

7 Cowlitz Subbasin - Upper Cowlitz

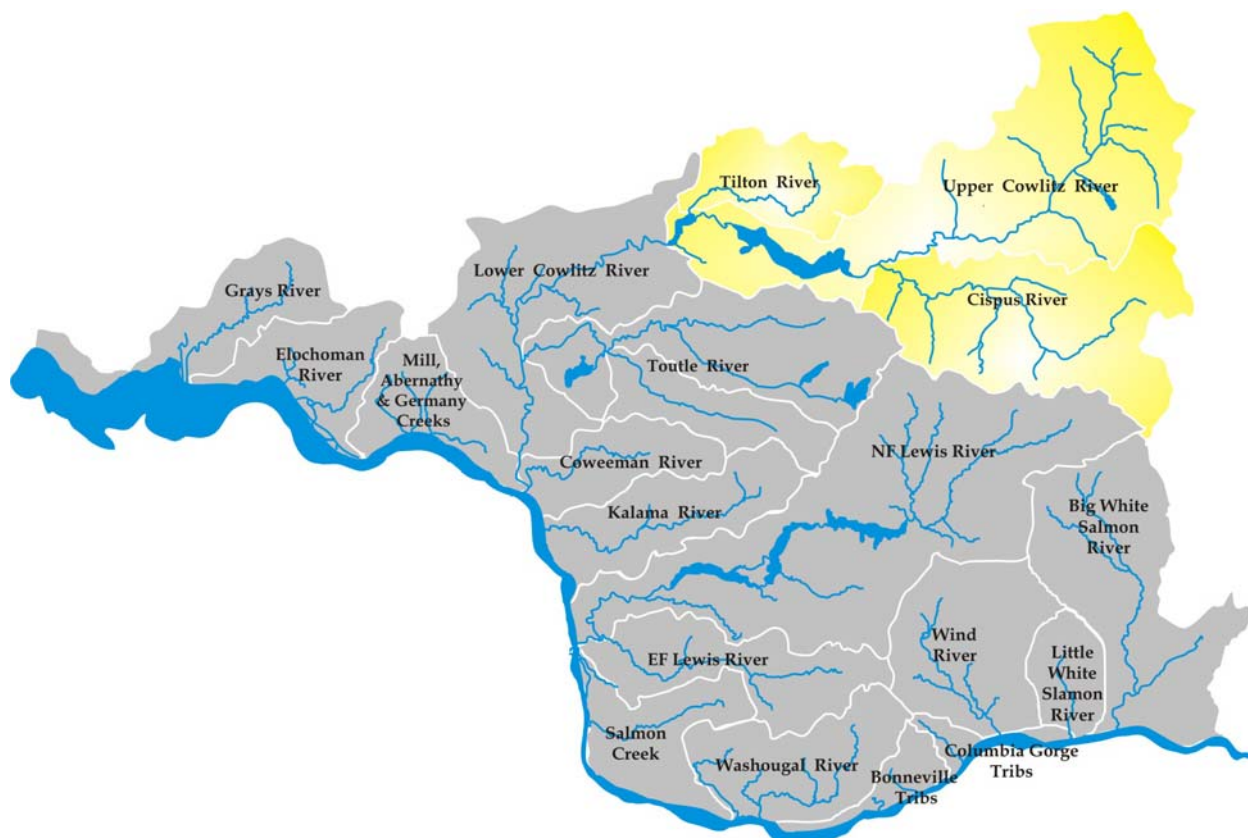


Figure 7-1. Location of the Upper Cowlitz River Basin within the Lower Columbia River Basin.

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.

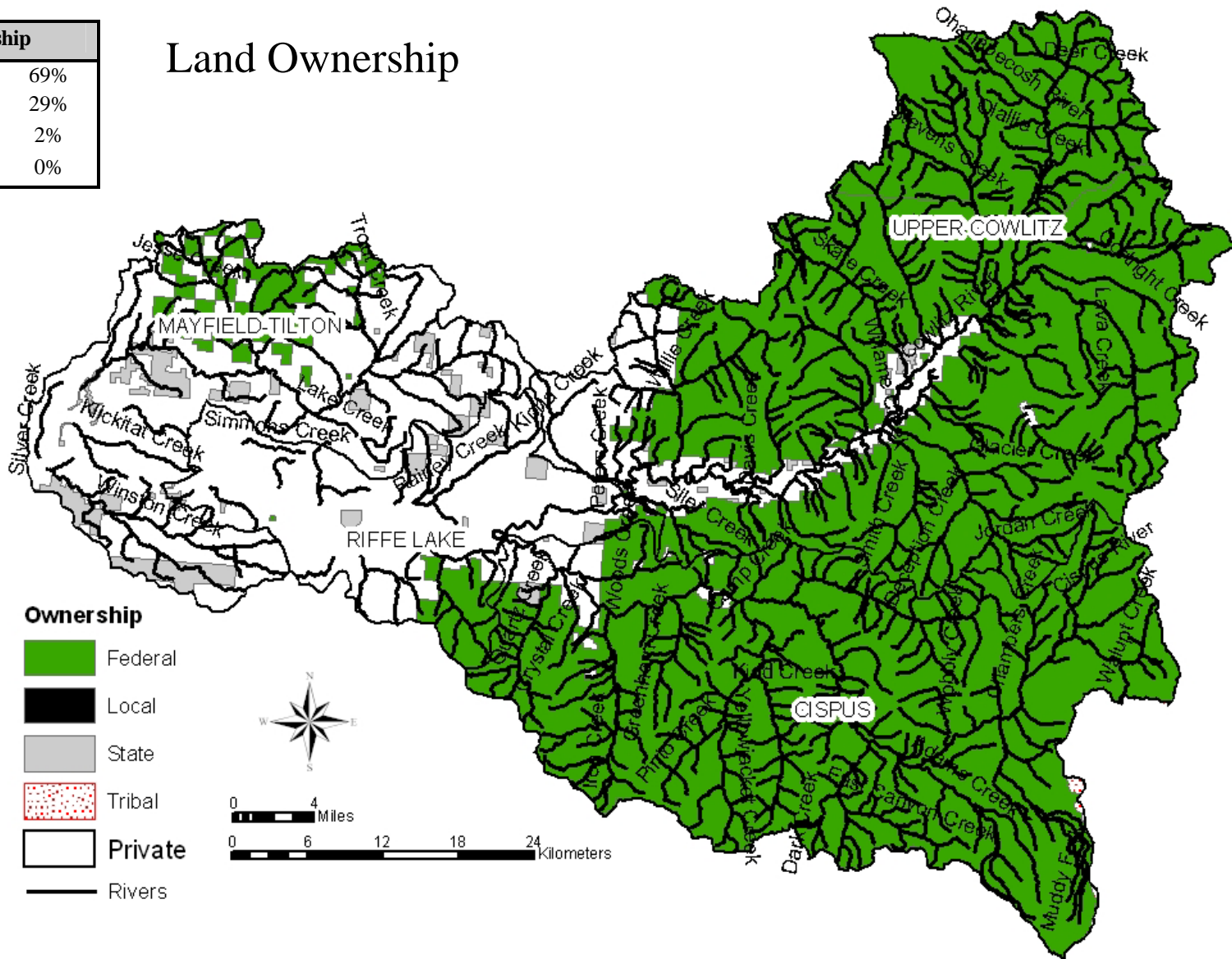
The upper Cowlitz is mostly National Forest in the Cispus and upper mainstem Cowlitz basins. The mainstem Cowlitz River valley (above Cowlitz Falls Dam), much of the Tilton Basin, and tributary basins to the reservoirs are in private lands. Forestry is the greatest land use in the middle and upper elevations, 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.

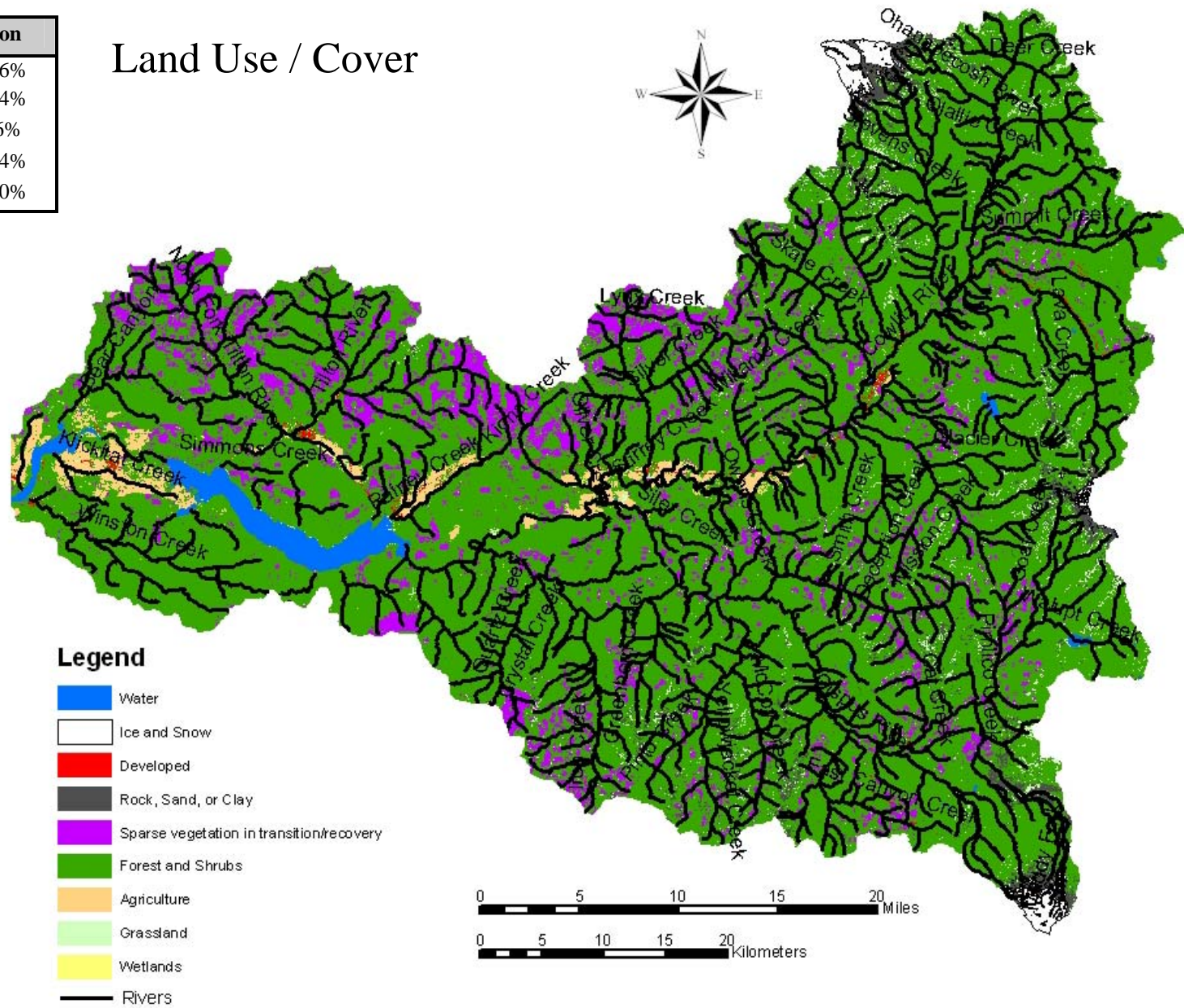
Land Ownership	
Federal	69%
Private	29%
State	2%
Other public	0%

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.

Species	ESA Status	Hatchery Component	Current		Objective	
			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.

Upper Cowlitz

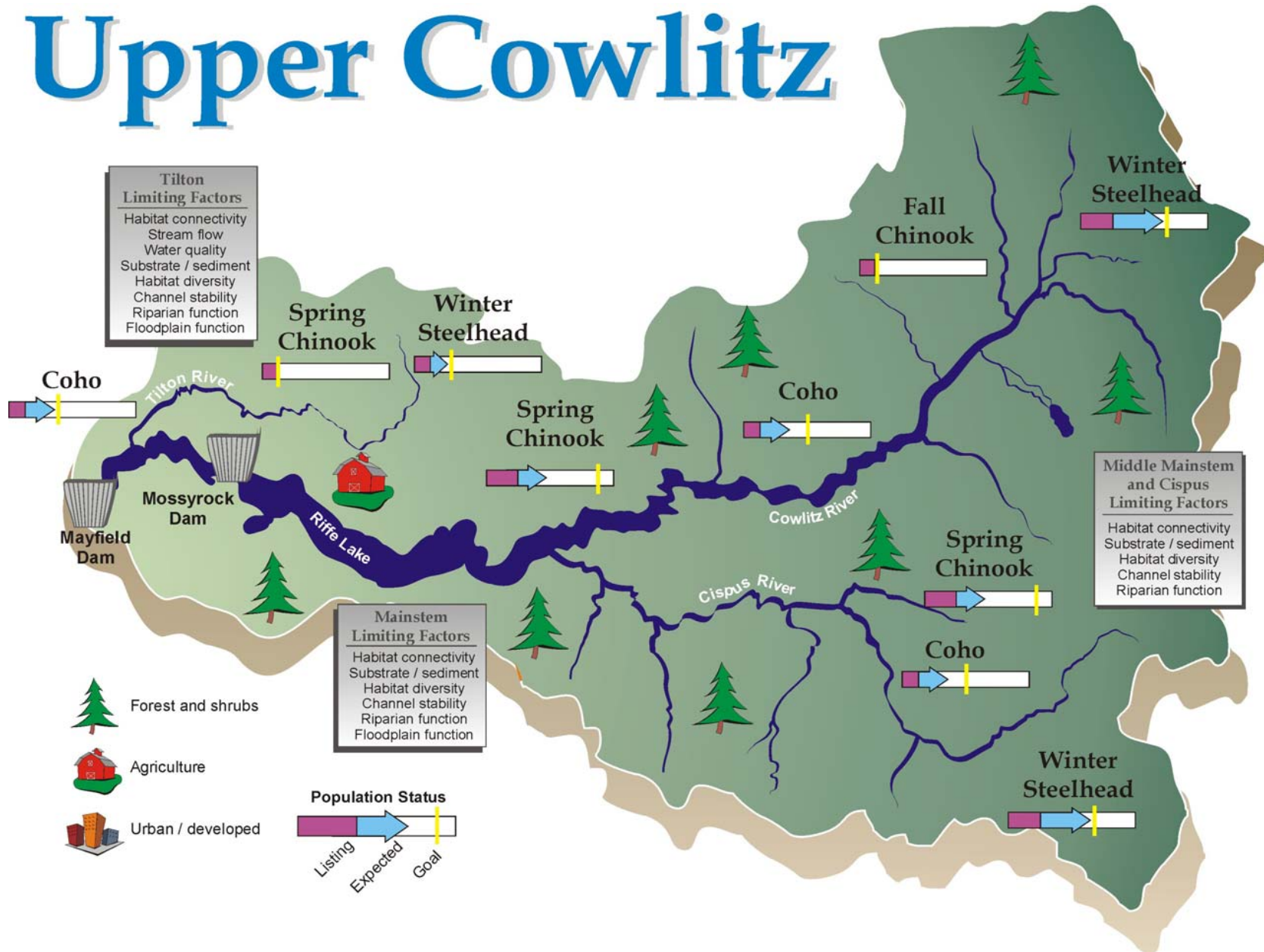
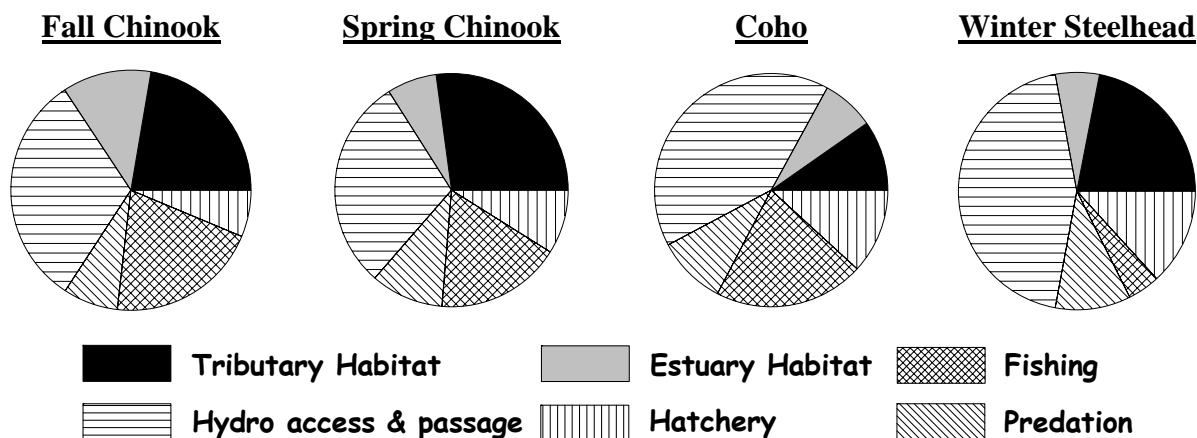


Figure 7-2. Summary of habitat limiting factors, population status, expected population improvement trend with existing programs and biological objectives depicted for the Upper Cowlitz Basin.

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 efficiency 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 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 Cowlitz 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 in Table 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.

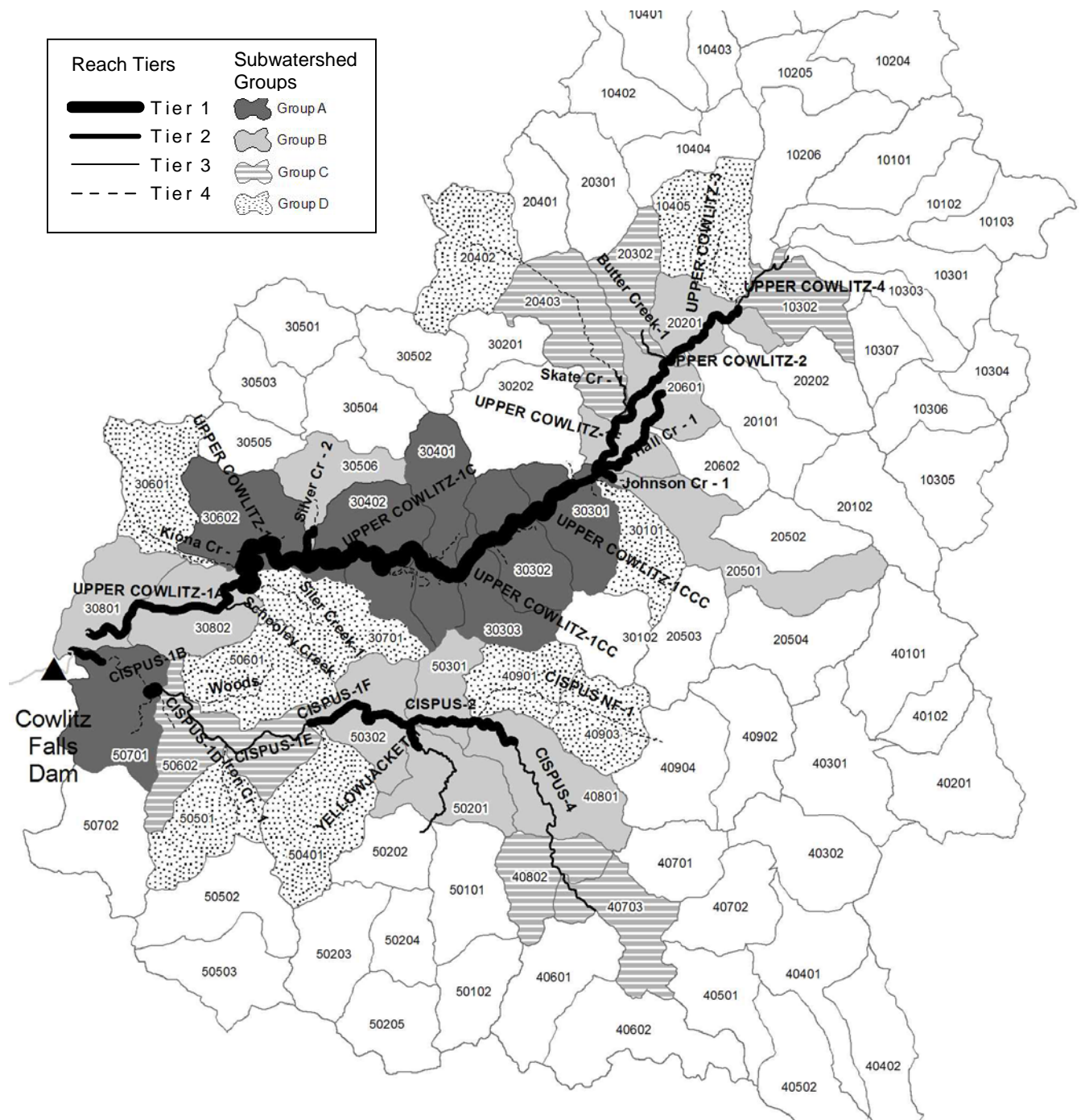


Figure 7-4. Reach tiers and subwatershed groups in the Upper Cowlitz and Cispus Basins. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers.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

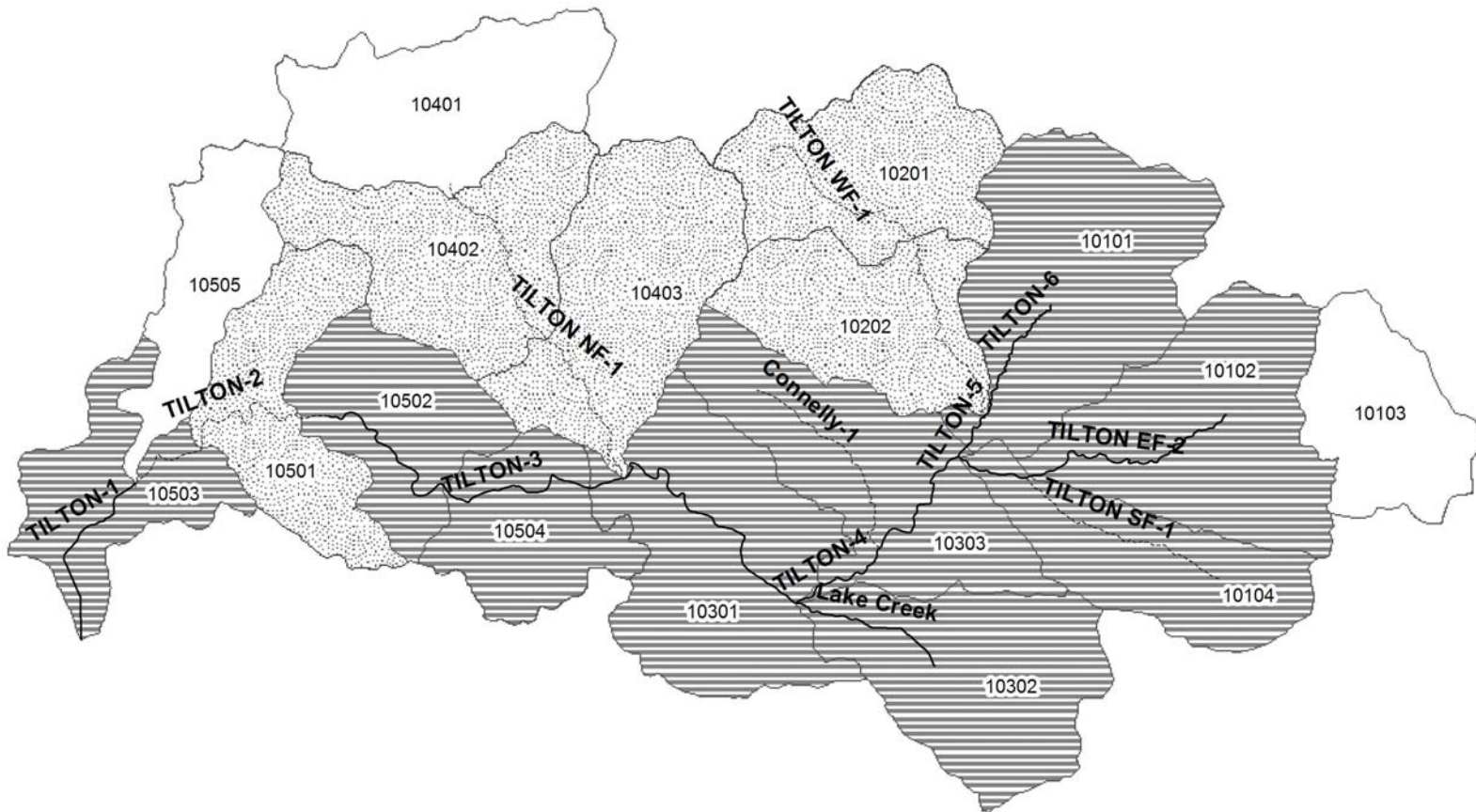


Figure 7-5. Reach tiers and subwatershed groups in the Tilton Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities at the reach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

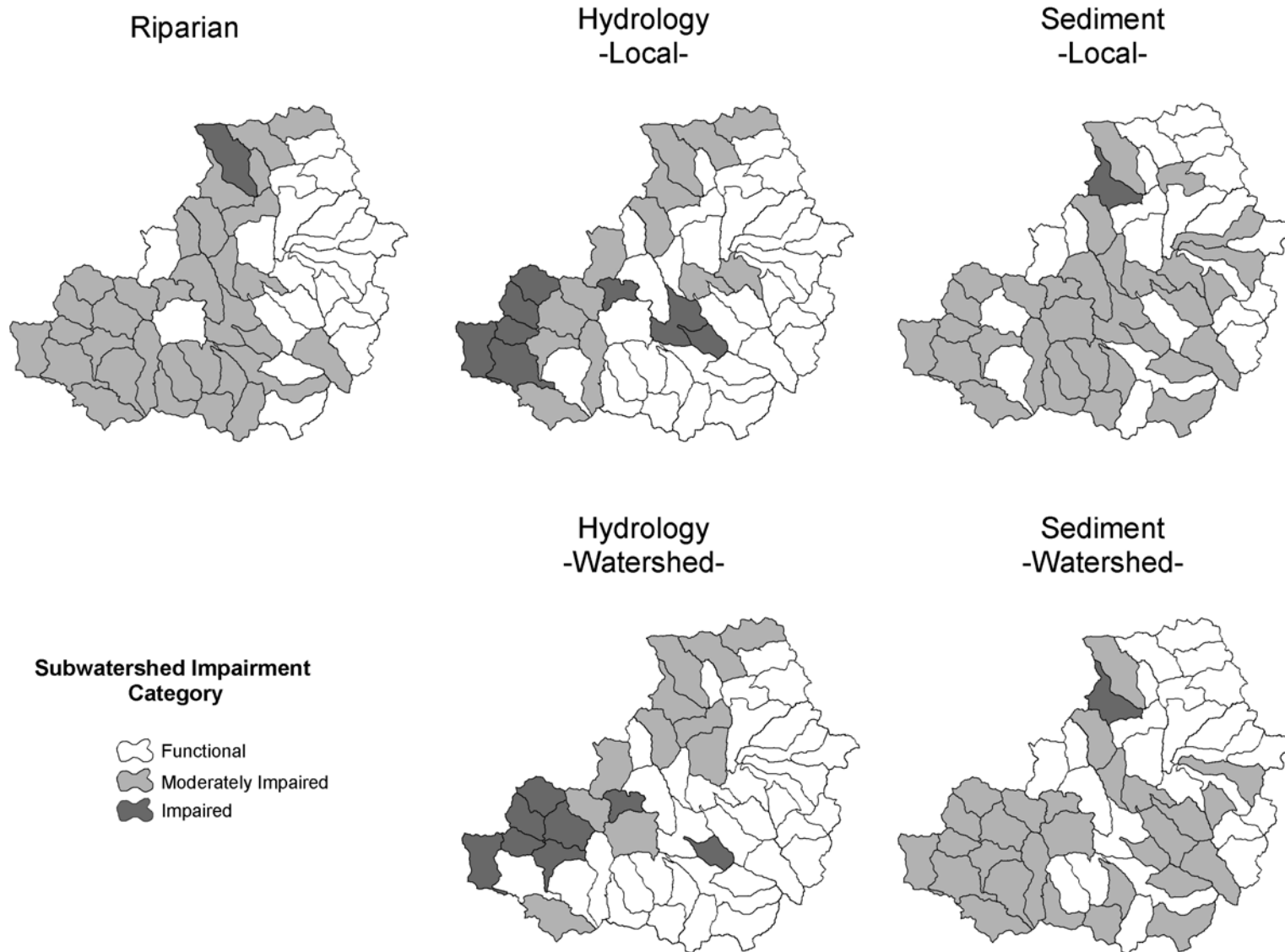


Figure 7-6. IWA subwatershed impairment ratings by category for the Upper Cowlitz Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation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

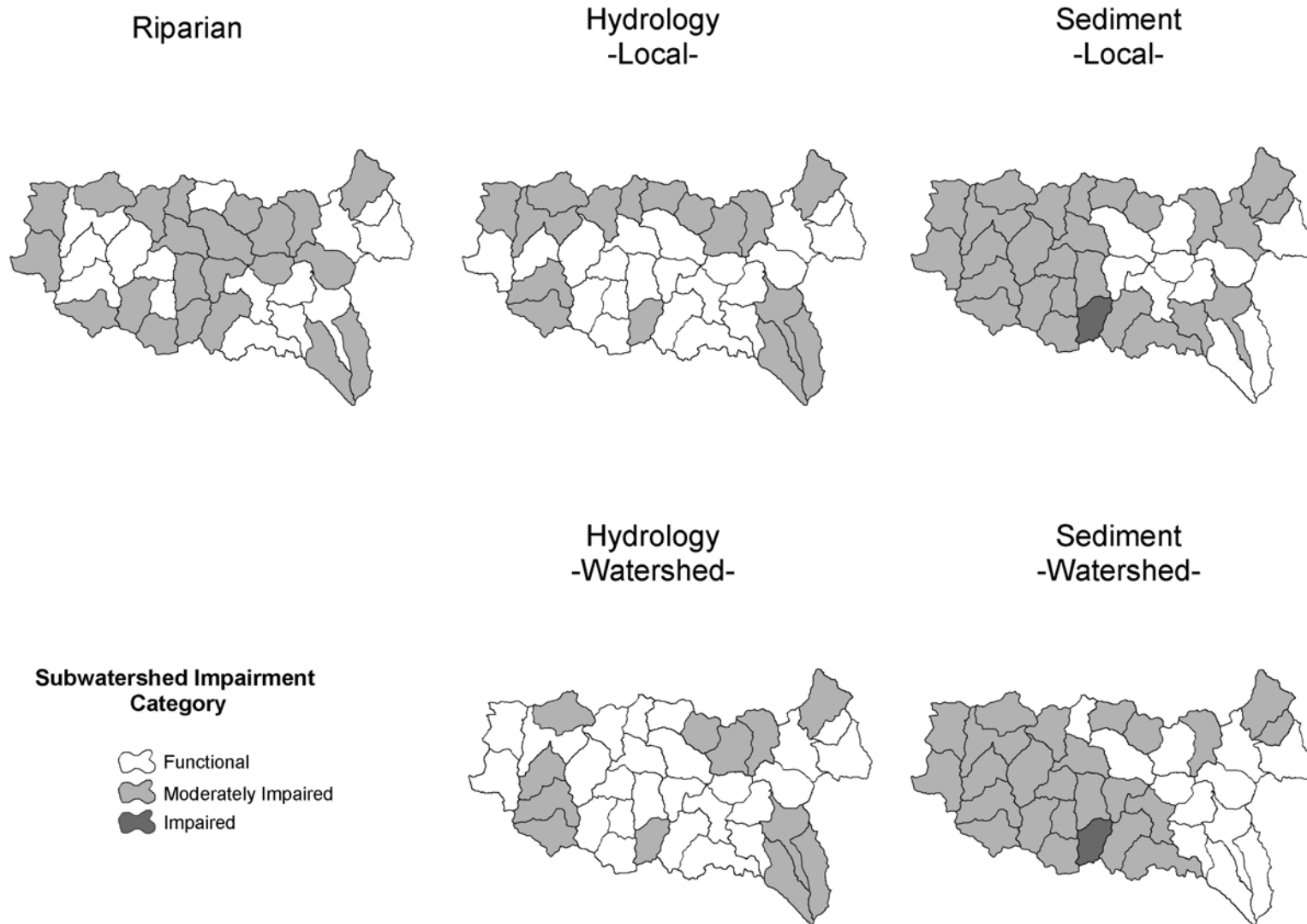


Figure 7-7. IWA subwatershed impairment ratings by category for the Cispus Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation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

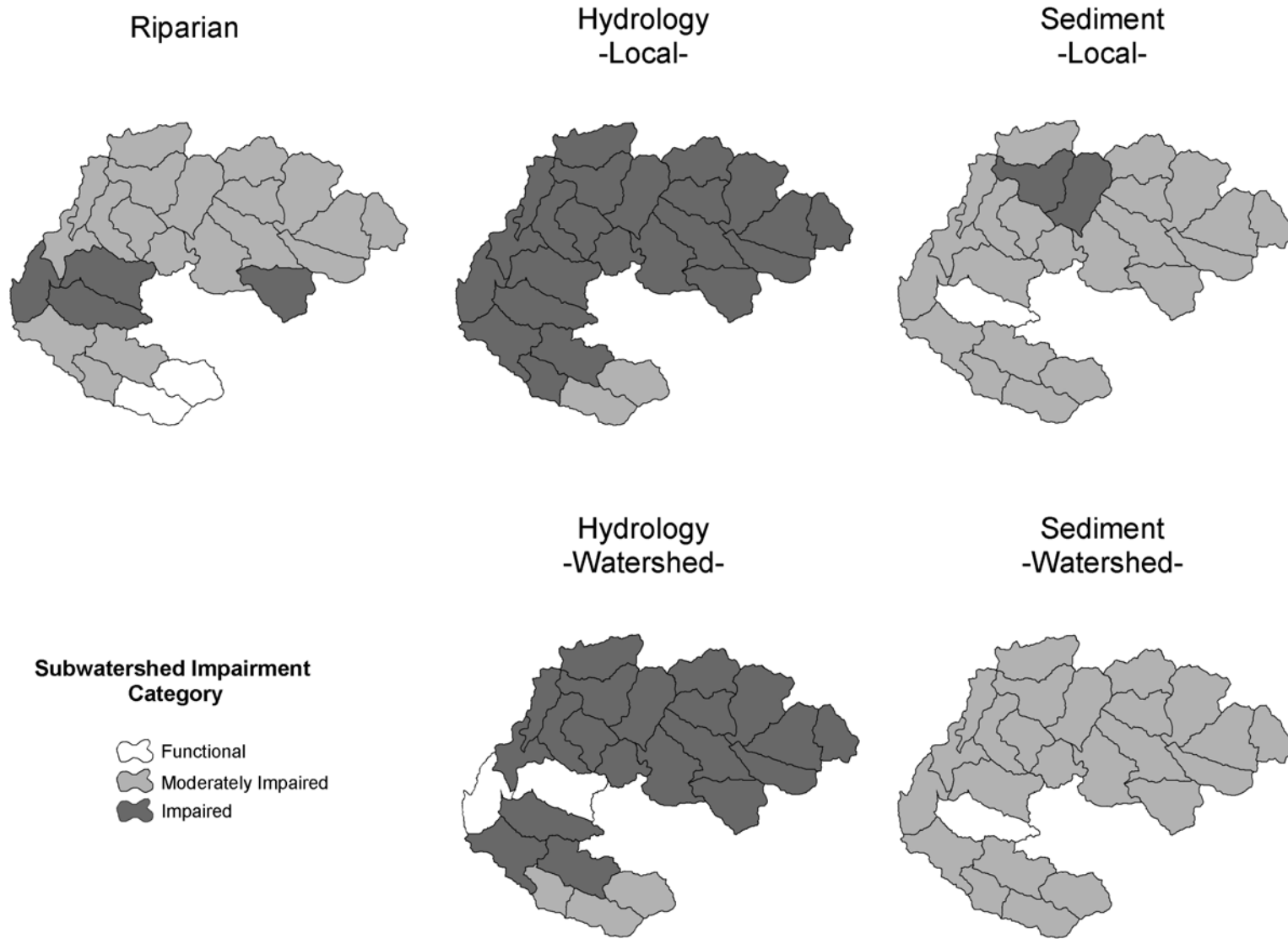


Figure 7-8. IWA subwatershed impairment ratings by category for the Mayfield-Tilton Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical 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)			Watershed processes (watershed)	
								Hydrology	Sediment	Riparian	Hydrology	Sediment
A	30301	Dry Creek UPPER COWLITZ-1CCC UPPER COWLITZ-1D UPPER COWLITZ-1E	ChS	UPPER COWLITZ-1CCC UPPER COWLITZ-1E	egg incubation fry colonization summer rearing adult holding	channel stability habitat diversity	P	F	M	M	F	F
			StW	UPPER COWLITZ-1D UPPER COWLITZ-1E	summer rearing winter rearing	habitat diversity	PR					
			Coho	UPPER COWLITZ-1E	egg incubation summer rearing winter rearing	channel stability habitat diversity	PR					
			ChF	UPPER COWLITZ-1CCC UPPER COWLITZ-1D UPPER COWLITZ-1E	egg incubation fry colonization early rearing adult holding	channel stability habitat diversity	P					
	30302	Burton Creek Garret Creek UPPER COWLITZ-1CCC	ChS	UPPER COWLITZ-1CCC	egg incubation fry colonization summer rearing adult holding	habitat diversity	P	F	M	M	F	F
			StW									
			Coho									
	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	Cunningham 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									
	30402	Cunningham 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					
	50701	CISPUS-1A CISPUS-1B CISPUS-1C Quartz Cr - 1	ChS	CISPUS-1C	egg incubation fry colonization summer rearing winter rearing	channel stability habitat diversity sediment	PR	M	M	M	F	M
			StW									
			Coho									
ChF			CISPUS-1C	egg incubation early rearing	sediment	PR						

Sub-watershed Group	Subwatersheds	Reaches within subwatershed	Species present	High priority reaches by species	Critical life stages	High impact habitat factors	Restoration or preservation emphasis	Watershed processes (local)			Watershed processes (watershed)		
								Hydrology	Sediment	Riparian	Hydrology	Sediment	
B	20201	UPPER COWLITZ-2	ChS StW Coho ChF					M	M	M	F	M	
	20501	Johnson Cr - 1 Johnson Cr - 2	ChS StW Coho ChF	Johnson Cr - 1	spawning egg incubation fry colonization summer rearing winter rearing	habitat diversity	PR	F	F	M	F	F	
	20601	Hall Cr - 1 UPPER COWLITZ-1F UPPER COWLITZ-2	ChS StW Coho ChF	UPPER COWLITZ-2	summer rearing winter rearing	none	PR	I	M	M	F	F	
	30506	Silver Cr - 1 Silver Cr - 2	ChS StW Coho ChF	Silver Cr - 1	spawning egg incubation fry colonization summer rearing winter rearing	habitat diversity flow	R	M	M	M	I	M	
	30801	UPPER COWLITZ-1A	ChS StW Coho ChF	UPPER COWLITZ-1A	egg incubation fry colonization summer rearing	none	P	I	M	M	F	M	
			ChF	UPPER COWLITZ-1A	egg incubation fry colonization early rearing	sediment	PR						
	30802	Schooley Creek UPPER COWLITZ-1A	ChS StW Coho ChF	UPPER COWLITZ-1A	egg incubation fry colonization summer rearing	none	P	I	M	M	F	M	
			ChF	UPPER COWLITZ-1A	egg incubation fry colonization early rearing	sediment	PR						
	40801	CISPUS-3 CISPUS-4	ChS StW Coho ChF	CISPUS-3	egg incubation summer rearing	sediment	PR	F	F	M	F	F	
				CISPUS-3	egg incubation fry colonization summer rearing winter rearing	channel stability habitat diversity sediment key habitat quantity	R						
	50201	YELLOWJACKET-1 YELLOWJACKET-2	ChS StW Coho ChF	YELLOWJACKET-1	egg incubation summer rearing	sediment	PR	F	M	M	F	M	
	50301	CISPUS-2	ChS StW Coho ChF	CISPUS-2	egg incubation summer rearing	sediment	PR	M	M	M	F	F	
				CISPUS-2	egg incubation summer rearing winter rearing	habitat diversity sediment key habitat quantity	R						
	50302	CISPUS-1F	ChS StW Coho ChF	CISPUS-1F	egg incubation summer rearing winter rearing	sediment	PR	M	M	M	F	M	
	60101	BARRIER RESERVOIR MID COWLITZ-6 MID COWLITZ-7	ChS StW Coho ChF	MID COWLITZ-7	summer rearing winter rearing	none	R	I	M	M	M	M	
	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	Cunningham 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)			Watershed processes (watershed)		
								Hydrology	Sediment	Riparian	Hydrology	Sediment	
C	10504	TILTON-3	ChS	TILTON-3	spawning egg incubation fry colonization summer rearing winter rearing juvenile migrant (age-1) adult holding	sediment	R						
			StW	TILTON-3	egg incubation summer rearing winter rearing juvenile migrant (age-1) juvenile migrant (age-2) adult migrant	sediment	R	I	M	M	I	M	
			Coho	TILTON-3	All	channel stability habitat diversity sediment	R						
	10503	TILTON-1 TILTON-2	ChS	none									
			StW	TILTON-1	egg incubation summer rearing winter rearing	sediment	R	I	M	M	I	M	
			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						
			StW	TILTON-3	egg incubation summer rearing winter rearing juvenile migrant (age-1) juvenile migrant (age-2) adult migrant	sediment	R	I	M	M	I	M	
			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									
			Coho	Lake Creek	spawning egg incubation fry colonization summer rearing winter rearing juvenile migrant (age-0) adult holding	habitat diversity sediment key habitat	R	I	M	I	I	M	
	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						
StW			TILTON EF-1 TILTON-5	egg incubation summer rearing winter rearing	temperature flow sediment key habitat	R	I	M	M	I	M		
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										
		StW	TILTON EF-2	spawning egg incubation fry colonization summer rearing winter rearing	sediment key habitat	R	I	M	M	I	M		
		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					
			StW	TILTON-6	spawning egg incubation summer rearing winter rearing adult holding	flow sediment	R	I	M	M	I	M
			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	Limiting Factors			Threats	Threats		
	CO	CI	TI		CO	CI	TI
<i>Habitat connectivity</i>				<i>Hydropower operations</i>			
Blockages to off-channel habitats	✓		✓	Passage obstructions (dams)	✓	✓	✓
Blockages to channel habitats due to structures	✓	✓	✓	<i>Agriculture/grazing</i>			
<i>Habitat diversity</i>				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	✓		✓	<i>Urban/rural development</i>			
<i>Channel stability</i>				Clearing of vegetation	✓		✓
Bed and bank erosion	✓	✓	✓	Floodplain filling	✓		✓
Channel down-cutting (incision)	✓	✓	✓	Roads – riparian/floodplain impacts	✓		✓
Mass wasting		✓		<i>Forest practices</i>			
<i>Riparian function</i>				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			✓
<i>Floodplain function</i>				<i>Channel manipulations</i>			
Altered nutrient exchange processes	✓		✓	Bank hardening	✓		✓
Reduced flood flow dampening	✓		✓	Channel straightening	✓		✓
Restricted channel migration	✓		✓	Artificial confinement	✓		✓
Disrupted hyporheic processes	✓		✓				
<i>Water quality</i>							
Altered stream temperature regime	✓	✓	✓				
<i>Substrate and sediment</i>							
Excessive fine sediment	✓	✓	✓				
Embedded substrates	✓	✓	✓				
<i>Stream flow</i>							
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	<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • Floodplain filling • Channel straightening • Artificial confinement 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Blockages to off-channel habitats • Loss of off-channel and/or side-channel habitats • Altered habitat unit composition 	<ul style="list-style-type: none"> • Floodplain filling • Channel straightening • Artificial confinement 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability 	<ul style="list-style-type: none"> • Timber harvest – riparian harvests • Riparian grazing • Clearing of vegetation due to 	<ul style="list-style-type: none"> • 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
<p><i>Tilton mainstem</i> Tilton 3-4</p>	<ul style="list-style-type: none"> • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or noxious species 	<p>rural development and agriculture</p>			<p>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.</p>
<p>4. Protect and restore natural sediment supply processes <i>A. Address forest road related sources</i> <i>B. Address timber harvest related sources</i></p>					
<p><i>Entire basin</i></p>	<ul style="list-style-type: none"> • Excessive fine sediment • Excessive turbidity • Embedded substrates 	<ul style="list-style-type: none"> • Timber harvest – impacts to sediment supply • Forest roads – impacts to sediment supply 	<ul style="list-style-type: none"> • All species 	<p>5-50 years</p>	<p>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.</p>
<p>5. Protect and restore runoff processes <i>A. Address forest road impacts</i> <i>B. Address timber harvest impacts</i> <i>C. Limit additional watershed imperviousness</i></p>					
<p><i>Entire basin</i></p>	<ul style="list-style-type: none"> • Stream flow – altered magnitude, duration, or rate of change of flows 	<ul style="list-style-type: none"> • Timber harvest – impacts to runoff • Forest roads – impacts to runoff 	<ul style="list-style-type: none"> • All species 	<p>5-50 years</p>	<p>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.</p>

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
<p>6. Protect and restore instream flows</p> <p><i>A. Water rights closures</i></p> <p><i>B. Purchase or lease existing water rights</i></p> <p><i>C. Relinquishment of existing unused water rights</i></p> <p><i>D. Enforce water withdrawal regulations</i></p> <p><i>E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption</i></p>					
<i>Entire basin</i>	<ul style="list-style-type: none"> Stream flow – altered magnitude, duration, or rate of change of flows 	<ul style="list-style-type: none"> Water withdrawals 	<ul style="list-style-type: none"> 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.
<p>7. Protect and restore water quality</p> <p><i>A. Restore the natural stream temperature regime</i></p>					
<i>Entire basin</i>	<ul style="list-style-type: none"> Altered stream temperature regime 	<ul style="list-style-type: none"> Riparian harvests Riparian grazing Clearing of vegetation for agriculture or residential uses 	<ul style="list-style-type: none"> All species 	1-50 years	Primary emphasis for restoration should be placed on stream segments that are listed on the 2004 303(d) list.
<p>8. Protect and restore instream habitat complexity</p> <p><i>A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting</i></p> <p><i>B. Structurally modify stream channels to create suitable habitat types</i></p>					
<p><i>Upper mainstem Cowlitz</i> Upper Cowlitz 1A-2; Silver Cr; Johnson Cr; Hall Cr</p> <p><i>Cispus mainstem</i> Cispus 1A, 1C, 1F-3; Yellowjacket 1</p> <p><i>Tilton mainstem</i> Tilton 1,3-6; EF Tilton 1-2</p>	<ul style="list-style-type: none"> Lack of stable instream woody debris Altered habitat unit composition 	<ul style="list-style-type: none"> None (symptom-focused restoration strategy) 	<ul style="list-style-type: none"> 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.
<p>9. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development</p> <p><i>A. Plan growth and development to avoid sensitive areas (e.g., wetlands, riparian zones, floodplains, unstable geology)</i></p> <p><i>B. Encourage the use of low-impact development methods and materials</i></p> <p><i>C. Apply mitigation measures to off-set potential impacts</i></p>					
<i>Privately owned portions of the basin</i>	Preservation Measure – addresses many potential limiting factors and threats		<ul style="list-style-type: none"> 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.
<p>10. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection</p> <p><i>A. Purchase properties outright through fee acquisition and manage for resource protection</i></p> <p><i>B. Purchase easements to protect critical areas and to limit potentially harmful uses</i></p> <p><i>C. Lease properties or rights to protect resources for a limited period</i></p>					
<i>Privately owned portions of the basin</i>	<i>Preservation Measure</i> – addresses many potential limiting factors and threats		<ul style="list-style-type: none"> • 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.

Protection Programs

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*

- **Gifford Pinchot NF's Forest Plan:** 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 administratively closed selected areas within the lower North Fork Lewis watershed to further surface and groundwater withdrawals (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; 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.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