Lower Columbia Salmon Recovery And Fish & Wildlife Subbasin Plan

Volume II – Subbasin Plan
Chapter L – Upper Gorge Tributaries

Lower Columbia Fish Recovery Board

December 15, 2004

Preface

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

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

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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Subbasin Plan Vol. II.L.
Columbia Gorge Tributaries

Contents

1.0 Columbia Gorge Tributaries – Executive Summary

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

The Columbia Gorge Tributaries Subbasin is one of eleven major subbasins in the Washington portion of the Lower Columbia Region. This subbasin historically supported winter steelhead, chum, and coho. Today, numbers of naturally spawning salmon and steelhead have plummeted to levels far below historical numbers. steelhead and chum have been listed as Threatened under the Endangered Species Act and coho is proposed for listing. The decline has occurred over decades and the reasons are many. Freshwater and estuary habitat quality has been reduced by agricultural and forestry practices. Key habitats have been isolated or eliminated by inundation or channel modifications. Altered habitat conditions have increased predation. Competition and interbreeding with domesticated or non-local hatchery fish has reduced productivity. Hydropower construction and operation has altered flows, habitat, and migration conditions. Fish are harvested in fresh and saltwater fisheries. Gorge tributary coho salmon will need to be restored to a high level of viability and chum to a medium level of viability to meet regional recovery objectives. This means that the populations are productive, abundant, exhibit multiple life history strategies, and utilize significant portions of the subbasin.

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

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

ecosystems and can only be answered through ongoing monitoring and adaptive management against the backdrop of what is socially possible.

1.1 Key Priorities

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

1. Reduce Passage Mortality at Bonneville Dam and Mitigate for Effects of Reservoir Inundation

Anadromous fish populations in the Columbia Gorge Tributaries are affected by Bonneville Dam operations including inundation of historically available key habitat in lower reaches of streams and dam passage effects. The extent of habitat inundation due to Bonneville Pool varies for each stream and generally constitutes a large share of the naturally limited amount of available habitat. Upstream and downstream fish passage facilities are operated at Bonneville Dam in the mainstem Columbia River but significant mortality and migration delay occurs. Adults are typically delayed in the tailrace but most eventually find and use fish ladders. A varying percentage of adults do not pass successfully or pass but fall back over the spillway. Juvenile passage mortality results primarily from passage through dam turbines rather than spillway or fish bypass systems. Anadromous fish populations will benefit from regional recovery measures and actions identified for operations of Bonneville Dam with respect to fish passage. The suite of in-subbasin and out-of-subbasin actions will help to mitigate for habitat loss and dam passage impacts.

2. Address Immediate Risks with Short-term Habitat Fixes

Restoration of normal watershed processes that allow a basin to restore itself over time has proven to be the most effective strategy for long term habitat improvements. However, restoration of some critical habitats may take decades to occur. In the near term, it is important to initiate short-term fixes to address current critical low numbers of some species and to mitigate for the effects of Bonneville Dam and Reservoir on fish passage. Examples in the Columbia Gorge Tributaries Subbasin include building chum salmon spawning channels and constructing coho overwintering habitat such as alcoves, side channels, and log jams. Benefits of structural enhancements are often temporary but will help bridge the period until normal habitat-forming processes are reestablished.

3. Manage Forest Lands to Protect and Restore Watershed Processes

The majority of the Rock Creek Basin is state or private timber land managed for timber production and has experienced intensive past forest practices activities. Proper forest management is critical to fish recovery. Past forest practices have reduced fish habitat quantity and quality by altering stream flow, increasing fine sediment, and degrading riparian zones. Effects have been magnified due to high rainfall and erodable soils. In addition, forest road culverts have blocked fish passage in small tributary streams. Effective implementation of new forest practices through the Department of Natural Resources' Habitat Conservation Plan (state lands), Forest Practices Rules (private lands), and the Northwest Forest Plan (federal lands) are expected to substantially improve conditions by restoring passage, protecting riparian conditions, reducing fine sediment inputs, lowering water temperatures, improving flows, and restoring habitat diversity. Improvements will benefit all species, particularly winter steelhead and coho.

4. Restore Riparian Function and Stream Habitat Diversity

Forest practices activities, rural residential development and transportation corridors have degraded riparian areas and stream channels in portions of the subbasin. Existing riparian function and habitats will be protected through forest practices programs, local land use ordinances, partnerships with landowners, and the acquisition of land, where appropriate. Restoration will be achieved by working with willing landowners, non-governmental organizations, conservation districts, and state and federal agencies.

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

The human population in the basin is relatively low, but it is projected to grow by at least one third in the next twenty years. The local economy is also in transition with reduced reliance on forest products. Population growth will primarily occur in lower river valleys and along the major stream corridors. There are currently growth restrictions in the lower portion of the subbasin that lies within the Columbia River Gorge National Scenic Area. Growth in other portions of the subbasin, as well as in-filling growth in areas zoned for urban uses (e.g. Stevenson, WA), is likely to result in the conversion of forestry land uses to residential uses, with potential impacts to habitat conditions. Land-use changes will provide a variety of risks to terrestrial and aquatic habitats. Careful land-use planning will be necessary to protect and restore natural fish populations and habitats and will also present opportunities to preserve the rural character and local economic base of the basin.

6. Hatchery Priorities are Consistent with Conservation Objectives

Hatcheries throughout the Columbia Basin historically focused on producing fish for fisheries as mitigation for hydropower development and widespread habitat degradation. Emphasis of hatchery production without regard for natural populations can pose risks to natural population viability. Hatchery priorities must be aligned to conserve natural populations, enhance natural fish recovery, and avoid impeding progress toward recovery while continuing to provide some fishery mitigation benefits. There are no hatchery programs in the small upper Gorge tributaries, although four federal hatcheries operate in the vicinity. 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.

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

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

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

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

2.0 Background

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

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

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

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

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

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

3.0 Assessment

3.1 Subbasin Description

3.1.1 *Topography & Geology*

For the purposes of this analysis, the Columbia Gorge subbasin includes the tributaries in the Columbia Gorge between Bonneville Dam and the White Salmon River, excluding the Wind River and the Little White Salmon River, which are addressed in separate sections. The subbasin is located within Skamania County and is in Washington State Water Resources Inventory Area (WRIA) 29.

Rock Creek is the largest watershed in this subbasin at 43 mi^2. The headwaters of Rock Creek originate near Lookout Mountain at an elevation of over 4,000 feet. The terrain is generally very steep, with incised drainages (USFS 2000). The river empties into Rock Cove on the Columbia River just west of Stevenson, Washington. A few small tributaries enter the Columbia east of Rock Creek, including LaBong Creek, which is the water source for Stevenson. Carson Creek, which flows through Carson, WA, enters the Columbia just west of the Wind River. Between the Wind and the White Salmon Rivers are also a few tributaries, with Dog Creek being the largest.

Geologic history in the area consists of the extensive flood basalts of the Columbia River Basalt Group, which date back 6-17 million years ago. The stratovolcanoes of the Cascades began to build in the Quaternary Period. Mt. Adams and vicinity was a large site of Quaternary volcanic activity that produced some large lava flows down ancient river valleys in the subbasin. Late Miocene and Pliocene compression created the Yakima fold belt that gave rise to much of the topography of the Columbia Gorge. Syncline and anticline features have shaped the topography of most of the stream systems. Glacial floods (Bretz Floods) dating back 12,700-15,300 years ago funneled through the Columbia Gorge and deposited alluvium in lower elevation areas (Welch et al. 2002). In portions of the Rock Creek and LaBong Creek basins (near Stevenson) there is instability associated with what is known as the Bonneville Landslide. This feature involves the slippage of large blocks of conglomerate material on top of underlying saprolite (soft, clay-rich decomposed rock) (Welch et al. 2002) and contributes to instability in the area.

3.1.2 *Climate*

The climate is typified by cool, wet winters and warm, dry summers. Air temperatures are moderated by marine air coming through the Columbia Gorge from the Pacific. However, in winter months, cold temperatures result from the influx of cold continental air masses from the east (Welch et al. 2002). Precipitation and temperature vary considerably from the western to the eastern edge of the subbasin. Mean annual precipitation ranges from 77 inches at Bonneville Dam to 30 inches at Hood River, OR (WRCC 2003). Orographic lifting of marine air masses results in high precipitation values near the Cascade crest (western portion of subbasin), whereas eastern regions receive less precipitation due to rainshadow effects.

3.1.3 *Land Use, Ownership, and Cover*

The Rock Creek basin is predominantly forestland (93%), much of it within the Gifford Pinchot National Forest. Western hemlock forest associations dominate the basin, with pacific silver fir forests in the uppermost portion of the watershed. 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. The State of Washington owns, and the Washington State Department of Natural Resources (DNR) manages the beds of all navigable waters within the subbasin. Any proposed use of those lands must be approved in advance by the DNR. A breakdown of land ownership in the basin is presented in Figure 1. Figure 2 displays the pattern of land cover / land-use.

3.1.4 *Development Trends*

Rural residential development in the lower basin is increasing. Continued population growth will increase pressures for conversion of forestry and agricultural land uses to residential uses, with potential impacts to habitat conditions.

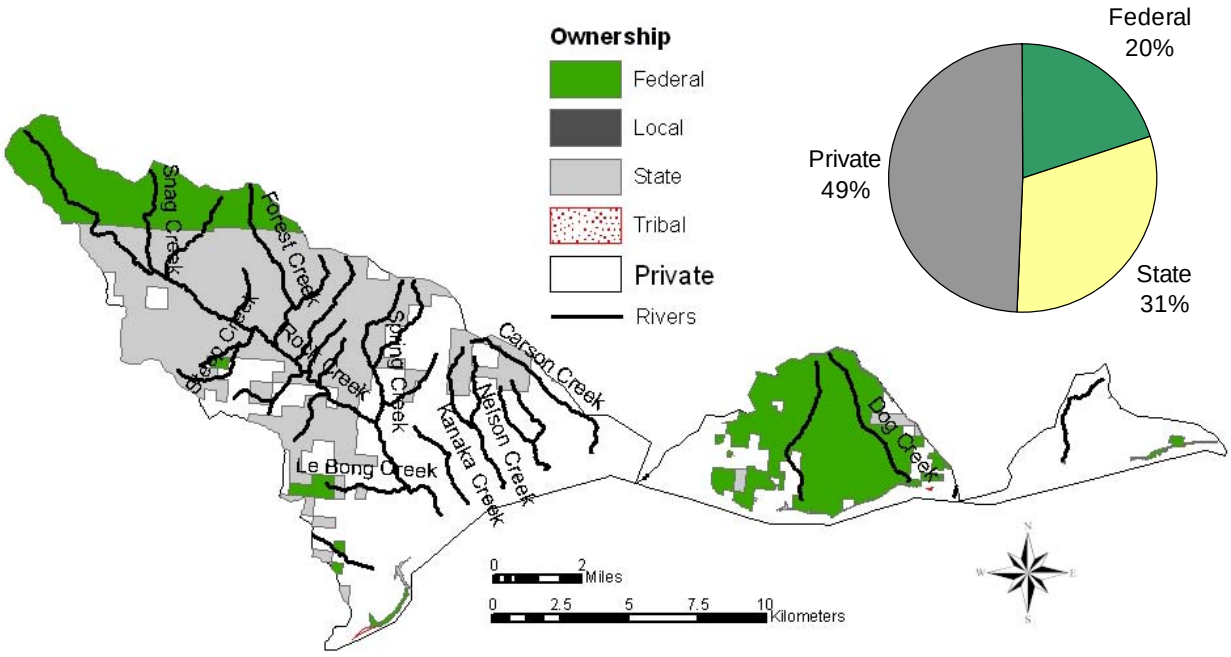

Figure 1. Landownership within the Columbia Gorge Tributaries. Data is WDNR data that was obtained from the Interior Columbia Basin Ecosystem Management Project (ICBEMP).

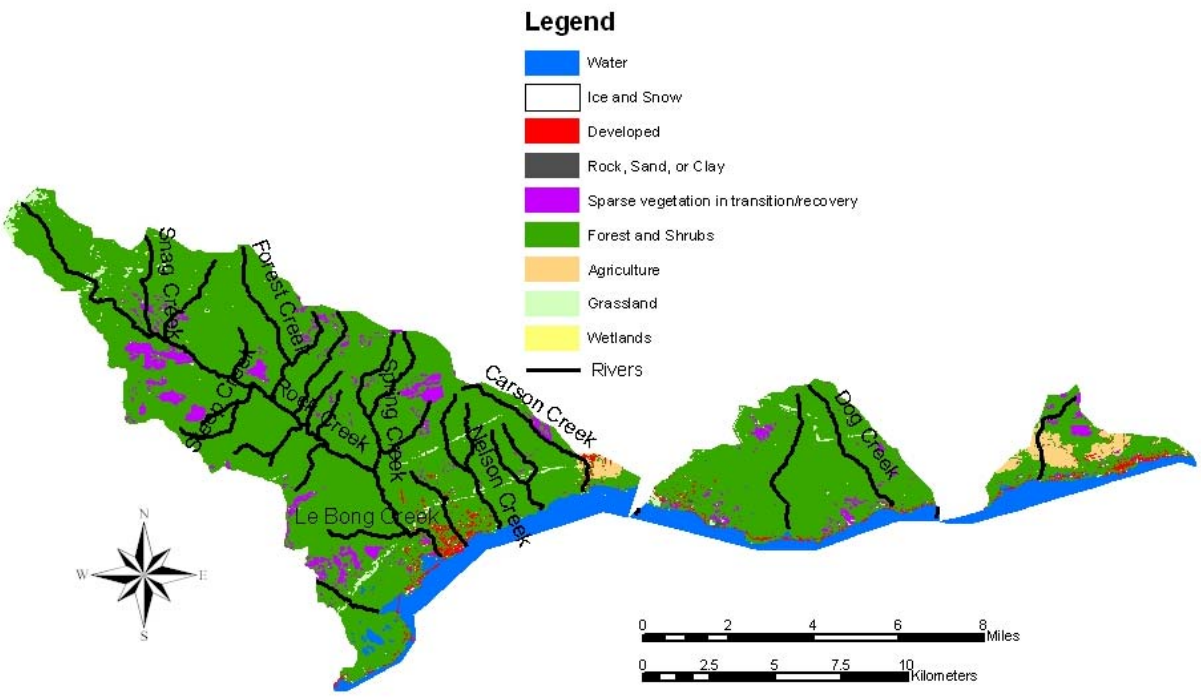

Figure 2. Land cover within the Columbia Gorge Tributaries Subbasin. Data was obtained from the USGS National Land Cover Dataset (NLCD).

3.2 Focal and Other Species of Interest

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

Focal salmonid species in upper Gorge tributary watersheds include chum, coho and winter steelhead. These populations are combined with Wind River and Little White Salmon River populations to from the upper Gorge populations. The upper Gorge aggregate populations are considered for recovery objectives. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 1). Extinction risks are significant for all focal species – the current health or viability ranges from very low for chum to low-low+ for chum, and winter steelhead.

Table 1. Status of focal salmonid and steelhead populations in the upper Gorge Tributaries subbasin.

Focal Species	ESA Status	Hatchery Component[1]	Historical numbers[2]	Recent numbers[3]	Current viability[4]	Extinction risk[5]
Chum	Threatened	No	unknown	unknown	Very Low	~70%
Coho	Proposed	No	200-1,000	unknown	Low	~70%
Winter steelhead	Threatened	No	unknown	<100	Low+	~40%

[1] *Hatchery fish are not released in the subbasin.*
[2] *Historical population size inferred from presumed habitat conditions using Ecosystem Diagnosis and Treatment Model and NOAA back-of-envelope calculations..*
[3] *Approximate current annual range in number of naturally-produced fish returning to the subbasin.*
[4] *Propsects for long term persistence based on criteria developed by the NOAA Technical Recovery Team.*
[5] *Probability of extinction within 100 years corresponding to estimated viability.*

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

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

3.2.1 *Other Species*

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.

3.3 Subbasin Habitat Conditions

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

3.3.1 *Watershed Hydrology*

Annual high flows in the Rock Creek basin typically occur in winter months, related to rain and rain-on-snow events. Based on WDNR classifications, approximately 49% of the basin is in the rain-dominated zone, 44% is in the rain-on-snow zone, and the remainder is in the snow-dominated zone. Coffin (USFS 2000) notes that in reality more of the basin may be within the rain-on-snow zone due to the funneling of cold air masses through the Gorge from the east during winter. There are no streamflow records available for the Rock Creek basin; however, Welch et al. (2002) used streamflow records from the Wind River basin to estimate Rock Creek

flows. High flows were estimated at near 280 cu ft per sec (cfs) for December and April, and below 40 cfs in September.

Many of the smaller stream systems have either very low perennial flow, seasonal flow, or ephemeral flow. Information is lacking on specific hydrologic characteristics of these streams.

Information on changes to runoff conditions is only available for the Rock Creek basin. Approximately 30% of the basin is in early successional or non-forest conditions, potentially increasing the amount of snowfall accumulation and melt rates, which can increase peak flow volumes. High road densities is the basin may also have altered runoff conditions. The upper Rock Creek, Spring Creek, and lower Rock Creek basins all have road densities of over 4 mi/mi^2. An analysis of the relative risk of increased peak flows was assessed by the USFS using vegetation condition, road density, and elevation. Based on the results, two of the nine watersheds, upper Rock Creek and Spring Creek, were identified as being susceptible to an increase in peak flows (USFS 2000). Using an analysis developed by the Washington Department of Natural Resources, which models flows using USGS Regional Regression Equations, current peak flows in the various watersheds were estimated to be 1 to 13 percent higher than those expected under fully forested conditions (USFS 2000).

Information is lacking on runoff conditions for other streams within the subbasin. In general, forest vegetation is younger than historical conditions or has been removed completely. Many of the streams, in particular Carson Creek, have suffered from a dramatic increase in percent of basin area with impervious surfaces, likely increasing runoff rates and peak flow volumes. The Carson / Nelson Creek basin also has a very high road density of 5.25 mi/mi^2.

An assessment of the adequacy of low flows for fish was evaluated using the toe-width method on lower Rock Creek and Carson Creek in 1998. Spot flows measured from late August to early November on Rock Creek were well below optimum flows for salmon and steelhead spawning. Flows were approximately 70% of optimum for salmon and steelhead rearing. Flows in lower Carson Creek for the same time period were even further below optimum levels for spawning and rearing (Caldwell et al. 1999).

3.3.2 *Passage Obstructions*

Several passage barriers were identified in the 1999 Limiting Factors Analysis for WRIA 29 (WCC 1999). Lower Rock Creek Falls at river mile (RM) 1 is a natural barrier that restricts passage to all anadromous species. Foster creek, which flows into the western part of Rock Creek Cove, has a culvert and a dam/pond that restrict passage. A natural cascade blocks passage in Carson Creek approximately 100 feet from its mouth. Collins Creek (Columbia RM 157.9) has a culvert under the railroad that may create a passage problem. Passage at the mouth of Dog Creek may be limited due to sediment buildup.

3.3.3 *Water Quality*

Limited water quality data is available throughout the subbasin, and is restricted primarily to Rock Creek. A one-day, spot sampling effort on Rock Creek recorded a temperature of 57ºF (14ºC) 2 miles downstream of the National Forest boundary and 70ºF (21ºC) at the mouth (USFS 2000). It was suggested that low shading or input of geothermal water might be causing high temperatures in the lower river. Another sampling effort, conducted by Fishman Environmental Services (1997), recorded 63ºF (17ºC) at the mouth of Rock Creek and 77ºF (25ºC) at the west end of Rock Cove. Investigators also noted that runoff from the surrounding urban area may be degrading water quality in Rock Cove. There may also be concerns related to the Skamania

Lodge Golf Course and the County Dump that was located where the lodge now stands (Michaud 2002). The 1999 Limiting Factors Analysis noted that Nelson Creek, which flows through Stevenson and enters the Columbia at RM 151.5, suffers from water quality degradation related to road runoff and land development.

3.3.4 *Key Habitat Availability*

Information gathered on the lower mile of Rock Creek as part of a Rock Cove assessment (Fishman Environmental Services 1997) noted that this reach is generally undisturbed by human activities. The habitat is mostly riffles with few pools, though there are side channels that provide rearing habitat. Information on in-stream habitat is lacking for Rock Creek from above the lower falls to the National Forest boundary. Above this, the USFS gathered habitat data in 1997. The survey revealed a pool frequency of 20 pools/mile, lower than reference levels but potentially a natural condition. Nearly half (45%) of the pools were deeper than 3 feet. A total of eight side channels and three braids were observed (USFS 2000).

3.3.5 *Substrate & Sediment*

Coarse bedload from landslides has been observed in the upper Rock Creek basin (WCC 1999). USFS stream survey data (1997) revealed less than 12% fines in reaches in the upper basin. Overall, in the upper basin, gravel/cobble substrates dominate the upper and lower sections and bedrock substrate dominates the middle section (USFS 2000).

The first mile of Rock Creek has been identified as having limited spawning gravels (Fishman Environmental Services 1997). Grant Lake Creek, which enters the Columbia at RM 158.4 and supports winter steelhead spawning, has sediment accumulations related to natural landslides in the upper basin (WCC 1999).

The same vegetation and road conditions that make a basin susceptible to peak flow alterations can also modify sediment transport dynamics. Rock Creek has high road densities in portions of the basin, especially in the upper basin, which also has many immature forest stands. These conditions may increase sediment production from hillslope sources and can increase delivery rates to stream channels. Stream turbidity and excess coarse bedload volumes have been attributed to landslides in the upper basin, especially along the Washington DNR 2000 Road (WCC 1999).

Sediment supply conditions were evaluated as part of IWA watershed process modeling, which is presented later in this chapter. The IWA indicated that 1 of the 9 subwatersheds rated “impaired” with respect to landscape conditions influencing sediment supply. Six subwatersheds were rated as “moderately impaired” and 2 were rated “functional”. The greatest impairment was in the upper Rock Creek basin and is due to high road densities on steep, erodable slopes on WDNR lands.

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

3.3.6 *Woody Debris*

Only limited information exists for instream LWD and most of it is restricted to the Rock Creek basin. A total of only 6.5 pieces of LWD per mile were measured in the 4.3 miles

surveyed in upper Rock Creek in 1997. This is about 8% of the NMFS standard for Properly Functioning Condition (USFS 2000). Poor riparian conditions create lack of LWD recruitment potential.

3.3.7 *Channel Stability*

Information is lacking on bank stability conditions for most of the subbasin. The Limiting Factors Analysis identified landslides in the Rock Creek basin related to the WDNR 2000 road (WCC 1999). USFS surveys in 1997 measured high width-to-depth ratios (31:1 in the upper Rock Creek basin and 16:1 in the Rock Creek Headwaters basin), revealing potential problems with sediment accumulation and subsequent bank erosion. Overall streambank condition in Rock Creek was rated good to fair (USFS 2000).

3.3.8 *Riparian Function*

Specific information on riparian conditions is limited to data collected by the USFS as part of the Rock Creek Watershed Analysis. Fire, logging, and splash damming have impacted riparian forests in the Rock Creek basin. Of the riparian reserves, 28% are in early-seral vegetation, with the lower Rock Creek basin having 47% in early-seral conditions. However, it should be noted that hardwoods are included in these early-seral vegetation numbers though they may be well-established hardwoods that colonized riparian areas following the large Yacolt Burn in the early 1900s (USFS 2000). Riparian conditions in other subbasin streams are largely undocumented.

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

3.3.9 *Floodplain Function*

Most streams in the subbasin have very little natural floodplain habitat due to the steep valley walls of the Columbia Gorge. The Bonneville Pool now covers much of the floodplain habitats that did exist. Floodplain areas are limited to the lower reaches of channels and have been impacted primarily by transportation corridors and residential and industrial development. SR-14 and the Burlington Northern Railroad cross most of the streams in the basin, constricting floodplains and altering natural channel dynamics.

3.4 Stream Habitat Limitations

Due to the small size of the Columbia Gorge Tributaries Basin, an in-depth stream habitat assessment was not conducted using EDT. The habitat information that was used to generate priority measures and actions for the Management Plan was obtained from existing studies and from the watershed process assessment (IWA) that follows.

3.5 Watershed Process Limitations

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

Watershed process impairments that affect stream habitat conditions were evaluated using a watershed process screening tool termed the Integrated Watershed Assessment (IWA). The IWA is a GIS-based assessment that evaluates watershed impairments at the subwatershed scale (3,000 to 12,000 acres). The tool uses landscape conditions (i.e. road density, impervious surfaces, vegetation, soil erodability, and topography) to identify the level of impairment of 1) riparian function, 2) sediment supply conditions, and 3) hydrology (runoff) conditions. For sediment and hydrology, the level of impairment is determined for local conditions (i.e. within subwatersheds, not including upstream drainage area) and at the watershed level (i.e. integrating the entire drainage area upstream of each subwatershed). See Technical Appendix 5 for additional information on the IWA.

The Columbia Gorge Tributaries Watershed includes 9 subwatersheds, comprised of the Rock Creek drainage and several other independent tributaries that flow into the Columbia River between Bonneville Dam and the Little White Salmon River. These smaller drainages include the Nelson – Carson Creek drainage, and the Dog Creek drainage. IWA results were calculated only for sediment conditions for subwatersheds in the Columbia Gorge Tributaries watershed. Geospatial data was unavailable for assessing hydrologic and riparian conditions. IWA results for the Columbia Gorge Tributaries watershed are shown in Table 2. A reference map showing the location of each subwatershed in the basin is presented in Figure 3. Maps of the distribution of local and watershed level IWA results are displayed in Figure 4.

Table 2. IWA results for the Columbia Gorge Tributaries Watershed

Process Condition	Total Number of Subwatersheds	Local Level Conditions*			Watershed Level Conditions**		
		Functional	Moderately Impaired	Impaired	Functional	Moderately Impaired	Impaired
Hydrology	—	—	—	—	—	—	—
Sediment	9	2	6	1	0	8	1
Riparian	—	—	—	—	NA	NA	NA

Notes:
*Conditions within the subwatershed, not considering upstream effects.
**Conditions within the subwatershed integrating the entire upstream drainage area.
— No result determined because of a lack of available data.
NA Not Applicable.

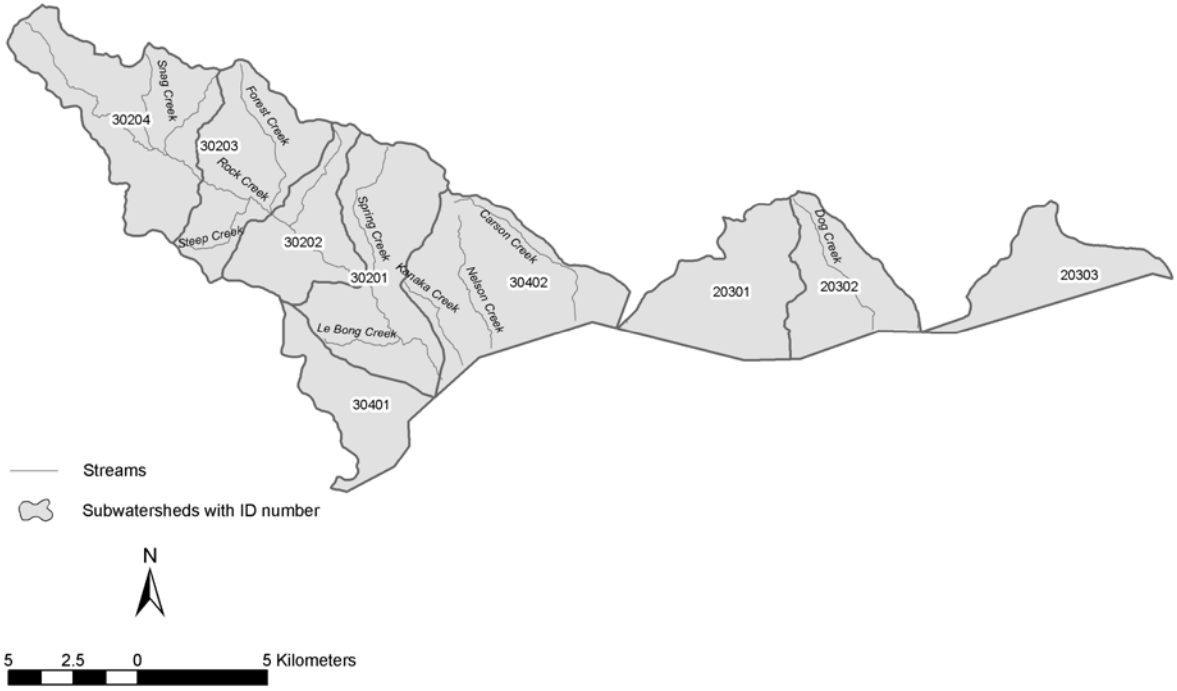

Figure 3. Map of the Columbia Gorge Tributaries showing the location of the IWA subwatersheds.

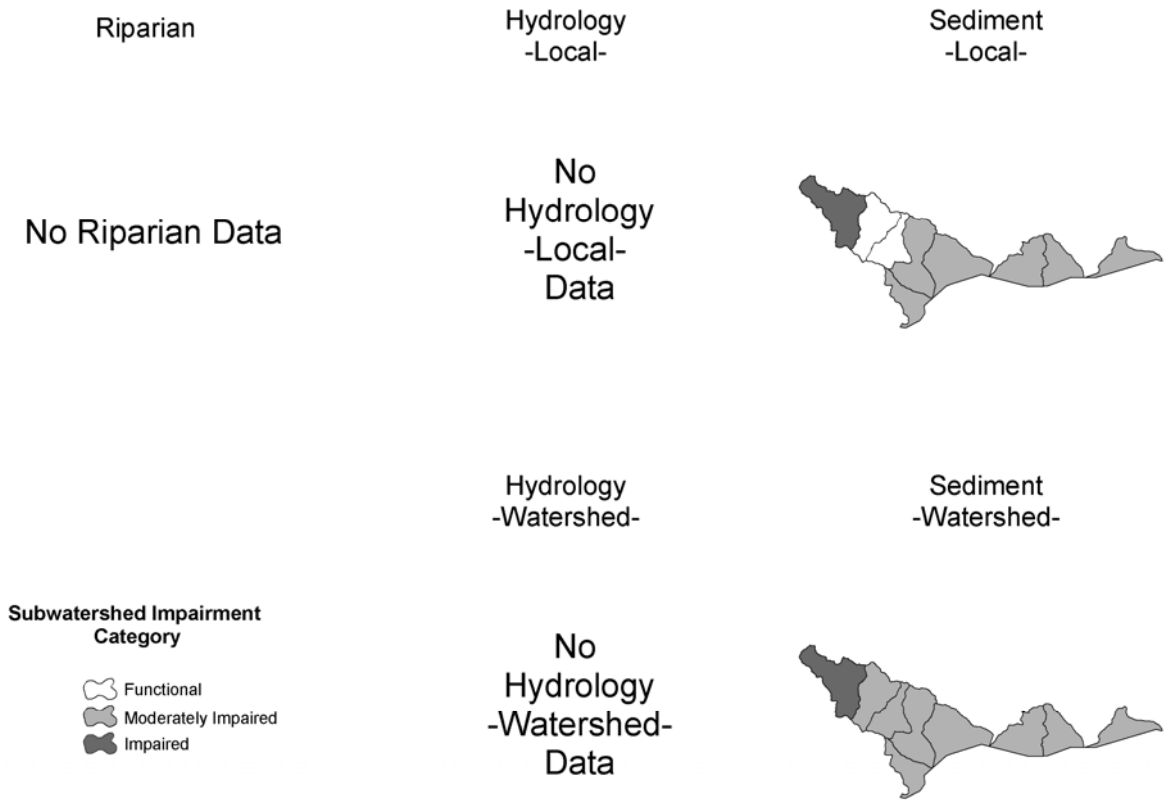

Figure 4. IWA subwatershed impairment ratings by category for the Columbia Gorge Tributaries

3.5.1 *Hydrology*

Current Conditions.— IWA results were not developed for hydrologic conditions in the Columbia Gorge Tributaries watershed because of a lack of GIS based data for forest cover.

Predicted Future Trends.— Public ownership in the upper portions of Rock Creek is high, and much of the lower subwatersheds are under federal management regulations as part of the Columbia River Gorge National Scenic Area. However, the drainage possesses high road densities in the headwaters and lower subwatersheds (greater than 3 mi/mi^2.), and there may be some additional development pressure between the cities of Stevenson and Carson, WA.

Although hydrologic conditions in the Columbia Gorge watershed could not be evaluated using the IWA analysis, overall, hydrologic conditions are expected to remain stable.

3.5.2 *Sediment Supply*

Current Conditions.— Local sediment conditions are rated as impaired in one subwatershed, the headwaters of Rock Creek (30204). Impaired conditions in the Rock Creek headwaters are associated with high road densities in sensitive areas (steep, erodable slopes) on WDNR lands. IWA rates the upper and middle Rock Creek subwatersheds (30202 and 30203) as locally functional. When taking watershed level effects into account, the impaired sediment conditions in the Rock Creek headwaters causes degradation in these functional local level conditions, leading to rankings of moderately impaired for the upper and middle mainstem Rock Creek subwatersheds.

All other independent subwatersheds are terminal (i.e., no upstream subwatersheds) and are rated moderately impaired at both the local and watershed levels.

Predicted Future Trends.— The extent of public lands ownership ranges broadly in these subwatersheds. Terminal, independent drainages have public ownership rates as low as 12%, whereas upper Rock Creek has over 95% of its total area in WDNR and USFS land. Because these subwatersheds all border the Columbia Gorge National Scenic Area, restrictive land use regulations will limit significant development or timber harvest. Given these conditions, the sediment conditions are predicted to trend stable over the next 20 years. Sediment conditions in Rock Creek will remain moderately impaired to impaired until headwaters sediment sources are addressed.

3.5.3 *Riparian Condition*

Current Conditions.— IWA results were not developed for riparian conditions in the Columbia Gorge Tributaries watershed because of a lack of GIS based data for forest cover.

Predicted Future Trends.— Streamside road densities exceed 1 mile/stream mile in lower Rock Creek (30201 and 30202), indicating that riparian recovery will be limited by the extent of existing roads.

Although riparian conditions could not be evaluated using the IWA analysis, overall, riparian conditions are expected to remain stable.

3.6 Other Factors and Limitations

3.6.1 *Hatcheries*

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

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.

Risk Assessment

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

Policy Framework

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

Risk Assessment

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

Following the identification of risks through the assessment process, a strategy is developed to describe a general approach for addressing those risks. Building upon those

strategies, program-specific actions and an adaptive management plan are developed as the final steps in the WDFW framework for hatchery reform.

Table 3 identifies hazards levels associated with risks involved with hatchery programs in the Columbia Gorge Tributaries Basin. Table 4 identifies preliminary strategies proposed to address risks identified in the BRAP for the same populations.

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

Table 3. Preliminary BRAP for hatchery programs affecting populations in the Columbia Gorge Tributaries Basin.

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

	Hatchery Program		Risk Assessment of Hazards											
			Genetic			Ecological			Demographic		Facility			
Wind Population	Name	Release (millions)	Effective Population Size	Domestication	Diversity	Predation	Competition	Disease	Survival Rate	Reproductive Success	Catastrophic Loss	Passage	Screening	Water Quality
Fall Chinook	Big White Salmon W. Steelhead 1+	0.020				ⓘ	ⓘ	●				●	●	●
	Drano Lake S. Steelhead 1+	0.020				ⓘ	ⓘ	●				●	●	●
Spring Chinook	Big White Salmon W. Steelhead 1+	0.020				ⓘ	ⓘ	●				●	●	●
	Drano Lake S. Steelhead 1+	0.020				●	●	●				●	●	●
Chum	Big White Salmon W. Steelhead 1+	0.020				ⓘ	●	●				●	●	●
	Drano Lake S. Steelhead 1+	0.020				ⓘ	●	●				●	●	●
Summer Steelhead	No WDFW Programs													
Winter Steelhead	Big White Salmon W. Steelhead 1+	0.020	●	●	ⓘ	ⓘ	ⓘ	●				●	●	●
	Drano Lake S. Steelhead 1+	0.020				ⓘ	ⓘ	●				●	●	●

Table 4. Preliminary strategies proposed to address risks identified in the BRAP for Columbia Gorge Tributaries Basin populations.

	Hatchery Program		Risk Assessment of Hazards													
			Address Genetic Risks					Address Ecological Risks				Address Demographic Risks		Address Facility Risks		
Upper Gorge Population	Name	Release (millions)	Mating Procedure	Integrated Program	Segregated Program	Research/ Monitoring	Broodstock Source	Number Released	Release Procedure	Disease Containment	Research/ Monitoring	Culture Procedure	Research/ Monitoring	Reliability	Improve Passage	Improve Screening	Pollution Abatement
Fall Chinook	Big White Salmon W. Steelhead 1+	0.020		—	—	—		●	●		●		—		—	—	
	Drano Lake S. Steelhead 1+	0.020						●	●		●						
Spring Chinook	Big White Salmon W. Steelhead 1+	0.020						●	●		●						
	Drano Lake S. Steelhead 1+	0.020															

3.6.2 *Harvest*

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

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

Current fishing impact rates on lower Columbia River naturally-spawning salmon populations ranges from 2.5% for chum salmon to 18% for coho (Table 5). These rates include estimates of direct harvest mortality as well as estimates of incidental mortality in catch and release fisheries. Fishery impact rates for hatchery produced coho and steelhead are higher than for naturally-spawning fish of the same species because of selective fishing regulations. These rates generally reflect recent year (2001-2003) fishery regulations and quotas controlled by weak stock impact limits and annual abundance of healthy targeted fish. Actual harvest rates will vary for each year dependent on annual stock status of multiple west coast salmon populations, however, these rates generally reflect expected impacts of harvest on lower Columbia naturally-spawning and hatchery salmon and steelhead under current harvest management plans.

Table 5. Approximate annual exploitation rates (% harvested) for naturally-spawning lower Columbia salmon and steelhead under current management controls (represents 2001-2003 fishing period).

	AK./Can. Ocean	West Coast Ocean	Col. R. Comm.	Col. R. Sport	Trib. Sport	**Wild Total**	Hatchery Total	Historic Highs
Chum	0	0	1.5	0	1	**2.5**	2.5	60
Coho	<1	9	6	2	1	**18**	51	85
Steelhead	0	<1	3	0.5	5	**8.5**	70	75

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

Harvest of Gorge tributary coho occurs in the ocean commercial and recreational fisheries off the Washington and Oregon coasts and Columbia. Wild coho impacts are limited by fishery management to retain marked hatchery fish and release unmarked wild fish. The upper Gorge tributaries are closed to salmon fishing.

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

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

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

3.6.3 *Mainstem and Estuary Habitat*

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

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

(Technical Appendix 6). Estuary effects are described more fully in the estuary subbasin volume of this plan (Volume II-A).

3.6.4 *Hydropower Construction and Operation*

There are no hydro-electric dams in the Columbia Gorge tributaries Subbasin. However, Gorge tributary species are affected by changes in Columbia River mainstem and estuary related to Columbia basin hydropower development and operation. The mainstem Columbia River and estuary provide important habitats for anadromous species during juvenile and adult migrations between spawning and rearing streams and the ocean where they grow and mature. These habitats are particularly important for chum which rear extensively in the Columbia mainstem and estuary. Aquatic habitats have been fundamentally altered throughout the Columbia River basin by the construction and operation of a complex of tributary and mainstem dams and reservoirs for power generation, navigation, and flood control.

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

3.6.5 *Ecological Interactions*

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

Predation is one interaction where effects can be estimated although interpretation can be complicated. In the lower Columbia River, northern pikeminnow, Caspian tern, and marine mammal predation on salmon has been estimated at approximately 5%, 10-30%, and 3-12%, respectively of total salmon numbers (see Technical Appendix 6 for additional details). Predation has always been a source of salmon mortality but predation rates by some species have been exacerbated by human activities.

3.6.6 *Ocean Conditions*

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

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

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

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

4.0 Key Programs and Projects

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

4.1 Federal Programs

4.1.1 *NOAA Fisheries*

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

4.1.2 *US Army Corps of Engineers*

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

4.1.3 *Environmental Protection Agency*

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

4.1.4 *United States Forest Service*

The Unites States Forest Service (USFS) manages federal forest lands within the Gifford Pinchot National Forest (GPNF) and the Columbia River Gorge National Scenic Area (CRGNSA). The GPNF operates under the Gifford Pinchot Forest Plan (GPFP). Management prescriptions within the GPFP have been guided by the 1994 Northwest Forest Plan, which calls for management of forests according to a suite of management designations including Reserves (e.g. late successional forests, riparian forests), Adaptively-Managed Areas, and Matrix Lands. Most timber harvest occurs in Matrix Lands. The GPNF implements a wide range of ecosystem restoration activities. The CRGNSA was established in 1986 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. CRGNSA lands designated as General Management Area are subject to review of new development and land use.

4.1.5 *Natural Resources Conservation Service*

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

4.1.6 *Northwest Power and Conservation Council*

The Northwest Power and Conservation Council, an interstate compact of Idaho, Montana, Oregon, and Washington, has specific responsibility in the Northwest Power Act of 1980 to mitigate the effects of the hydropower system on fish and wildlife of the Columbia River Basin. The Council does this through its Columbia River Basin Fish and Wildlife Program, which is funded by the Bonneville Power Administration. Beginning in Fiscal Year 2006, funding is guided by locally developed subbasin plans that are expected to be formally adopted in the Council's Fish and Wildlife Program in December 2004.

4.2 State Programs

4.2.1 *Washington Department of Natural Resources*

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

4.2.2 *Washington Department of Fish & Wildlife*

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

4.2.3 *Washington Department of Ecology*

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

4.2.4 *Washington Department of Transportation*

The Washington State Department of Transportation (WSDOT) must ensure compliance with environmental laws and statutes when designing and executing transportation projects. Programs that consider and mitigate for impacts to salmonid habitat include: the Fish Passage

Barrier Removal program; the Regional Road Maintenance ESA Section 4d Program, the Integrated Vegetation Management & Roadside Development Program; Environmental Mitigation Program; the Stormwater Retrofit Program; and the Chronic Environmental Deficiency Program.

4.2.5 *Interagency Committee for Outdoor Recreation*

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

4.2.6 *Lower Columbia Fish Recovery Board*

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

4.3 Local Government Programs

4.3.1 *Skamania County*

Skamania County is not planning under the State's Growth Management Act in its Comprehensive Planning process. Skamania County manages natural resources primarily through a Critical Areas Ordinance. Skamania County has adopted special land use and environmental regulations implementing the Columbia River Gorge National Scenic Area Act for some areas within their jurisdiction.

4.3.2 *Underwood Conservation District*

The Underwood CD provides technical assistance, cost-share assistance, project and water quality monitoring, community involvement and education, and support of local stakeholder groups within the district. UCD implements a wide variety of programs, including conservation and restoration projects, water quality monitoring, a spring tree sales program, education and outreach activities, and support for local watershed committees.

4.4 Non-governmental Programs

4.4.1 *Columbia Land Trust*

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

4.4.2 *Lower Columbia Fish Enhancement Group*

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

4.5 NPCC Fish & Wildlife Program Projects

Western Pond Turtle Recovery - Columbia River Gorge (Project 200102700)

Abstract: Protect existing WPT population through habitat improvements, expand WPT population through "head start" program and continue reintroductions at USFWS Pierce National Wildlife Refuge. Funding Status: funded 2001, 2002, recommended for funding 2003.

Bull trout population assessment in the Columbia River Gorge, WA (Project 199902400).

Abstract: Determining the status of bull trout populations and developing and implementing protection and recovery plans will be critical for their continued survival. This proposal provides the basic data to develop these plans. This project will provide critical information to determine status of bull trout populations in the Wind, Little White Salmon, White Salmon, and Klikitat subbasins and to develop and implement required mgmt actions to restore & maintain healthy population. Funding Status: funded 2000, 2001, 2002, recommended for funding 2003.

Evaluate Status of Coastal Cutthroat Trout in the Columbia River Basin above Bonneville Dam (Project 200102600)

Abstract: Survey Columbia River tributaries above Bonneville Dam for coastal cutthroat trout to determine population status, to identify limiting factors, and to understand the role of current and past human and natural disturbances affecting status. Funding Status: funded 2001.

5.0 Management Plan

5.1 Vision

Washington lower Columbia salmon, steelhead, and bull trout are recovered to healthy, harvestable levels that will sustain productive sport, commercial, and tribal fisheries through the restoration and protection of the ecosystems upon which they depend and the implementation of supportive hatchery and harvest practices.

The health of other native fish and wildlife species in the lower Columbia will be enhanced and sustained through the protection of the ecosystems upon which they depend, the control of non-native species, and the restoration of balanced predator/prey relationships.

The Columbia Gorge Tributaries Subbasin will play a role in the regional recovery of salmon and steelhead by contributing to the recovery of the upper Gorge populations. Natural populations of upper Gorge (including Wind, Little White Salmon, and Gorge tributaries) chum, coho and winter steelhead will be restored to high levels of viability by significant reductions in human impacts throughout the lifecycle. Salmonid recovery efforts will provide broad ecosystem benefits to a variety of subbasin fish and wildlife species. Recovery will be accomplished through a combination of improvements in subbasin, Columbia River mainstem, and estuary habitat conditions as well as careful management of hatcheries, fisheries, and ecological interactions among species.

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

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

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

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

This plan uses a planning period or horizon of 25 years. The goal is to achieve recovery of the listed salmon species and the biological objectives for other fish and wildlife species of

interest within this time period. It is recognized, however, that sufficient restoration of habitat conditions and watershed processes for all species of interest will likely take 75 years or more.

5.2 Biological Objectives

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

Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). The scenario differentiates the role of populations by designating primary, contributing, and stabilizing categories. *Primary populations* are those that would be restored to high or better probabilities of persistence. *Contributing populations* are those where low to medium improvements will be needed to achieve stratum-wide average of moderate persistence probability. *Stabilizing populations* are those maintained at current levels.

Recovery goals call for restoring upper Gorge coho (including Wind River and Gorge tributaries) to a high viability level, providing for a 95% chance of persistence over 100 years, restoring upper Gorge chum (including Wind, Little White Salmon, and Gorge tributaries) to a medium viability level, providing for a 75-94% probability of persistence over 100 years, and maintaining winter steelhead (including Wind and Gorge tributaries) 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 6. Current viability status of upper Gorge 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
Chum (a)	Threatened	No	Very low	Unknown	Medium[C]	<100-1,100
Coho (b)	Proposed	No	Low	Unknown	High[P]	600
Winter Steelhead (b)	Threatened	No	Low+	<100	Low+ [S]	100

(a) Includes Wind River, Little White Salmon and upper Gorge tributaries
(b) Includes Wind River and upper Gorge tributaries
P = primary population in recovery scenario
C = contributing population in recovery scenario
S = stabilizing population in recovery scenario

5.3 Tributary Habitat

Due to the small size of the Columbia Gorge Tributaries Subbasin, an in-depth stream habitat assessment was not conducted using EDT. Development of prioritized measures and actions in this basin relied upon existing information on salmonid habitat and on the results of the watershed process assessment (IWA). As a first step toward measure and action development, existing habitat information and watershed assessment results were integrated to develop a multi-species view of 1) priority areas, 2) factors limiting recovery, and 3) contributing land-use threats. For the purpose of this assessment, limiting factors are defined as the biological and physical conditions serving to suppress salmonid population performance, whereas threats are the land-use activities contributing to those factors. Limiting Factors refer to local (reach-scale) conditions believed to be directly impacting fish. Threats, on the other hand, may be local or non-local. Non-local threats may impact instream limiting factors in a number of ways, including: 1) through their effects on habitat-forming processes – such as the case of forest road impacts on reach-scale fine sediment loads, 2) due to an impact in a contributing stream reach – such as riparian degradation reducing wood recruitment to a downstream reach, or 3) by blocking fish passage to an upstream reach.

Priority areas, limiting factors, and land-use threats were determined from a variety of sources including Washington Conservation Commission Limiting Factors Analyses, the IWA, the State 303(d) list, air photo analysis, the Barrier Assessment, personal knowledge of investigators, or known cause-effect relationships between stream conditions and land-uses.

Priority areas, limiting factors and threats were used to develop a prioritized suite of habitat measures. Measures are based solely on biological and physical conditions. For each measure, the key programs that address the measure are identified and the sufficiency of existing programs to satisfy the measure is discussed. The measures, in conjunction with the program sufficiency considerations, were then used to identify specific actions necessary to fill gaps in measure implementation. Actions differ from measures in that they address program deficiencies as well as biophysical habitat conditions. The process for developing measures and actions is illustrated in Figure 5 and each component is presented in detail in the sections that follow.

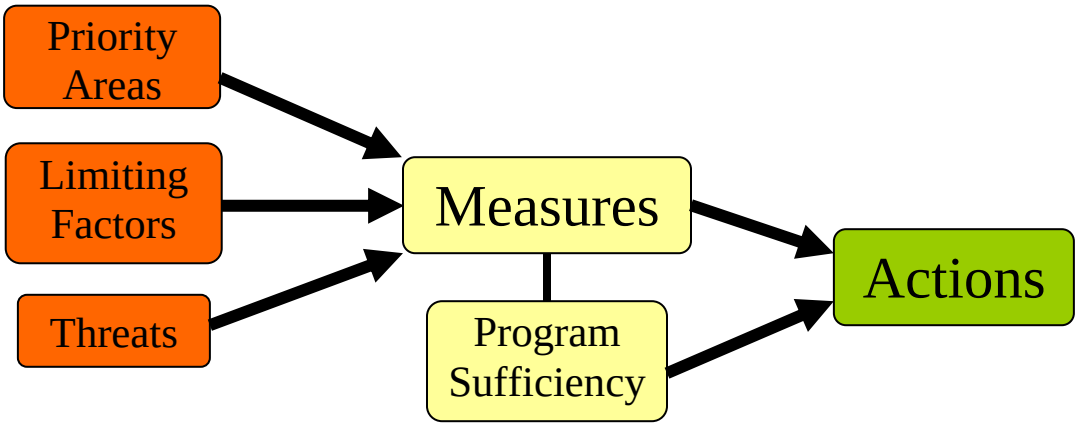

Figure 5. Flow chart illustrating the development of subbasin measures and actions.

5.3.1 *Priority Areas, Limiting Factors and Threats*

Decades of human activity in the Columbia Gorge Tributaries Subbasin have significantly altered watershed processes and reduced both the quality and quantity of habitat needed to sustain viable populations of salmon and steelhead. 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 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). The following bullets provide an overview of each of the priority areas in the basin. These descriptions summarize the species most affected, the primary limiting factors, the contributing land-use threats, and the general type of measures that will be necessary for recovery. A tabular summary of the key limiting factors and land-use threats can be found in Table 7.

- **Lower mainstem Rock Creek** *(from Rock Cove to Lower Rock Creek falls at RM 1)* – The greatest amount of habitat exists in the lower mile of Rock Creek between Rock Cove and lower Rock Creek Falls (RM 1). There is abundant habitat for resident fish and wildlife in other portions of these basins, particularly in the Rock Creek basin. Past fires and forest practices activities have had the greatest impact on Rock Creek stream habitats.
- **Lower sections of small Columbia River tributary streams** *(Nelson, Carson, Collins, Dog Creeks)* – Small amounts of habitat are found in Nelson Creek, Carson Creek, Collins Creek, and Dog Creek. These streams are impacted by channel modifications, passage limitations, and riparian habitat degradation associated with urbanization and road/railroad corridors along the Columbia River.

Table 7. 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	RC	TR	Threats	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	✓	✓			

5.3.2 *Habitat Measures*

Measures are means to achieve the regional strategies that are applicable to the Gorge Tributaries subbasin and necessary to accomplish the biological objectives for focal fish species. Measures are based on the technical assessments for this basin (Section 3.0) as well as on the synthesis of priority areas, limiting factors, and threats presented earlier in this section. The measures applicable to the Columbia Gorge Tributaries Basin are presented in priority order in Table 8. Each measure has a set of submeasures that define the measure in greater detail and add specificity to the particular circumstances occurring within the basin. The table for each measure and associated submeasures indicates the limiting factors that are addressed, the contributing threats that are addressed, the species that would be most affected, and a short discussion. Priority locations are given for some measures. Priority locations typically refer to either stream reaches or subwatersheds, depending on the measure. Addressing measures in the highest priority areas first will provide the greatest opportunity for effectively accomplishing the biological objectives.

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

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

5.3.3 *Habitat Actions*

The prioritized measures and associated gaps are used to develop specific Actions for the basin. These are presented in Table 9. Actions are different than the measures in a number of ways: 1) actions have a greater degree of specificity than measures, 2) actions consider existing programs and are therefore not based strictly on biophysical conditions, 3) actions refer to the agency or entity that would be responsible for carrying out the action, and 4) actions are related to an expected outcome with respect to the biological objectives. Actions are not presented in priority order but instead represent the suite of activities that are all necessary for recovery of listed species. The priority for implementation of these actions must consider the priority of the measures they relate to, the “size” of the gap they are intended to fill, and feasibility considerations.

Table 8. Pioritized measures for the Columbia Gorge Tributaries Basin.

#1 – Protect stream corridor structure and function

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Protect floodplain function and channel migration processes B. Protect riparian function C. Protect access to habitats D. Protect instream flows through management of water withdrawals E. Protect channel structure and stability F. Protect water quality G. Protect the natural stream flow regime	Potentially addresses many limiting factors	Potentially addresses many limiting factors	All Species	Stream corridors in the Columbia Gorge Subbasin have been impacted by forestry activities, rural residential development, urbanization, and transportation corridors. Preventing further degradation of stream channel structure, riparian function, and floodplain function will be an important component of recovery.

Priority Locations

1st- Lower mainstem Rock Creek up to Rock Creek Falls (RM 1) (anadromous access)
2nd- Middle mainstem Rock Creek between Rock Creek Falls and Steep Creek (approx. RM 7) (resident fish)
3rd- Rock Creek tributaries and independent Columbia River tributaries (resident and anadromous access)

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
NOAA Fisheries	ESA Section 7 and Section 10	✓	
USFS	Northwest Forest Plan, Columbia River Gorge National Scenic Area	✓	
US Army Corps of Engineers (USACE)	Dredge & fill permitting (Clean Water Act sect. 404); Navigable waterways protection (Rivers & Harbors Act Sect, 10)	✓	
WA Department of Natural Resources (WDNR)	State Lands HCP, Forest Practices Rules, Riparian Easement Program	✓	
WA Department of Fish and Wildlife (WDFW)	Hydraulics Projects Approval	✓	
Skamania County	Comprehensive Planning		✓
Underwood Conservation District / NRCS	Landowner technical assistance, conservation programs		✓
Noxious Weed Control Boards (State and County level)	Noxious Weed Education, Enforcement, Control		✓
Non-Governmental Organizations (NGOs) (e.g. Columbia Land Trust) and public agencies	Land acquisition and easements		✓

Program Sufficiency and Gaps

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

may be necessary. Public land acquisition should be used as a last resort due to strong opposition by Skamania County to reducing their tax base in an area that is already overwhelming publicly owned.

#2 – Protect hillslope processes

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Manage forest practices to minimize impacts to sediment supply processes, runoff regime, and water quality B. Manage growth and development to minimize impacts to sediment supply processes, runoff regime, and water quality	• Excessive fine sediment • Excessive turbidity • Embedded substrates • Stream flow – altered magnitude, duration, or rate of change of flows • Water quality impairment	• Timber harvest – impacts to sediment supply, water quality, and runoff processes • Forest roads – impacts to sediment supply, water quality, and runoff processes • Development – impacts to sediment supply, water quality, and runoff processes	All species	Hillslope runoff and sediment delivery processes are impaired in portions of the subbasin due to forest practices (timber harvest and road building) and development. Limiting additional degradation will be necessary to prevent further habitat impairment.

Priority Locations

1st- Functional subwatersheds (functional for sediment according to the IWA (local rating)
Subwatersheds: 30203, 30202
2nd- Moderately Impaired subwatersheds
Subwatersheds: 30401, 30201, 30402, 20301, 20302, 20303

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	Forest Practices Rules, State Lands HCP	✓	
USFS	Northwest Forest Plan, CRGNSA	✓	
Skamania County	Comprehensive Planning		✓
Underwood Conservation District / NRCS	Landowner technical assistance, conservation programs		✓

Program Sufficiency and Gaps

Hillslope processes on federal and state timber lands are protected through the Northwest Forest Plan and State Timber Lands HCP, respectively. Private forest lands are protected through Forest Practices Rules administered by the WDNR. These rules, developed as part of the Forests & Fish Agreement, are believed to be adequate for protecting watershed sediment supply, runoff processes, and water quality on private forest lands. The program is new, however, and careful monitoring of the effect of the regulations is necessary, particularly effects on subwatershed hydrology and sediment delivery. Small private landowners may be unable to meet some of the requirements on a timeline commensurate with large industrial landowners. Financial assistance to small owners would enable greater and quicker compliance. On non-forest lands, local government comprehensive planning is the primary nexus for protection of hillslope processes. Counties can control impacts through stormwater management, zoning that protects existing uses, and through tax incentives to keep forest lands from becoming developed.

#3 - Restore riparian conditions throughout the basin

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore the natural riparian plant community B. Eradicate invasive plant species from riparian areas	• Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or invasive species	• Timber harvest – riparian harvests • Clearing of vegetation due to residential development	All species	Degradation of riparian forests in the subbasin has contributed to loss of large woody debris recruitment potential, loss of stream shading, loss of streambank stability, loss of floodplain function, and disruption of nutrient exchange and hyporheic flow processes; all of which have potentially deleterious effects to aquatic and terrestrial species. The increasing abundance of exotic and invasive species is also of concern. Riparian restoration projects are relatively inexpensive and are often supported by landowners.

Priority Locations

1st- Lower Rock Creek reaches within private lands
2nd- Independent Columbia River tributaries with residential and transportation corridor impacts
3rd- Upper Rock Creek Basin

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	State Lands HCP, Forest Practices Rules	✓	
USFS	Northwest Forest Plan, CRGNSA, Habitat Projects	✓	
WDFW	Habitat Program		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Underwood Conservation District / NRCS	Landowner technical assistance, conservation programs, habitat restoration projects		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
Noxious Weed Control Boards (State and County level)	Noxious Weed Enforcement, Education, Control		✓

Program Sufficiency and Gaps

There are no regulatory mechanisms for actively restoring riparian conditions; however, existing programs will afford protections that will allow for the *passive* restoration of riparian forests. These protections are believed to be adequate for riparian areas on forest lands that are subject to the Northwest Forest Plan, Forest Practices Rules, or the State forest lands HCP. Other lands receive variable levels of protection and passive restoration through the Skamania County Comprehensive Plan and Gorge Scenic Act Ordinances. Degraded riparian zones in residential or transportation corridor uses will not passively restore with existing regulatory protections and will require active measures that are not called for in any existing policy. Riparian restoration in these areas may entail tree planting, road relocation, invasive species eradication, and adjusting current land-use in the riparian zone. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects.

#4- Restore degraded hillslope processes

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Upgrade or remove problem forest roads B. Reforest heavily cut areas not recovering naturally C. Reduce watershed imperviousness D. Manage stormwater runoff from developed areas	• Excessive fine sediment • Excessive turbidity • Embedded substrates • Stream flow – altered magnitude, duration, or rate of change of flows • Water quality impairment	• Timber harvest – impacts to sediment supply, water quality, and runoff processes • Forest roads – impacts to sediment supply, water quality, and runoff processes • Development – impacts to water quality and runoff processes	All species	Hillslope runoff and sediment delivery processes are impaired in portions of the subbasin due to forest practices (timber harvest and road building), especially in the Rock Creek Basin. Forest practices, as well as rural residential and urban development, have affected hillslope processes in other basins. Degraded hillslope processes must be addressed for reach-level habitat recovery to be successful.

Priority Locations

1st- Moderately impaired or impaired subwatersheds (mod. impaired or impaired for sediment according to IWA – local rating)
Subwatersheds: 30401, 30201, 30402, 20301, 20302, 20303, 30204

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	State Lands HCP, Forest Practices Rules	✓	
USFS	Northwest Forest Plan	✓	
WDFW	Habitat Program		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Underwood Conservation District / NRCS	Landowner technical assistance, conservation programs, habitat restoration projects		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓

Program Sufficiency and Gaps

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

#5 – Provide for adequate instream flows during critical periods

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Protect instream flows through water rights closures and enforcement B. Restore instream flows through acquisition of existing water rights C. Restore instream flows through implementation of water conservation measures	• Stream flow – Maintain or improve low Summer flows	• Water withdrawals	All species	Current and predicted consumptive water withdrawals are believed to represent a negligible amount of the low flow volume of Rock Creek (Greenberg and Callahan 2003). There is little streamflow information available for other basins. This measure applies to instream flows associated with water withdrawals and diversions, generally a concern only during low flow periods. Hillslope processes also affect low flows but these issues are addressed in separate measures.

Priority Locations

Entire Basin

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WRIA 29 Watershed Planning Unit	Watershed Planning		✓
Washington Department of Ecology	Water Resources Program		✓

Program Sufficiency and Gaps

The Water Resources Program of the WDOE, in cooperation with the WDFW and other entities, manages water rights and instream flow protections. A collaborative process for setting and managing instream flows was launched in 1998 with the Watershed Planning Act (HB 2514), which called for the establishment of local watershed planning groups who's objective was to recommend instream flow guidelines to WDOE through a collaborative process. The current status and near-term direction of this planning effort is outlined in the WDOE's Action Plan for Setting, Achieving, and Protecting Instream Flows (WDOE 2004). The action plan is a working document that describes the strategies that will be used to set, achieve, and protect instream flows in each WRIA using the recommendations of local watershed planning units. In the case of the Columbia Gorge Tributaries, "The [WRIA 29] Planning Unit developed a detailed instream flow proposal, but ultimately voted to not request a supplemental instream flow grant from Ecology. This was largely due to concerns with having responsibility for developing flow recommendations." (from WDOE Watershed Planning website). The role of the Planning Unit in setting instream flows therefore remains uncertain. If the Planning Unit does not make any recommendations to Ecology, Ecology would have until 2007 to establish minimum instream flows.

#6 – Restore degraded water quality

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Increase riparian shading B. Decrease channel width-to-depth ratios C. Reduce delivery of chemical contaminants to streams D. Address leaking septic systems	• Bacteria • Altered stream temperature regime • Chemical contaminants	• Timber harvest – riparian harvests • Leaking septic systems • Clearing of vegetation due to development • Chemical contaminants from developed lands	• All fish species	There has been little water quality monitoring throughout the basin. High temperatures have been recorded in lower Rock Creek and in Rock Cove (USFS 2000). There is the potential for bacteria contamination from leaking septic systems and the potential for polluted runoff from Stevenson and Carson, WA.

Priority Locations

1st- Lower Rock Creek and Carson Creek
2nd- All remaining reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
Washington Department of Ecology	Water Quality Program		✓
USFS	Northwest Forest Plan, Habitat Projects		✓
WDNR	State Lands HCP, Forest Practices Rules		✓
WDFW	Habitat Program		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Underwood Conservation District / NRCS	Landowner technical assistance, conservation programs, habitat restoration projects		✓
WRIA 29 Watershed Planning Unit	Watershed Planning		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓

Program Sufficiency and Gaps

The WDOE Water Quality Program manages the State 303(d) list of impaired water bodies. There are no listings in the Columbia Gorge Tributaries Basin (WDOE 2004). The 303(d) listings are believed to address the primary water quality concerns; however, impairments may exist that the current monitoring effort is unable to detect. Additional monitoring is needed to fully understand the degree of water quality impairment in the basin.

#7 – Restore access to habitat blocked by artificial barriers

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore access to isolated habitats blocked by culverts, dams, or other barriers	• Blockages to channel habitats • Blockages to off-channel habitats	• Dams, culverts, in-stream structures	All species	There are a few barriers to anadromous fish located near the mouths of Columbia River tributaries. There are additional potential barriers to resident fish in the upper watersheds although little information exists on such obstructions. Passage restoration projects should focus only on cases where it can be demonstrated that there is good potential benefit and reasonable project costs.

Priority Locations

1st- Foster Creek, Collins Creek
2nd- Upper Rock Creek tributary streams and small Columbia River tributaries with blockages

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	Forest Practices Rules, Family Forest Fish Passage, State Forest Lands HCP		✓
USFS	Northwest Forest Plan, Habitat Projects		✓
WDFW	Habitat Program		✓
Washington Department of Transportation / WDFW	Fish Passage Program		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Skamania County	Roads		✓

Program Sufficiency and Gaps

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

#8 - Restore channel structure and stability

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting B. Structurally modify channel morphology to create suitable habitat C. Restore natural rates of erosion and mass wasting within river corridors	• Lack of stable instream woody debris • Altered habitat unit composition • Reduced bank/soil stability • Excessive fine sediment • Excessive turbidity • Embedded substrates	• None (symptom-focused restoration strategy)	All species	Information on channel structure and stability is limited primarily to National Forest lands in the Upper Rock Creek Basin where LWD levels are low and areas of streambank erosion have been identified (USFS 2000). Past riparian timber harvests and splash dam logging have impacted channel structure and stability. Large wood installation projects could benefit habitat conditions in many areas although watershed processes contributing to wood deficiencies should be considered and addressed prior to placing wood in streams. Other structural enhancements to stream channels may be warranted in some places.

Priority Locations

1st- Lower mainstem Rock Creek up to Rock Creek Falls (RM 1) (anadromous access)
2nd- Middle mainstem Rock Creek between Rock Creek Falls and Steep Creek (approx. RM 7) (resident fish)
3rd- Rock Creek tributaries and independent Columbia River tributaries (resident and anadromous access)

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
NGOs, tribes, agencies, landowners	Habitat Projects		✓
USFS	Northwest Forest Plan, Habitat Projects	✓	
WDFW	Habitat Program		✓
USACE	Water Resources Development Act (Sect. 1135 & Sect. 206)		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Underwood Conservation District / NRCS	Landowner technical assistance, conservation programs, habitat restoration projects		✓

Program Sufficiency and Gaps

There are no regulatory mechanisms for actively restoring channel stability and structure. Passive restoration is expected to slowly occur as a result of protections afforded to riparian areas and hillslope processes. Projects are likely to occur in a piecemeal fashion as opportunities arise and only if financing is made available. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects.

#9 – Create habitats to replace those lost as a result of Bonneville Dam inundation

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Create new channel or off-channel habitats (i.e. spawning channels)	• Loss of habitat	• Bonneville Dam inundation	chum, coho, fall chinook	There has been significant loss of habitats in the lower portion of streams currently inundated by Bonneville Dam. Important anadromous habitat, especially for chum, coho, and fall chinook, has been lost. Sustaining production of some populations (i.e. chum) may require creating suitable spawning habitat.

Priority Locations

1st- Lower Rock Creek area
2nd- Lower portion of other tributaries or Columbia River channel margin areas that may have potential for habitat creation

Key Programs

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

Program Sufficiency and Gaps

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

Table 9. Habitat actions for the Columbia Gorge Tributaries Basin.

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
Gorge 1. Continue to manage federal forest lands according to the Northwest Forest Plan	Activity is currently in place	USFS	1, 2, 3, 4, 6 & 7	Medium: National Forest lands	High: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats	High
Gorge 2. Conduct forest practices on state lands in accordance with the Habitat Conservation Plan in order to afford protections to riparian areas, sediment processes, runoff processes, water quality, and access to habitats	Activity is currently in place	WDNR	1, 2, 3, 4, 6 & 7	High: State timber lands in the Gorge Tribs Basin (approximately 31% of the basin area)	High: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats. Response is medium because of location and quantity of state lands	Medium
Gorge 3. Expand standards in County and City Comprehensive Plans to afford adequate protections of ecologically important areas (i.e. stream channels, riparian zones, floodplains, CMZs, wetlands, unstable geology)	Expansion of existing program or activity	Skamania County	1 & 2	Medium: Applies to private lands under county jurisdiction	High: Protection of water quality, riparian function, stream channel structure (e.g. LWD), floodplain function, CMZs, wetland function, runoff processes, and sediment supply processes	High
Gorge 4. Manage future growth and development patterns to ensure the protection of watershed processes. This includes limiting the conversion of lands to developed uses through zoning regulations and tax incentives	Expansion of existing program or activity	Skamania County	1 & 2	Medium: Applies to private lands under county jurisdiction	High: Protection of water quality, riparian function, stream channel structure (e.g. LWD), floodplain function, CMZs, wetland function, runoff processes, and sediment supply processes	High
Gorge 5. Prevent floodplain impacts from new development through land use controls and Best Management Practices	New program or activity	Skamania County, WDOE	1	Low: Applies to privately owned floodprone lands under county jurisdiction	High: Protection of floodplain function, CMZ processes, and off-channel/side-channel habitat. Prevention of reduced habitat diversity and key habitat availability	High
Gorge 6. Review and adjust operations to ensure compliance with the Endangered Species Act; examples include roads, parks, and weed management	Expansion of existing program or activity	Skamania County	1, 3, 4, & 6	Low: Applies to lands under public jurisdiction	Medium: Protection of water quality, greater streambank stability, reduction in road-related fine sediment delivery, restoration and preservation of fish access to habitats	High
Gorge 7. Increase funding available to purchase easements in sensitive areas in order to protect watershed function where existing programs are inadequate	Expansion of existing program or activity	LCFRB, NGOs, WDFW, USFWS, BPA (NPCC)	1 & 2	Low: Residential or forest lands at risk of further degradation	High: Protection of riparian function, floodplain function, water quality, wetland function, and runoff and sediment supply processes	High
Gorge 8. Increase technical assistance to landowners and increase landowner participation in conservation programs that protect and restore habitat and habitat-forming processes. Includes	Expansion of existing program or activity	NRCS, UCD, WDNR, WDFW, LCFEG, Skamania County	All measures	Low: Private lands. Applies to lands in rural residential and forestland uses	High: Increased landowner stewardship of habitat. Potential improvement in all factors	Medium

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

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
increasing the incentives (financial or otherwise) and increasing program marketing and outreach						
Gorge 9. Fully implement and enforce the Forest Practices Rules (FPRs) on private timber lands in order to afford protections to riparian areas, sediment processes, runoff processes, water quality, and access to habitats	Activity is currently in place	WDNR	1, 2, 3, 4, 6 & 7	Low: Private commercial timber lands	High: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats	Medium
Gorge 10. Address instream flow setting through the WRIA 29 Planning Unit and/or through WDOE	Expansion of existing program or activity	WDOE, WDFW, WRIA 29 Planning Unit	5	High: Entire basin	Medium: Adequate instream flows to support life stages of salmonids and other aquatic biota.	Medium
Gorge 11. Assess the impact of fish passage barriers throughout the basin and restore access to potentially productive habitats	Expansion of existing program or activity	WDFW, WDNR, Skamania County, WSDOT	7	Low: There are few passage concerns in the basin	Medium: Increased habitat availability	Medium
Gorge 12. Increase the level of implementation of voluntary habitat enhancement projects in high priority reaches and subwatersheds. This includes building partnerships with landowners and agencies and increasing funding	Expansion of existing program or activity	LCFRB, BPA (NPCC), NGOs, WDFW, NRCS, UCD, LCFEG	3, 4, 6, 7, 8 & 9	Low: Priority stream reaches and subwatersheds	Medium: Improved conditions related to water quality, LWD quantities, bank stability, key habitat availability, habitat diversity, riparian function, floodplain function, sediment availability, & channel migration processes	Medium
Gorge 13. Increase technical support and funding to small forest landowners faced with implementation of Forest Practices Rules to ensure full and timely compliance with regulations	Expansion of existing program or activity	WDNR	1, 2, 3, 4, 6 & 7	Low: Small private timberland owners	Medium: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats	Medium
Gorge 14. Protect and restore native plant communities from the effects of invasive species	Expansion of existing program or activity	Weed Control Boards (local and state); NRCS, UCD, LCFEG	1 & 3	Medium: Greatest risk is in residential use areas	Medium: restoration and protection of native plant communities necessary to support watershed and riparian function	Low
Gorge 15. Assess, upgrade, and replace on-site sewage systems that may be contributing to water quality impairment	Expansion of existing program or activity	Skamania County, UCD	6	Low: Private rural residential lands	Medium: Protection and restoration of water quality (bacteria)	Low

5.4 Hatcheries

5.4.1 *Subbasin Hatchery Strategy*

The desired future state of fish production within the upper Gorge tributaries Basin includes natural salmon and steelhead populations that are improving on a trajectory to recovery and hatchery programs that either enhance the natural fish recovery trajectory or are operated to not impede progress towards recovery. Hatchery recovery actions in each subbasin are tailored to the specific ecological and biological circumstances for each species in the subbasin. This often involves substantial changes in many hatchery programs from their historical focus on production for fishery mitigation. The recovery strategy includes a mixture of conservation programs and mitigation programs. Mitigation programs involve areas or practices selected for consistency with natural population conservation and recovery objectives.

There are no hatchery programs in the upper Gorge tributaries, although four federal hatcheries release salmon into the Little White Salmon, Wind, and mainstem Columbia rivers in the vicinity of the upper Gorge tributaries. These upper Gorge hatchery programs include specific requirements for production levels as per a Federal Court mandated Agreement between the parties to *U.S. v. Oregon*. The types of natural production enhancement strategies and fishery enhancement strategies to be implemented in the upper Gorge tributary Basin is displayed by species in Table 10. The fishery enhancement programs represent all the federal hatchery programs in the upper Gorge. None of these fish are released into the upper Gorge tributaries. More detailed descriptions and discussion of the regional hatchery strategy can be found in the Regional Recovery and Subbasin Plan Volume I.

Table 10. Summary of natural production enhancement strategies to be implemented in the upper Gorge tributaries and fishery enhancement strategies in the upper Gorge area (no fish released into the upper Gorge tributaries subbasin)

		Species					
		Fall Chinook	Spring Chinook	Coho	Chum	Winter Steelhead	Summer Steelhead
Natural Production Enhancement	Supplementation						
	Hatch/Nat Conservation [1/]						
	Isolation						
	Refuge					✓	
Fishery	Hatchery Production	✓2/	✓3/	✓4/			

1/ Hatchery and natural population management strategy coordinated to meet biological recovery objectives. Strategy may include integration and/or isolation strategy over time. Strategy will be unique to biological and ecological circumstances in each watershed.
2/Tule fall chinook released into mainstem Columbia from Spring Creek Hatchery and URB fall chinook released into Little White Salmon River from LWS Hatchery
3/Spring Chinook released into the Wind River from Carson Hatchery
4/Coho released into the Little White salmon River from LWS and Willard hatcheries

Conservation-based hatchery programs include strategies and actions which are specifically intended to enhance production of a particular wild fish population within the basin. Hatchery conservation strategies employ four general approaches:

Hatchery Supplementation: This strategy utilizes hatchery production as a tool to assist in rebuilding depressed natural populations. Supplementation would occur in selected areas that

are producing natural fish at levels significantly below current capacity or expected increases capacity as a result of immediate benefits of habitat or passage improvements This strategy would not be included in near-term actions for the upper Gorge tributaries.

Hatchery/Natural Merged Conservation Strategy: A unique conservation strategy is developed for each watershed depending on the status of the natural population, the biological relationship between the hatchery and natural populations, ecological attributes of the watershed, and logistical opportunities to jointly manage the populations. This strategy may include integration or isolation, annual abundance driven distribution, and brood stock development. The strategies are expected to evolve over time dependent on changes in the populations and in the habitat productivity. This strategy is currently aimed at Chinook salmon in areas where harvest production occurs. There is not a spring Chinook harvest program in the Wind Basin but not a natural spring Chinook population to manage for. There is no fall Chinook hatchery program in the upper Gorge tributaries.

Hatchery/Natural Isolation: This strategy is focused on separating hatchery adult fish from Natural produced adult fish to avoid or minimize spawning interactions. The strategy may be implemented in the entire watershed or more often in a section of the watershed upstream of a barrier or trap where the hatchery fish can be removed. This strategy is currently aimed at hatchery steelhead in watersheds with trapping capabilities. The strategy may also become part of spring and fall Chinook as well as coho strategy in certain watersheds in the future as unique wild runs develop. This strategy would not be included in near-term actions for the upper Gorge tributaries but could be considered in the future for coho.

Natural Refuge Watersheds: This strategy is species specific and requires certain sub-basins to be designated as wild fish only areas for a particular species. The refuge areas include watersheds where populations have persisted with minimum hatchery influence and areas that may have a history of hatchery production but would not be subjected to future hatchery influence as part of the recovery strategy. More refuge areas may be added over time as wild populations recover. The upper Gorge tributaries would be a refuge area for natural winter steelhead

The majority of funding for lower Columbia basin hatchery operations is for producing salmon and steelhead for harvest to mitigate for lost harvest of natural production due to hydro development and habitat degradation. Programs for fishery enhancement will continue during the recovery period, but will be managed to minimize risks and ensure they do not compromise recovery objectives for natural populations. It is expected that the need to produce compensatory fish for harvest through artificial production will reduce in the future as natural populations recover and become harvestable. Fishery enhancement programs in the upper Gorge area included in Federal Court mandated Production Agreements between federal, state, and tribal parties to *U.S. v. Oregon*

The Carson National Fish Hatchery will continue to support Treaty Indian and non-Indian spring Chinook fisheries with hatchery releases in the Wind Basin. The Little White Salmon and Willard hatcheries will continue to support Treaty Indian and non-Indian fisheries with URB fall Chinook, spring Chinook and coho releases in the Little White Salmon River, and Spring Creek Hatchery will continue to support Treaty Indian and non-Indian fisheries with releases of tule fall Chinook into the mainstem Columbia River (Table 26).

Table 11. A summary of conservation and harvest strategies to be implemented through Wind River Hatchery programs.

		Stock
Natural Production Enhancement	Supplementation	
	Hatch/Nat Conservation 1/	
	Isolation	
	Refuge	Rock Creek Winter Steelhead
	Broodstock development	
Fishery Enhancement	In-basin releases	
	Out of Basin Releases (final rearing at Wind, LWS, Willard, and SCH))	Carson Spring Chinook
		Spring Creek fall Chinook
		URB fall Chinook
		LWS early coho

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

5.4.2 *Hatchery Measures and Actions*

Hatchery strategies and measures are focused on evaluating and reducing biological risks consistent with the recovery strategies identified for each natural population.. Artificial production programs within the upper Gorge area facilities have been evaluated in detail through the WDFW Benefit-Risk Assessment Procedure (BRAP) relative to risks to natural populations. The BRAP results were utilized to inform the development of these program actions specific to the upper Gorge subbasin tributary (Table 12). Further hatchery program benefits and risks to wild populations are addressed in HGMPs for the federal hatchery programs which were developed by USFWS and submitted to NOAA Fisheries. It is expected that the HGMPs and these recovery actions will be complementary and provide a coordinated strategy for the upper Gorge area hatchery programs. Further explanation of specific strategies and actions for hatcheries can be found in the Lower Columbia Salmon and Steelhead Recovery and Subbasin Plan, Volume I, Chapter 7 under Regional Strategies and Measures.

Table 12. Hatchery Program actions to be implemented in the upper Gorge area.

Action	Description	Comments
H.M6	Evaluate Carson NFH, LWS NFH, and Spring Creek 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.A4, H.A.11, H.A.28	Juvenile release strategies to minimize impacts to naturally-spawning populations.	Release strategies would be aimed at minimizing interactions between hatchery released spring Chinook, coho, and fall 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.

5.5 Harvest

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

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

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

Fishery actions specific to the subbasins are addressed through the Washington State Fish and Wildlife sport fishing regulatory process. This public process includes an annual review focused on emergency type regulatory changes and a comprehensive review of sport fishing regulations which occurs every two years. This regulatory process includes development of fishing rules through the Washington Administrative Code (WAC) which are focused on protecting weak stock populations while providing appropriate access to harvestable populations. The actions consider the specific circumstances in each area of each subbasin and respond with rules that fit the relative risk to the weak populations in a given time and area of the subbasin. Following is a general summary of the fishery regulatory and protective actions specific to the Washougal River (Table 13). More complete details can be found in the WDFW Sport Fishing Rules Pamphlet.

Table 13. Summary of sport fishing regulatory and protective actions in the upper Gorge tributaries.

Species	General Fishing Actions	Explanation	Other Protective Fishing Actions	Explanation
Fall Chinook	Closed to retention	Protects wild fall Chinook. No hatchery produced fall Chinook in the Lower Gorge tributaries	No fisheries for other salmon	Further protection of wild fall Chinook spawners
Chum	Closed to retention	Protects wild chum. Hatchery chum are not released in the Lower Gorge tributaries for harvest	No fisheries for other salmon and trout season closes in late fall	Further protection of wild chum spawners
Coho	Closed to retention	Protects wild coho. Hatchery coho are not released in the Lower Gorge tributaries for harvest.	No fisheries for other salmon and trout closes in late fall	Further protection of wild coho spawners
Winter steelhead	Winter season closed	Trout season closes in the fall prior to entry of winter steelhead and reopens in the summer after steelhead have spawned	Minimum size restrictions during trout season	Minimum size protects juveniles

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

Table 14. Regional harvest actions from Volume I, Chapter 7 with significant application to the Gorge Tributaries Subbasin populations.

Action	Description	Responsible Parties	Programs	Comments
*F.A13	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	WDFW, ODFW	Columbia Compact, BPA Fish and Wildlife Program	Includes monitoring of naturally-spawning steelhead encounter rates in fisheries and refinement of long-term catch and release handling mortality estimates. Would include assessment of the current monitoring programs and determine their adequacy in formulating naturally-spawning steelhead incidental mortality estimates.
*F.A14	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	WDFW, ODFW	Columbia Compact, BPA Fish and Wildlife Program	Regulatory agencies should continue to refine gear, handle and release methods, and seasonal options to minimize mortality of naturally-spawning steelhead in commercial and sport fisheries.
*F.A20	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	WDFW, NOAA, ODFW, USFWS	PFMC, Columbia Compact, BPA Fish and Wildlife Program, WDFW Creel	Mass marking of lower Columbia River coho and steelhead has enabled successful ocean and freshwater selective fisheries to be implemented since 1998. Marking programs should be continued and fisheries monitored to provide improved estimates of naturally-spawning salmon and steelhead release mortality.

* Extension or improvement of existing action
** New action

5.6 Hydropower

No dams hydropower facilities exist in the Gorge Tributaries Subbasin, hence, no in-basin hydropower measures are identified. Gorge tributary anadromous fish populations will benefit from regional hydropower actions recovery actions and measures identified in regional plans to address habitat effects in the mainstem and estuary.

No hydropower facilities exist in the upper Gorge tributaries, however the anadromous fish populations in the upper Gorge tributaries are effected by Bonneville Dam operations with reservoir and dam passage effects.

The configuration and operation of Bonneville Dam affects juvenile and adult salmon migration and passage. Hydropower operations reduce the resiliency and inhibit the recovery of anadromous salmonid populations in the Wind River Subbasin. Upstream and downstream fish passage facilities are operated at Bonneville Dam in the mainstem Columbia River but significant mortality and migration delay occurs. No bypass system is 100% effective. Adults are typically delayed in the tailrace but most eventually find and use fish ladders. A varying percentage of adults do not pass successfully or pass but fall back over the spillway. Juvenile passage mortality results primarily from passage through dam turbines rather than spillway or fish bypass systems. Anadromous fish populations will benefit from regional recovery actions and actions identified for operations of Bonneville Dam relative to fish passage and for habitat conditions in the mainstem and estuary (Table 15).

Table 15. Regional hydropower operation actions from Volume I, Chapter 7 with significant application to the upper Gorge tributary Subbasin populations

Measure	Description	Responsible Parties	Programs	Comments
D.M2	Maintain and operate effective juvenile and adult passage facilities (including facilities, flow, and spill) at Bonneville Dam.	BPA; NOAA; ACOE	ESA Section 7, FPAC, TMT	Effective flow, spill, and facilities are crucial for dam passage.

5.7 Mainstem and Estuary Habitat

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

5.8 Ecological Interactions

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

5.9 Monitoring, Research, & Evaluation

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

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

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

Table 16. Summary of the biological monitoring plan for Upper Gorge Tributaries subbasin populations.

Upper Gorge Tributaries: Lower Columbia Biological Monitoring Plan			
Monitoring Type	**Chum**	**Coho**	**Winter Steelhead**
Routine	AA	AA	AA
Intensive			
Level 1			
Level 2			
Level 3			

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

Table 17. Summary of the habitat monitoring plan for Upper Gorge Tributaries subbasin populations.

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

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

6.0 References

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