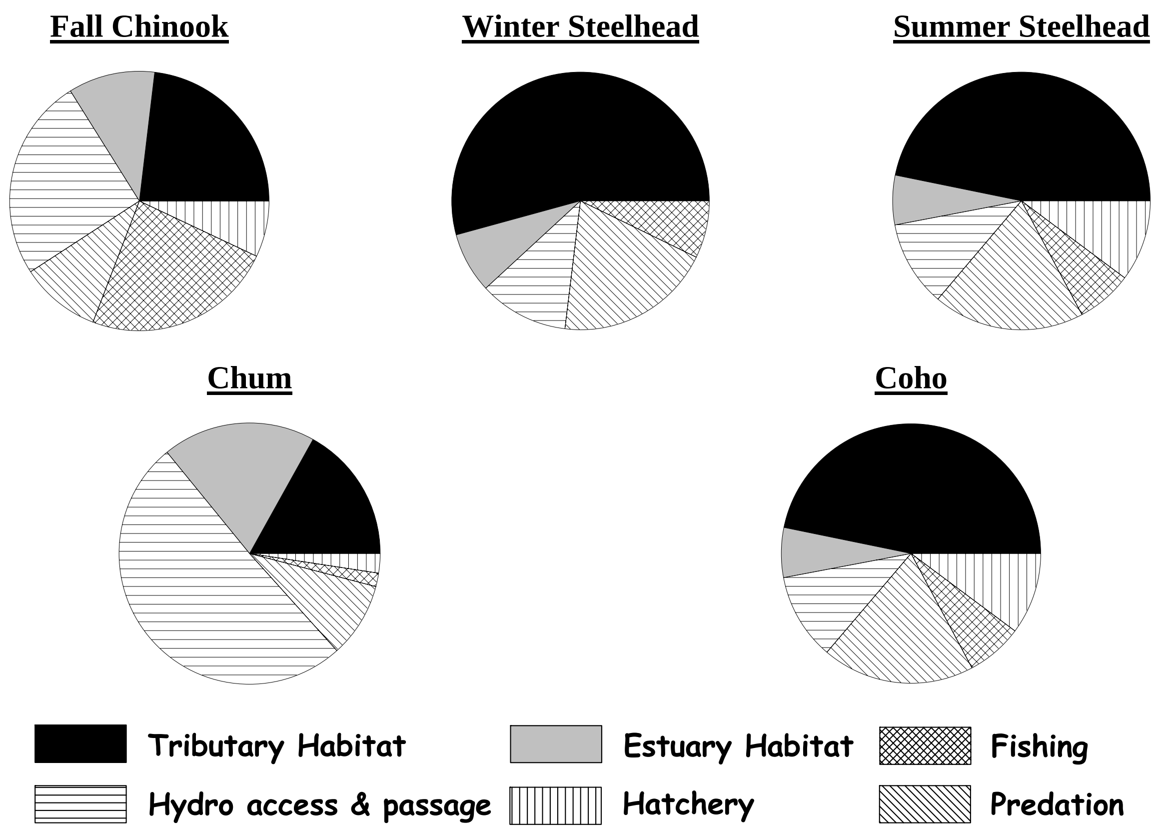


Figure 17-3. Relative contribution of potentially manageable impacts for Wind populations.

17.4 Limiting Factors, Threats, and Measures

17.4.1 Hydropower Operation and Configuration

There are no hydro-electric dams in the Wind River basin. However, Wind species are affected by mainstem Columbia hydro operations and flow regimes which affect habitat in migration corridors and in the estuary. Mainstem hydro factors and threats are addressed by regional strategies and measures identified in Volume I.

17.4.2 Harvest

Most harvest of Wind River wild salmon and steelhead is incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. This mortality is very low for chum and steelhead, but is more significant for fall Chinook. Wind River fall Chinook are harvested in ocean and Columbia River commercial, and sport fisheries, Columbia River treaty Indian fisheries, as well as in-basin sport fisheries. Non-Indian harvest is controlled by an ESA harvest limit associated with Coweeman natural fall Chinook. No harvest of chum occurs in ocean fisheries, there are no directed Columbia River commercial chum fisheries and retention of chum is prohibited in Columbia River and tributary sport fisheries. Chum are impacted incidental to fisheries directed at coho and winter steelhead. Harvest of Wind River coho occurs in the ocean commercial and recreational fisheries off the Washington and Oregon coasts and in the Columbia River. Wild coho impacts are limited by fishery management to retain marked hatchery fish and release unmarked wild fish. 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 marked hatchery steelhead and commercial fisheries cannot retain hatchery or wild steelhead.

Measures 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. The regional measures 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 Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest measures with significant application to Wind River subbasin populations are summarized in the following table:

Table 6. Regional harvest measures with significant application to the Wind Subbasin populations.

Measure	Description	Comments
F.M18	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	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.M19	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	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.M24	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	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.

17.4.3 Hatcheries

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

The Carson National Fish Hatchery (since 1937) operates in the mainstem Wind at RM 18. The hatchery produces spring Chinook for treaty Indian and non-Indian harvest opportunity. Spring Chinook are not native to the Wind River. Releases of summer steelhead from Skamania Hatchery occurred until 1997. The main threats from hatchery released spring Chinook are potential ecological interactions between natural juvenile salmon and steelhead and hatchery released spring Chinook.

Table 17-2. Wind River hatchery production.

Hatchery	Release Location	Spring Chinook
Carson NFH	Wind River	1,420,000

Regional hatchery strategies and measures are focused on evaluating and reducing biological risks and reducing the risks to natural populations. Federal artificial production programs will be evaluated in detail through the Hatchery and Genetic Management Plan (HGMP) process relative to risks to natural populations. The resulting program specific actions will be developed, evaluated, and documented through the HGMPs for public review and consideration by NOAA Fisheries (details in programs Technical Foundation, Volume IV). Regional hatchery measures identified in Volume I, Chapter 7 with potential applications at facilities within the Wind subbasin are summarized in Table 7.

Table 17-3. Regional hatchery measures from Volume I, Chapter 7 with potential implementation actions in the Wind River Subbasin.

Measure	Description	Comments
H.M6	Evaluate Carson NFH facility and operations.	Evaluate through HGMP and APRE processes to assess need for facility and operational changes to reduce impacts to wild salmonids.
H.M22	Juvenile release strategies to minimize impacts to naturally-spawning populations.	Release strategies would be aimed at minimizing interactions between hatchery released spring Chinook smolts and wild steelhead, fall Chinook, chum, and coho.
H.M8	Adaptively manage hatchery programs to further protect and enhance natural populations and improve operational efficiencies.	Appropriate research, monitoring, and evaluation programs along with guidance from regional hatchery evaluations will be utilized to improve the survival and contribution of hatchery fish, reduce impacts to natural fish, and increase benefits to natural fish.

17.4.4 Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Wind salmon and steelhead are affected throughout their lifecycle by ecological interactions with non-native species, food web components, and predators. Interactions are similar for Wind populations to those of most other subbasin salmonid populations. These Ecological Interactions are addressed by regional strategies and measures identified in Volume I.

17.4.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. 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 are similar for Wind populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook than spring Chinook, steelhead, and coho. Estuary and mainstem effects on Wind salmon and steelhead populations are addressed by regional strategies and measures identified in Volume I and the Columbia Mainstem and Estuary Subbasin sections of Volume II.

17.4.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity 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 Wind River basin have the greatest impact on the health and viability of salmon and steelhead relative to the other limiting factors and threats discussed in this chapter.

Subwatersheds, reaches, and habitat attributes have been prioritized for protection and/or restoration based on the plan's biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Priority areas for habitat preservation and restoration are identified in Figure 17-4. A summary of the primary habitat limiting factors and threats are presented in Table 17-5. Habitat measures and related information are presented in Table 17-6. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 17-5. Reach- and subwatershed-scale limiting factors generated from the technical assessment are included in Table 17-4. Details on species-specific spatial priorities and limiting factors at the subbasin level may be found in Volume II of the Technical Foundation. A description of the methodology used to generate composite (multi-species) reach and subwatershed priorities can be found in the introduction to this volume of the recovery plan.

The areas with the greatest current or potential contribution to focal salmonid population health and productivity are listed below. Tier 1 and 2 reaches within these priority areas are included in the list. The habitat limiting factors, threats, and measures included in this chapter focus primarily on the priority areas and the Tier 1 and 2 reaches within them. Tier, 3, 4, and non-tiered reaches are considered secondary priority, but in many cases, these lower priority areas will also require restoration and preservation actions in order to achieve recovery objectives. Watershed process measures generally focus on the entire basin as opposed to being limited only to high priority areas because conditions in high priority areas are often influenced by cumulative watershed effects. High priority areas and reaches in the Wind River basin include the following:

- Lower mainstem and Little Wind – Wind 1-3; Little Wind 1
- Middle & upper mainstem Wind – Wind 5a-7b
- Trout Creek – Trout 1a-2b; Martha Creek
- Wind and Panther Creek Canyons – Wind 4a-4b; Panther 1a-1b
- Upper Panther – Panther 1e-2a

The following paragraphs provide a brief overview of each of these priority areas, including species most affected, land-use threats, and the general type of measures that will be necessary for recovery. Additional detail can be found in the tables and figures that follow.

While reach level habitat conditions often result from local factors, they are also affected or shaped by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input, and large woody debris recruitment are often affected by or result from upstream conditions and degraded watershed processes. Access to key reaches may also be affected by barriers that occur downstream of a reach. Accordingly, restoration of a priority reach may require action outside the targeted reach. The IWA analysis was used to identify potential upstream watershed areas that could influence reach level habitat attributes. EDT was used to allow a relative comparison of reaches and habitat attributes within a reach.

The lower mainstem and Little Wind River reaches provide habitat for fall Chinook, chum, coho, and winter steelhead, all of which do not typically ascend Shipherd Falls at river mile 2. These reaches are impacted by the Bonneville Dam impoundment, development activities around the towns of Carson and Home Valley, and basin-wide forest practices. Effective recovery measures here will include controlling excessive runoff and soil erosion from the Carson Golf Course, floodplain reconnection near the mouth of the Little Wind, and passive restoration of riparian areas. Emphasis should also be placed on addressing sediment supply conditions in the Little Wind Basin.

Productive reaches in the middle and upper mainstem are located between Stabler and Paradise Creek. These reaches have been impacted by upper basin forest practices and by localized riparian and floodplain development. Although restoration opportunities exist in these reaches, the primary recovery emphasis is preservation. The lower (privately-owned) reaches are likely to witness increased development along the river valley bottom. It is imperative that land-use planning and critical areas protections are adequate to prevent impairment of habitat and habitat-forming processes.

The Trout Creek system contains productive steelhead spawning habitat in the Trout Creek flats area (reach Trout 1d) and good rearing in the reach just upstream of Hemlock Lake. Trout Creek flats was heavily impacted by past forest practices and has undergone significant restoration in recent years. The primary recovery emphasis is for preservation. These reaches are almost entirely within the Gifford Pinchot National Forest and there is good potential for continued preservation and passive restoration of watershed processes.

The lower Wind and Panther Creek canyons have good current production and have been identified in the technical assessment as having high preservation value. The Wind Canyon is located between Shipherd Falls and Trout Creek. Panther Creek Canyon extends from the mouth of Panther Creek to approximately Cedar Creek. Although these reaches are surrounded by private lands, they are relatively protected from riparian impacts due to steep, inaccessible canyons. Residential development encroaches into the riparian corridor of Panther Creek in a few places but the impacts are minor. These reaches are most important for steelhead parr rearing. The recovery emphasis is for preservation and therefore no limiting factors or threats are identified for these areas.

Upper Panther Creek also has high preservation value. These relatively functioning stream reaches support summer steelhead spawning and rearing and are completely within the Gifford Pinchot National Forest. There are good opportunities for passive restoration and preservation of watershed process conditions in the Panther Creek Basin.

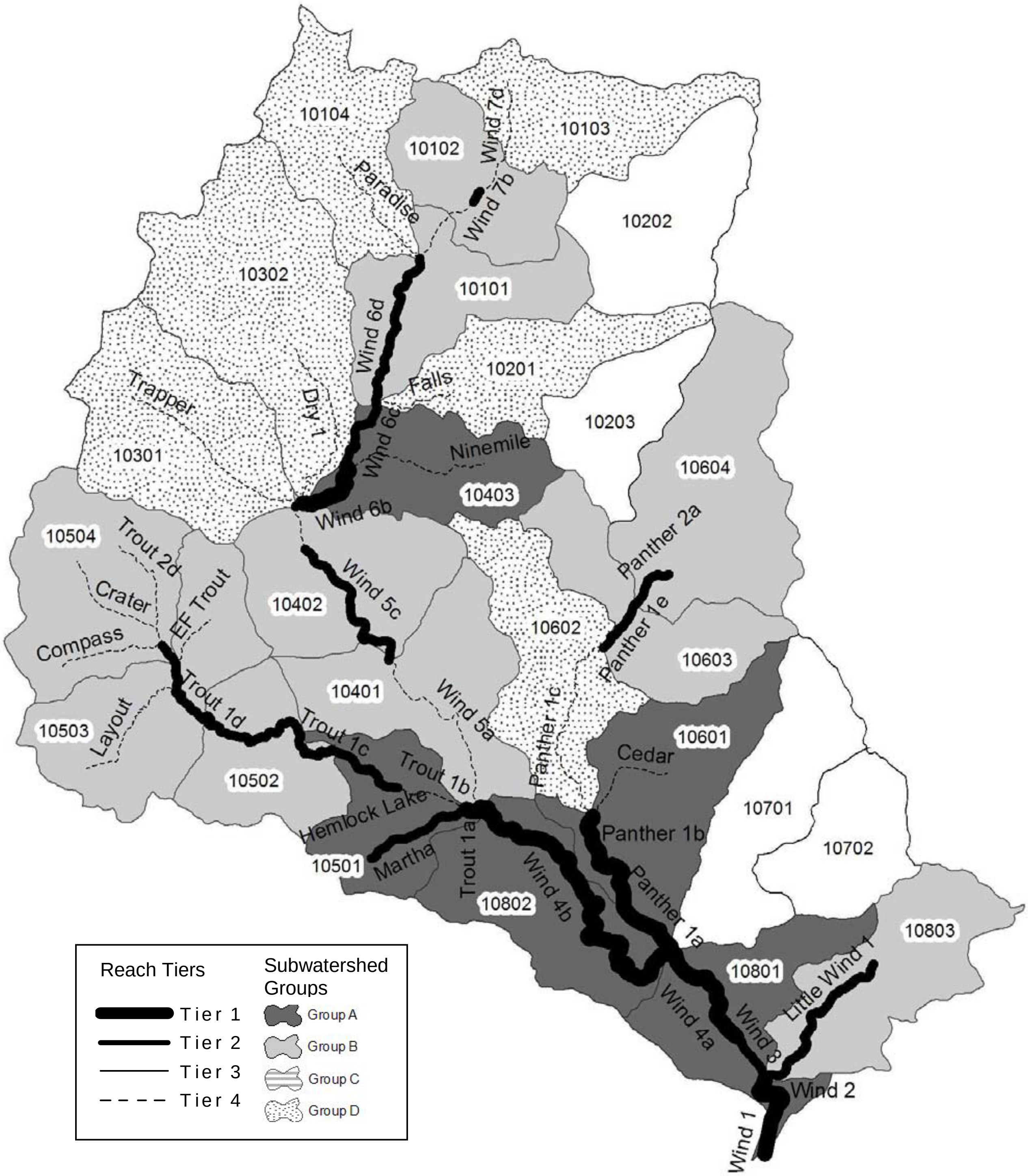


Figure 17-4. Reach tiers and subwatershed groups in the Wind River Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities at 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.

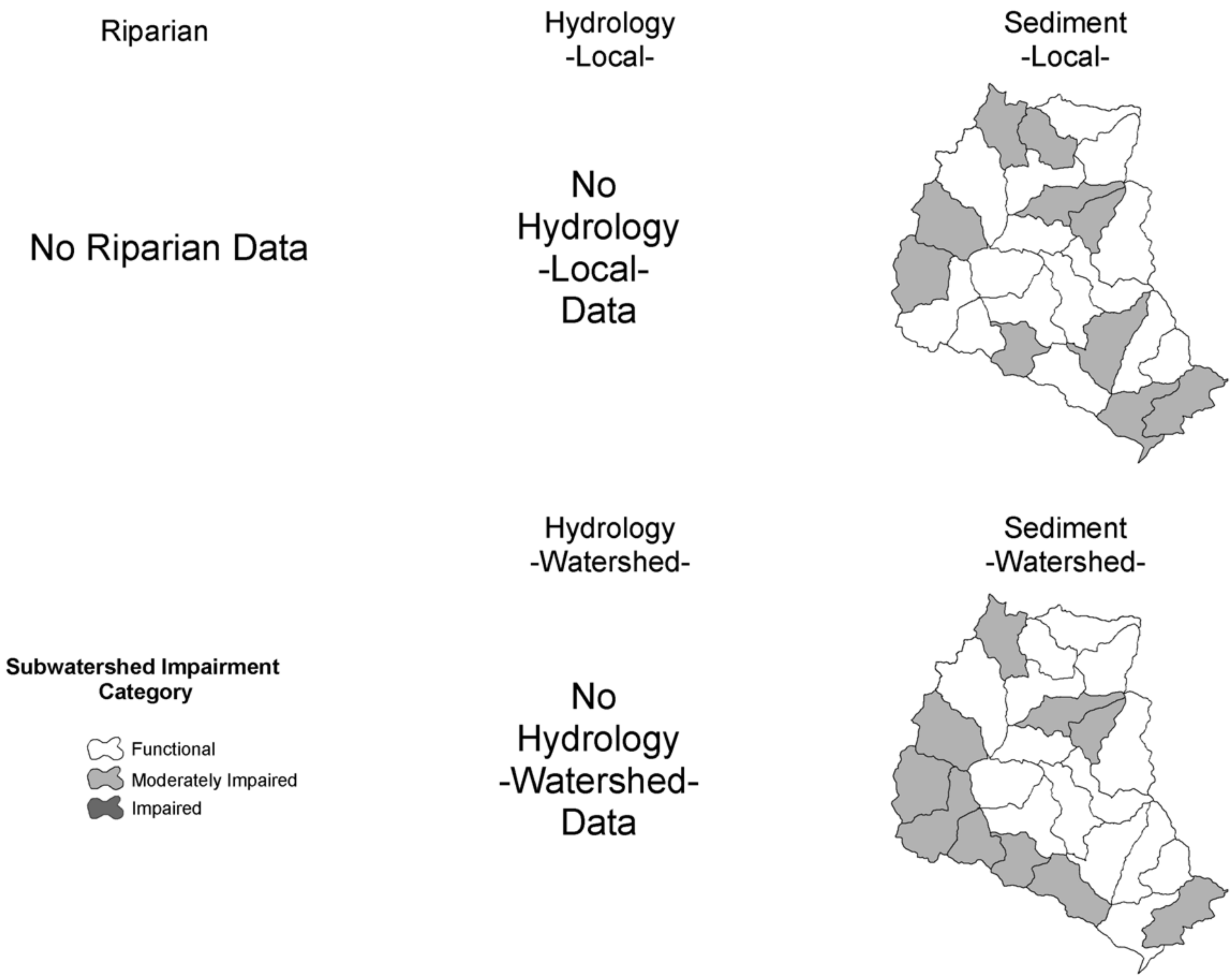


Figure 17-5. IWA subwatershed impairment ratings by category for the Wind River Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 17-4. 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. ND = No Data available for the analysis

								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	10802	Wind 4b	StS	Wind 4b	Egg incubation Fry colonization Summer rearing Winter rearing	sediment	P	ND	F	ND	ND	M
	10801	Shipherd Falls	Chum	Wind 2	Spawning Egg incubation Fry colonization Adult holding	none	PR	ND	M	ND	ND	F
		Wind 1	StS	Wind 4a	Egg incubation Fry colonization Summer rearing Winter rearing	habitat diversity sediment	P					
		Wind 2 Wind 3 Wind 4a	Coho	Wind 1 Wind 2	Spawning Egg incubation Fry colonization Summer rearing Juvenile migrant (age 0) Winter rearing Adult holding	habitat diversity key habitat quantity	PR					
			ChF	Wind 2	Spawning Egg incubation Fry colonization Adult holding	none	P					
			StW	none								
	10601	Cedar Panther 1a Panther 1b	StS	Panther 1a Panther 1b	Egg incubation Fry colonization Summer rearing Winter rearing	habitat diversity sediment	P	ND	M	ND	ND	F
	10501	Hemlock Dam Hemlock Lake Martha Trout 1a Trout 1b Trout 1c	StS	Trout 1a	Egg incubation Fry colonization Summer rearing Winter rearing	habitat diversity	P	ND	M	ND	ND	M
	10403	Ninemile Wind 6b Wind 6c	StS	Wind 6b	Egg incubation Fry colonization Summer rearing Adult holding	none	P	ND	F	ND	ND	F
B	10803	Little Wind 1	Coho	none				ND	M	ND	ND	M
			StW	Little Wind 1	Spawning Egg incubation Fry colonization Summer rearing Adult holding	key habitat quantity	PR					
	10604	Panther 2a Panther 2b	StS	none				ND	F	ND	ND	F
	10603	Panther 1e	StS	none				ND	F	ND	ND	F
	10504	Compass Crater Trout 2a Trout 2b Trout 2c Trout 2d	StS	none				ND	M	ND	ND	M
	10503	EF Trout Layout Trout 1d Trout 2a	StS	none				ND	F	ND	ND	M
	10502	Trout 1c Trout 1d	StS	none				ND	F	ND	ND	M
	10402	Wind 5c Wind 5d Wind 6a	StS	none				ND	F	ND	ND	F
	10401	Wind 5a Wind 5b	StS	none				ND	F	ND	ND	F
	10102	Wind 7a Wind 7b Wind 7c	StS	none				ND	M	ND	ND	F
	10101	Wind 6d Wind 7a	StS	none				ND	F	ND	ND	F
D	10602	Panther 1c Panther 1d	StS	none				ND	F	ND	ND	F
	10302	Dry 1	StS	none				ND	F	ND	ND	F
	10301	Trapper	StS	none				ND	M	ND	ND	M
	10201	Falls	StS	none				ND	M	ND	ND	M
	10104	Paradise	StS	none				ND	M	ND	ND	M
	10103	Wind 7d	StS	none				ND	F	ND	ND	F

Table 17-5. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the lower mainstem & Little Wind (LW), middle & upper mainstem Wind (UW), and Trout Creek (TR). Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors	LW	UW	TR
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 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	✓	✓	✓
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	LW	UW	TR
Rural development			
Clearing of vegetation	✓	✓	
Floodplain filling	✓	✓	
Increased impervious surfaces	✓		
Increased drainage network	✓		
Roads – riparian/floodplain impacts	✓	✓	
Leaking septic systems	✓	✓	
Forest practices			
Timber harvests –sediment supply impacts	✓	✓	✓
Timber harvests – impacts to runoff		✓	✓
Riparian harvests	✓		✓
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	✓	✓	

Table 17-6. Habitat measures in priority areas, with reference to limiting factors addressed, threats addressed, target species, and estimated time until benefits would be realized (time). Tier 1 and 2 reaches, or other areas of known priority, are listed under the location column for some measures (i.e., stream corridor measures). Reaches not included in the table (Tier, 3, 4, and non-tiered reaches) are considered secondary priority.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
1. Protect and restore floodplain function and channel migration processes ***A. Set back, breach, or remove artificial channel confinement structures***					
Lower Wind & Little Wind Wind 3; Little Wind 1 ***Middle Wind*** Wind 5a-5d	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes • Channel incision	• Floodplain filling • Channel straightening • Artificial confinement	• All species	2-15 years	Great potential benefit due to improvements in many limiting factors. This passive restoration approach can allow channels to restore naturally once confinement structures are removed. There are challenges with implementation on private lands due to existing infrastructure already in place, potential flood risk to property, and large expense. Opportunities exist in areas of public ownership in these reaches.
2. Protect and restore off-channel and side-channel habitats ***A. Restore historical off-channel and side-channel habitats where they have been eliminated*** ***B. Provide access to blocked off-channel habitats*** ***C. Create new off-channel or side-channel habitats (i.e., spawning channels)***					
Lower Wind & Little Wind Wind 3; Little Wind 1 ***Middle Wind*** Wind 5a-5d	• Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats • Altered habitat unit composition	• Artificial confinement • Channel straightening • Floodplain filling	• chum • Coho • Summer steelhead	2-15 years	Good potential benefit especially for chum (lower Wind), which have lost a significant portion of historically available off-channel habitat for spawning. Potential benefit is limited by moderate probability of success with creation of new habitats. There are challenges with implementation due to existing infrastructure already in place, private property, and large expense. No regulatory mechanisms in place for this type of restoration.
3. Protect and restore riparian function ***A. Reforest riparian zones*** ***B. Allow for the passive restoration of riparian vegetation*** ***C. Livestock exclusion fencing*** ***D. Invasive species eradication*** ***E. Hardwood-to-conifer conversion***					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
Lower Wind & Little Wind Wind 1-3; Little Wind 1 ***Middle & upper Wind*** Wind 5a-7b ***Trout Creek*** Trout 1a-2b; Martha Cr	• Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or noxious species	• Timber harvest – riparian harvests • Riparian grazing • Clearing of vegetation due to rural development	• All species	20-100 years	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. Riparian protections on forest lands are provided for under current harvest policy. Riparian restoration projects are relatively inexpensive and are often supported by landowners. The specified stream reaches are the highest priority for riparian measures, however, riparian restoration and preservation should occur throughout the basin since riparian conditions affect downstream reaches. Use IWA riparian ratings to help identify restoration and preservation opportunities.
4. Protect and restore streambank stability ***A. Restore eroding streambanks*** ***B. Restore mass wasting (landslides, debris flows) within river corridors***					
Lower mainstem Wind 2-3 ***Middle mainstem*** Wind 5a-5c	• Reduced bank/soil stability • Excessive fine sediment • Embedded substrates	• Artificial confinement • Clearing of vegetation • Roads – riparian / floodplain impacts	• All species	5-50 years	There are a few areas along the lower mainstem where landslides, debris flows, and gullies have contributed large quantities of sediment to the river. Inadequate control of runoff at the Carson Golf Course is a major contributor. There are also portions of the middle Wind with severe bank erosion concerns. Recovery measures should focus on controlling stormwater runoff and using bio-engineered approaches that rely on structural as well as vegetative techniques to stabilize erosion-prone areas.
5. Protect and restore natural sediment supply processes ***A. Address forest road related sources*** ***B. Address timber harvest related sources*** ***C. Address agricultural sources*** ***D. Address developed land sources***					
Entire basin	• Excessive fine sediment • Embedded substrates	• Timber harvest – impacts to sediment supply • Forest roads – impacts to sediment supply	• All species	5-50 years	High potential benefit due to sediment effects on egg incubation and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. There are challenges with

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
		• Development – impacts to sediment supply			implementation on developing lands due to few sediment-focused regulatory requirements for developed lands. Use IWA impairment ratings to identify restoration and preservation opportunities.
6. Protect and restore runoff processes ***A. Address forest road impacts*** ***B. Address timber harvest impacts*** ***C. Limit additional watershed imperviousness*** ***D. Manage stormwater runoff***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Timber harvest – impacts to runoff • Forest roads – impacts to runoff • Increased impervious surfaces • Increased drainage network (road ditches, storm drains) • Clearing of vegetation (development, agriculture)	• All species	5-50 years	High potential benefit due to flow effects on habitat formation, redd scour, and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. There are challenges associated with addressing runoff issues on developed lands due to continued increase in watershed imperviousness related to development and lack of adequate mitigation. Use IWA impairment ratings to identify restoration and preservation opportunities.
7. Protect and restore instream flows ***A. Water rights closures*** ***B. Purchase or lease existing water rights*** ***C. Relinquishment of existing unused water rights*** ***D. Enforce water withdrawal regulations*** ***E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Water withdrawals	• All species	1-5 years	Instream flow management strategies for the Wind River basin are being identified as part of Watershed Planning for WRIA 29.
8. Protect and restore water quality ***A. Restore the natural stream temperature regime*** ***B. Reduce fecal coliform bacteria levels***					
Entire basin	• Altered stream temperature regime • Bacteria	• Riparian harvests • Riparian grazing • Leaking septic	• All species	1-50 years	Primary emphasis for restoration should be placed on stream segments that are listed on the 2004 303(d) list.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
		systems			
9. Protect and restore instream habitat complexity ***A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting*** ***B. Structurally modify stream channels to create suitable habitat types***					
Lower Wind & Little Wind Wind 1-3; Little Wind 1 ***Middle & upper Wind*** Wind 5a-7b ***Trout Creek*** Trout 1a-2b; Martha Cr	• Lack of stable instream woody debris • Altered habitat unit composition	• None (symptom-focused restoration strategy)	• All species	2-10 years	Moderate potential benefit due to the high chance of failure. Failure is probable if habitat-forming processes are not also addressed. These projects are relatively expensive for the benefits accrued. Moderate to high likelihood of implementation given the lack of hardship imposed on landowners and the current level of acceptance of these type of projects. There has been considerable success with LWD installation projects on several reaches in the Wind River basin.
10. Protect and restore fish access to channel habitats ***A. Hemlock Dam and Lake***					
Trout Creek Hemlock Dam and Lake	• Blockages to channel habitats	• Hemlock Dam	• summer steelhead	immediate	Hemlock Dam and Lake may present a passage concern for juvenile and adult fish, although the extent of the impact is unknown. The USFS is currently evaluating options for dam removal.
11. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development ***A. Plan growth and development to avoid sensitive areas (e.g. wetlands, riparian zones, floodplains, unstable geology)*** ***B. Encourage the use of low-impact development methods and materials*** ***C. Apply mitigation measures to off-set potential impacts***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	The focus should be on management of land-use conversion and managing continued development in sensitive areas (e.g., wetlands, stream corridors, unstable slopes), especially within the river corridor of the middle mainstem. Many critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary mechanisms need to be put in place to restore currently degraded habitats.
12. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection ***A. Purchase properties outright through fee acquisition and manage for resource protection*** ***B. Purchase easements to protect critical areas and to limit potentially harmful uses*** ***C. Lease properties or rights to protect resources for a limited period***					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit. These programs are under-funded and have low landowner participation.

17.5 Program Gap Analysis

The Wind Basin (~224 sq mi) is located in Skamania County. Approximately 10% of the land is private, while almost all of the remainder lies within the Gifford Pinchot National Forest. Forestry land uses dominate the subbasin.

- Gifford Pinchot Forest lands comprise approximately 200 square miles of the Wind Basin;
- Department of Natural Resources timber lands are estimated at 5 square miles;
- Private lands along the lower Wind mainstem are estimated at 10 square miles;
- There are no significant industrial forest lands;
- The Wind River subbbasin falls entirely in Skamania County.
- Carson and Stabler are unincorporated communities within the subbasin.
- Population growth is expected to remain stable over the next 20 years.

<u>Protection Programs</u>

Protection programs in the Wind Basin are implemented by the Gifford Pinchot NF, the Department of Natural Resources, Skamania County, and other regulatory agencies. Protection programs in this analysis include programs that protect habitat conditions or watershed functions through management policies and programs, regulatory measures, incentives, and fee title acquisition or the purchase of easements. Major programs implementing protection measures are identified below.

Federal Programs

➢ ***U.S. Forest Service Gifford Pinchot National Forest*:**
- The Gifford Pinchot NF Plan provides high levels of protection for riparian areas and forest stands within the Wind Basin; [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8A]
  - ✓ Riparian buffers in all areas of the Gifford Pinchot NF are at least 300’.
  - ✓ A significant portion of the Wind Basin is “Administratively Withdrawn” under protections offered through the Columbia Gorge National Scenic Act.
  - ✓ Most of the Wind Basin is managed as “Late-Successional Reserves,” and as a result, has excellent protections.
  - ✓ Some of the uppermost reaches of the Wind River is located in the Indian Heaven Wilderness Area. Trapper Creek headwaters are further protected by the Trapper Creek Wilderness Area.

➢ ***U.S. Army Corps of Engineers***

- Administers the Section 10 (Rivers and Harbor Act) and Section 404 (Clean Water Act) permit processes. Section 10 requires approval of any activity in, above, or below a navigable river, which affects course, location, condition, or capacity of navigable waters. Section 404 requires prior approval of dredging, filling, grading, clearing, and bank hardening. In waters used by listed fish species, the permits are subject to ESA Section 7 consultation with NOAA Fisheries to ensure that any approved action is adequately protective of the fish; [M.1A; M.2A; M.2B; M.9A; M.9B]

State Programs

- ***Department of Natural Resources***
  - State Forest Land HCP: State forest lands are managed under the provisions of a Habitat Conservation Plan (HCP). The Habitat Conservation Plan has protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8A]
  - State Forest Practices: Riparian areas and watershed functions on small- and industrial forest lands are protected under the State of Washington Forest Practices Rules, including the Forest and Fish Module. These rules provide for riparian buffers, harvest restrictions, sensitive area protections, and protective standards for new road construction. [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8A]

- ***Washington Department of Fish and Wildlife:***

  - Hydraulics Project Approval (HPA): The Department administers the state Hydraulic Code. The purpose of this program is to protect stream conditions and habitat. The regulations apply to such activities as streambank protection, instream construction, culvert installation, channel changes or realignments, debris removal, and water diversion facilities. Those proposing such actions must obtain a Hydraulic Project Approval (HPA) permit. [M.1A; M.2A; M.2B; M.9A; M.9B]

  - Habitat Program: The Department provides advice to local governments and landowners interested in measures to protect habitat values on their property. [M.1A; M.2A; M.2B; M.3A; M.4A; M.4B; M.5D; M.6D; M.7A; M.7B; M.7C; M.7D; M.7E; M.8A; M.9B; M.9A; M.9B]

- ***Washington Department of Ecology***

  - Water Resources Program/Water Rights: Department of Ecology, in consultation with the Department of Fish and Wildlife, has administratively closed selected areas within the North Fork Lewis watershed to further surface and groundwater withdraws (where groundwater is in continuity with surface water). Existing administrative closures by the Department of Ecology protect surface waters from further withdrawals. Formal rule-making would strengthen the closures. The extent of unauthorized surface water withdrawals is unknown, but may have the potential to adversely impact low summer stream flows. Currently, there are approximately 58 cfs of water rights in the EF Lewis. It is unknown how much of this volume is being utilized for beneficial uses. This compares to an average August low flow of 83 cfs. [M.7A; M.7B; M.7C; M.7D]

  - Water Resources Program/Watershed Planning: In cooperation with Skamania County, other state and federal agencies, tribes, local governments, and citizens, the Department funds and participates in a state authorized watershed planning process for Water Resource Inventory Area (WRIA) 29 pursuant to RCW 90.82. The goal of the plan is to ensure adequate water for people and fish. The planning process is dealing with water quantity and quality, stream flows and fish habitat. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.7A; M.7B; M.7C; M.7D; M.8A; M.8B; M.11A]

Local Government Programs

- ***Skamania County***
  - Comprehensive Planning and Land Use Regulation: Skamania County is required by state law to have a critical areas ordinance. It is not otherwise required to plan in accordance with the Washington Growth Management Act (GMA). The County's land use controls provide only fair protection of watershed processes and habitat. Wetland and stream setbacks range from 25 to 200 feet depending on the class designation. The County shoreline management ordinance provisions for the Wind protect the shorelines from substantial development or extensive timber harvest within a 200-foot buffer. [M.11A; M.11B; M.11C]
  - Road and Parks Programs: The County Road and Parks and Recreation programs have implemented management practices to deal with environmental issues.

Restoration Programs

Restoration programs in the Wind Basin are implemented by a variety of agencies, organizations, and private interests. Major programs implementing protection measures are identified below:

Federal Programs

- ***Gifford Pinchot National Forest***
  - The Wind Basin is one of five priority areas for the Gifford Pinchot NF. It receives significant restoration attention in terms of instream work, road decommissioning, and riparian restoration. Restoration efforts have focused on the Trout Creek watershed and the mining reach of the upper Wind River. [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8A]

State Programs

- ***Department of Natural Resources***
  - State Forest Land Habitat Conservation Plan (HCP): The Department manages state forest lands pursuant to a Habitat Conservation Plan (HCP). The HCP road maintenance and restoration objectives require barrier upgrades and road abandonment and/or other improvements. [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8A]
  - State Forest Practices Act:
    - Industrial forests within the lower NF Lewis Basin are governed by Forest and Fish regulations and have rigid schedules for maintaining and improving roads and removing barriers. Industrial landowners have 15 years to bring roads and barriers into compliance with regulations [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8A]
    - Small private forest owners are governed by Forest and Fish regulations; however their road and barrier maintenance and improvement programs are tied to state funding. In the State 2003-05 Biennial Budget, 2 million dollars was allocated statewide to support small private forest owners. [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.8A]

- ***Department of Fish and Wildlife***

    - Habitat Program: The Department provides advice and assistance to local governments and landowners interested in measures to restore habitat. [M.1A; M.2A; M.2B; M.3A; M.4A; M.4B; M.5D; M.6D; M.7A; M.7B; M.7C; M.7D; M.7E; M.8A; M.9B; M.9A; M.9B]

- ***Conservation Commission/ Underwood Conservation District:*** The Conservation District provides technical assistance and incentives (e.g., Conservation Reserve and Enhancement Program) to encourage agricultural landowners to restore riparian areas and stream habitat. The Conservation District is actively involved in the subbasin. It supports the Wind River Watershed Council and has sponsored several restoration projects within the Basin, including Upper Trout Creek Restoration and Sand Hill Road Landslide renovation. [M.1A; M.2A; M.2B; M.3A; M.3C; M.4A; M.4B; M.5C; M.8A; M.8B; M.9A; M.9B]

Local Government Programs

No active programs

Community Restoration Programs

- ***Wind River Watershed Council:*** This organization comprised of federal, state, and local agencies and interested community members develop watershed policies and restoration projects and priorities. [M.3A; M.9A; M.9B]

Gap Analysis

***Forest-related Programs*:** In the Wind Basin, forestry programs have a prominent role in protecting and restoring watershed functions and habitat conditions at levels supporting recovery goals. This is because forestry management and regulatory programs apply to approximately 93 % of the basin. The Wind Basin benefits from very high levels of protection and restoration from the Gifford Pinchot National Forest. Certainty of forestry-related protection and restoration programs is relatively high because programs are being implemented and funded. Program areas of concern include the continued potential for hydrologic impacts caused by past harvest practices. Monitoring of watershed processes and habitat conditions will be required to confirm the effectiveness of these measures.

Protection-related Programs: Watershed processes and habitat in the mid and lower Wind Basin have some protections through Skamania County's land use regulations. Skamania County's comprehensive plan and land use ordinances have fair levels of protection; however, Best Available Science updates would improve their Critical Area Ordinances and Shoreline Master Program. In addition, as in all lower Columbia subbasins, there are very limited protection mechanisms for agricultural practices relative to riparian areas and hydrologic impairment.

Restoration-related Programs: Forest related improvements to the Wind Basin will accrue over time as a result of improved forest management practices that are already in place.

Significant restoration activities are occurring in the Wind Basin and there appears to be excellent cooperation among the Forest Service, Underwood Conservation District and the Washington Department of Fish and Wildlife. Noxious weed control efforts are a concern in the Wind, as they are in most basins in the region. Focused attention on the Japanese Knotweed, as well as other invasive plant species is important.

Table 17-7. Program Actions to Address Gaps

Action #	Lead Agency	Proposed Action
WIND.1	Skamania County, Carson, Stabler	Develop and implement controls to adequately protect riparian areas to maintain currently functional and restored habitat around rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Require mitigation, where necessary, to offset unavoidable damage to habitat conditions in riparian management areas
WIND.2	Skamania County; Carson, Stabler	Development and implement controls to protect historic stream meander patterns and channel migration zones and avoid hardening stream banks and shorelines
WIND.3	Skamania County, Carson, Stabler	Development and implement controls and development standards to adequately protect wetlands, wetland buffers, and wetland function.
WIND.4	Skamania County, Carson, Stabler	Develop and implement controls to address erosion and sediment run-off during (and after) construction to prevent sediment and pollutant discharge to streams, wetlands and other water bodies
WIND.5	Skamania County, Carson, Stabler	Apply land use and resource protection code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
WIND.6	LCFRB, WDNR. WSDOT, Counties, private property owners.	Develop and implement a coordinated and strategic barrier removal program based on watershed fish priorities and ensuring an effective and efficient sequencing of barrier removal work.
WIND.7	Skamania County, Underwood Conservation District	Utilize a combination of public outreach/education and, incentives, and to promote (1) stewardship practices for protecting habitat and water quality and (2) landowner support of and participation in habitat restoration efforts.
WIND.8	State of Washington (DOE, DFW)	Close the Wind Basin to further surface water withdrawals, including groundwater in connectivity with surface waters; curtail unauthorized withdrawals
WIND.9	LCFRB, WDFW, Skamania County, Underwood CD, LCFEG	Build capacity (e.g. technical and administrative skills, personnel and fiscal resources) needed to allow agencies and organizations to undertake protection and restoration projects, including noxious weed control in a reasonable period time.
WIND.10	SRFB, BPA, NOAA, USFWS, DOE, ACOE	Increase available funding for projects that implement measures and address underlying threats
WIND.11	State of Washington (Dept of Agriculture, and Department of Ecology)	Develop and implement agricultural practices and regulations to protect riparian conditions and water quality
WIND.12	Underwood CD	Expand landowner incentive (e.g. CREP) and education plans to promote further habitat protection and restoration.
WIND.13	LCFRB, Underwood CD, Skamania County	Address threats proactively by building agreement on priorities among the various program implementers
WIND.14	FEMA	Update floodplain maps using Best Available Science

18 Little White Salmon Subbasin

Figure 18-1. Location of the Little White Salmon River Subbasin within the Lower Columbia River Basin.

18.1 Basin Overview

The Little White Salmon Subbasin encompasses approximately 136 square miles just east of the Cascade Crest. The river enters the Columbia River at Drano Lake at RM 162. Anadromous fish use is limited in this basin with only 500 feet of available habitat in the lower river.

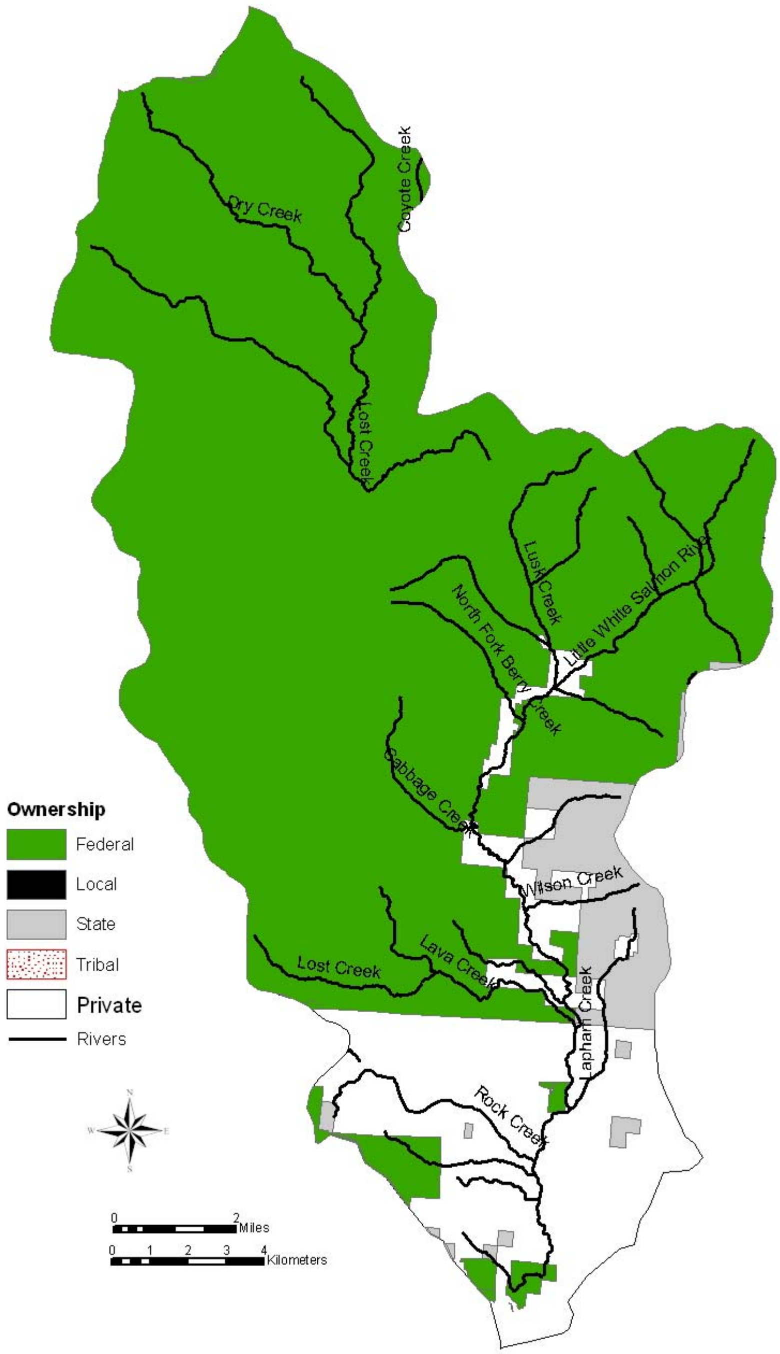
The Little White Salmon Subbasin will play a relatively minor role in the recovery of salmon and steelhead due to the very small amount of available habitat. The subbasin historically supported fall Chinook and chum but much of the habitat was lost with the construction of Bonneville Dam. Today, Chinook and chum are listed as threatened under the ESA. Little White Salmon Chinook and chum are affected by a variety of in-basin and out-of-basin factors including stream, Columbia River mainstem, estuary, and ocean habitat conditions; harvest; hatcheries; and ecological relationships with other species. Recovery will require action to reduce or eliminate all manageable factors or threats. The deterioration of habitat conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonids within the Columbia Basin. Direct harvest of listed salmon and steelhead is prohibited but sport and commercial fisheries focusing on hatchery fish and other healthy wild populations, primarily in the mainstem Columbia and ocean, incidentally affect ESA-listed Little White Salmon fish. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the Little White Salmon Subbasin.

Nearly the entire basin is forested, with timber harvest being the primary land use. The northern three-quarters of the basin is within the Gifford Pinchot National Forest (GPNF). The southern portion is privately owned, with scattered rural residential development and small-scale agriculture. Approximately 20% of the basin is in early-seral vegetation.The major population centers are Willard, Cook, and Mill A. The year 2000 population, estimated at 513 persons, is forecasted to increase to 753 by 2020 (Greenberg and Callahan 2002). Population growth in the basin is not expected to be a major limiting factor affecting fish habitat in the next 20 years.

The greatest area of concern for anadromous fish is the lower mainstem. The historically limited amount of habitat accessible to anadromous fish in the lower mainstem has been further limited by Bonneville Dam and by the hatchery barrier dam.

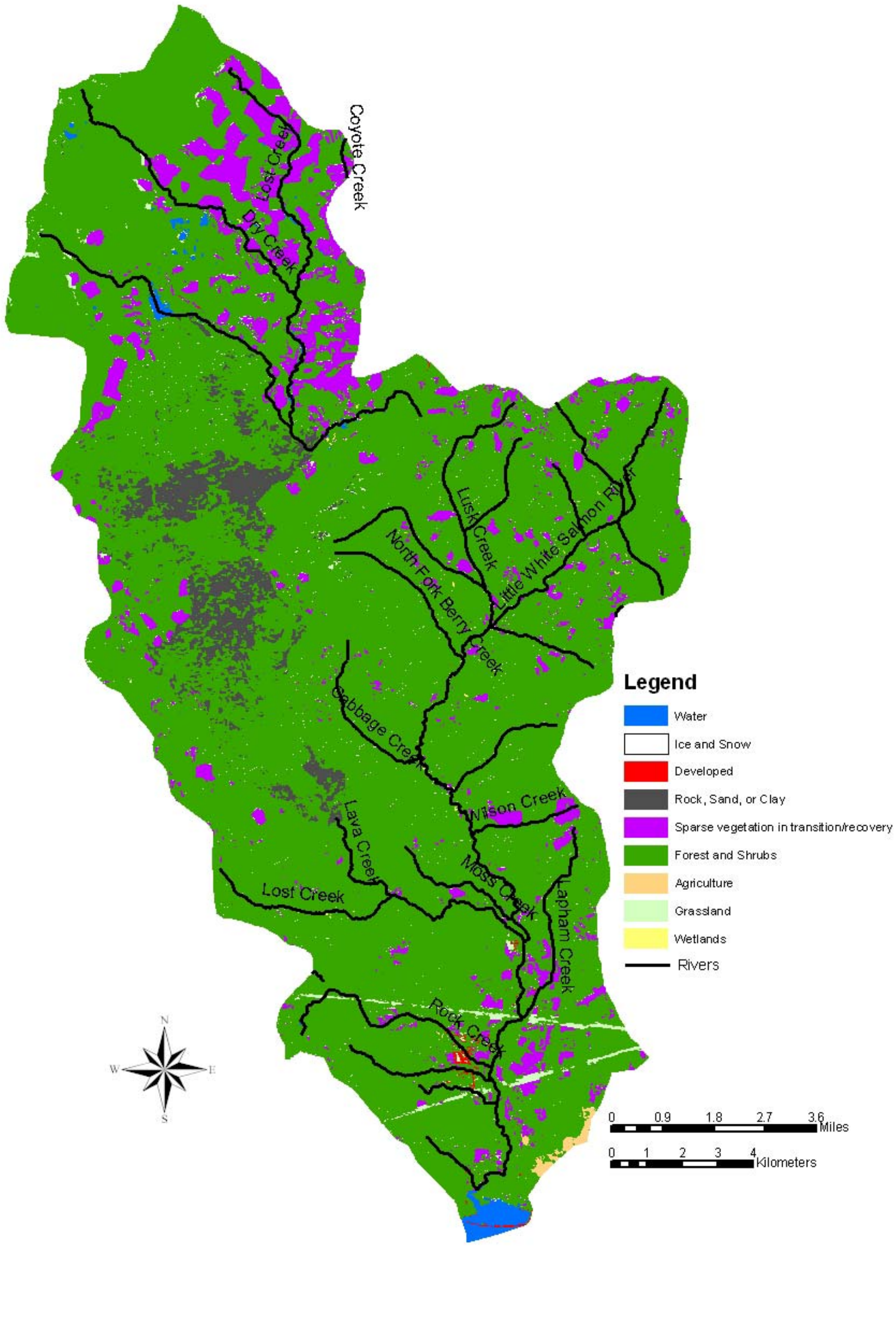
Land Ownership	
Private	22%
Federal	78%
State	0%
Other public	0%

Land Ownership



Vegetation Composition	
Late Seral	35%
Mid Seral	30%
Early Seral	20%
Non Forest	15%

Land Use / Cover



18.2 Species of Interest

Focal salmonid species in the Little White Salmon Subbasin include fall Chinook and chum. The health or viability of these populations is currently very low for chum and low for fall Chinook. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Recovery goals call for restoring chum to a medium viability level, providing for 75-94% probability of persistence over 100 years, and maintaining fall Chinook at low viability levels, providing for a 40-74% probability of persistence over 100 years. Spawning habitat for salmon and other species of interest is limited with only 400 meters of spawning area between a natural anadromous blockage by a falls at RM 1.5 and Drano Lake (where the river mouth is inundated by Bonneville Reservoir).

Table 18-1. Current viability status of Little White Salmon populations and the biological objective status that is necessary to meet the recovery criteria for the Cascade strata and the lower Columbia ESU.

Species	ESA Status	Hatchery Component	Current Viability	Current Numbers	Objective Viability	Objective Numbers
Fall Chinook	Threatened	Yes	Low	100-200	Low	na
Chum	Threatened	No	Very low	Very low	Medium	na

Fall Chinook– The historical Little White Salmon adult tule fall Chinook population is estimated from 4,000-5,000 fish. Current natural spawning returns are 100-200 fish. The Little White Salmon Hatchery produces URB fall Chinook which are not part of the lower Columbia ESU. Fall Chinook spawning occurs in a ¼ mile stretch of river downstream from the Little White Salmon Hatchery and Drano Lake. Spawning occurs from mid-September to mid-October. The URB fall Chinook from late October through November. Juvenile rearing occurs near and downstream of the spawning areas. Juveniles migrate from the Bonneville tributaries in the spring and early summer of their first year.

Chum– The historical size of the adult population is unknown, but historical accounts indicate there were chum present in the lower Little White Salmon. Current natural spawning returns are assumed to be very low or zero. Most of the chum habitat is inundated by Bonneville Reservoir.

18.3 Limiting Factors, Threats, and Measures

18.3.1 Hydropower Operation and Configuration

There are no hydro-electric dams in the Little White Salmon River Basin. However, Little White Salmon species are affected by mainstem Columbia hydro operations and flow regimes which affect habitat in migration corridors and in the estuary. Mainstem hydro factors and threats are addressed by regional strategies and measures identified in Volume I.

18.3.2 Harvest

Most harvest of Little White Salmon wild fall Chinook and chum occurs incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. This mortality is very low for chum, but is more significant for fall Chinook. Little White Salmon fall Chinook are harvested in ocean and Columbia River commercial and sport fisheries, in-basin sport fisheries, and Columbia River treaty Indian fisheries. Non-Indian harvest is controlled by an ESA harvest limit associated with Coweeman natural fall Chinook. No harvest of chum occurs in ocean fisheries, there are no directed Columbia River commercial chum fisheries and retention of chum is prohibited in Columbia River and tributary sport fisheries. Some chum can be impacted incidental to fisheries directed at coho and winter steelhead.

Measures 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. The regional measures 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 Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is applicable to steelhead and salmon while regional management is more applicable to salmon.

18.3.3 Hatcheries

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

The Little White National Fish Hatchery (since 1937) operates in the Little White Salmon at RM 1, and the Williard National Fish Hatchery is located at RM 5. These hatcheries coordinate production of coho, spring Chinook, and fall Chinook and are referred to as the Little White Salmon Hatchery Complex. The hatchery complex produces Carson stock spring Chinook, URB stock fall Chinook, and early stock coho for treaty Indian and non-Indian harvest. The main threats associated with the salmon hatchery programs are domestication of natural salmon populations and potential ecological interactions between hatchery and natural juveniles

Table 18-2. Little White Salmon Hatchery Production.

Hatchery	Release Location	Fall Chinook (URB Stock)	Early Coho	Spring Chinook
Little White Salmon Complex	Little White Salmon River	2,000,000	1,000,000	1,000,000

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 Little White Salmon facilities will be evaluated in detail through the HGMP process. The resulting program specific actions will be developed, evaluated, and documented through the HGMP for public review and consideration by NOAA Fisheries (details in programs Technical Foundation, Volume IV). Regional hatchery measures identified in Volume I, Chapter 7 with potential applications at facilities within the Little White salmon subbasin are summarized in Table 18-3.

Table 18-3. Regional hatchery measures from Volume I, Chapter 7 with potential implementation actions in the Little White Salmon River Subbasin.

Measure	Description	Comments
H.M23,41	Mass mark hatchery produced coho and spring Chinook.	Will enable out-of-basin selective fishing and accountability of hatchery fish spawning in the wild.
H.M6	Evaluate Little White Salmon Hatchery Complex facilities and operations	Evaluate through HGMP and APRE processes to assess need for facility and operational changes to reduce impacts to wild salmonids.
H.M22	Juvenile release strategies to minimize impacts to naturally-spawning populations.	Release strategies would be aimed at minimizing interactions between hatchery released spring Chinook smolts and wild fall Chinook and chum.
H.M8	Adaptively manage hatchery programs to further protect and enhance natural populations and improve operational efficiencies.	Appropriate research, monitoring, and evaluation programs along with guidance from regional hatchery evaluations will be utilized to improve the survival and contribution of hatchery fish, reduce impacts to natural fish, and increase benefits to natural fish.

18.3.4 Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Little White Salmon River salmon are affected throughout their lifecycle by ecological interactions with non-native species, food web components, and predators. Interactions are similar for Little White Salmon populations to those of most other subbasin salmonid populations. Ecological Interactions are addressed by regional strategies and measures identified in Volume I.

18.3.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. 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 are similar for Little White Salmon populations to those of most other subbasin salmonid populations. Effects are likely to be great for chum and fall Chinook. Estuary and mainstem effects on Little White Salmon salmon populations are addressed by regional strategies and measures identified in Volume I and the Columbia Mainstem and Estuary Subbasin sections of Volume II.

18.3.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity have significantly altered watershed processes and reduced both the quality and quantity of habitat needed to sustain viable populations of salmon and steelhead. There is currently very little habitat available to anadromous fish in the Little White Salmon Subbasin. Historically, anadromous fish could ascend only as far as RM 3, where a barrier falls (Spirit Falls) blocked upstream passage. Approximately 1 mile of this historically available habitat was impounded by Bonneville Dam and is now Drano Lake. The remaining two miles are currently blocked by the barrier dam at the Little White Salmon National Fish Hatchery. No fish are passed above the barrier dam due to limited available habitat and a concern of the effects of naturally-spawning fish introducing pathogens to the hatchery.

Due to the small amount of available habitat and the low potential contribution of Little White Salmon fish populations to regional recovery objectives, the Little White Salmon populations have not been analyzed using the EDT model and reaches have not been prioritized. Nevertheless, the lowest reach of the mainstem between the barrier dam and the barrier falls provides potential habitat for anadromous fish and the remainder of the basin contains abundant habitat for resident fish and wildlife. The limiting factors and threats that are listed in this chapter were obtained primarily through consideration of the USFS Little White Salmon Watershed Analysis (USFS 1995) and the Washington Conservation Commission Limiting Factors Analysis (WCC 1999). A summary of the primary habitat limiting factors and threats are presented in Table 18-4. Habitat measures and related information are presented in Table 18-5. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 18-2.

The areas with the greatest potential production of anadromous salmonid populations in the Little White Salmon basin are the following:

- Lower mainstem – from Drano Lake to the barrier falls (RM 3)

While reach level habitat conditions often result from local factors, they are also affected or shaped by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input and large woody debris recruitment are often affected by or result from upstream conditions and degraded watershed processes. Access to key reaches may also be affected by barriers that occur downstream of a reach. Accordingly, restoration of a priority reach may require action outside the targeted reach. The IWA analysis was used to identify potential upstream watershed areas that could influence reach level habitat attributes.

There is very little habitat available to anadromous fish in the Little White Salmon Subbasin. The reach with the greatest potential to support natural spawning is the 400-500 meter reach between the hatchery barrier dam and the hatchery water intake (RM 1.5, measured from the Hwy 14 Bridge). There is additional potential habitat above the intake up to the barrier falls at RM 3 but this stretch of river is confined within a steep canyon and spawning habitat is likely limited. The lower reach (barrier dam to intake) is in relatively good condition though past forest practices (log flumes) and the current hatchery complex have impacted floodplain function and riparian vegetation. Re-introduction of naturally-spawning fish above the barrier dam warrants further investigation and may be reasonable if fish health concerns can be adequately addressed. At a minimum, existing habitat quality should be protected. If fish passage is provided, this reach may present opportunities for riparian and floodplain restoration. Within and downstream of the hatchery complex, there may also be potential sites for creation of new habitats (i.e., spawning channels) to compensate for lost or currently inaccessible habitat.

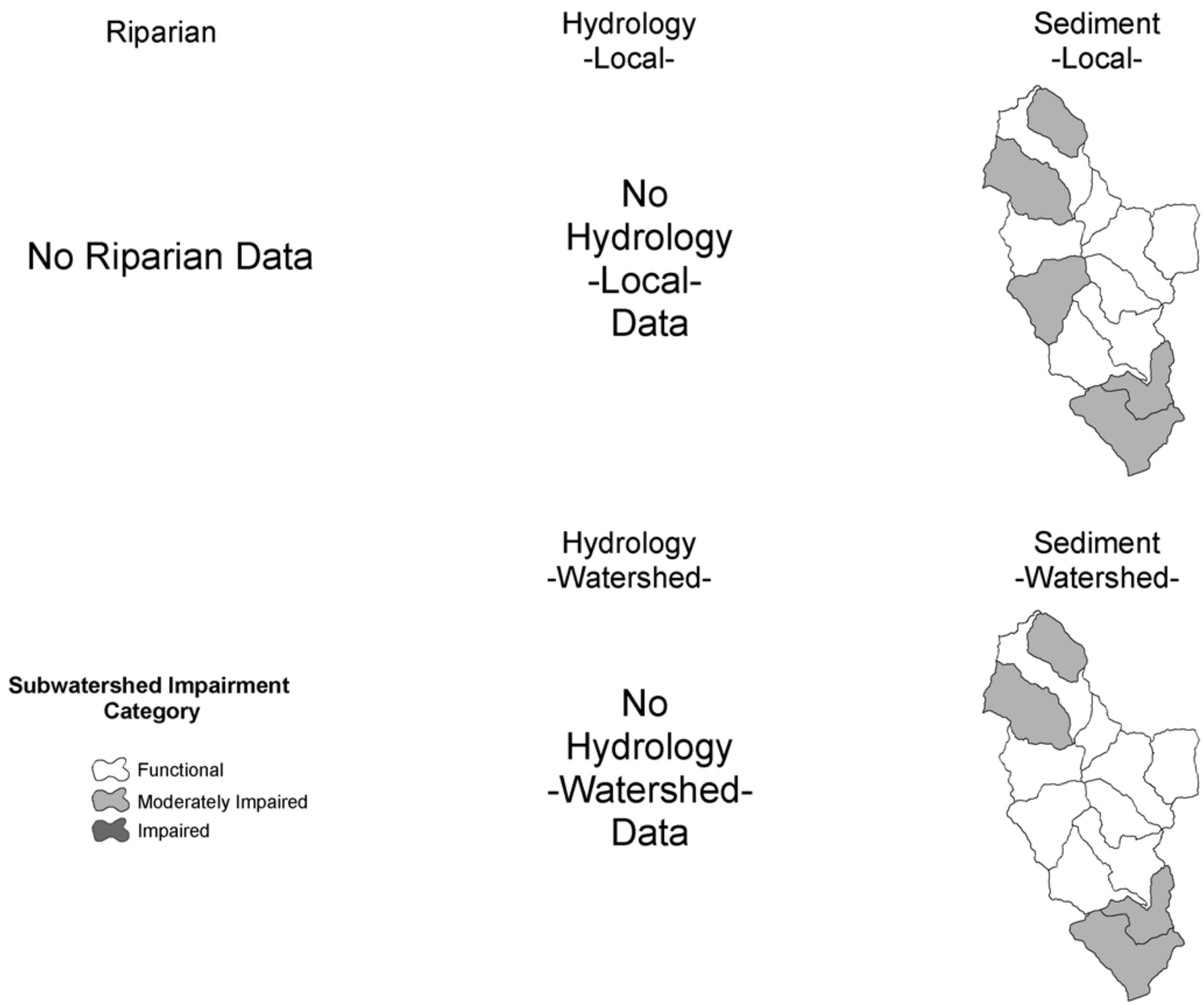


Figure 18-2. IWA subwatershed impairment ratings by category for the Little White Salmon Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 18-4. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the lower mainstem (LM). Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors		Threats	
	LM		**LM**
Habitat connectivity		***Forest practices***	
Blockages to channel habitats	✓	Timber harvests –sediment supply impacts	✓
Habitat diversity		Forest roads – impacts to sediment supply	✓
Lack of stable instream woody debris	✓	***Channel manipulations***	
Altered habitat unit composition	✓	Blockages to channel habitat	✓
Loss of off-channel and/or side-channel habitats	✓	***Hatchery complex development***	
Riparian function		Floodplain filling	✓
Reduced stream canopy cover	✓	Clearing of vegetation	✓
Reduced wood recruitment	✓	Barrier Dam	✓
Floodplain function			
Altered nutrient exchange processes	✓		
Reduced flood flow dampening	✓		
Restricted channel migration	✓		
Disrupted hyporheic processes	✓		
Substrate and sediment			
Excessive fine sediment	✓		
Embedded substrates	✓		

Table 18-5. Habitat measures in priority areas, with reference to the limiting factors addressed, threats addressed, target species, and estimated time until benefits would be realized (Time). Reaches not included in the table are considered secondary priority.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
1. Evaluate issues related to providing fish passage above the hatchery barrier dam					
Lower mainstem	• Blockages to channel habitats	• Hatchery Barrier Dam	• Spring Chinook • Coho	1-5 years	Fish are not passed above the barrier dam due to hatchery fish health concerns. Two miles of potentially productive habitat exists above the dam if fish health concerns can be adequately addressed.
2. Evaluate opportunities for channel, riparian, and floodplain restoration if passage is provided above the hatchery barrier dam					
Lower mainstem	• Lack of woody debris • Altered habitat unit composition • Loss off-channels or side channels • Reduced stream canopy cover • Reduced wood recruitment	• Floodplain filling • Clearing of vegetation (past logging practices and hatchery complex development)	• Spring Chinook • Coho	2-50 years	The riparian zone and floodplain in the 400-500 meter reach upstream of the barrier dam is moderately degraded. If fish are re-introduced to this reach, there may be some potential for riparian, channel, and floodplain restoration; including reforestation, large wood supplementation, and off-channel/side-channel creation. The lower mainstem is the highest priority for stream corridor restoration, however, stream corridor restoration and preservation should occur throughout the basin to benefit resident fish, wildlife, and anadromous fish in downstream reaches.
3. Protect and restore natural sediment supply processes ***A. Address forest road related sources*** ***B. Address timber harvest related sources***					
Entire basin	• Excessive fine sediment • Embedded substrates	• Timber harvest – impacts to sediment supply • Forest roads – impacts to sediment supply	• All species	5-50 years	High potential benefit due to sediment effects on egg incubation and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. Use IWA impairment ratings to identify restoration and preservation opportunities.
4. Protect and restore runoff processes ***A. Address forest road impacts*** ***B. Address timber harvest impacts***					
Entire basin	• Stream flow – altered magnitude, duration, or	• Timber harvest – impacts to runoff	• All species	5-50 years	High potential benefit due to flow effects on habitat formation, redd scour, and early

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
	rate of change of flows	• Forest roads – impacts to runoff			rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. Use IWA impairment ratings to identify restoration and preservation opportunities.
5. Protect and restore instream flows ***A. Water rights closures*** ***B. Purchase or lease existing water rights*** ***C. Relinquishment of existing unused water rights*** ***D. Enforce water withdrawal regulations*** ***E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Water withdrawals	• All species	1-5 years	Instream flow management strategies for the Little White Salmon Basin have been identified as part of Watershed Planning for WRIA 29. Strategies will need to include water rights closures, setting of minimum flows, and drought management policies.
6. Protect and restore water quality ***A. Restore the natural stream temperature regime***					
Entire basin	• Altered stream temperature regime	• Riparian harvests	• All species	1-50 years	Primary emphasis for restoration should be placed on stream segments that are listed on the 2004 303(d) list.
7. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development ***A. Plan growth and development to avoid sensitive areas (e.g. wetlands, riparian zones, floodplains, unstable geology)*** ***B. Encourage the use of low-impact development methods and materials*** ***C. Apply mitigation measures to off-set potential impacts***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	The focus should be on management of land-use conversion and managing continued development in sensitive areas (e.g., wetlands, stream corridors, unstable slopes). Critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary mechanisms need to be put in place to restore currently degraded habitats.
8. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection ***A. Purchase properties outright through fee acquisition and manage for resource protection*** ***B. Purchase easements to protect critical areas and to limit potentially harmful uses***					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
C. Lease properties or rights to protect resources for a limited period					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit. These programs are under-funded and have low landowner participation.

18.4 Program Gap and Sufficiency Analysis

The Little White Basin (~136 sq mi) is located in Skamania and Klickitat Counties. Approximately 75% of the land lies within the Gifford Pinchot National Forest. Forestry land uses dominate the subbasin.

- Gifford Pinchot Forest lands comprise approximately 106 square miles of the Little White Basin;
- Department of Natural Resources public lands are estimated at 8 square miles;
- Private lands along the Little White mainstem are estimated at 22 square miles;
- Skamania and Klickitat County has regulatory authority for private lands within the Basin;
- Willard and Cook are unincorporated communities within the Basin;
- Population growth is expected to remain stable over the next 20 years.

<u>Protection Programs</u>

Protection programs in the Little White Basin are implemented by the Gifford Pinchot NF, the Department of Natural Resources, Skamania County, and other regulatory agencies. Protection programs in this analysis include programs that protect habitat conditions or watershed functions through management policies and programs, regulatory measures, and fee title acquisition or the purchase of easements. Major programs implementing protection measures are identified below.

Federal Protection Programs

- ***Gifford Pinchot National Forest*:**
  - The Gifford Pinchot NF Plan provides high levels of protection for riparian areas and forest stands within the Little White Basin; [M.3A; M.3B; M.4A; M.4B; M.6A]
    - ✓ Riparian buffers in all areas of the Gifford Pinchot NF are at least 300';
    - ✓ A significant portion of the Little White Basin is "Matrix," (managed for multiple objectives);

- ***U.S. Army Corps of Engineers***

  - Administers the Section 10 (Rivers and Harbor Act) and Section 404 (Clean Water Act) permit processes. Section 10 requires approval of any activity in, above, or below a navigable river, which affects course, location, condition, or capacity of navigable waters. Section 404 requires prior approval of dredging, filling, grading, clearing, and bank hardening. In waters used by listed fish species, the permits are subject to ESA Section 7 consultation with NOAA Fisheries to ensure that any approved action is adequately protective of the fish; [M.1; M2]

State Protection Programs

- ***Department of Natural Resources***

  - <u>State Forest Land HCP:</u>

    State forest lands are managed under the provisions of a Habitat Conservation Plan (HCP). The Habitat Conservation Plan protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. [M.3A; M.3B; M.4A; M.4B; M.6A]

- State Forest Practices:

  Riparian zones and harvest restrictions represent significant protections under the State of Washington Forest Practices Rules, including the Forest and Fish Module. These rules also establish standards for new road construction. [M.3A; M.3B; M.4A; M.4B; M.6A]

➢ ***Washington Department of Fish and Wildlife***

- Washington State Hydraulic Code

  The Washington State Hydraulic Code is administered through the Washington Department of Fish and Wildlife. The purpose of this program is to protect stream conditions and habitat. The regulations apply to such activities as stream bank protection, instream construction, culvert installation, channel changes or realignments, debris removal, and water diversion facilities. Those proposing such actions must obtain a Hydraulic Project Approval (HPA) permit; [M.1; M2]

Local Government Protection Programs

➢ ***Skamania County***

- Comprehensive Planning and Land Use Regulation: Skamania County is required by state law to have a critical areas ordinance. It is not otherwise required to plan in accordance with the Washington Growth Management Act (GMA). The County's land use controls provide only fair protection of watershed processes and habitat. Wetland and stream setbacks range from 25 to 200 feet depending on the class designation. The County shoreline management ordinance provisions for the Little White protect the shorelines from substantial development or extensive timber harvest within a 200-foot buffer. [M.7A; M.7B; M.7C]
- Road and Parks Programs: The County Road and Parks and Recreation programs have implemented management practices to deal with environmental issues. [M.6A]

Restoration Programs

Restoration programs in the Little White Basin are implemented by a variety of agencies, organizations, and private interests. Major programs implementing protection measures are identified below:

Federal Restoration Programs

➢ ***Gifford Pinchot National Forest***

- The Little White Basin is not a priority restoration area in the Gifford Pinchot NF; [M.3A; M.3B; M.4A; M.4B; M.6A]

State Restoration Programs

➢ ***Department of Natural Resources***

- State Forest Land Habitat Conservation Plan (HCP): The Department manages state forest lands pursuant to a Habitat Conservation Plan (HCP). The HCP road maintenance and restoration objectives require barrier upgrades and road abandonment and/or other improvements. [M.3A; M.3B; M.4A; M.4B; M.6A]

- State Forest Practices Act:
  - Industrial forests within the lower NF Lewis Basin are governed by Forest and Fish regulations and have rigid schedules for maintaining and improving roads and removing barriers. Industrial landowners have 15 years to bring roads and barriers into compliance with regulations [M.3A; M.3B; M.4A; M.4B; M.6A]
  - Small private forest owners are governed by Forest and Fish regulations; however their road and barrier maintenance and improvement programs are tied to state funding. In the State 2003-05 Biennial Budget, 2 million dollars was allocated statewide to support small private forest owners [M.3A; M.3B; M.4A; M.4B; M.6A].

➢ ***Department of Fish and Wildlife***

- Habitat Program: The Department provides advice and assistance to local governments and landowners interested in measures to restore habitat. [M.1; M.2; M.5A; M.5B; M.5C; M.5D; M.6A; M.7A; M.7B; M.7C]

Local Government Restoration Programs

No Active Programs.

Community Restoration Programs

No active programs

Gap Analysis

Forest-related Programs: In the Little White Basin, forestry-related programs, particularly the Gifford Pinchot National Forest Plan, have an important role in protecting and restoring watershed functions and habitat conditions at levels supporting recovery goals. Certainty of forestry-related protection and restoration programs is relatively high because programs are being implemented and funded. Program areas of concern include the continued potential for hydrologic impacts caused by past harvest practices. Monitoring of watershed processes and habitat conditions will be required to confirm the effectiveness of these measures.

Protection-related Programs: Watershed processes and habitat in the Little White Basin have limited protection through Skamania County's land use regulations. Skamania County's comprehensive plan and land use ordinances have good levels of protection; however, Best Available Science updates would improve their Critical Area Ordinances and Shoreline Master Program. In addition, as in all lower Columbia subbasins, there are very limited protection mechanisms for agricultural practices relative to riparian areas and hydrologic impairment.

Restoration-related Programs: Passive restoration in the forests of the Little White Basin will accrue over time as a result of improved forest management practices that are already in place. The Hatchery barrier dam limits the upstream migration of salmonids to approximately two additional miles of habitat.

Table 18-6. Program Actions to Address Gaps

Action #	Lead Agency	Proposed Action
L-WHITE.1	Skamania County, Willard, Cook	Develop and implement controls to adequately protect riparian areas to maintain currently functional and restored habitat around rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Require mitigation, where necessary, to offset unavoidable damage to habitat conditions in riparian management areas
L-WHITE	Skamania County; Willard, Cook	Development and implement controls to protect historic stream meander patterns and channel migration zones and avoid hardening stream banks and shorelines
L-WHITE	Skamania County, Willard, Cook	Development and implement controls and development standards to adequately protect wetlands, wetland buffers, and wetland function.
L-WHITE	Skamania County, Willard, Cook	Develop and implement controls to address erosion and sediment run-off during (and after) construction to prevent sediment and pollutant discharge to streams, wetlands and other water bodies
L-WHITE	Skamania County, Willard, Cook	Apply land use and resource protection code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
L-WHITE	LCFRB, WDNR. WSDOT, WDFW Counties, private property owners.	Develop and implement a coordinated and strategic barrier removal program based on watershed fish priorities and ensuring an effective and efficient sequencing of barrier removal work.
L-WHITE	Skamania County, Underwood Conservation District	Utilize a combination of public outreach/education and, incentives, and to promote (1) stewardship practices for protecting habitat and water quality and (2) landowner support of and participation in habitat restoration efforts.
L-WHITE	State of Washington (DOE, DFW)	Close the Little White Basin to further surface water withdrawals, including groundwater in connectivity with surface waters; curtail unauthorized withdrawals
L-WHITE	LCFRB, WDFW, Skamania County, Underwood CD, LCFEG	Build capacity (e.g. technical and administrative skills, personnel and fiscal resources) needed to allow agencies and organizations to undertake protection and restoration projects, including noxious weed control in a reasonable period time.
L-WHITE	SRFB, BPA, NOAA, USFWS, DOE, ACOE	Increase available funding for projects that implement measures and address underlying threats
L-WHITE	State of Washington (Dept of Agriculture, and Department of Ecology)	Develop and implement agricultural practices and regulations to protect riparian conditions and water quality
L-WHITE	Underwood CD	Expand landowner incentive (e.g. CREP) and education plans to promote further habitat protection and restoration.
L-WHITE	LCFRB, Underwood CD, Skamania County	Address threats proactively by building agreement on priorities among the various program implementers
L-WHITE	FEMA	Update floodplain maps using Best Available Science

19 Columbia Gorge Tributaries Subbasin

Figure 19-1. Location of the Columbia Gorge Tributaries Subbasin within the Lower Columbia River Basin.

19.1 Basin Overview

This subbasin includes tributaries in the Columbia Gorge between Bonneville Dam and the White Salmon River, excluding the Wind River and the Little White Salmon River. The subbasin is located in Skamania County and is in WRIA 29. Rock Creek (43 square miles) is the largest tributary in the subbasin.

The Columbia Gorge Tributaries Subbasin will play key role in the recovery of salmon and steelhead. The subbasin has historically supported populations of winter steelhead, chum, and coho. Today, steelhead and chum are listed as threatened under the ESA. Coho salmon are a candidate for listing. Other fish species of interest are Pacific lamprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

Gorge tributary salmon and steelhead are affected by a variety of in-basin and out-of basin factors including stream, Columbia River mainstem, estuary, and ocean habitat conditions; harvest; hatcheries; and ecological relationships with other species. Analysis has demonstrated that recovery cannot be achieved by addressing only one limiting factor. Recovery will require action to reduce or eliminate all manageable factors or threats. The deterioration of habitat conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonids within the Columbia Basin. Direct harvest of listed salmon and steelhead is prohibited but sport and commercial fisheries focusing on hatchery fish and other healthy wild populations, primarily in the mainstem Columbia and ocean, incidentally affect ESA-listed Columbia Gorge tributary fish. Key ecological interactions of concern include effects of nonnative species; nutrient inputs from salmon carcasses; and predation by species affected by development including Caspian terns, northern pikeminnow, seals, and sea lions. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the Columbia Gorge Tributaries Subbasin.

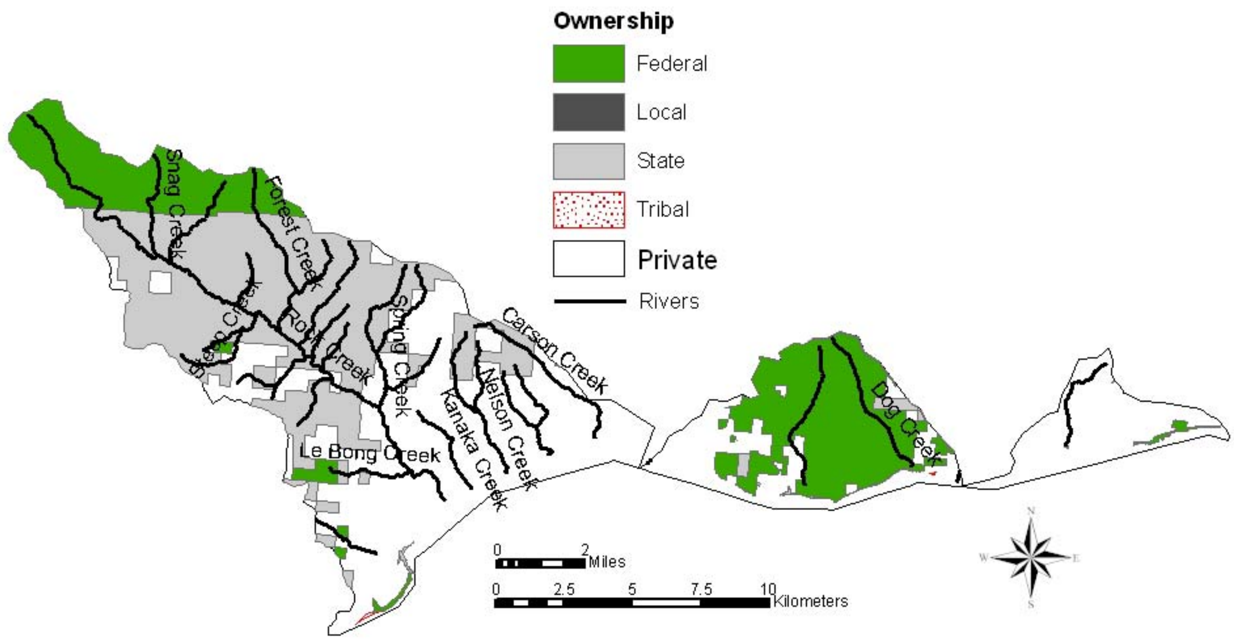
The Rock Creek basin is predominantly forestland (93%), much of it within the Gifford Pinchot National Forest. The large Yacolt Burn in 1902 destroyed much of the forest vegetation in the basin. More recently, timber harvests have served to reduce forest cover. Late-successional forests make up only 16% of the basin and early-seral conditions make up 23% of the basin. Rural residential development in the lower basin is increasing.

The smaller stream systems in the basin are mostly within private lands in either rural residential use or small-scale timber production. Lower Rock Creek and smaller streams to the east are impacted by urban development in the town of Stevenson. Carson Creek is impacted by small-scale urban development in and around the town of Carson.

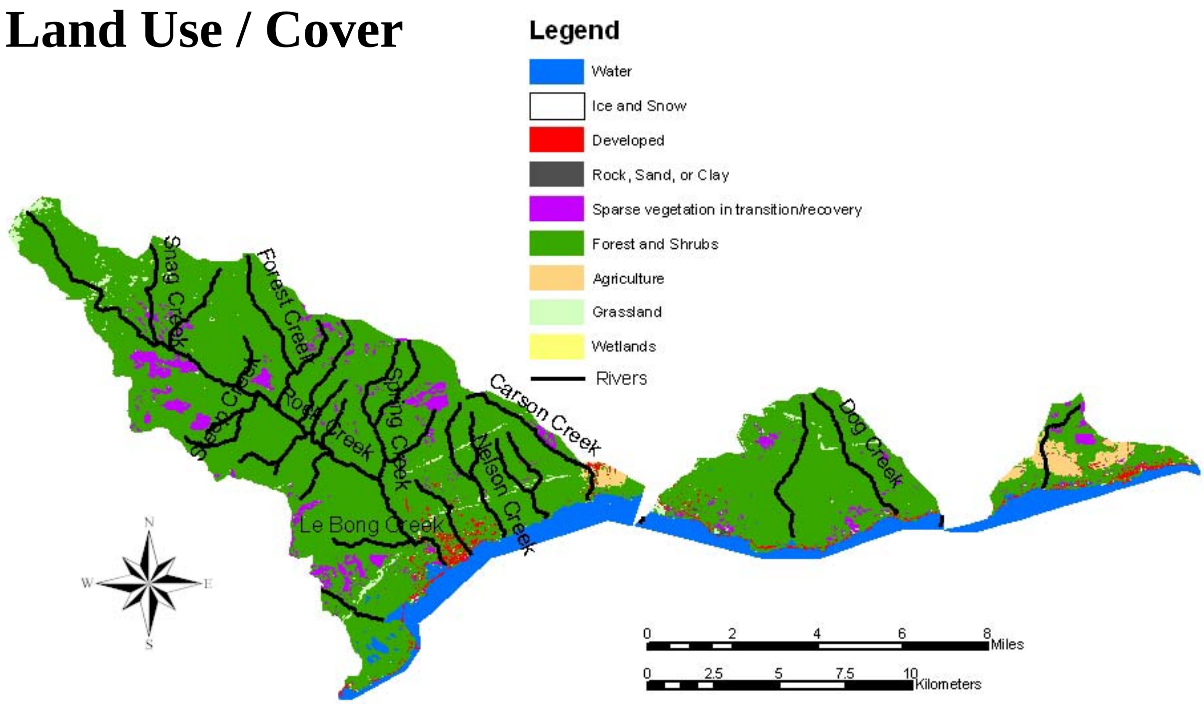
Anadromous fish access is limited to the lower reaches of Columbia Gorge tributary streams. The largest stream is Rock Creek, but access is naturally blocked by a falls at RM 1. This reach contains the greatest amount of potential habitat and is therefore the highest priority for habitat restoration and preservation measures.

Land Ownership	
Private	49%
Federal	20%
State	31%

Land Ownership



Land Use / Cover



19.2 Species of Interest

Focal salmonid species in the small upper Gorge tributaries include winter steelhead, chum, and coho. The health or viability of these populations (when included with Wind River and Little White Salmon River populations) is currently very low for chum, low for coho, and between low and medium for winter steelhead. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Recovery goals call for restoring upper Gorge coho to a high viability level, providing for a 95% chance of persistence over 100 years, restoring chum to a medium viability level, providing for a 75-94% probability of persistence over 100 years, and maintaining winter steelhead at low viability levels, providing for a 40-74% probability of persistence over 100 years. Other species of interest in the upper Gorge tributaries include coastal cutthroat trout and Pacific lamprey. Regional objectives for these species are described in Volume I, Chapter 6. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for these other species. Cutthroat will benefit from improvements in stream habitat conditions for salmonids. Lamprey are expected to benefit from habitat improvements in the estuary, Columbia River, and mainstem, and in the upper Gorge tributaries, although specific spawning and rearing habitat requirements for lamprey are not well known.

Table 19-1. Current viability status of Gorge tributary populations and the biological objective status that is necessary to meet the recovery criteria for the Gorge strata and the lower Columbia ESU. Objective numbers represent combined objective for Wind and upper Gorge tributaries.

	ESA	Hatchery	Current		Objective	
Species	**Status**	**Component**	**Viability**	**Numbers**	**Viability**	**Numbers**
Winter Steelhead	Threatened	No	Low+	Unknown	Low+	100
Chum	Threatened	No	Very low	Unknown	Medium	1,100-5,900
Coho	Candidate	No	Low	Unknown	High	--

Winter Steelhead–There is no specific information concerning historical or current winter steelhead populations in the small upper Gorge tributaries. Rock Creek is likely the main area with potential for natural production.

Chum– There is no specific information concerning historical or current adult chum populations in the small upper Gorge tributaries. However, current production is very low, as indicated by Bonneville Dam counts of less than 100 chum in most years. Rock Creek is likely the main area with potential for natural production.

Coho– The historical upper Gorge tributary and Wind combined early coho adult population is estimated from 1,000-10,000. Current natural spawning returns are low at about 200-300 fish. The numbers specific to the small upper Gorge tributaries is unknown. The primary spawning area is likely Rock Creek. Early coho spawning occurs from mid-October to mid-November. Juvenile rearing occurs upstream and downstream of spawning areas. Juveniles rear for a full year in the upper Gorge tributaries before migrating as yearlings in the spring.

Coastal Cutthroat– Coastal cutthroat abundance in the upper Gorge tributaries has not been quantified but the population is considered depressed. Anadromous and resident forms of cutthroat trout may be present in these small tributaries. Anadromous cutthroat enter their streams of origin from July-December and spawn from December through June. Most juveniles rear 2-4 years before migrating from their natal stream.

Pacific lamprey– Information on lamprey abundance is limited and does not exist for the upper Gorge tributary populations. However, based on declining trends measured at Bonneville Dam it is assumed that Pacific lamprey have declined in the upper Gorge tributaries also. Adult lamprey return from the ocean to spawn in the spring and summer. Juveniles rear in freshwater up to 6 years before migrating to the ocean.

19.3 Limiting Factors, Threats, and Measures

19.3.1 Hydropower Operation and Configuration

There are no hydro-electric dams in the Gorge tributary subbasin. However, Gorge tributary species are affected by mainstem Columbia hydro operations and flow regimes which affect habitat in migration corridors and in the estuary. Mainstem hydro factors and threats are addressed by regional strategies and measures identified in Volume I.

19.3.2 Harvest

Most harvest of upper Gorge tributary wild salmon and steelhead occurs incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. This mortality is very low for chum and steelhead, and low for coho. Chum are not harvested in ocean fisheries, there are no directed Columbia River commercial chum fisheries and retention of chum is prohibited in Columbia River sport fisheries. Some chum can be impacted incidental to fisheries directed at coho and winter steelhead. Harvest impacts to upper Gorge tributary coho occur in the ocean commercial and recreational fisheries off the Washington and Oregon coasts and Columbia River. There are no salmon fisheries in the upper Gorge tributaries. Wild coho impacts are limited by fishery management to retain fin-marked hatchery fish and release unmarked wild fish. 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.

Measures 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. The regional measures 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 Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest measures that have significant application to upper Gorge tributary populations are summarized in the following table:

Table 19-2. Regional harvest measures with significant application to the Columbia Gorge Tributaries Subbasin populations.

Measure	Description	Comments
F.M18	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	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.M19	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	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.M24	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	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.

19.3.3 Hatcheries

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

There are no hatchery programs in the small upper Gorge tributaries, although four federal hatcheries in the vicinity have large scale salmon programs. Carson National Fish Hatchery (since 1937) produces spring Chinook, Little White Salmon Hatchery (since 1898) and Williard National Fish Hatchery (since 1951), produce spring Chinook, fall Chinook, and coho, and Spring Creek Hatchery (since 1901) produces fall Chinook. The main threats from hatchery released fall Chinook are domestication of naturally-produced fish and the main threats from hatchery releases of spring Chinook and coho are ecological interactions with naturally-produced salmon.

Regional hatchery strategies and measures are focused on evaluating and reducing biological risks and reducing the risks to natural populations. Artificial production in federal hatchery programs will be evaluated in detail through the HGMP process. The resulting program specific actions will be developed, evaluated, and documented through the HGMP for public review and consideration by NOAA Fisheries (details in programs Technical Foundation, Volume IV).

19.3.4 Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Gorge tributary salmon and steelhead are affected throughout their lifecycle by ecological interactions with non native species, food web components, and predators. Interactions are similar for Gorge tributary populations to those of most other subbasin salmonid populations. Ecological Interactions are addressed by regional strategies and measures identified in Volume I.

19.3.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. 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 are similar for Gorge tributary populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum than steelhead and coho. Estuary and mainstem effects on Gorge tributary salmon and steelhead populations are addressed by regional strategies and measures identified in Volume I and the Columbia Mainstem and Estuary Subbasin sections of Volume II.

19.3.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity 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 Columbia Gorge Tributaries Basin have the greatest impact on the health and viability of salmon and steelhead relative to the other limiting factors and threats discussed in this chapter. There is currently very little habitat available to anadromous fish in the Columbia Gorge Tributaries Basin.

Due to the small amount of available habitat, the Columbia Gorge Tributary populations have not been analyzed using the EDT model and reaches have not been prioritized using the methodology applied to other subbasins. The most important reaches for anadromous fish are located only in the lower segments of streams that are accessible. The greatest amount of habitat exists in the lower mile of Rock Creek between Rock Cove and lower Rock Creek Falls (RM 1). Small amounts of habitat are also found in Nelson Creek, Carson Creek, Collins Creek, and Dog Creek. There is abundant habitat for resident fish and wildlife in other portions of these basins, particularly in the Rock Creek basin. The limiting factors and threats that are listed in this chapter were obtained through consideration of various analyses, including the USFS Rock Creek Watershed Analysis (USFS 2000) and the Washington Conservation Commission Limiting Factors Analysis for WRIA 29 (WCC 1999). A summary of the primary habitat limiting factors and threats are presented in Table 19-4. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 19-2. Habitat measures and related information are presented in Table 19-3.

The areas with the greatest potential production for anadromous salmonids in the Columbia Gorge Tributaries Basin are the following:

- Lower mainstem Rock Creek – from Rock Cove to Lower Rock Creek falls (RM 1)
- Lower sections of small streams – Nelson, Carson, Collins, Dog Creeks.

While reach level habitat conditions often result from local factors, they are also affected or shaped by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input and large woody debris recruitment are often affected by or result from upstream conditions and degraded watershed processes. Access to key reaches may also be affected by barriers that occur downstream of a reach. Accordingly, restoration of a priority reach may require action outside the targeted reach. The IWA analysis was used to identify potential upstream watershed areas that could influence reach level habitat attributes.

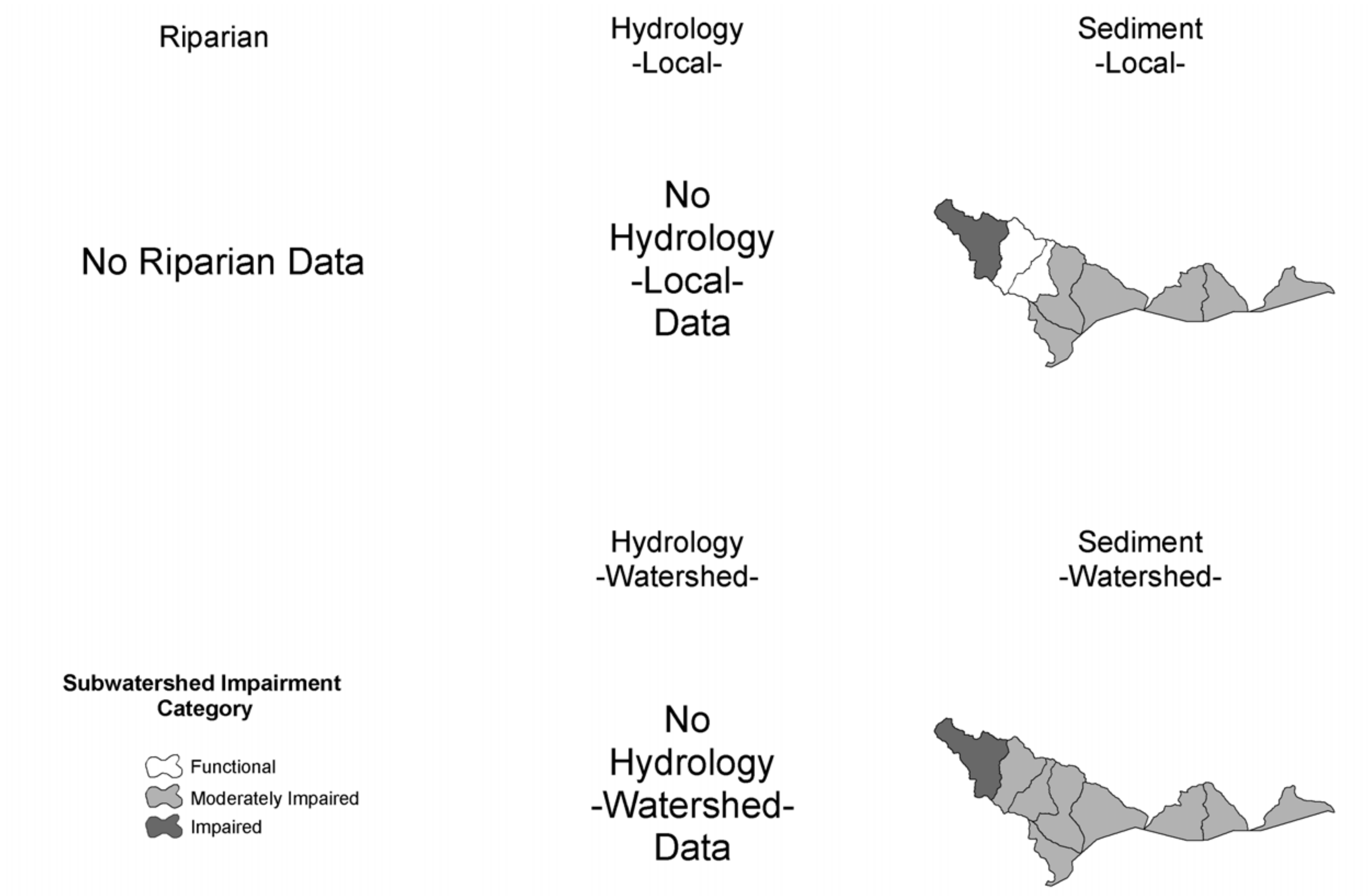


Figure 19-2. IWA subwatershed impairment ratings by category for the Columbia Gorge Tributaries Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 19-3. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the lower mainstem Rock Creek (RC) and lower sections of small Columbia River tributaries (TR). Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors			Threats		
	RC	TR		RC	TR
Habitat connectivity			***Urban and rural development***		
Blockages to channel habitats (Bonneville Dam & Pool)	✓	✓	Clearing of vegetation	✓	✓
Habitat diversity			Increased impervious surfaces	✓	✓
Lack of stable instream woody debris	✓	✓	Increased drainage network	✓	✓
Altered habitat unit composition	✓	✓	Roads – riparian/floodplain impacts	✓	✓
Riparian function			***Forest practices***		
Reduced stream canopy cover	✓	✓	Timber harvests –sediment supply impacts	✓	
Exotic and/or noxious species	✓	✓	Timber harvests: impacts to runoff	✓	
Reduced wood recruitment	✓	✓	Forest roads – impacts to sediment supply	✓	
Water quality			Forest roads: impacts to runoff	✓	
Altered stream temperature regime	✓		***Channel manipulations***		
Substrate and sediment			Blockages to channel habitat (Bonneville Dam & Pool)	✓	✓
Lack of adequate spawning substrate	✓				
Embedded substrates	✓	✓			
Excessive fine sediment	✓	✓			
Stream flow					
Altered magnitude, duration, or rate of change of flows	✓	✓			

Table 19-4. Habitat measures in priority areas, with reference to the limiting factors addressed, threats addressed, target species, and estimated time until benefits would be realized (Time). Reaches not included in the table are considered secondary priority.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
1. Protect and restore riparian function ***A. Reforest riparian zones*** ***B. Allow for the passive restoration of riparian vegetation*** ***C. Invasive species eradication*** ***D. Hardwood-to-conifer conversion***					
Lower mainstem Rock Creek ***Lower reaches of Columbia tribs***	• Reduced stream canopy cover • Altered stream temperature regime • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or noxious species	• Clearing of vegetation due to urban and rural residential development	• All species	20-100 years	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. Riparian restoration projects are relatively inexpensive and are often supported by landowners. The specified stream reaches are the highest priority for riparian measures, however, riparian restoration and preservation should occur throughout the basin since riparian conditions affect downstream reaches.
2. Protect and restore instream habitat complexity ***A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting*** ***B. Structurally modify stream channels to create suitable habitat types***					
Lower mainstem Rock Creek ***Lower reaches of Columbia tribs***	• Lack of stable instream woody debris • Altered habitat unit composition	• None (symptom-focused restoration strategy)	• Coho • Summer steelhead	2-10 years	Moderate potential benefit due to the high chance of failure. Failure is probable if habitat-forming processes are not also addressed. These projects are relatively expensive for the benefits accrued. Moderate likelihood given the lack of hardship imposed on landowners and the current level of acceptance of these type of projects
3. Protect and restore natural sediment supply processes ***A. Address forest road related sources*** ***B. Address timber harvest related sources***					
Entire basin	• Excessive fine sediment • Embedded substrates	• Timber harvest – impacts to sediment supply • Forest roads – impacts to sediment supply	• All species	5-50 years	High potential benefit due to sediment effects on egg incubation and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. Use IWA impairment ratings to identify restoration and preservation opportunities.
4. Protect and restore runoff processes ***A. Address forest road impacts***					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
B. Address timber harvest impacts					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Timber harvest – impacts to runoff • Forest roads – impacts to runoff	• All species	5-50 years	High potential benefit due to flow effects on habitat formation, redd scour, and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs.
5. Protect and restore instream flows ***A. Water rights closures*** ***B. Purchase or lease existing water rights*** ***C. Relinquishment of existing unused water rights*** ***D. Enforce water withdrawal regulations*** ***E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Water withdrawals	• All species	1-5 years	Instream flow management strategies for the Columbia Gorge Tributaries basins have been identified as part of Watershed Planning for WRIA 29.
6. Protect and restore water quality ***A. Restore the natural stream temperature regime***					
Entire basin	• Altered stream temperature regime	• Clearing of riparian vegetation	• All species	1-50 years	Primary emphasis for restoration should be placed on stream segments that are listed on the 2004 303(d) list.
7. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development ***A. Plan growth and development to avoid sensitive areas (e.g., wetlands, riparian zones, floodplains, unstable geology)*** ***B. Encourage the use of low-impact development methods and materials*** ***C. Apply mitigation measures to off-set potential impacts***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	The focus should be on management of land-use conversion and managing continued development in sensitive areas (e.g., wetlands, stream corridors, unstable slopes). Critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary mechanisms need to be put in place to restore currently degraded habitats.
8. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection ***A. Purchase properties outright through fee acquisition and manage for resource protection*** ***B. Purchase easements to protect critical areas and to limit potentially harmful uses*** ***C. Lease properties or rights to protect resources for a limited period***					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit. These programs are under-funded and have low landowner participation.

19.4 Program Gap Analysis

The Columbia Gorge Tributaries Basin (~85 sq mi) is located in Skamania County. Forestry land uses dominate the subbasin.

- Gifford Pinchot public lands are estimated at 17 square miles;
- Department of Natural Resources public lands are estimated at 26 square miles;
- Private lands are estimated at 41 square miles;
- Skamania has regulatory authority for private lands within the Basin;
- Stevenson and Carson are unincorporated communities within the Basin;
- Population growth is expected to remain stable over the next 20 years.

Protection Programs

Protection programs in the Columbia Gorge Tributaries Basin are implemented by the Gifford Pinchot NF, the Department of Natural Resources, Skamania County, and other regulatory agencies. Protection programs in this analysis include programs that protect habitat conditions or watershed functions through management policies and programs, regulatory measures, and fee title acquisition or the purchase of easements. Major programs implementing protection measures are identified below.

Federal Programs

- ***Gifford Pinchot National Forest*:**
  - The Gifford Pinchot NF Plan provides high levels of protection for riparian areas and forest stands within the Columbia Gorge Tributaries Basin; [M.1A; M.1B; M.3A; M.3B; M.4A; M.4B; M.6A]
    - ✓ Riparian buffers in all areas of the Gifford Pinchot NF are at least 300';
    - ✓ Forest lands within the Gifford Pinchot NF relating to the Columbia Gorge Tributaries are "Matrix," (managed for multiple objectives);

- ***U.S. Army Corps of Engineers***

  - Administers the Section 10 (Rivers and Harbor Act) and Section 404 (Clean Water Act) permit processes. Section 10 requires approval of any activity in, above, or below a navigable river, which affects course, location, condition, or capacity of navigable waters. Section 404 requires prior approval of dredging, filling, grading, clearing, and bank hardening. In waters used by listed fish species, the permits are subject to ESA Section 7 consultation with NOAA Fisheries to ensure that any approved action is adequately protective of the fish;

State Programs

- ***Department of Natural Resources***

  - State Forest Land HCP:

    State forest lands are managed under the provisions of a Habitat Conservation Plan (HCP). The Habitat Conservation Plan protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. [M.1A; M.1B; M.3A; M.3B; M.4A; M.4B; M.6A]

- State Forest Practices:

  Riparian zones and harvest restrictions represent significant protections under the State of Washington Forest Practices Rules, including the Forest and Fish Module. These rules also establish standards for new road construction. [M.1A; M.1A; M.3A; M.3B; M.4A; M.4B; M.6A]

➢ ***Washington Department of Fish and Wildlife***

- Washington State Hydraulic Code

  The Washington State Hydraulic Code is administered through the Washington Department of Fish and Wildlife. The purpose of this program is to protect stream conditions and habitat. The regulations apply to such activities as stream bank protection, instream construction, culvert installation, channel changes or realignments, debris removal, and water diversion facilities. Those proposing such actions must obtain a Hydraulic Project Approval (HPA) permit;

➢ ***Washington Departments of Ecology and the Department of Fish and Wildlife:***

- Administrative flow restrictions may exist in the Columbia Gorge Tributaries Basin; [M.5A; M.5B; M.5C; M.5D]

Local Government Programs

➢ ***Skamania County***

- Land Use:

  Land use protections that apply to non-forested private lands within their jurisdictional authority; [M.7A; M.7B; M.7C]
  - ✓ *Critical Areas stream buffers*
  - ✓ *Critical Areas wetland buffers*
  - ✓ *Shoreline Master Program*

➢ ***Underwood Conservation District and NRCS:*** Implements landowner and incentive programs (e.g., CREP); [M.1A; M.1B; M.2A; M.2B; M.6A]

Restoration Programs

Restoration programs in the Columbia Gorge Tributaries Basin are implemented by a variety of agencies, organizations, and private interests. Major programs implementing protection measures are identified below:

Federal Programs

- ***Gifford Pinchot National Forest***
  - The Columbia Gorge Tributaries Basin is not a priority restoration area in the Gifford Pinchot NF; [M.1A; M.1B; M.3A; M.3B; M.4A; M.4B; M.6A]

State Programs

- ***Department of Natural Resources***

State Forest Land HCP:

State forest lands are managed under the provisions of a Habitat Conservation Plan (HCP). The Habitat Conservation Plan protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. [M.1A; M.1B; M.3A; M.3B; M.4A; M.6A]

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Local Government Programs

- ***Skamania County***
  - Public Works Program replaces and/or upgrades barriers associated with roads; [M.6]
- ***Underwood Conservation District:***
  - Underwood CD is active in the Columbia Gorge Tributaries.

Gap Analysis

Forest-related Programs: In the Columbia Gorge Tributaries Basin, forestry programs have an important role in protecting and restoring watershed functions and habitat conditions at levels supporting recovery goals. This is because these forestry programs apply to a significant amount of the basin. Certainty of forestry-related protection and restoration programs is relatively high because programs are being implemented and funded. Program areas of concern include the continued potential for hydrologic impacts caused by past harvest practices. Monitoring of watershed processes and habitat conditions will be required to confirm the effectiveness of these measures.

Protection-related Programs: Lands in the Columbia Gorge Tributaries Basin have protections through Skamania County's regulatory authority. Skamania County's comprehensive plan and land use ordinances have good levels of protection; however, Best Available Science updates would improve their Critical Area Ordinances and Shoreline Master Program. In addition, as in all lower Columbia subbasins, there are very limited protection mechanisms for agricultural practices relative to riparian areas and hydrologic impairment.

Restoration-related Programs: Passive restoration in the forests of the Columbia Gorge Tributaries Basin will accrue over time as a result of improved forest management practices that are already in place.

Table 19-5. Program Actions to Address Gaps

Action #	Lead Agency	Proposed Action
CG TRIB.1	Skamania County, Stevenson, Carson	Develop and implement controls to adequately protect riparian areas to maintain currently functional and restored habitat around rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Require mitigation, where necessary, to offset unavoidable damage to habitat conditions in riparian management areas
CG TRIB.2	Skamania County, Stevenson, Carson	Development and implement controls to protect historic stream meander patterns and channel migration zones and avoid hardening stream banks and shorelines
CG TRIB.3	Skamania County, Stevenson, Carson	Development and implement controls and development standards to adequately protect wetlands, wetland buffers, and wetland function.
CG TRIB.4	Skamania County, Stevenson, Carson	Develop and implement controls to address erosion and sediment run-off during (and after) construction to prevent sediment and pollutant discharge to streams, wetlands and other water bodies
CG TRIB.5	Skamania County, Stevenson, Carson	Apply land use and resource protection code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
CG TRIB.6	LCFRB, WDNR. WSDOT, WDFW Counties, private property owners.	Develop and implement a coordinated and strategic barrier removal program based on watershed fish priorities and ensuring an effective and efficient sequencing of barrier removal work.
CG TRIB.7	Skamania County, Underwood Conservation District	Utilize a combination of public outreach/education and, incentives, and to promote (1) stewardship practices for protecting habitat and water quality and (2) landowner support of and participation in habitat restoration efforts.
CG TRIB.8	State of Washington (DOE, DFW)	Close the Columbia Gorge Tributaries Basin to further surface water withdrawals, including groundwater in connectivity with surface waters; curtail unauthorized withdrawals
CG TRIB.9	LCFRB, WDFW, Skamania County, Underwood CD, LCFEG	Build capacity (e.g. technical and administrative skills, personnel and fiscal resources) needed to allow agencies and organizations to undertake protection and restoration projects, including noxious weed control in a reasonable period time.
CG TRIB.10	SRFB, BPA, NOAA, USFWS, DOE, ACOE	Increase available funding for projects that implement measures and address underlying threats
CG TRIB.11	State of Washington (Dept of Agriculture, and Department of	Develop and implement agricultural practices and regulations to protect riparian conditions and water quality

	Ecology)	
CG TRIB.12	Underwood CD	Expand landowner incentive (e.g. CREP) and education plans to promote further habitat protection and restoration.
CG TRIB.13	LCFRB, Underwood CD, Skamania County	Address threats proactively by building agreement on priorities among the various program implementers
CG TRIB.14	FEMA	Update floodplain maps using Best Available Science