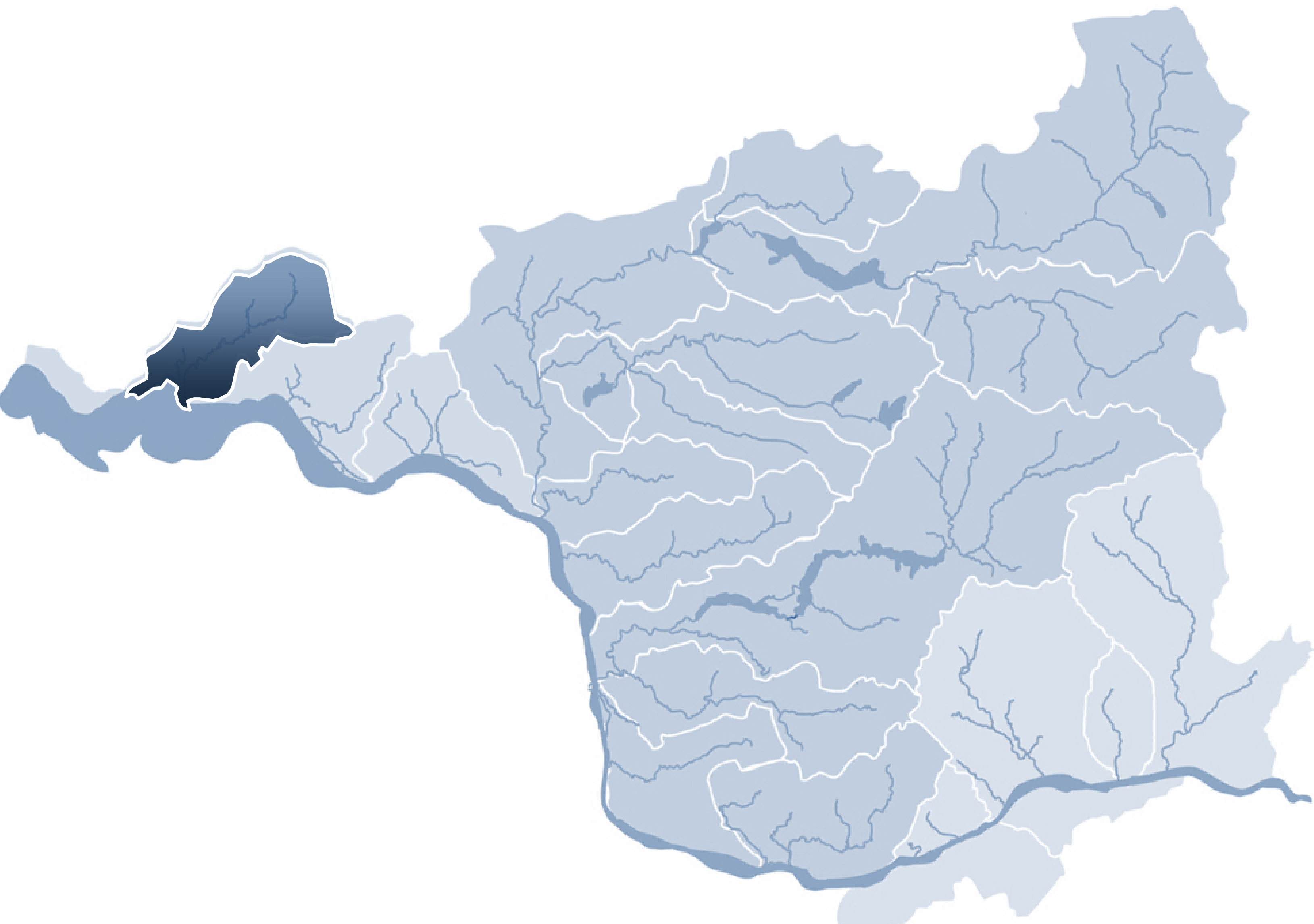
C. GRAYS SUBBASIN



C. GRAYS SUBBASIN

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C.1. Executive Summary

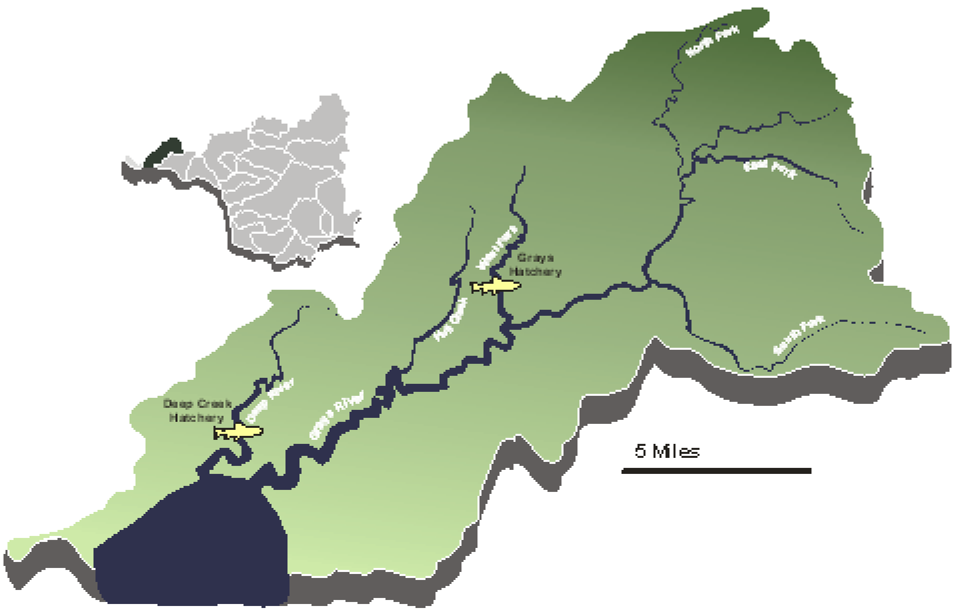


Figure C-1. Map of the Grays River.

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

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

The Grays River is particularly important to regional recovery of salmon and steelhead because it is one of two major basins in the coastal portion of the ESU. Grays River chum, coho, and winter steelhead will need to be restored to a high level of viability to meet regional recovery objectives. Fall Chinook will need to be restored to a medium level of viability to meet 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 Grays River fish populations. Specific strategies, measures, actions and priorities have been developed to address these threats and limiting factors. The specified strategies identify the best long term and short term avenues for achieving fish restoration and mitigation goals. While it is understood that data, models, and theories have their limitations and growing knowledge will certainly spawn new strategies, the LCFRB is confident that by implementation of the recommended actions in this Plan, the population goals in the Grays River Basin can be achieved. Success will depend on implementation of these strategies at the program and project level. It remains uncertain what level of effort will need to be invested in each area of impact to ensure the desired result. The answer to the question of precisely how much is enough is currently beyond our understanding of the species and ecosystems and can only be answered through ongoing monitoring and adaptive management against the backdrop of what is socially possible.

C.1.1. Key Priorities

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

1. **Manage Forest Lands to Protect and Restore Watershed Processes**

Most of the Grays Basin is managed for commercial 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 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-owned lands) and Forest Practices Rules on private lands are expected to improve conditions by restoring passage, protecting riparian conditions, reducing sediment inputs, lowering water temperatures, improving flows, and restoring habitat diversity. Improvements will benefit all species, particularly winter steelhead and coho.

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

Most lower and middle mainstem and tributary stream reaches are used for agriculture or rural residences. Construction of levees, bank stabilization, and riparian vegetation removal have heavily impacted fish habitat in these areas. Removing or modifying channel control and containment structures to reconnect the stream and its floodplain will restore normal habitat-forming processes to reestablish habitat complexity, of-channel habitats, and conditions favorable to fish spawning and rearing. These improvements will be particularly beneficial to chum, fall Chinook, and coho. Normal floodplain functions will also help control catastrophic flooding and provide wetland and riparian habitats critical to other fish, wildlife, and plant species. Existing floodplain function and riparian areas will be protected through local land use ordinances, partnerships with landowners, and the acquisition of land, where appropriate. Restoration will be achieved by working with willing landowners, non-governmental organizations, conservation districts, and state and federal agencies.

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

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

4.**Help Address Immediate Risks with Short-term Habitat Fixes**

Restoration of normal watershed processes that allow a basin to restore itself over time has proven to be the most effective strategy for long term habitat improvements. However, restoration of some critical habitats may take decades to occur. In the near term, it is important to initiate short-term fixes to address current critical low numbers of some species. Examples in the Grays basin include building of chum salmon spawning channel and construction of coho overwinter habitat with alcoves, side channels, or engineered log jams. Benefits will be temporary but will help bridge the period until normal habitat-forming processes are reestablished.

5**. Align Hatchery Priorities 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 practices must conserve natural populations, enhance natural fish recovery, and avoid impeding progress toward recovery while continuing to provide some fishing benefits. The Grays River hatchery program will produce and/or acclimate chum, coho, and winter steelhead for use in the Grays subbasin. Chum will be used to supplement and reduce risks to declining natural production as appropriate. Coho will be used to supplement natural production in appropriate areas of the basin and adjacent tributary streams, develop a local broodstock to reestablish historical diversity and life history characteristics, and also to provide fishery enhancement in a manner that does not pose significant risk to natural population rebuilding efforts. The hatchery also acclimates and releases a temporally-segregated hatchery winter steelhead run to mitigate for reduced fishing opportunities on the wild population in the interim until natural productivity is restored. Fall Chinook releases in the Grays have been discontinued to provide a natural fish refuge and an opportunity to monitor prospects for success.

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

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

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

Grays River salmon and steelhead are exposed to a variety of human and natural threats in migrations outside of the subbasin. Human impacts include drastic habitat changes in the Columbia River estuary, effects of Columbia Basin hydropower operation on mainstem, estuary, and nearshore ocean conditions, interactions with introduced animal and plant species, and altered natural predation patterns by northern pikeminnow, birds, seals, and sea lions. A variety of restoration and management actions are needed to reduce these out-of-basin effects so that the benefits in-subbasin actions can be realized. Owing to its close proximity, estuary habitat improvements including restoration of wetlands, will be particularly critical to Grays salmonid populations. 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.

C.2. Background

This plan describes a vision and framework for rebuilding salmon and steelhead populations in Washington's Grays River Subbasin. The plan addresses subbasin elements of a regional recovery plan for Chinook salmon, chum salmon, coho salmon, steelhead, and bull trout listed 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 LCFRB 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.

C.3. Assessment

C.3.1. Subbasin Description

Topography & Geology

For the purposes of this analysis, the Grays River subbasin includes the Grays River and other tributaries to Grays Bay, including the basins of Deep Creek and Crooked Creek. The Grays River originates in southeast Pacific County, flows southwest through Wahkiakum County, and enters the Columbia River estuary at RM 21 near Oneida, Washington. Tidal influence extends upriver for 6 miles. The entire basin encompasses 124 mi^2. Principal tributaries include Hull Creek, and the East, West, North and South Forks. The subbasin is part of WRIA 25.

The upper reaches of the Grays River flow through steep valleys in the Willapa Hills, and the lower reaches flow through the relatively flat terrain of the plains of the Columbia Valley. In general, the topography consists of low rolling hills and undulating glacial drift plains. The maximum elevation is 2,840 ft. and the minimum elevation is 5 ft. Approximately 49% of the underlying rock in the Grays River watershed is sedimentary, and 35% is of volcanic origin. Soils in the Grays River watershed are mostly of the Lytell-Astoria (43%) and Bunker-Knappton (36%) soil types according to data from the Cowlitz and Wahkiakum Conservation Districts (CCD/WCD). Based on NRCS criteria that incorporates soil type and terrain slope, approximately 26% of the area in the Grays River watershed has high erodability (Wade 2002).

Climate

The subbasin has a typical northwest maritime climate. Summers are dry and cool and winters are mild, wet, and cloudy. Most of the watershed is in the rain-dominated or lowland precipitation zones according to DNR classification (Wade 2002). Mean temperature at the Grays River Hatchery (on the West Fork) ranges from 33°-47°F (1°-8°C) in the winter to 50°-74° F (10°-23°C) in summer. Average annual precipitation is 110 inches at the hatchery, with less than 2 inches in July and more than 17 inches in December (WRCC 2003). Data from the CCD/WCD lists a mean annual precipitation of 88.3 inches for the entire Grays River watershed (Wade 2002).

Land Use, Ownership, and Cover

Approximately 95% of the subbasin is forested (Figure C-3). Commercial timber companies own 73% of the subbasin; 3% is in agriculture, 4% is rural residential development, and 19% is non-industrial forestland (CCD/WCD data). State ownership comprises the bulk of the remaining lands (Figure C-2). The only population centers are the unincorporated towns of Grays River, Rosburg, and Chinook. Potential natural vegetation includes western hemlock, western red cedar, Sitka spruce, and Douglas fir. Much of the basin has been impacted by timber harvest and is primarily composed of young forest stands. 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. Approximately 500 acres of land in the lower Grays River have been acquired by the Columbia Land Trust for protection of natural resources.

Development Trends

Projected population change from 2000-2020 for unincorporated areas in WRIA 25 is 37% (LCFRB 2001). Continued population growth will increase pressures for conversion of forestry and agricultural land uses to residential uses, with potential impacts to habitat conditions.

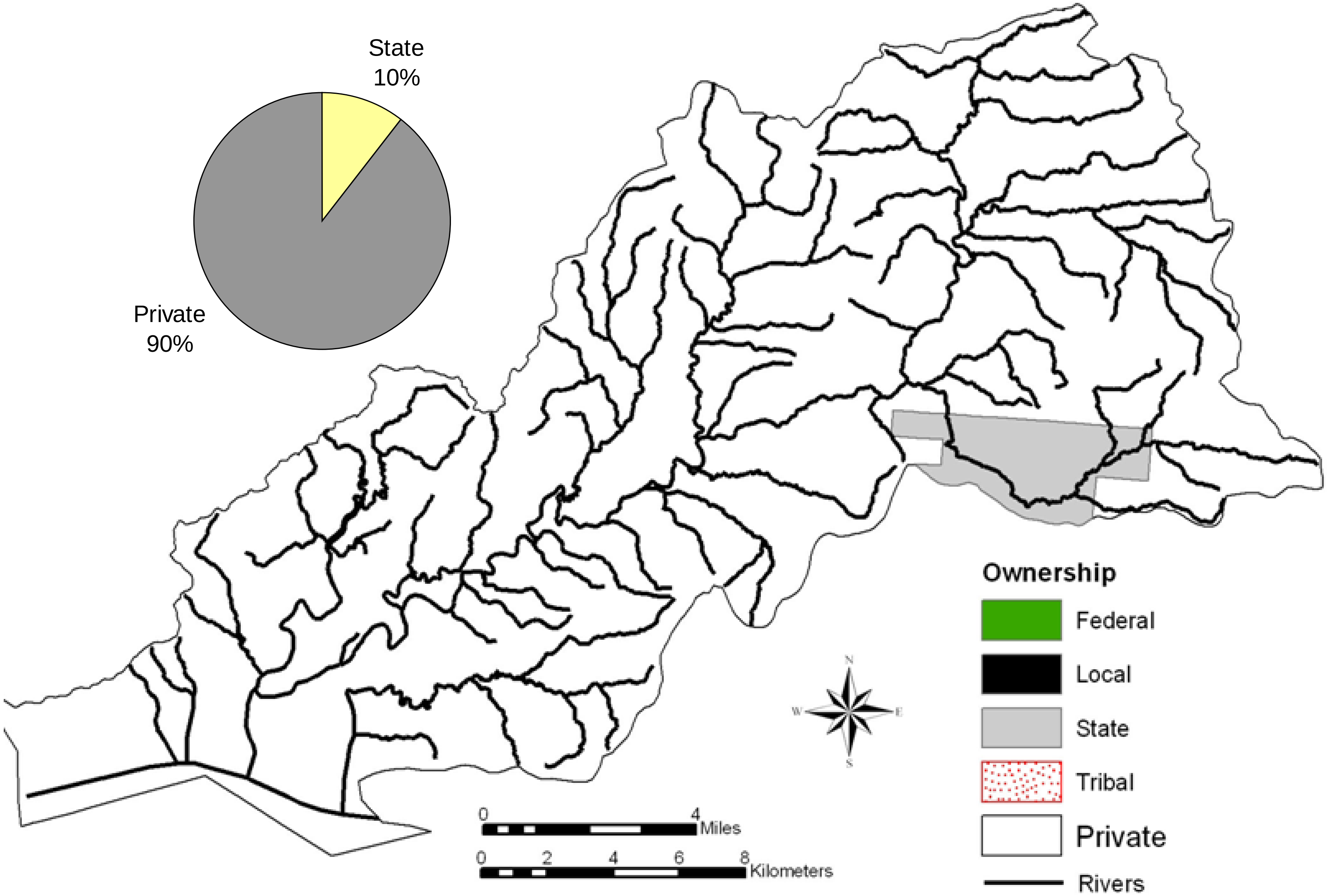


Figure C-2. Landownership within the Grays basin. Data is WDNR data that was obtained from the Interior Columbia Basin Ecosystem Management Project (ICBEMP).

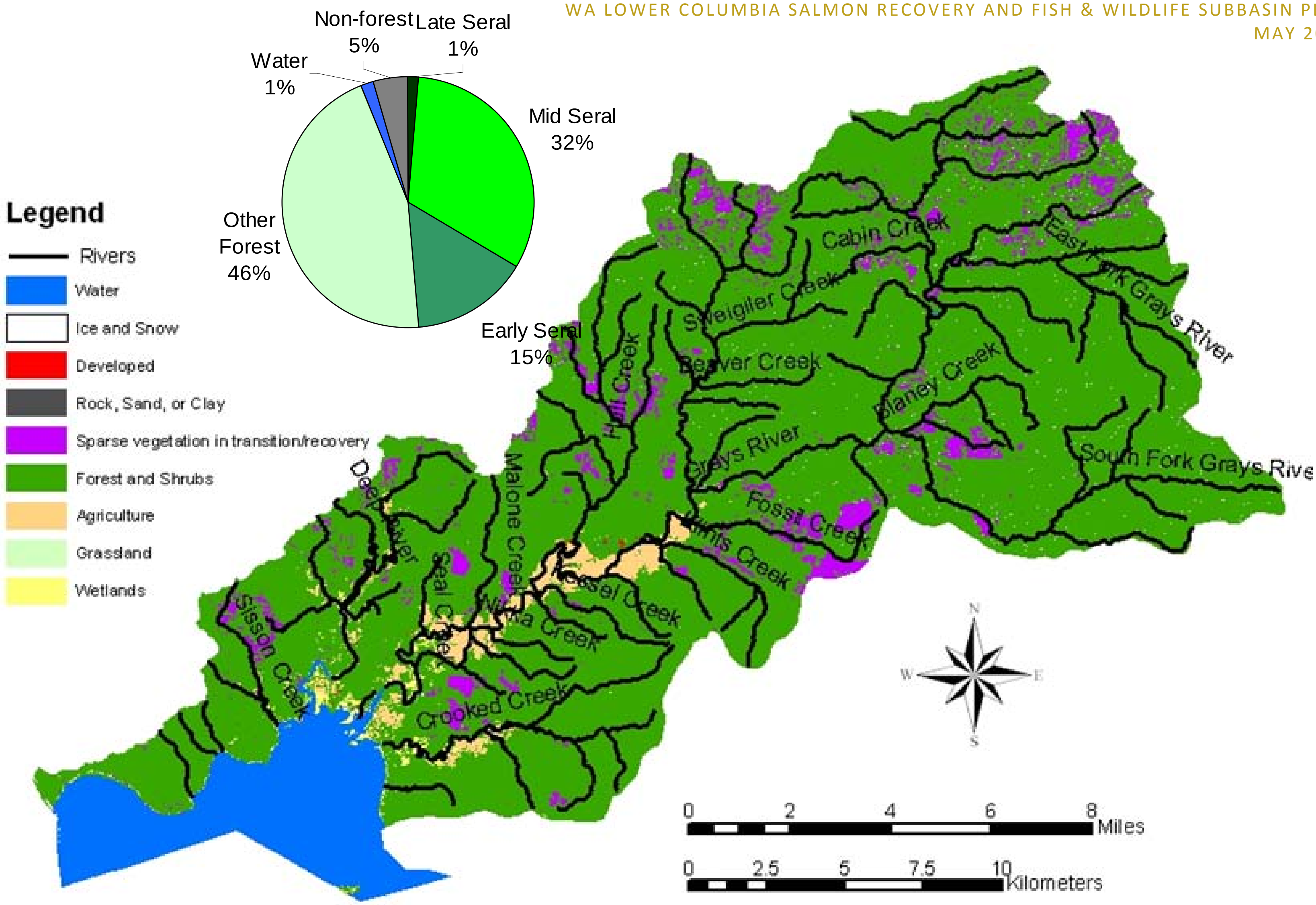


Figure C-3. **Land cover within the Grays basin. Vegetation cover (pie chart) derived from Landsat data based on methods in Lunetta et al 1997. Mapped data was obtained from the USGS National Land Cover Dataset (NLCD).**

C.3.2. Focal and Other Species of Interest

Listed salmon, as well as steelhead, and trout species are focal species of this planning effort for the Grays Subbasin. Other species of interest were also identified as appropriate. Species were selected because they are listed listed 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 Grays ecosystem supports and depends on a wide variety of fish and wildlife in addition to designated species. A comprehensive ecosystem-based approach to salmon and steelhead recovery will provide significant benefits to other native species through restoration of landscape-level processes and habitat conditions. Other fish and wildlife species not directly addressed by this plan are subject to a variety of other Federal, State, and local planning or management activities.

Focal salmonid species in Grays River watersheds include fall Chinook, winter steelhead, chum and coho. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table C-1). Extinction risks are significant for all focal species – the current health or viability of ranges from very low for coho and fall Chinook to medium for chum and winter steelhead. Returns of winter steelhead, fall Chinook, chum, and coho include both natural and hatchery produced fish.

Table C-1. Status of focal salmonid and steelhead populations in the Grays River subbasin.

Species	Population	Recovery Priority[1]	Viability		Improve-ment[4]	Abundance		
			Status[2]	Obj[3]		Historical[5]	Current[6]	Target[7]
Fall Chinook	Grays/Chinook	Contributing	VL	M+	500%	800	<50	1000
Chum	Grays/Chinook	Primary	M	VH	0%[8]	10,000	1,600	1,600
Winter Steelhead	Grays/Chinook	Primary	M	H	0%[8]	1,600	800	800
Coho	Grays/Chinook	Primary	VL	H	370%	3,800	<50	2,400

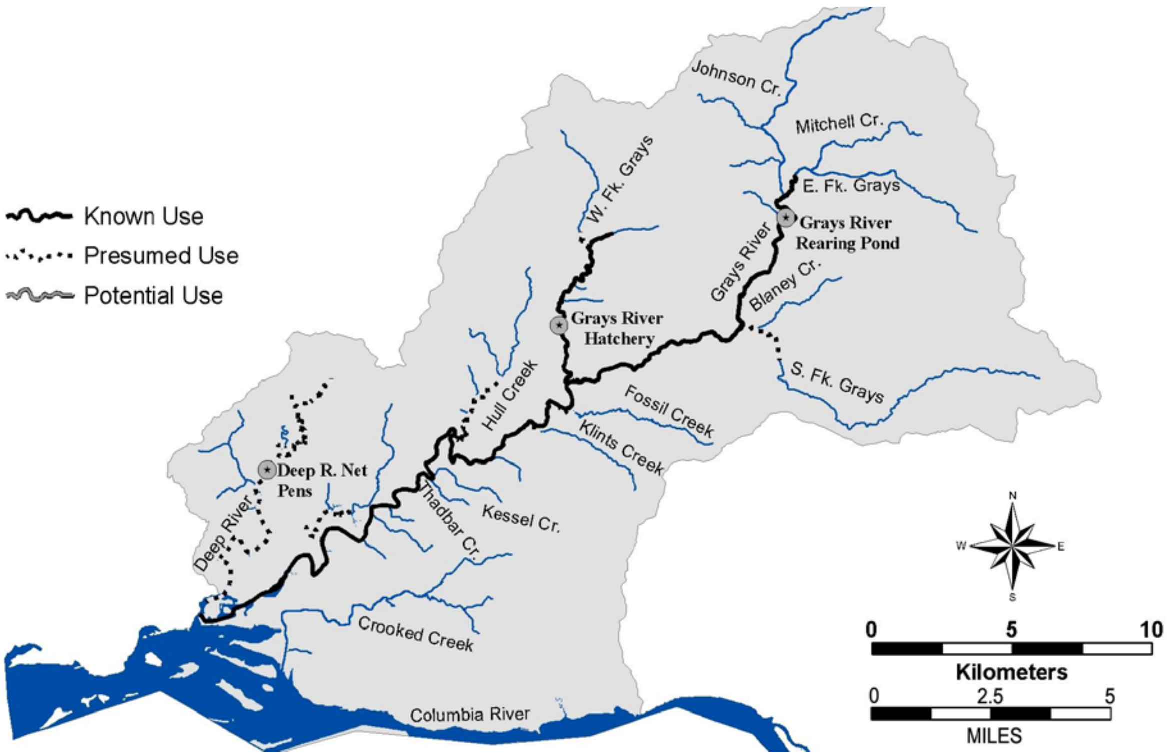
[1] Primary, Contributing, and Stabilizing designations reflect the relative contribution of a population to major population group recovery goals.
[2] Baseline viability is based on Technical Recovery Team viability rating approach.
[3] Viability objective is based on the scenario contribution.
[4] Improvement is the relative increase in population production required to reach the prescribed viability goal
[5] Historical population size inferred from presumed habitat conditions using Ecosystem Diagnosis and Treatment Model and NMFS back-of-envelope calculations.
[6] Approximate current annual range in number of naturally-produced fish returning to the watershed.
[7] Abundance targets were estimated by population viability simulations based on viability goals.
[8] Improvement increments are based on abundance and productivity, however, this population will require improvements in spatial structure or diversity to meet recovery objectives.

Other species of interest in the Grays Subbasin include coastal cutthroat trout and Pacific lamprey. These species have been affected by many of the same habitat factors that have reduced numbers of anadromous salmonids. Brief summaries of the population characteristics and status follow. Additional information on life history, population characteristics, and status assessments may be found in Appendix A (focal species) and B (other species).

Fall Chinook—Grays Subbasin

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

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



Distribution

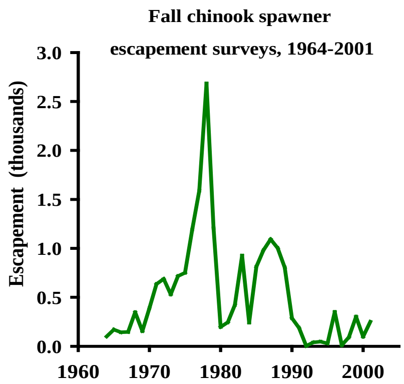
- Spawning occurs in the West Fork below the Grays River Salmon Hatchery (RM 1.4) and in the mainstem Grays River from the area of tidal influence to above the confluence of the West Fork (RM 8-14)

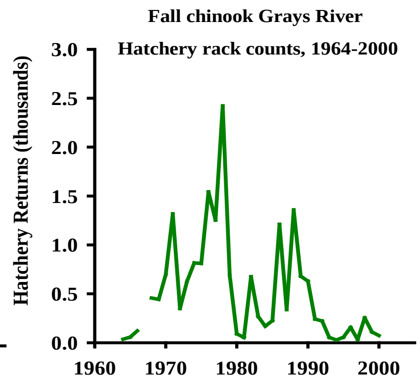
Life History

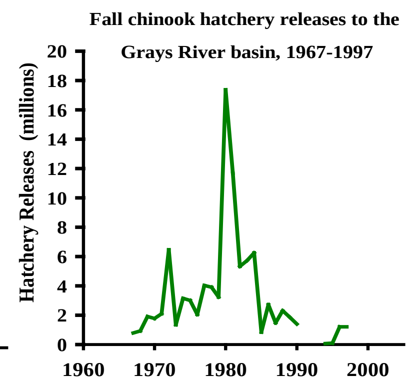
- Columbia River tule fall Chinook migration occurs from mid August to mid September, depending partly on early fall rain
- Natural spawning occurs between late September and late October, peaking in mid-October
- Age ranges from 2-year-old jacks to 6-year-old adults, with dominant adult ages of 3 and 4 (averages are 27% and 57% respectively)
- Fry emerge around early April, depending on time of egg deposition and water temperature; fall Chinook fry spend the summer in fresh water, and emigrate in the late spring/summer as sub-yearlings

Diversity

- Considered a component of the tule population in the lower Columbia River Evolutionarily Significant Unit (ESU)
- Stock designated based on distinct spawning distribution







Abundance

- In 1951, WDF estimated fall Chinook escapement to the Grays River was 1,000 fish
- Spawning escapements from 1964-2001 ranged from 4 to 2,685 (average 523)

Productivity & Persistence

- Baseline risk assessment determined a high to very high risk of extinction for fall Chinook in the Grays River basin
- Evidence suggests few natural fall Chinook juveniles are produced annually

Hatchery

- Grays River Hatchery located about RM 1.4 on the West Fork; hatchery began operation in 1961
- Hatchery releases of fall Chinook in the basin began in 1947; Release data are for 1967-97
- The Grays River Hatchery was used as an egg bank facility for North Toutle Hatchery fall Chinook stock for several years after the eruption of Mt. St. Helens
- The Grays River Hatchery fall Chinook program was discontinued in 1998 because of federal funding cuts
- A significant portion of past years fall Chinook spawners in the Grays River were first generation hatchery fish from the Grays River Hatchery; the Grays River Hatchery adult returns were eliminated beginning in 2002

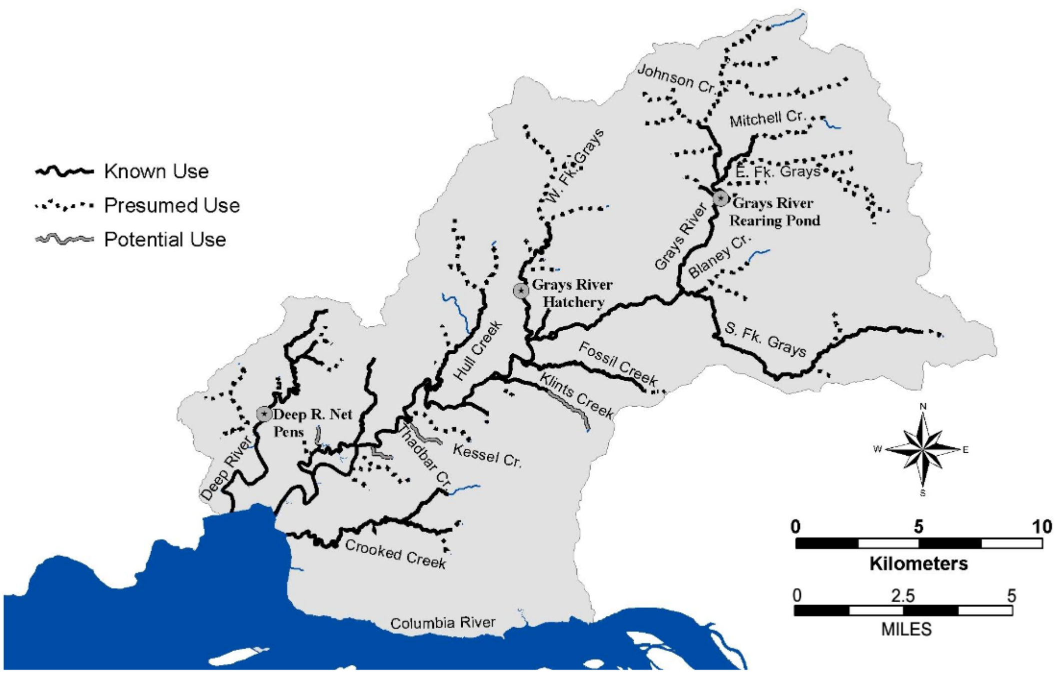
Harvest

- Fall Chinook are harvested in ocean commercial and recreational fisheries from Oregon to Alaska, and in Columbia River commercial gill net and sport fisheries
- Lower Columbia tule fall Chinook are an important contributor to Washington ocean troll and sport fisheries and to the Columbia River estuary sport fishery
- Columbia River commercial harvest occurs primarily in September, but tule Chinook flesh quality is low once they move from salt water; price is low compared to higher quality bright Chinook
- CWT data analysis of the 1991-94 brood Grays River Hatchery Chinook indicate a harvest rate of 54% of the Grays River stock
- The majority of the Grays River Hatchery fall Chinook stock harvest occurred in Southern British Columbia (51.0%), Washington ocean (12.0%), and Columbia River (25.0%) fisheries
- Current annual harvest rate is dependent on management response to annual abundance in PSC (U.S./Canada), PFMC (U.S. ocean), and Columbia River Compact forums
- Sport harvest in the Grays River averaged 156 fall Chinook annually from 1981-1988. There is currently no tributary sport fishery for fall Chinook in the Grays.
- Ocean and mainstem Columbia River fisheries are limited to a 49% harvest due to ESA limits on Coweeman tule fall Chinook

Coho—Grays Subbasin

ESA: Threatened 2005 **SASSI: Unknown 2002**

The historical Grays Chinook adult coho population is estimated from 5,000-40,000 fish, with the returns being late stock which spawn from late November to March. Current returns are unknown but assumed to be low. A number of hatchery produced fish spawn naturally. Natural spawning occurs primarily in upper mainstem and large tributaries throughout the basin. Juvenile rearing occurs upstream and downstream of spawning areas. Juveniles rear for a full year in these basins basin before migrating as yearlings in the spring.

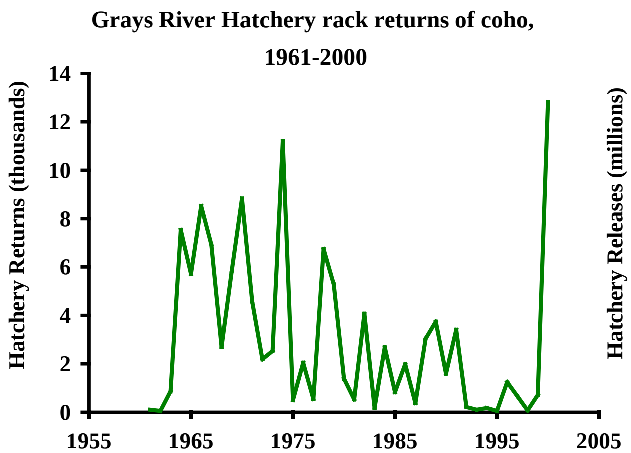


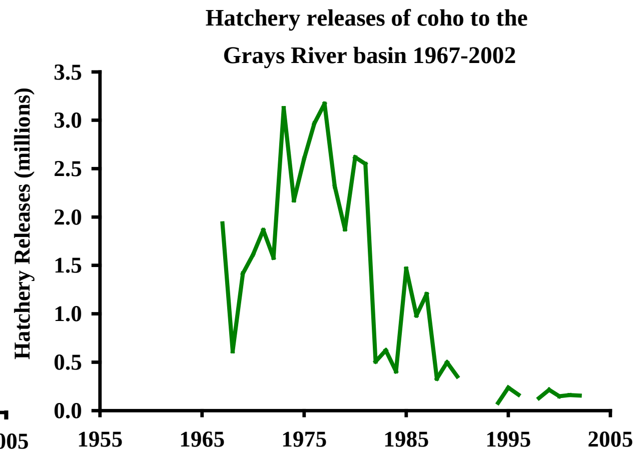
Distribution

- Managers refer to early stock coho as Type S due to their ocean distribution generally south of the Columbia River
- Managers refer to late coho as Type N due to their ocean distribution generally north of the Columbia River
- Potential natural spawning areas include the upper Grays, South Fork, West Fork, Crazy Johnson Creek, and Hull Creek
- Vicinity streams with coho spawning potential include Crooked Creek, Hitchcock Creek, and Jim Crow Creek

Life History

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





Diversity

- Late stock coho (or Type N) were historically present in the Grays basin with spawning occurring from late November into March
- Early stock coho (or Type S) are also present in the basin and are produced at Grays River Hatchery
- Columbia River early and late stock coho produced from Washington hatcheries are genetically similar

Abundance

- Grays River wild coho run is a fraction of its historical size
- USFWS surveys in 1936 and 1937 indicated coho presence in all accessible areas of the Grays River and its tributaries; no population estimate was made
- WDF estimated 2,500 natural spawning late coho in the Grays River in 1951
- Hatchery production accounts for most coho returning to Grays River

Productivity & Persistence

- Natural spawning of early stock coho is presumed to be very low; natural production of late stock coho is likely less than 15% of smolt density estimate
- Smolt density model estimated basin potential to be 125,874 smolts
- Baseline risk assessment determined a high to very high risk of extinction for coho in the Grays River basin

Hatchery

- Grays River Hatchery is located about 2.5 miles upstream of Highway 4 on the West Fork; hatchery was completed in 1961; hatchery produces early stock coho
- Grays River Hatchery releases of early coho smolts ranged from about 500,000 to 3 million per year during 1967-87; the current program is reduced to 150,000 early coho smolts released annually

Harvest

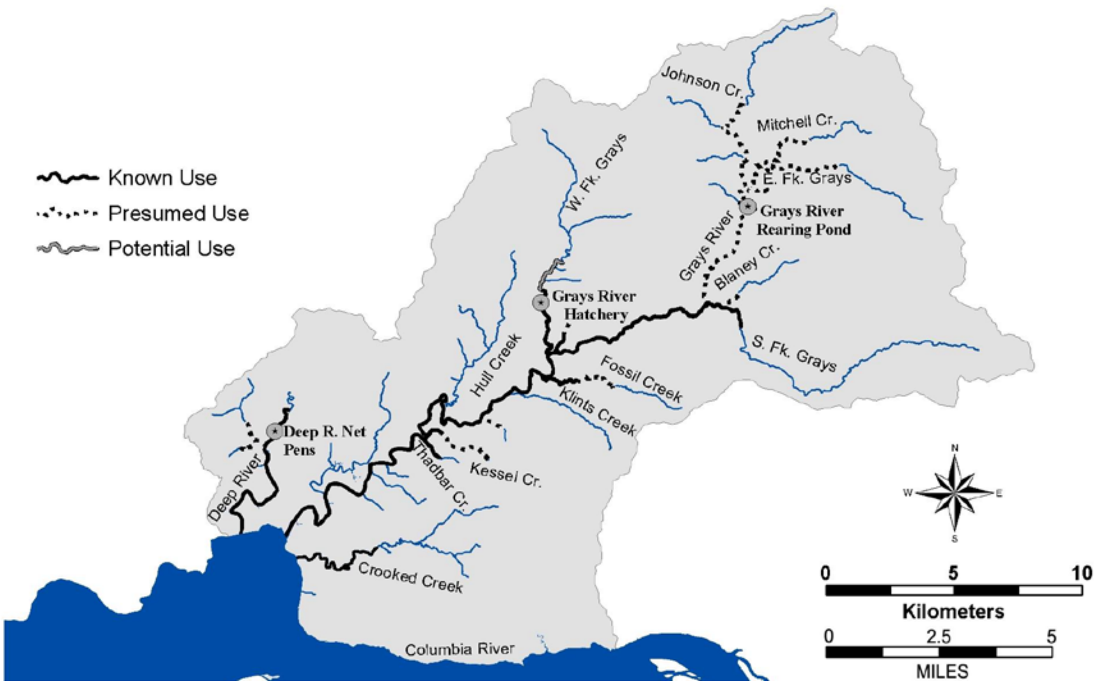
- Until recent years, natural produced Columbia River coho were managed like hatchery fish and subjected to similar harvest rates; ocean and Columbia River combined harvest rates ranged from 70% to over 90% during 1970-83
- Ocean fisheries were reduced in the mid 1980s to protect several Puget Sound and Washington coastal wild coho populations
- Columbia River commercial coho fishing in November was eliminated in the 1990s to reduce harvest of late Clackamas wild coho

- Since 1999, returning Columbia River hatchery coho have been mass marked with an adipose fin clip to enable fisheries to selectively harvest hatchery coho and release wild coho
- Natural produced lower Columbia River coho are beneficiaries of harvest limits aimed at Federal ESA listed Oregon Coastal coho and Oregon State listed Clackamas and Sandy River coho
- During 1999-2002, fisheries harvest of ESA listed coho was less than 15% each year
- Hatchery coho can contribute significantly to the lower Columbia River gill net fishery; commercial harvest of early coho is constrained by status of fall Chinook and Sandy River coho management; commercial harvest of late coho is focused in October during the peak abundance of hatchery late coho
- A substantial estuary sport fishery exists between Buoy 10 and the Astoria-Megler Bridge; majority of the catch is early coho, but late coho harvest can also be substantial
- An average of 94 coho (1978-1986) were harvested annually in the Grays River sport fishery
- CWT data analysis of 1994, 1996, and 1997 brood early coho releases from Grays River Hatchery indicates 43% were captured in a fishery and 57% were accounted for in escapement
- Fishery CWT recoveries of 1994, 1996, and 1997 brood Grays early coho were distributed between Columbia River (58%), Oregon ocean (21%), Washington ocean (19%), and California ocean (1%) sampling areas

Chum—Grays Subbasin

ESA: Threatened 1999 **SASSI: Depressed 1992**

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



Distribution

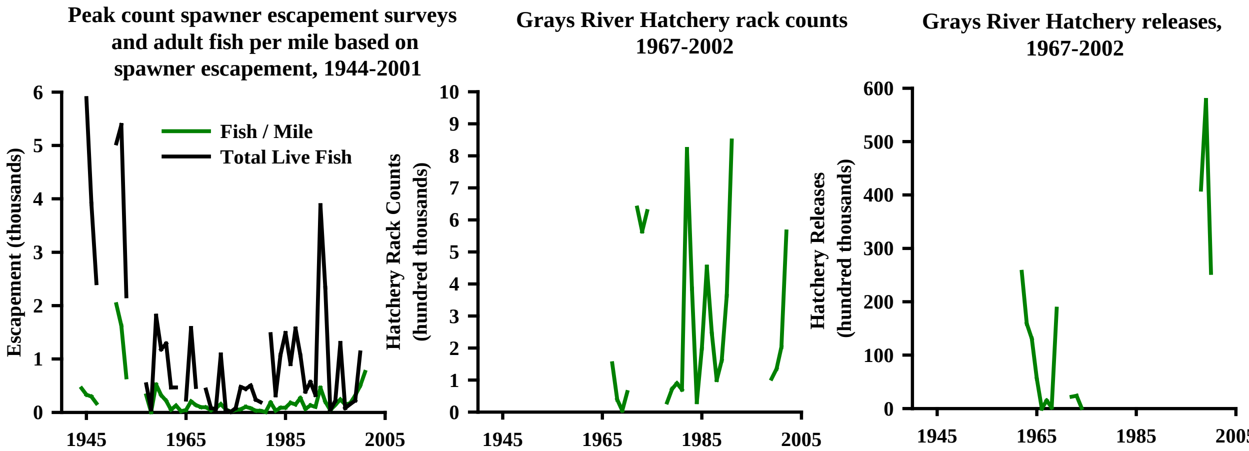
- Spawning occurs in the mainstem Grays River from RM 9.5-13.0, the lower 1.4 miles of the West Fork of the Grays River, the lower 0.5 miles of Crazy Johnson Creek, and in Gorley Creek at RM 12 of the Grays River.

Life History

- Adults enter the Grays River from mid-October through November
- Peak spawning occurs in late November
- Dominant adult ages are 3 and 4
- Fry emerge in early spring; chum emigrate as age-0 smolts, generally from March to may with peak migration from mid-April to early May

Diversity

- One of two genetically distinct populations in the Columbia ESU
- Stock designated based on geographic distribution
- Outside stocks used for hatchery brood in the 1980s from Hood Canal and Japan failed to produce significant adult returns
- Outside stock use was discontinued and only Grays Stock currently exists in the hatchery program



Abundance

- Peak escapement counts in 1936 were 7,674 chum; peak counts from 1945-2000 ranged from 12 to 5,887 chum (average 1,149)
- Adult fish/mile generally ranges from 0-500 from 1944-2000 as estimated from escapement ground spawner surveys, except for 4 years during the 1950s
- Recent survey results (since 1999) indicate an increasing chum population. The 2002 chum return was estimated to be 11,713 spawners.

Productivity & Persistence

- Baseline risk assessment determined a moderate risk of extinction for chum in the Grays River basin

Hatchery

- Grays River hatchery located about RM 1.4 on the West Fork; hatchery primarily releases Chinook and coho; chum are captured annually in the hatchery rack
- Small chum releases have been made with little success
- Hatchery program goal since 1998 is to produce Grays stock chum to augment and reduce risks to naturally spawning Grays River chum

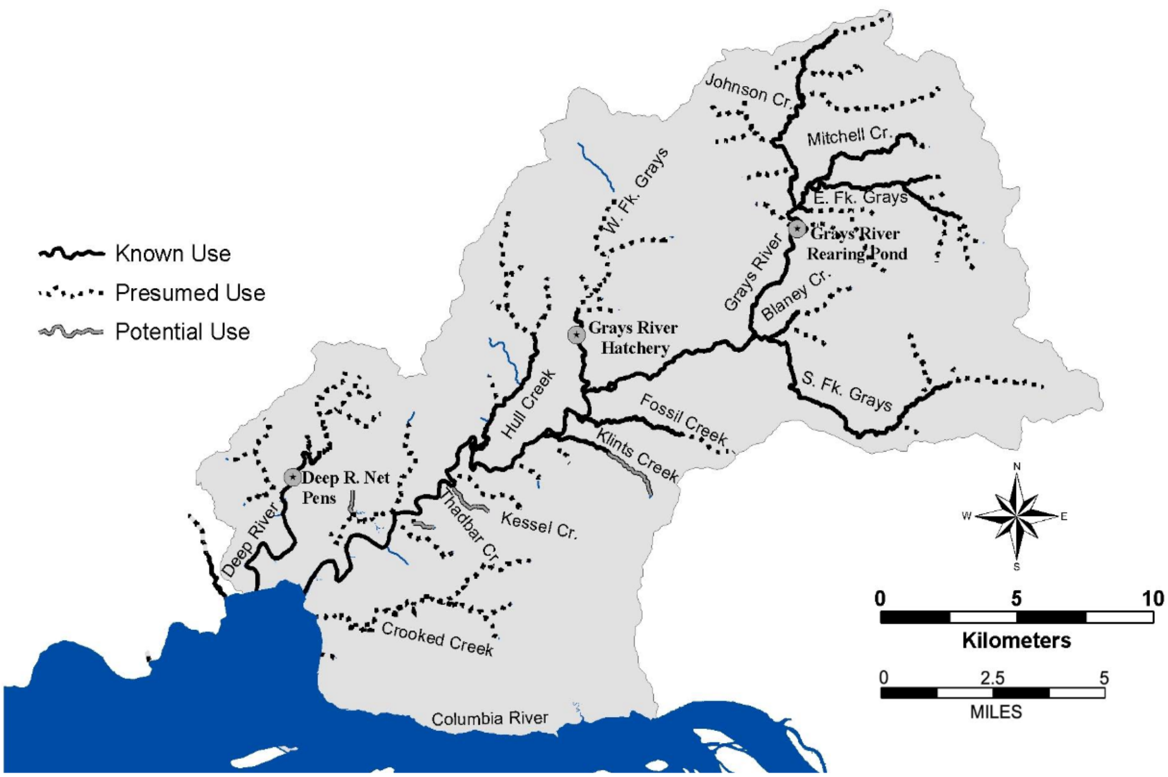
Harvest

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

Winter Steelhead—Grays Subbasin

ESA: Not Warranted **SASSI: Depressed 2002**

The historical Grays River adult population is estimated to be about 4,500 fish. Current natural spawning returns range from 400-600. Interaction with Chambers Creek/Beaver Creek stock hatchery steelhead is likely lower due to different spawn timing. Spawning occurs in accessible streams throughout the system from March to early June. Juvenile rearing occurs both downstream and upstream of the spawning areas. Juveniles rear for a full year or more before migrating to the Columbia River.

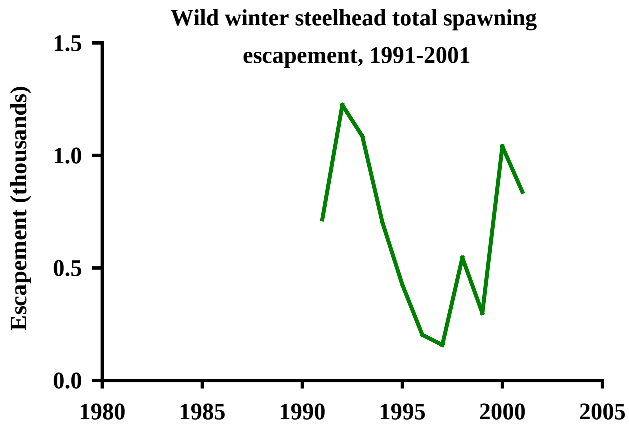


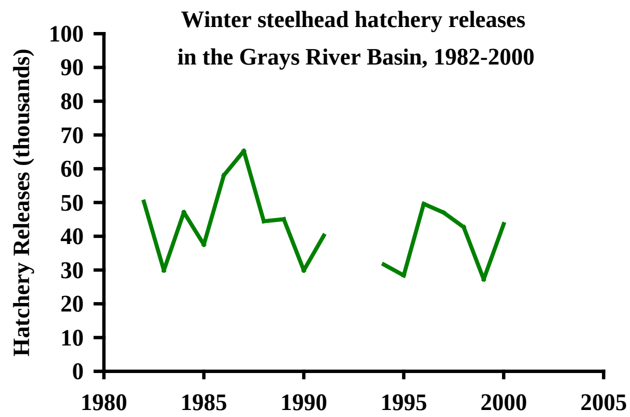
Distribution

- Winter steelhead are distributed throughout the mainstem above tidal influence and throughout the East, West, and South Forks
- In 1957, Grays River Falls (RM 13) was lowered with explosives, providing easier upstream migration; during the 1950s numerous other natural and man-made barriers above Grays Falls were cleared to improve steelhead access to the upper watershed

Life History

- Adult migration timing for Grays River winter steelhead is from December through April
- Spawning timing on the Grays River is generally from early March to early June
- Age composition data for Grays River winter steelhead are not available
- Wild steelhead fry emerge from March through May; juveniles generally rear in fresh water for two years; juvenile emigration occurs from April to May, with peak migration in early May





Diversity

- Stock designated based on distinct spawning distribution
- Concern with wild stock interbreeding with hatchery brood stock from the Elochoman River, Chambers Creek, and the Cowlitz River
- Allele frequency analyses of Grays River winter steelhead in 1994 and 1995 were unable to determine the distinctiveness of this stock compared to other lower Columbia steelhead stocks

Abundance

- Steelhead abundance in the Grays River during the 1920s and 1930s was estimated at 2,000 fish annually
- In 1936, more than 100 steelhead were documented in the Grays River during escapement surveys
- Wild winter steelhead run size in the early 1990s was estimated to be 400-600 fish
- Total escapement counts from 1991-2001 ranged from 158-1,224 (average 658)
- Escapement goal for the Grays River is 1,486 wild adult steelhead; this goal has not been met in recent years

Productivity & Persistence

- The smolt density model estimated potential winter steelhead smolt production was 45,300
- Baseline risk assessment determined a moderate risk of extinction for winter steelhead in the Grays River basin

Hatchery

- The Grays River Hatchery, located on the West Fork, does not produce winter steelhead
- Hatchery winter steelhead have been planted in the Grays River basin since 1957; brood stock from the Elochoman and Cowlitz Rivers and Chambers Creek have been used; release data are displayed from 1982-2000
- Hatchery fish contribute little to natural winter steelhead production in the Grays River basin

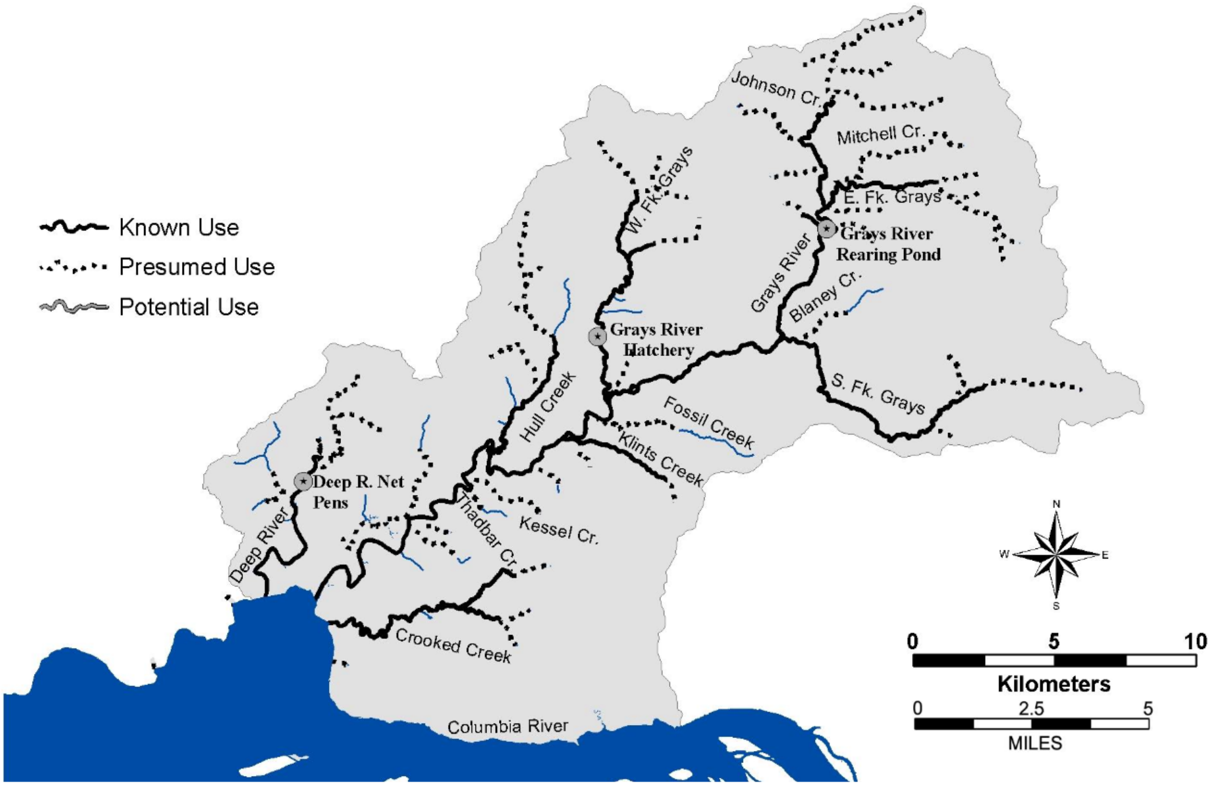
Harvest

- No directed commercial or tribal fisheries target Grays winter steelhead; incidental mortality currently occurs during the lower Columbia River spring Chinook tangle net fisheries
- Treaty Indian harvest does not occur in the Grays River basin
- Winter steelhead sport harvest in the Grays River from 1980-1990 ranged from 354-1,031 (average 533); since 1986, regulations limit harvest to hatchery fish only
- ESA limits fishery impact of wild winter steelhead in the mainstem Columbia River and in the Grays River

Cutthroat Trout—Grays River Subbasin

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

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



Distribution

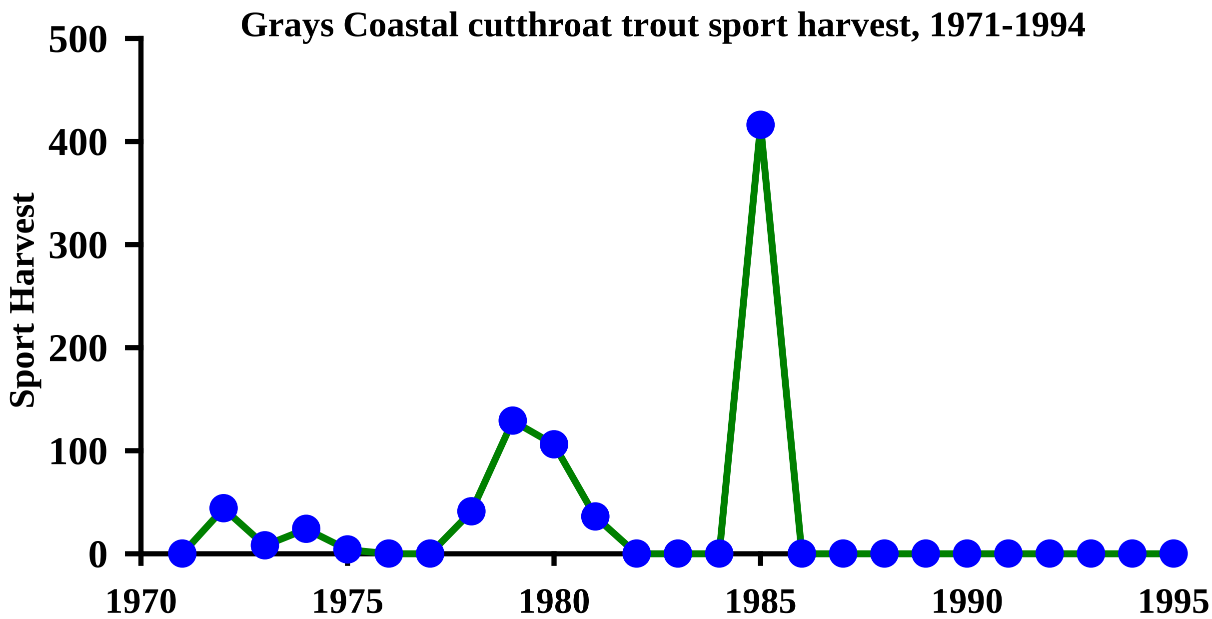
- Anadromous, fluvial, and resident forms distribute themselves throughout the basin
- Anadromous forms have access to the entire subbasin but are not believed to use steep gradient upper tributary reaches
- Resident forms are documented throughout the system

Life History

- Anadromous, fluvial, and resident forms are present
- Anadromous adults enter the Grays River from late July through mid-April
- Anadromous spawning occurs from January through mid-April
- Fluvial and resident spawn timing is not documented but is believed to be similar to anadromous timing

Diversity

- No genetic sampling or analysis has been conducted
- Genetic relationship to other stocks and stock complexes is unknown



Abundance

- No total abundance or anadromous run size data are available
- Some incomplete historical sport catch data are available

Hatchery

- Grays River Hatchery (RM 2 of the West Fork) does not produce or release coastal cutthroat

Harvest

- Not harvested in ocean commercial or recreational fisheries
- Angler harvest for adipose fin clipped hatchery fish occurs in mainstem Columbia summer fisheries downstream of the Grays River
- Wild Grays River cutthroat (unmarked fish) must be released in mainstem Columbia and Grays River sport fisheries

Other Species

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

C.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.

Watershed Hydrology

From west to east, the major stream systems in the subbasin are the Sisson Creek, Deep River, Grays River, and Crooked Creek basins. Major tributaries to the Grays River include Hull Creek, the West Fork Grays, the South Fork Grays, and Mitchell Creek. Peak flows are associated with fall and winter rains and low flows typically occur in late summer. The USGS collected streamflow data at several sites in the subbasin for various periods, though no data exists since 1979.

Results of the Integrated Watershed Assessment (IWA), which are presented in greater detail later in the chapter, indicate that nearly all of the Grays Subbasin is 'impaired' with regards to an increased risk of elevated peak flows. Only subwatersheds within the South Fork Grays River basin are rated as 'moderately impaired' and there are no 'functional' subwatersheds. These results are corroborated by an analysis conducted by Lewis County GIS (2000), which identified 'impaired' peak flow conditions throughout most of the subbasin, with 'likely impaired' peak flow conditions in the South Fork Grays River. The lack of mature vegetation, combined with high road densities (many subwatersheds have greater than 5 miles of road per square mile), contribute to hydrologic impairment.

Low flow volumes are also a concern in the subbasin. As part of an instream flow analysis, Toe-Width flows were estimated for the Grays River in 1998. The results showed that fall flows for salmon spawning and spring flows for steelhead spawning were sufficient; but that summer rearing flows were inadequate (Caldwell et al. 1999). A similar study on Crooked Creek indicated that flows were below optimum for rearing in mid-September and were below optimum for spawning into the first part of November (Caldwell et al. 1999).

Current and future effects of flow withdrawals on stream flow were estimated as part of watershed planning efforts by the LCFRB. Combined surface water and groundwater demand in the Grays subbasin, which totaled 1,264 acre-feet per year in 2000, is expected to increase 9.8% by 2020. This, coupled with Grays River channel width to depth ratios, makes groundwater withdrawal a concern.

Passage Obstructions

Low flow passage problems are a concern at the mouth of the Grays and on lower Seal River. Flow alterations on the middle mainstem that are related to the breaching of a dike at Gorley Springs in 1999 may create passage problems at certain times of the year. Sediment accumulations on lower Shannon Creek (West Fork tributary) create subsurface flow during the summer. A natural falls at approximately RM 13 was blasted in 1957 to improve fish passage. The numerous tide gates on tributaries and sloughs that connect to Grays Bay present potential passage problems. Various other culvert, low flow, and tidegate concerns are discussed in detail in Wade (2002).

Water Quality

High water temperatures are a concern throughout the subbasin. The West Fork Grays was listed on the state's 303(d) list of impaired water bodies due to elevated temperatures (WDOE 1998). Summer temperature monitoring conducted by the WCD on the mainstem and the West Fork Grays indicates that stream temperatures commonly exceed 16ºC. Stream temperature in the upper Grays River near the South Fork confluence regularly exceeded 16ºC in the summer of 2000. This may be due to its width and north-south orientation. High temperatures (>17ºC) have also been recorded in Hull Creek in the lower basin and in Crooked Creek (Wade 2002).

Problems other than water temperature also exist in the subbasin. Fecal coliform standards were exceeded on the Grays River in 1998. Malone Creek may have fecal coliform problems associated with failing residential septic systems. This stream also appears turbid at high flows. Turbidity is an observed problem in tributaries to Klints and King Creeks. Various sources of increased turbidity have been identified in the West Fork and the South Fork basins. High summer turbidity levels have been observed in the Grays Bay tributary of Hendrickson Creek, likely associated with mass wasting in the upper watershed. Nutrient levels are likely lower than they were historically due to lower salmonid escapement levels compared to historical conditions (Wade 2002).

Key Habitat Availability

Side channel habitat has been removed from most of the lower Grays River mainstem and lower mainstem tributaries as a result of diking. Side channel habitats in the upper Grays River basin are limited by naturally confined valleys and steep stream gradients, with generally adequate side channel habitats where they exist. The Deep River and Crooked Creek have few side channels, partly due to channelization associated with agriculture. On most other Grays Bay tributaries, tidegates limit access to side channel habitat in the lower reaches. Information on side channels is lacking for much of the subbasin (Wade 2002).

WCD surveys rated nearly the entire subbasin as having inadequate pool habitat. In each of the major Grays River basins, over 77% of surveyed reaches contained less than 40% pools, and 100% of the reaches in the West Fork and South Fork basins were identified as having a lack of pools. The percentage of the channel in pool habitat generally increases as gradient increases. Inadequate pool habitat is concentrated in the mainstem and in the lower reaches of tributaries, where agricultural practices and channel straightening have reduced pool quality and quantity. Good pool habitat generally corresponds with the presence of logjams (Wade 2002). In Grays Bay tributary streams, most streams had over 50% of reaches with less than 40% of the stream surface area in pools (Wade 2002).

Substrate & Sediment

Fine sediments naturally exist in the tidally influenced lower reaches of most streams. Reaches above tidal influence have a higher percentage of gravels but they are generally of soft rock and are highly embedded with fine sediment. This is in part due to the presence of sedimentary rock that breaks down quickly once delivered to stream channels. WCD surveys using visual estimates of fine sediment revealed that within the Grays River basin over 76% of surveyed reaches had greater than 17% fines.

High road densities and road crossings over streams can increase the potential for sediment production and delivery to streams. The Grays River basin contains a very high 7.32 miles of road / square mile, over twice as much as is considered high by NMFS standards. The number of stream crossings is also high, with 34.1 stream crossings per mile in the Mitchell Creek basin (upper watershed), the second highest value in the lower Columbia region. The results of the IWA, which are presented in greater detail later in the chapter, indicate that high road densities and naturally unstable soils have contributed to 'moderately impaired' sediment supply conditions throughout the subbasin, with a few areas experiencing 'impaired' conditions (lower Grays subwatershed and West Fork Grays subwatersheds). A preponderance of mass failures also provides a source for increased fine and coarse sediment production. A study by the WCD identified greater than 4 mass failures/mi2 in several areas, including the West Fork Grays River basin, the lower Grays River basin, the Deep River Basin, and the Crooked Creek basin (Wade 2002).

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.

Woody Debris

WCD stream surveys found that LWD was virtually non-existent in the lower mainstem Grays River. Throughout the entire lower basin 75% of surveyed reaches had inadequate LWD. LWD abundance is also low in the middle Grays, with over 74% of surveyed reaches below accepted standards. Only middle Klints Creek has decent wood quantities. All surveyed reaches in the West Fork basin were rated "poor" for LWD. Most of the LWD that is present is located in large logjams. Logging debris and debris flows have contributed to these jams. LWD quantities are low throughout the South Fork basin. All surveyed reaches rated "poor" for LWD. Wood in the South Fork is transported out of the system due to high gradient channels or it is deposited on the floodplains during high flows. Sixty-one percent of reaches in the upper Grays basin had "poor" LWD numbers. Most of the LWD that was present was in large logjams or deposited on the floodplain (Wade 2002).

In other Grays Bay tributaries, WCD stream surveys identified 89.7% of surveyed channels as lacking adequate LWD. Where LWD existed it was often deciduous and/or of small diameter (Wade 2002).

Channel Stability

The WCD recorded areas of bank instability in the subbasin during 1994 stream surveys. Areas of concern were identified on the lower Grays (along some of the dikes), upper Impie Creek, lower Thadbar Creek, lower Hull Creek, lower Silver Creek, and Honey Creek. Many of these sites have cattle access to the stream. Bank stability is low along the middle mainstem in the Gorley Springs area, where a dike breach in 1999 created a highly unstable channel. Portions of King and Fossil Creeks, primarily in the lower reaches, have bank stability concerns. Debris flows occur frequently in the West Fork and South Fork systems. Many of these events are related to shallow landslides on steep, geologically unstable slopes in confined river valleys. Areas of instability in the South Fork basin may be contributing to elevated turbidity levels. Only a handful of areas in the upper Grays have been noted for bank stability concerns. Railroad grades along the East Fork have experienced numerous slope failures that have caused debris flows (Wade 2002).

Grays Bay tributaries also have some bank stability concerns. According to WCD Surveys, reaches of Ragilla, Anderson, and Person Creeks had extensive streambank erosion. Lower Hendrickson Creek, lower Crooked Creek, and the North Fork Deep River had localized areas of unstable banks. A WCD assessment identified mass failure frequencies of 4.67 and 6.25 failures /mi^2 in the Deep River and Crooked Creek, respectively (Wade 2002).

Riparian Function

According to IWA watershed process modeling, which is presented in greater detail later in this chapter, 3 of 17 subwatersheds in the Grays subbasin are rated as 'impaired' for riparian function, 12 are rated as 'moderately impaired', and 2 are rated as 'functional'. The greatest impairments are in the lower basin and the least amount of impairment is located in the northeast portion of the basin. These results are consistent with the generally impaired condition of riparian forests identified in surveys conducted by the WCD.

WCD's riparian surveys in 1994 measured tree size, composition, and buffer width. Areas with small trees, an abundance of hardwoods, and narrow buffer widths were rated as having poor conditions. Based on the WCD's criteria, riparian forests were in poor shape throughout the basin. Eighty-eight percent of reaches in the West Fork, 90% in the lower basin, and 98% in the middle basin were rated as having "poor" riparian conditions. Most riparian forests along low gradient reaches lack coniferous cover or adequate buffer widths, whereas steeper reaches in the upper watershed suffer primarily from immature forests. Agricultural practices and cattle access were noted by the WCD as sources of riparian problems in the lower basin and timber harvest was cited as the primary cause of problems in the upper basin. The West Fork basin in particular is almost entirely (99%) composed of private and state forestland, with 77% of the area having forest stands less than 50 years old.

Poor conditions were identified for most reaches of the Deep River and the lower portions of the Crooked River. All of the surveyed streams had at least 33% of riparian areas in the "poor" category, except for the North Fork Deep River. Poor conditions were attributed primarily to agricultural practices and livestock access (Wade 2002).

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.

Floodplain Function

The lower Grays River mainstem and most lower mainstem tributary streams have been diked, armored, drained, and/or relocated, primarily for agricultural purposes (WCD surveys). A project is underway by Columbia Land Trust to preserve over 500 acres of degraded floodplain habitat and restore tidal function to 200 acres of the Grays River estuary.

Portions of the middle Grays have been diked for agricultural purposes and armored to protect streambanks from erosion. Streambed aggradation in Klints Creek is associated with bedload supplied during winter 1996 flooding, which may have actually improved floodplain connectivity. Significant aggradation occurred in lower Fossil Creek in 1996 as well, reducing sediment transport out of this tributary. Efforts to reconnect Fossil Creek to the Grays River have caused erosion of the aggraded sediment, and flooding problems still exist (Wade 2002).

The lower reaches of Deep Creek (up to RM 3.9) have been diked and the lower 2 miles of Crooked Creek is channelized and entrenched, reducing access to off-channel habitats. The effect of tidegates on floodplain connectivity on Grays Bay tributaries has not been assessed (Wade 2002).

C.3.4. Stream Habitat Limitations

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

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

Population Analysis

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

Habitat-based assessments were completed in the Grays River subbasin for winter steelhead, fall Chinook, coho, and chum (Table C-2). Chum in the Grays River make up one of the few remaining chum populations in the Columbia River. The other intact population is Hardy, Hamilton, and Duncan Creeks—lower Columbia Gorge tributaries. Despite the relatively healthy population of chum in the Grays, this population has witnessed the greatest decline in numbers compared to other Grays River populations (Figure C-4). Model results indicate that chum abundance has decreased by more than 84% from historical levels (Table C-2). Winter steelhead abundance shows a 46% decrease from historical levels, while fall Chinook shows a 37% decrease (Table C-2). Change in diversity (as measured by the diversity index) is the smallest for fall Chinook and the greatest for winter steelhead and coho (Table C-2). Coho and winter steelhead diversity has been negatively impacted by reduced and/or degraded tributary spawning habitat.

Current smolt abundance is substantially less than the historical level for all species (Table C-2), reflecting the significant loss of life history patterns (which is also reflected in the life history diversity index). Historical-to-current change in coho and chum smolt abundance shows a 70% and 64% decrease, respectively. Winter steelhead and fall Chinook smolt abundance have declined less dramatically, with a modeled 45% and 33% decrease, respectively.

Adult abundance and productivity trends track well with smolt trends for all populations with the exception of chum (Table C-2). Changes in chum smolt values are greater for both abundance (36% of historic for smolts, 15% for adults) and productivity (59% of historic for smolts, 24% for adults) when compared to the adult values. These results suggest that out-of-basin factors may be having the greatest impact on the chum population. However, high smolt productivity may also be an artifact of the way the EDT model calculates productivity. In the historical scenario, chum utilize a broad suite of small tributaries, which results in many different life history trajectories (life history pathways) in the model, many of which are only nominally productive. In the current scenario, degradation of these tributaries has resulted in those trajectories being removed from the model, because virtually no fish that originate from those tributaries return to spawn. Because the nominally productive trajectories are removed from the current scenario, the current smolt productivity may appear greater than the true productivity. Modeled adult chum productivity does not follow this same trend due to poor ocean survival.

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

	Adult Abundance		Adult Productivity		Diversity Index		Smolt Abundance		Smolt Productivity	
Species	**P**	**T**	**P**	**T**	**P**	**T**	**P**	**T**	**P**	**T**
Fall Chinook	484	774	3.7	8.6	0.99	1.00	63,894	95,128	446	920
Chum	1,569	10,174	2.5	10.5	0.96	1.00	441,069	1,209,737	530	891
Coho	1,113	3,760	3.8	16.9	0.73	0.98	19,522	65,924	66	289
Winter Steelhead	894	1,646	4.8	21.9	0.72	0.87	11,857	21,487	63	283

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

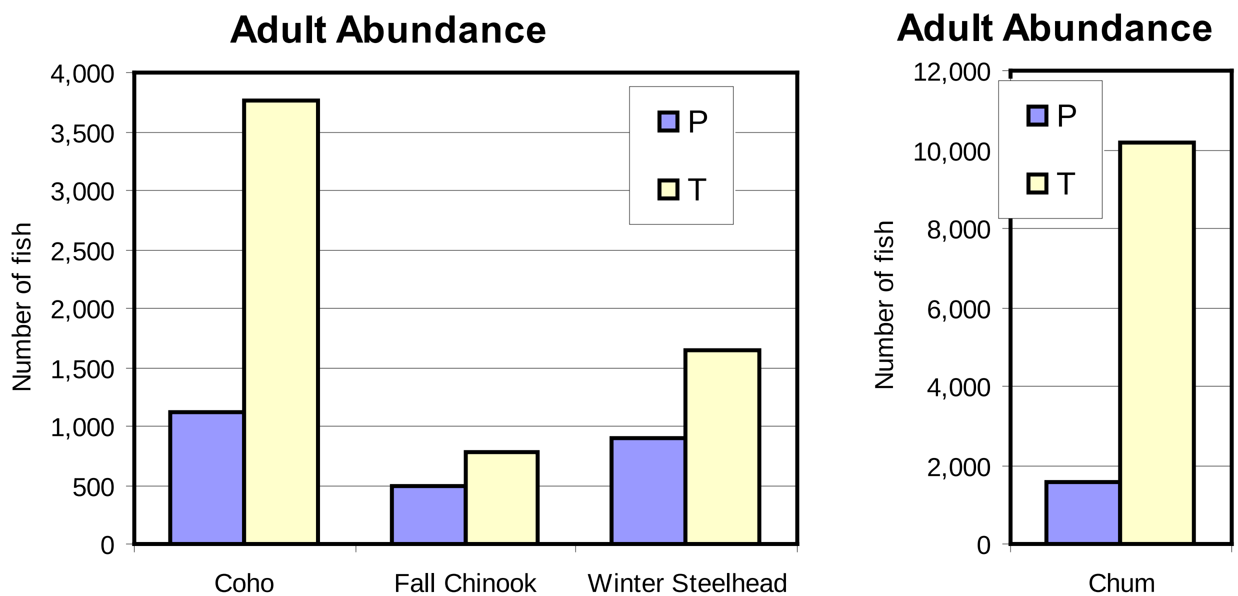


Figure C-4. Adult abundance of Grays River fall Chinook, coho, winter steelhead and chum based on EDT analysis of current (P or patient) and historical (T or template) habitat conditions.

Stream Reach Analysis

Habitat conditions and suitability for fish are better in some portions of a subbasin than in others. The reach analysis of the EDT model uses estimates of the difference in projected population performance between current/patient and historical/template habitat conditions to identify core and degraded fish production areas. Core production areas, where habitat degradation would have a large negative impact on the population, are assigned a high value for preservation. Likewise, currently degraded areas that provide significant potential for restoration are assigned a high value for restoration. Collectively, these values are used to prioritize the reaches within a given subbasin. For the purpose of this EDT analysis, the Grays subbasin was divided into approximately 120 reaches. Reach locations are displayed in Figure C-5.

Winter steelhead utilize the greatest proportion of Grays River subbasin habitats. Historically, only winter steelhead were able to ascend a falls located on the mainstem just upstream of its confluence with the West Fork Grays. This falls was lowered in 1957 to facilitate passage, and coho now commonly access the portion of the basin upstream of this former barrier. Chum primarily utilize the mainstem up to the West Fork confluence and the major tributaries Hull Creek and Seal Creek. Most of the spawning occurs in the mainstem in reach Grays 2 to 2C and the small tributary Crazy Johnson Creek, which flows into the West Fork. Until recently, there was also dense chum spawning in the Gorley Creek spawning channel. Fall Chinook have a similar distribution to chum but are unable to access Hull Creek due to their earlier run timing. Chinook also utilize the lower West Fork Grays.

Some of the high priority reaches for winter steelhead include middle mainstem reaches (Grays 2C, 2D, 3, and 3B), WF Grays 3, and reaches in the lower EF and SF (Figure C-6). Upper basin reaches represent some of the main spawning and rearing sites for winter steelhead. The middle mainstem is important as a rearing area for age 1 juveniles that originate from upstream spawning areas. For fall Chinook, the higher priority areas are in the lower river, including Grays 2 and 2A (Figure C-7). High priority reaches for Grays River coho are also located in the lower river. These reaches consist of Grays 2, 2A, and 2B (Figure C-9). High priority reaches for chum include Grays 2, 2B, and 2C, and spawning reaches such as Crazy Johnson Creek (a tributary to Grays 2C), Fossil and Klints creeks (Figure C-8).

Many of the above mentioned reaches currently support significant production and therefore have high preservation value. They also have considerable restoration potential. The important steelhead reaches in the upper basin have been affected by intense forestry activities and currently have low instream LWD and degraded riparian conditions. The lower river (including the tidal reaches) has experienced heavy agricultural use that affects riparian and sediment conditions. Lower river reaches have also experienced a loss of historical off-channel habitats due to hydromodifications (e.g. levees).

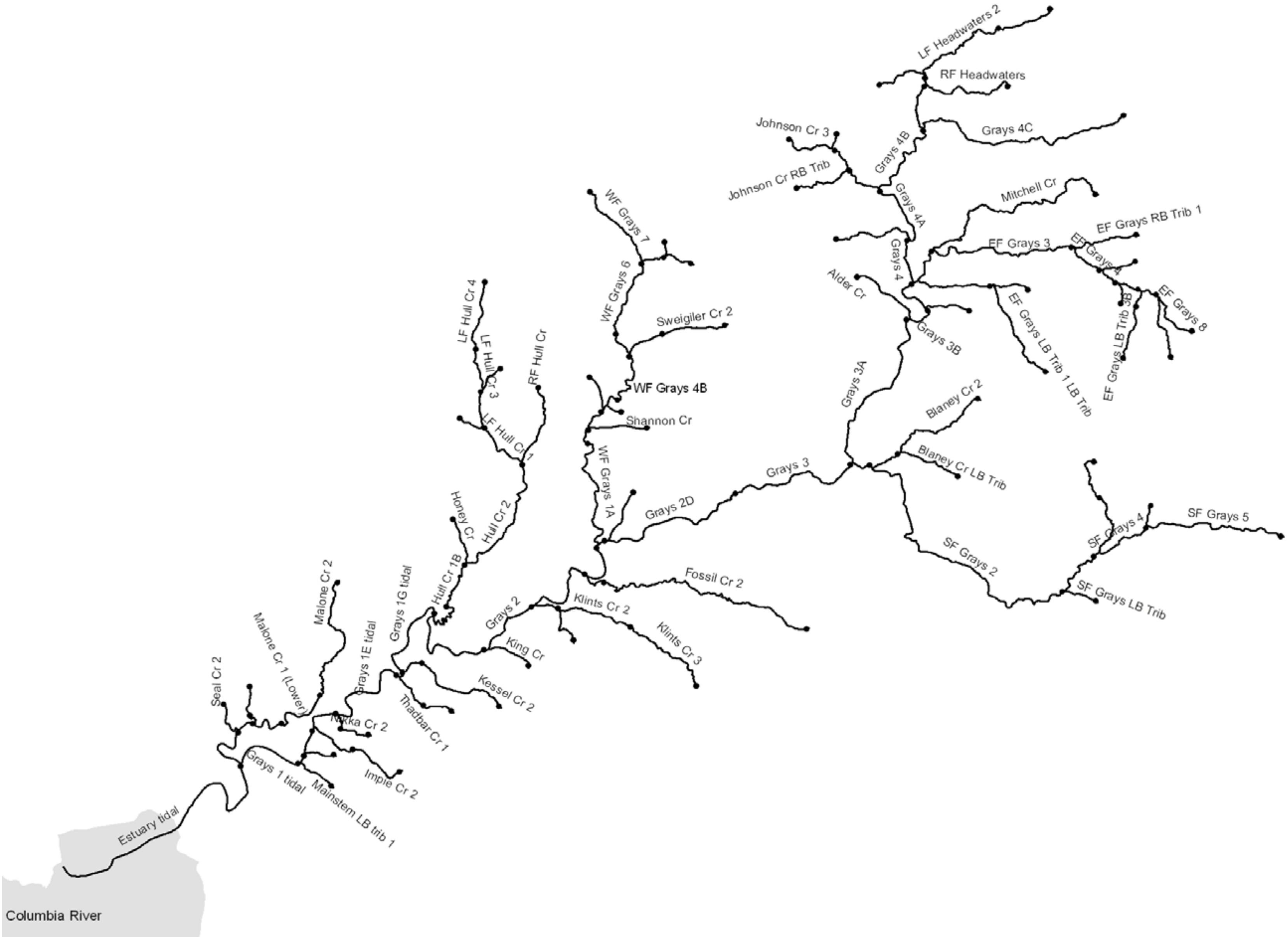


Figure C-5. Grays subbasin with EDT reaches identified. For readability, not all reaches are labeled.

Grays Winter Steelhead

Potential Change in Population Performance with Degradation and Restoration

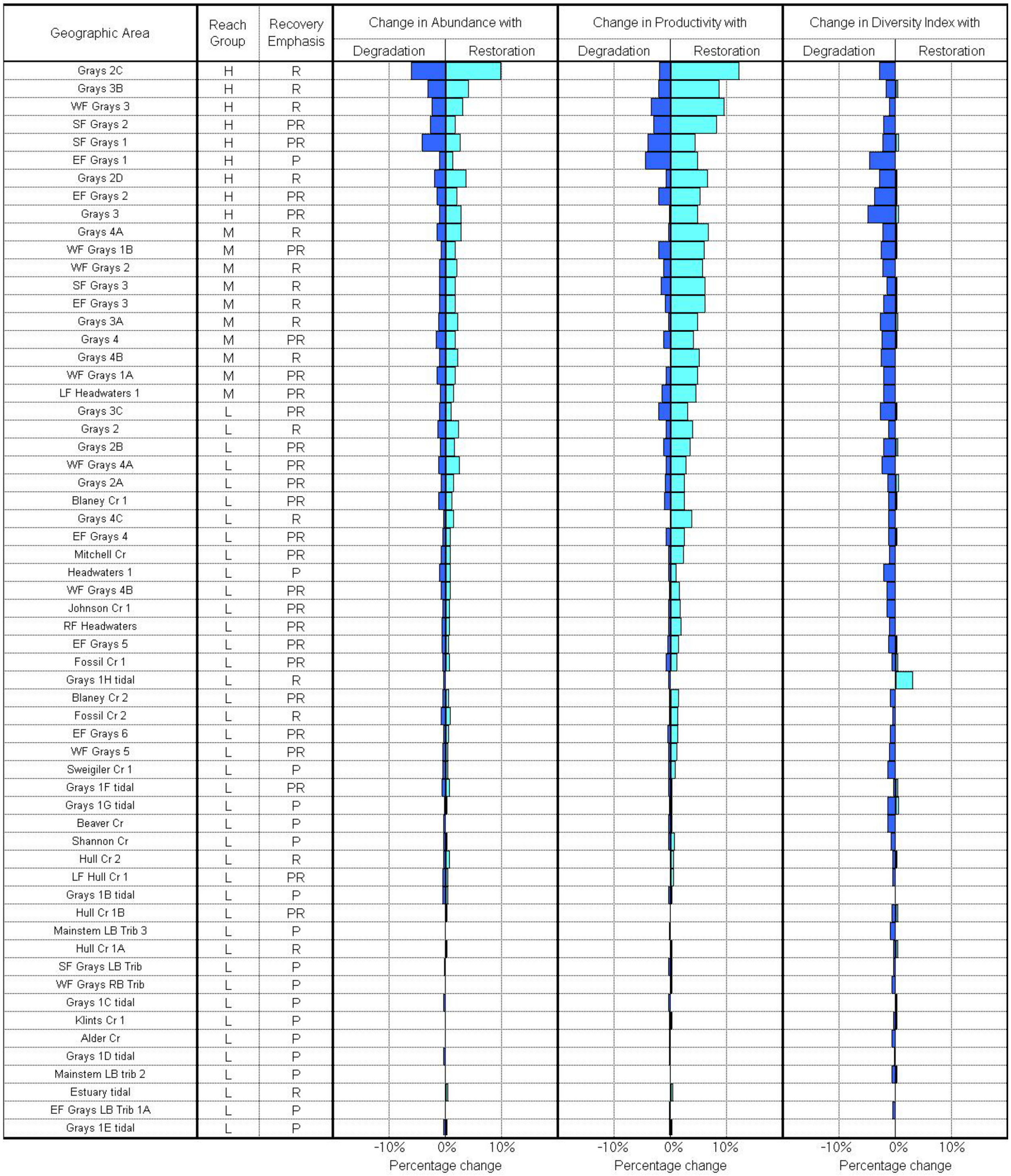


Figure C-6. Grays River subbasin winter steelhead ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current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

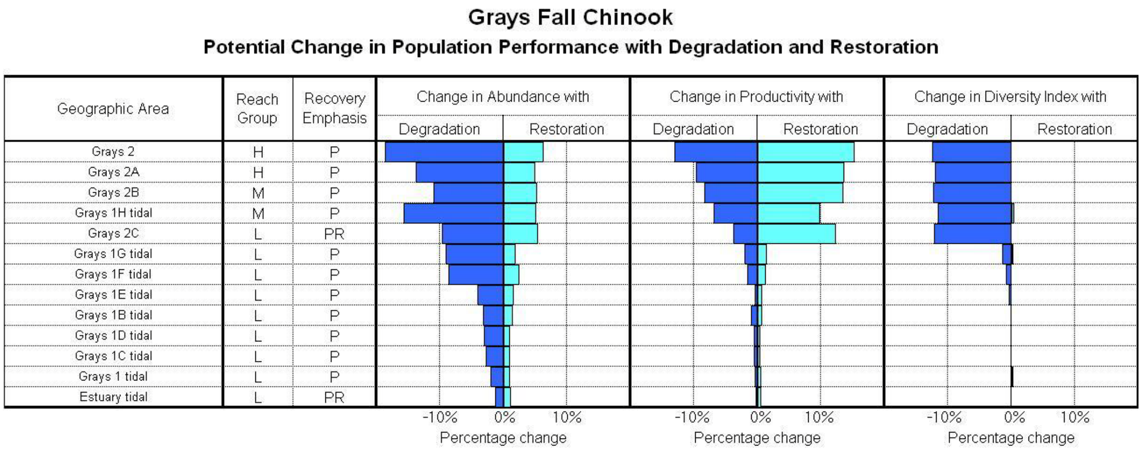


Figure C-7. Grays River subbasin fall Chinook ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current population.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

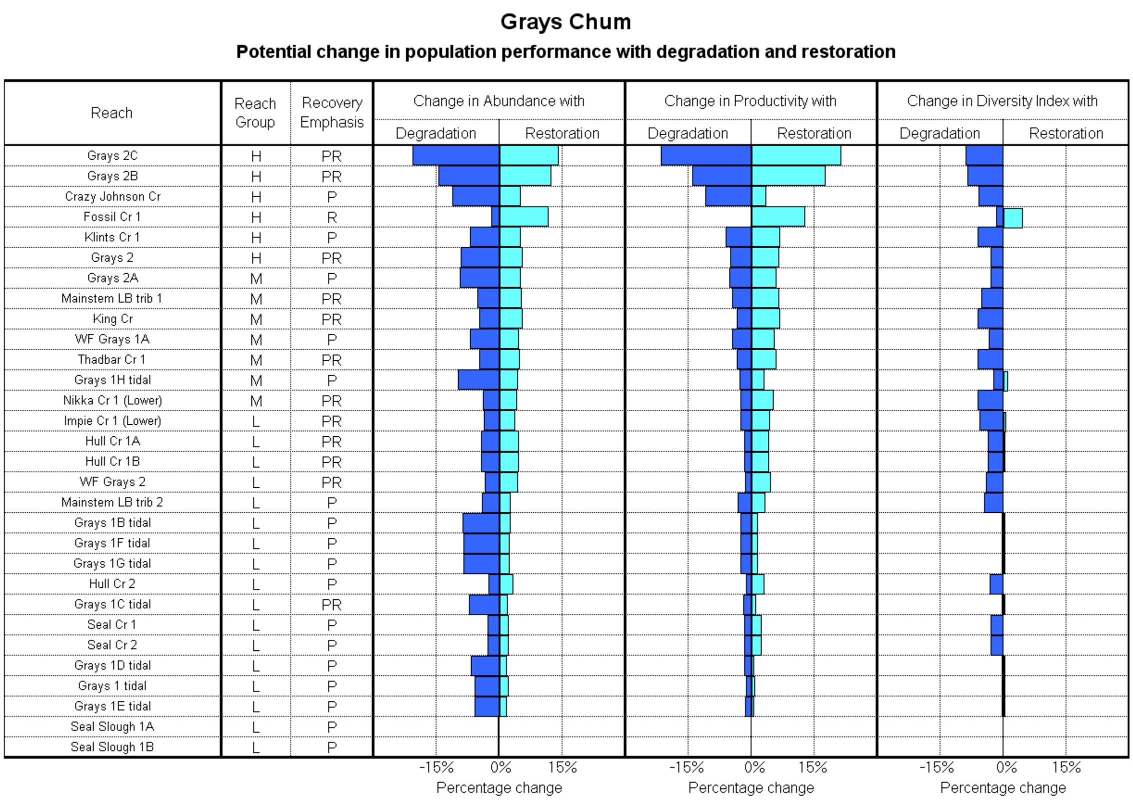


Figure C-8. Grays River subbasin chum ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current population. For each reach, a reach group designation and recovery emphasis designation is given. Percentage change values are expressed as the change per 1000 meters of stream length within the reach. See Appendix E Chapter 6 for more information on EDT ladder diagrams. Some low priority reaches are not included for display purposes.

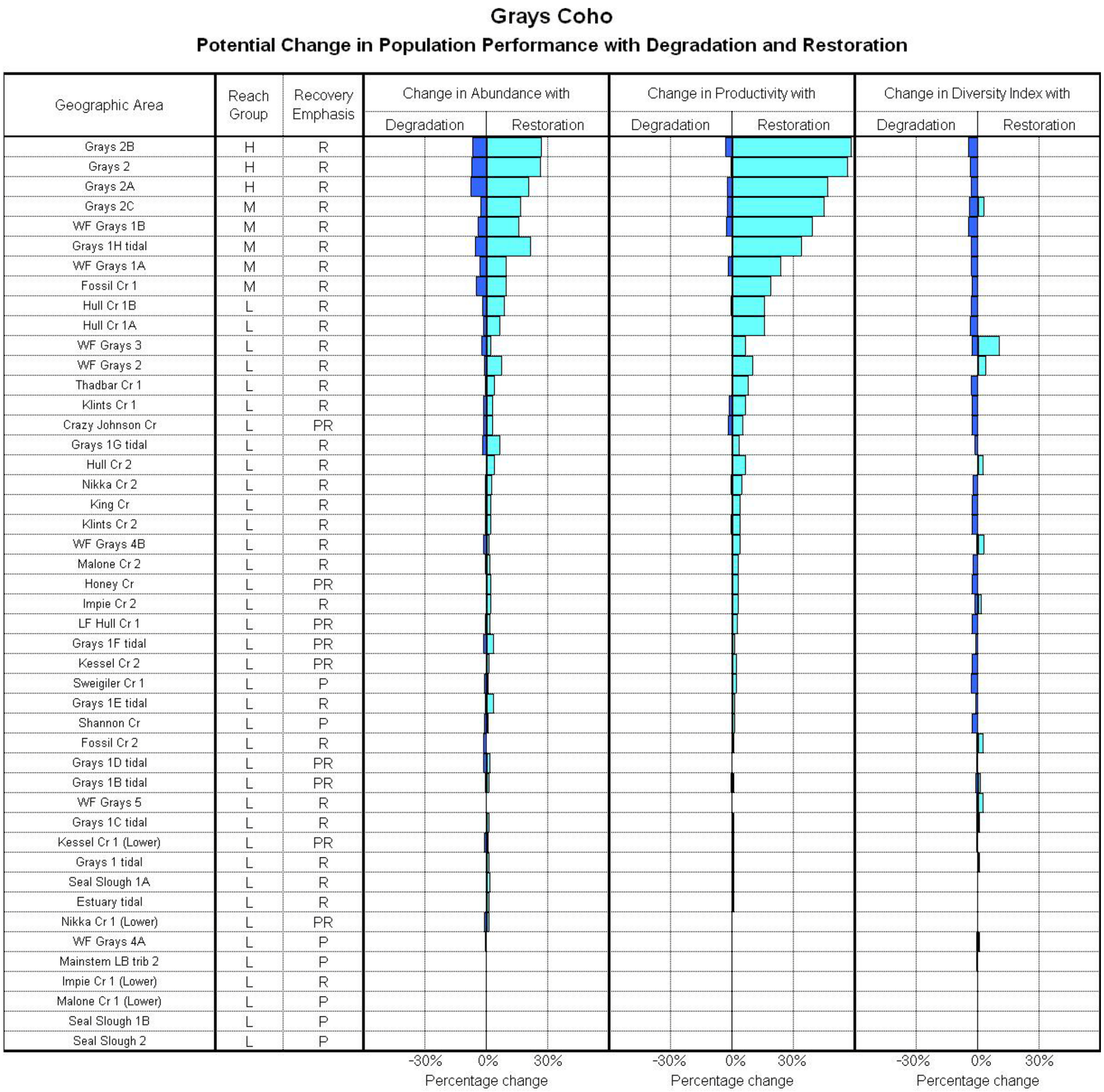


Figure C-9. Grays River subbasin coho ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current population. For each reach, a reach group designation and recovery emphasis designation is given. Percentage change values are expressed as the change per 1000 meters of stream length within the reach. See Appendix E Chapter 6 for more information on EDT ladder diagrams. Some low priority reaches are not included for display purposes.

Habitat Factor Analysis

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

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

Species and Lifestage		Primary factors	Secondary factors	Tertiary factors
Grays Fall Chinook				
most critical	Egg incubation	sediment	channel stability, temperature	
second	Spawning	temperature	habitat diversity	harassment, pathogens, predation
third	Prespawning holding	key habitat	flow, temperature	habitat diversity, predation
Grays Chum				
most critical	Egg incubation	sediment	channel stability	key habitat
second	Prespawning holding	key habitat	habitat diversity	flow, harassment
third	Spawning	habitat diversity	key habitat	
Grays Coho				
most critical	Egg incubation	key habitat, sediment	channel stability	
second	0-age summer rearing	key habitat, habitat diversity	flow	food, channel stability
third	0-age winter rearing	key habitat	temperature, habitat diversity, competition (hatch)	predation, pathogens, food, flow, competition (other sp.), channel stability
Grays Winter Steelhead				
most critical	Egg incubation	sediment, temperature, key habitat	channel stabilty	
second	0-age summer rearing	temperature, pathogens, habitat diversity	flow, predation, competition (hatch)	
third	0,1-age winter rearing	habitat diversity	flow	channel stability, sediment
	1-age summer rearing	competition (hatch), habitat diversity, temperature	flow, pathogens, predation	

The consumer reports diagrams have also been summarized to show the relative importance of habitat factors by reach. The summary figures are referred to as habitat factor analysis diagrams and are displayed for each species below. The reaches are ordered according to their combined restoration and preservation rank. The reach with the greatest potential benefit is listed at the top. The dots represent the relative impact of habitat attributes on reach-level performance.

The top priority restoration areas for winter steelhead are in upper sections of the subbasin, which suffer primarily from impacts to sediment, temperature, and key habitat quantity (Figure C- 10). Sediment impacts are believed to originate primarily from upper basin timber harvest, roads, and naturally unstable soils. The land ownership in the basin is predominantly private (90%) and most of the upper basin is in timber production. Road densities in upper basin subwatersheds are between 4 and 7 mi/mi^2. This area represents one of the highest concentrations of densely roaded subwatersheds in the entire lower Columbia region. Roads and timber harvest, combined with unstable sedimentary soils, result in a proliferation of mass wasting. Soil survey reports have indicated as many as 4.22 mass $failures/mi^2$ in the basin (Wade 2002). Channel stability, temperature, and habitat diversity are largely influenced by the poor condition of riparian forests. There is little shade provided by tree canopies and there is low LWD recruitment. The moderate impact from predation in some reaches is due to a recently discontinued (2000) steelhead and coho rearing facility in Grays 3B. The population is expected to be recovering from these impacts. The South Fork Grays has high sediment impacts from channel and upslope sources. The South Fork basin is steep, with unstable soils, and has experienced intensive timber harvest. Flow impacts in the South Fork basin are related to high road densities and young vegetation. Approximately 17% of the basin is in early seral conditions and 0% is in late seral. Road densities are over 4 mi/mi^2. Temperature and habitat diversity impacts are related primarily to degraded riparian zones and lack of LWD. Key habitat has been impacted by sedimentation and loss of instream LWD that is important for maintaining habitat.

Fall Chinook restoration priorities are similar to winter steelhead, with sediment, temperature, and key habitat quantity contributing the greatest impairments (Figure C-11). The major land uses affecting Chinook are the same as the ones discussed above for winter steelhead, with the addition of impacts to the lower mainstem. These include channel confinement from levees, lack of LWD, and channel instability around Grays 2B, 2C, and 2D that occurs once the stream exits the upper canyon in Grays 3. Many of the factors affecting chum, discussed below, also impact fall Chinook.

As for coho, restoration priorities are located in the lower river (Grays 2, 2A, 2B, and 2C). In these areas, channel stability, sediment, and key habitat quantity are the major factors. Many of the factors discussed below for chum also impact coho.

The top chum restoration priority is in the lower river (Grays 2B, 2C and 2D). Sediment and habitat diversity are the major factors (Figure C-13). Sediment and the moderate flow impact are from upstream sources and contribute to sediment aggradation and bed scour that reduce channel stability. The lower gradient, alluvial nature of these channels makes them prone to excess sedimentation. Loss of habitat diversity is due to artificially confined channels, low quantities of LWD, and denuded riparian conditions. Local agricultural practices have confined channels, reduced riparian vegetation, and reduced floodplain function. Seventy-nine percent of the subwatersheds that encompass reaches Grays 1 tidal upstream into Grays 2 are either non-forest (pavement, bare soil, structures) or other forest (shrubs, lawns, pasture, cropland). Low to moderate predation and competition impacts stem from Grays River Hatchery releases.

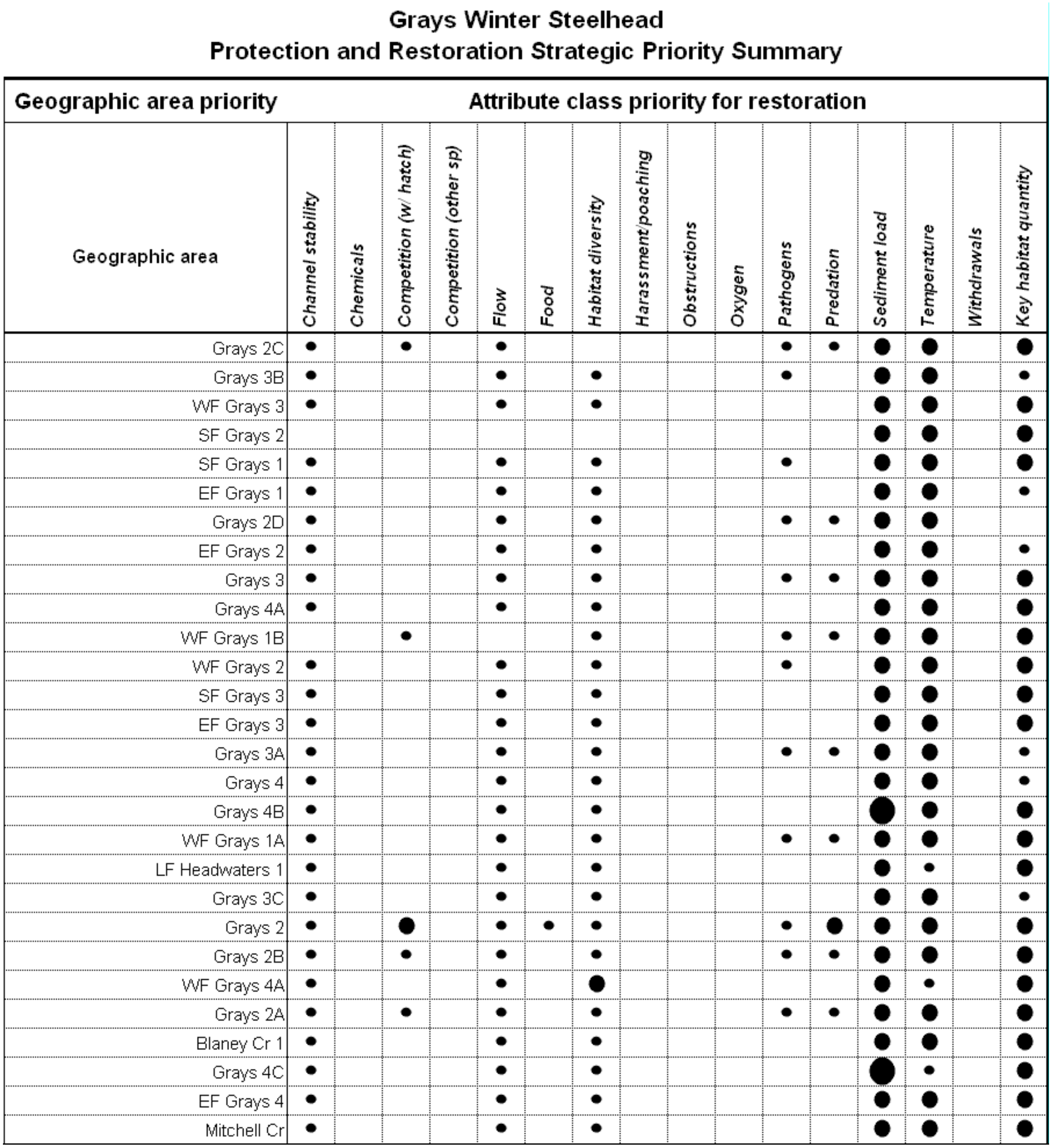


Figure C- 10. Grays River subbasin winter steelhead habitat factor analysis diagram. Diagram displays the relative impact of habitat factors in specific reaches. The reaches are ordered according to their restoration and preservation rank, which factors in their potential benefit to overall population abundance, productivity, and diversity. The reach with the greatest potential benefit is listed at the top. The dots represent the relative impact of habitat attributes on reach-level performance. See Appendix E Chapter 6 for more information on habitat factor analysis diagrams. Some low priority reaches may not be included for display purposes.

Grays Fall Chinook
Protection and Restoration Strategic Priority Summary

Geographic area priority	Attribute class priority for restoration															
Geographic area	Channel stability	Chemicals	Competition (w/ hatch)	Competition (other sp)	Flow	Food	Habitat diversity	Harassment/poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment load	Temperature	Withdrawals	Key habitat quantity
Grays 2	•				•	•	•						●	●		●
Grays 2A	•				•	•	•						●	●		●
Grays 2B	•				•	•	•						●	●		●
Grays 1H tidal	•				•	•						•	●	●		●
Grays 2C	•				•	•	●						●	●		●
Grays 1G tidal	•				•	•	•					•	•	•		•
Grays 1F tidal	•				•	•	•					•	•	•		•
Grays 1E tidal	•				•	•	•					•	•	•		•
Grays 1B tidal	•				•	•	•					•	•	•		•
Grays 1D tidal						•						•	•	•		•
Grays 1C tidal	•				•	•						•	•	•		•
Grays 1 tidal	•				•	•	•					•	•	•		•
Estuary tidal	•				•	•	•	•				•	•	•		•

1/ "Channel stability" applies to freshwater areas only.

Key to strategic priority (corresponding Benefit Category letter also shown)

A High; B Medium; C Low; D & E Indirect or General

Figure C-11. Grays fall Chinook habitat factor analysis diagram. Diagram displays the relative impact of habitat factors in specific reaches. The reaches are ordered according to their restoration and preservation rank, which factors in their potential benefit to overall population abundance, productivity, and diversity. The reach with the greatest potential benefit is listed at the top. The dots represent the relative impact of habitat attributes on reach-level performance. See Appendix E Chapter 6 for more information on habitat factor analysis diagrams. Some low priority reaches may not be included for display purposes.

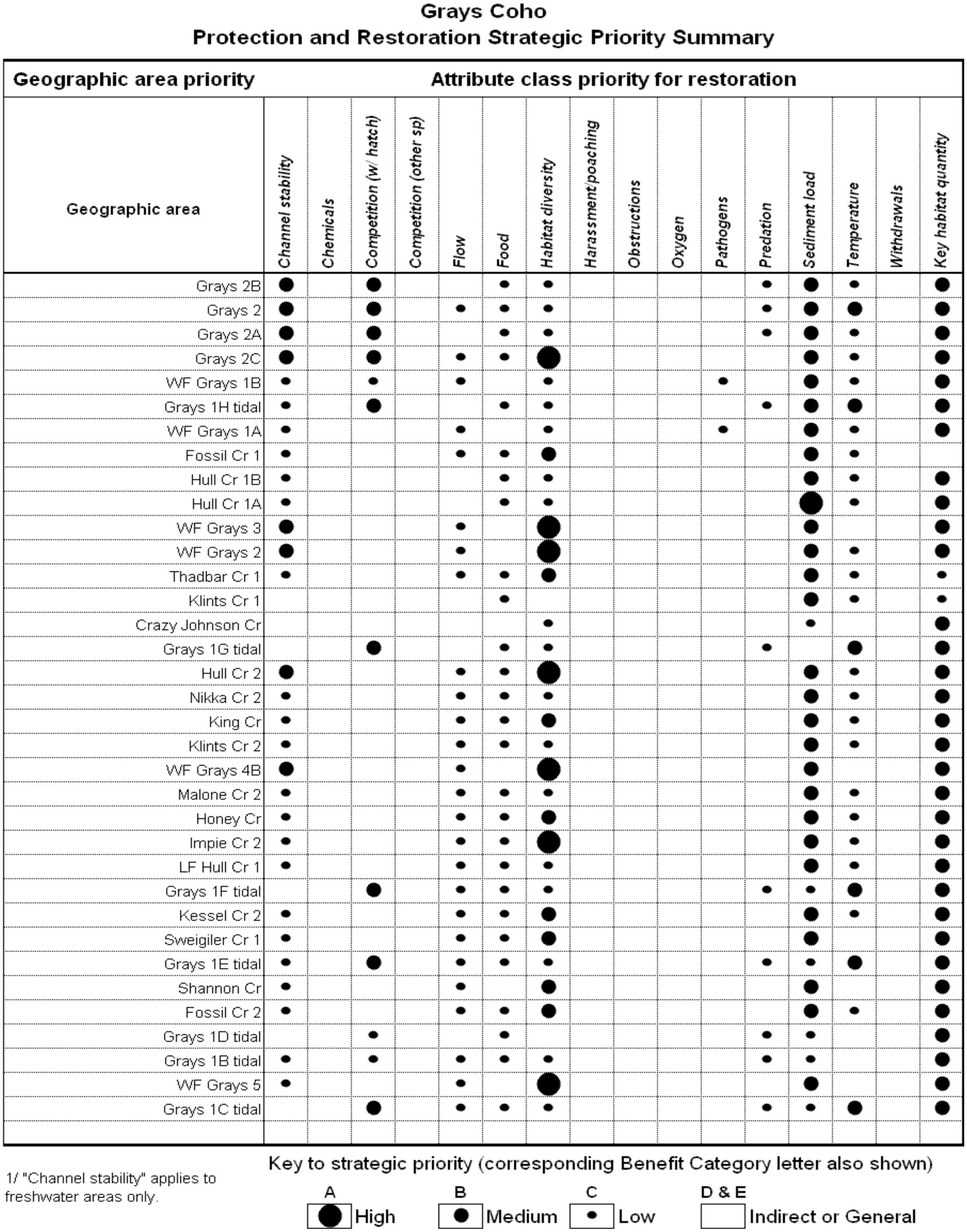


Figure C-12. Grays coho habitat factor analysis diagram. Some low priority reaches may not be included for display purposes. Diagram displays the relative impact of habitat factors in specific reaches. The reaches are ordered according to their restoration and preservation rank, which factors in their potential benefit to overall population abundance, productivity, and diversity. The reach with the greatest potential benefit is listed at the top. The dots represent the relative impact of habitat attributes on reach-level performance. See Appendix E Chapter 6 for more information on habitat factor analysis diagrams. Some low priority reaches may not be included for display purposes.

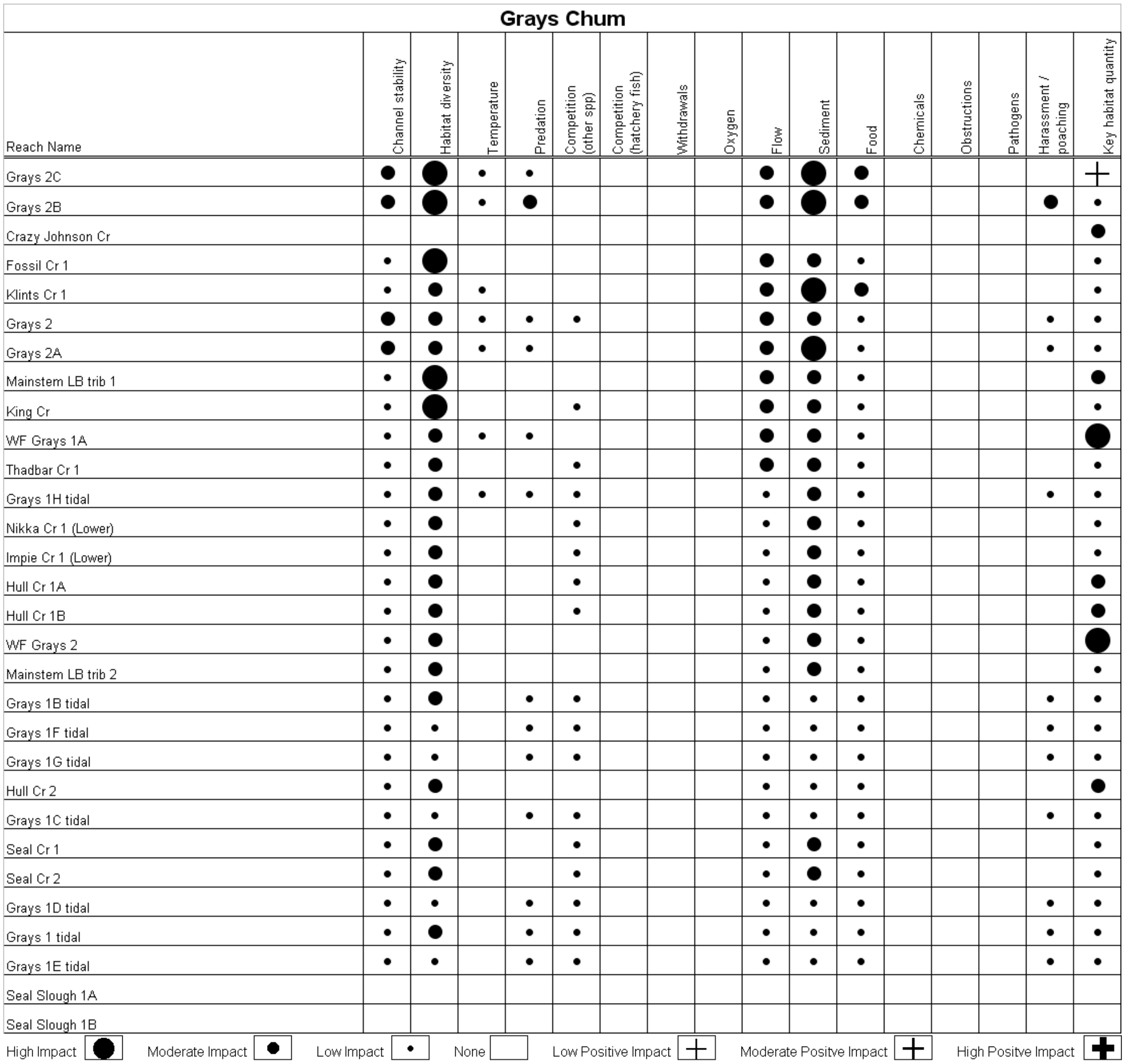


Figure C-13. Grays subbasin chum habitat factor analysis diagram. This chum habitat factor analysis diagram differs from the others in that the dot size represents not only the relative within-reach impact of the habitat attributes, but also the relative contribution of each reach's impact on total population performance. The dots therefore decrease in size towards the bottom of the chart.

C.3.5. Watershed Process Limitations

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

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

The Grays River Subbasin encompasses 124 mi^2, making up 17 IWA subwatersheds. IWA results for the Grays River watershed are shown in Table C-4. A reference map showing the location of each subwatershed in the basin is presented in Figure C-14. Maps of the distribution of local and watershed level IWA results are displayed in Figure C-15.

Hydrology

Current Conditions— Functional hydrologic conditions are distributed exclusively along the mainstem Columbia, incorporating the lower reaches of the Grays River, Deep River, and assorted small tributaries (30503, 30405, 30406). Moderately impaired hydrologic condition ratings are located within the upper reaches of the East Fork and South Fork of the Grays River (30104, 30303). The rest of the subwatersheds have an impaired IWA hydrology rating.

For the most part, the watershed level hydrology ratings are consistent with the local ratings. Possibly the most significant watershed level effect is apparent in subwatershed 30406, at the mouth of the Grays River. The hydrologic condition rating is downgraded to impaired from a functional rating at the local level. This is due to the overwhelming predominance of impaired hydrologic conditions upstream. However, it should be noted that the subwatershed is largely within the slough-like, tidally influenced portion of the river. This suggests that upstream effects may not be as severe as the IWA watershed level rating may suggest. A second, notable change in hydrologic rating occurs in the upper East and South Forks of the Grays River, where two downstream subwatersheds are upgraded into the moderately impaired category (30101, 30301) due to effects from their headwater subwatersheds.

Predicted Future Trends— All of subwatershed 30101 (Mitchell Creek and East Fork Grays River) is in private holdings, and primarily used for timber production. Hydrologic conditions are unlikely to improve in the short term with existing high road densities (6.0 mi/mi2), stream crossing densities (4.3 crossings/stream mile), and only moderate mature forest coverage (45%). Improved forest practices may lead to improved conditions over the long term.

Table C-4. IWA results for the Grays River Watershed

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
30101	I	M	M	M	M	30104
30102	I	I	M	I	I	30105
30103	I	M	M	I	M	30101, 30102, 30104, 30105
30104	M	M	F	M	M	none
30105	I	M	M	I	M	none
30201	I	I	M	I	M	30202
30202	I	I	M	I	I	none
30301	I	M	M	M	M	30303
30302	I	M	M	I	M	30101, 30102, 30103, 30104, 30105, 30301, 30303
30303	M	M	F	M	M	none
30401	I	I	I	I	M	30101, 30102, 30103, 30104, 30105, 30201, 30202, 30301, 30302, 30303, 30402, 30403
30402	I	M	M	I	M	none
30403	I	M	M	I	M	30101, 30102, 30103, 30104, 30105, 30201, 30202, 30301, 30302, 30303
30404	I	M	M	I	M	none
30405	F	M	M	F	M	none
30406	F	M	I	I	M	30101, 30102, 30103, 30104, 30105, 30201, 30202, 30301, 30302, 30303, 30401, 30402, 30403
30407	I	I	I	I	I	none

Notes:

[a] LCFRB subwatershed identification code abbreviation. All codes are 14 digits starting with 170800030#####.

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

F: Functional
M:Moderately impaired
I:Impaired

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

[d] Subwatersheds upstream from this subwatershed.

Figure C-14. Map of the Grays basin showing the location of the IWA subwatersheds.

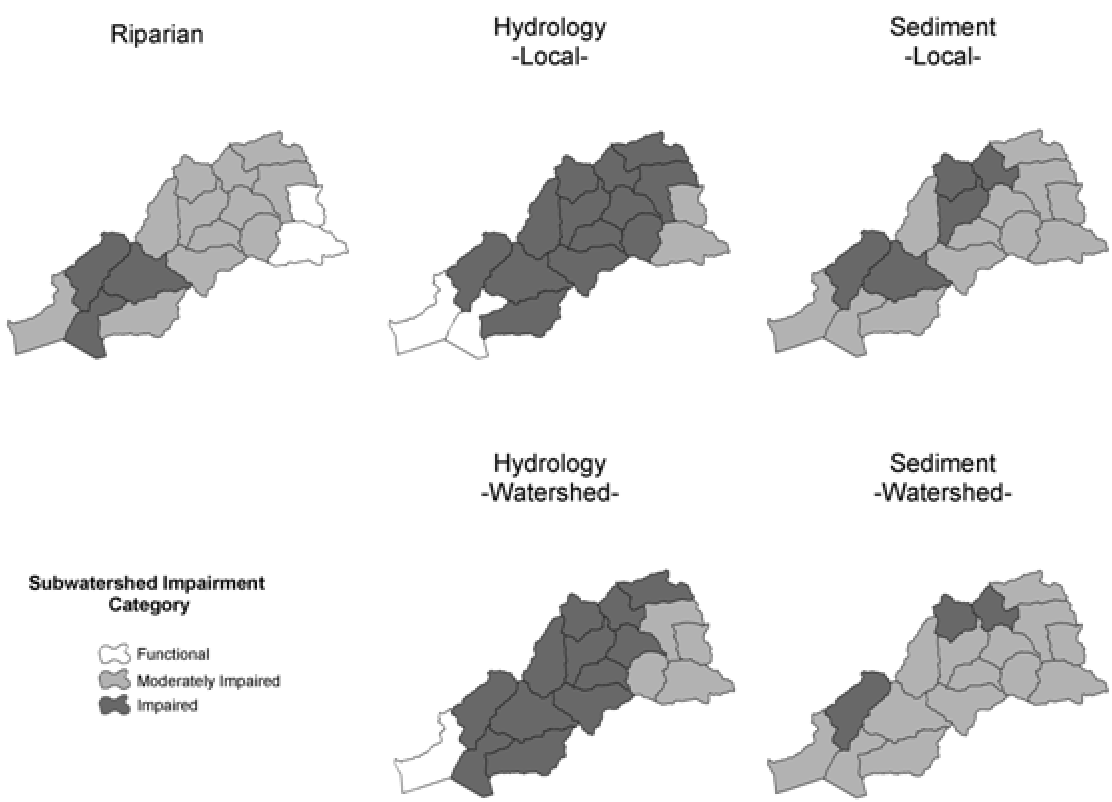


Figure C-15. IWA subwatershed impairment ratings by category for the Grays Subbasin

Approximately one third of subwatersheds 30301 and 30303 on the South Fork are in public hands, managed by the WDNR. Road densities on these timberlands are high, although streamside road density is relatively low. Hydrologic conditions are likely to improve or remain stable.

The upper mainstem subwatersheds (30105, 30102, 30103, 30302) are uniformly rated as hydrologically impaired. These subwatersheds have very high stream crossing densities (5.0-7.6 crossings/stream mile), high road densities, and roughly 33% mature forest cover. These key subwatersheds likely will take a long time to recover from past forestry and road building activities.

Lower mainstem subwatersheds are also almost exclusively under private ownership with variable stream crossing densities, ranging from a high of 5.1 crossings/stream mile in 30403 to a low of 2.2 in the tidally influenced area within 30406. Road densities in general show a similar pattern. Conditions in subwatersheds 30403 and 30401 are substantially degraded and hydrologic conditions will take some time to recover. Subwatershed 30406 is composed primarily of wetlands (86%), lending hydrologic integrity and resilience to this subwatershed if wetlands are adequately protected. It should be noted, however, that despite a functional rating in the IWA, 30406 contains extensive diking and other channel revetments. The Columbia Land Trust is actively negotiating on over 800 acres of land in the lower Grays River and Deep River watershed, including subwatershed 30406. Restoration goals include removing tidegates and dikes to reconnect the river with the floodplain to benefit salmon and a host of other fish and wildlife species. These projects have been identified as some of the most important conservation work in the Columbia River estuary.

Sediment Supply

Current Conditions— With respect to sediment conditions, there are no subwatersheds within the Grays River subbasin classified as functional. The large majority (12) are characterized as moderately impaired, with the balance rated as impaired (5). Impaired conditions can be found throughout the WF Grays River drainage (30201 and 30202), the Deep River drainage (30407), and in the Grays mainstem – Malone Creek subwatershed (30401). It should be noted that the natural levels of erodability are low to moderate within the watershed, scoring an area-adjusted composite rating of 16 on a scale of 0-126. Current, “managed” conditions have elevated that value substantially to near 40, but the overall erodability is still moderate

As with hydrologic conditions, watershed level sediment conditions do not change drastically from the local level. The lower West Fork Grays subwatershed (30201) improves to a moderately impaired rating, as does the Grays – Malone Creek subwatershed (30401) due to upstream inputs.

Predicted Future Trends— Watershed level sediment condition ratings are moderately impaired in all subwatersheds encompassing important anadromous stream reaches, with the exception of 30102 along the upper mainstem where conditions are rated as impaired. Along the East and South Fork, as well as in the upper mainstem subwatersheds, natural erodability levels are quite low, ranging from 5-18 on a scale of 0-126. Managed erodability levels are certainly higher, but all remain in the low or moderate categories, ranging from 3-43 on the erodability index. As described in the hydrology section above, land-use intensity is quite high in these upper areas, as measured by the density of roads, stream crossings and the level of timber harvest activities. Sediment conditions are unlikely to improve over the short term, with the possible exception of certain publicly managed timber parcels on the South Fork (30301, 30303).

Along the lower mainstem, current condition ratings are exceptionally poor in subwatersheds 30403 and 30401 with respect to land-use intensity as described above. Managed erodability is exceedingly high in subwatershed 30401 at 97 points on the index (scale of 0-126). Sediment conditions in these subwatersheds are unlikely to improve in the near future.

Although sediment conditions are rated as moderately impaired in subwatershed 30406, the estuarine character of the subwatershed, coupled with low road and stream side road density, high proportion of wetlands and ongoing efforts to protect the tidal areas, suggest that conditions in this subwatershed may improve over the next 20 years.

Riparian Condition

Current Conditions— Functional riparian conditions are found in two subwatersheds, while 12 subwatersheds are rated as moderately impaired, and three are classified as impaired. As with hydrologic conditions, the headwaters of the South and East Forks of the Grays River (30308 and 30101) have functional ratings, whereas the Deep River subwatershed (30407) is categorized as impaired. According to IWA, the estuarine subwatershed at the mouth of Crooked Creek and the Grays River also has impaired riparian conditions.

Predicted Future Trends— Riparian conditions are rated moderately impaired to impaired throughout the majority of the Grays River Subbasin, with only two subwatersheds rated as functional (30303- SF Grays headwaters & 30104- EF Grays headwaters). New forestry regulations should allow for recovery of riparian corridors over time.

The most impaired ratings are found in the estuary and lower river (30406, 30401), where the majority of the mainstem has been channelized through diking and most side-channel habitat has been lost. The presence of dikes and other channel revetments reduces the potential for riparian recovery. However, conservation easements and other public-private partnerships (such as those already being developed by the Columbia Trust) offer some promise that floodplain dynamics and riparian conditions in this estuarine area may improve over the next 20 years.

C.3.6. Other Factors and Limitations

Hatcheries

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

Grays River Hatchery: The Grays River Hatchery is located about RM 1.4 on the West Fork Grays River and primarily has produced fall Chinook and early run coho (type-S), and in recent years, chum salmon. In addition, Cowlitz/Lewis spring Chinook are released in the basin. Coho, spring Chinook, and steelhead are currently produced for harvest opportunity and chum for natural population enhancement (Table C-5). The Grays River Hatchery was completed in 1961, although releases of hatchery fall Chinook occurred in the basin as early as 1947. The fall Chinook hatchery program was discontinued in 1998 because of federal funding cuts.

The coho program includes releases into the Grays River as well as transfers to Deep River net pens. The main threats of the hatchery coho program are ecological interactions between natural juvenile salmon and hatchery coho in the Grays River and potential domestication of natural coho. The spring Chinook are imported to Grays River Hatchery as eggs (from Cowlitz or Lewis River hatcheries) for incubation and rearing prior to transfer to the Deep River net pens. The Deep River programs result in fish for harvest returning to Deep River, with negligible threats to natural populations.

Winter steelhead are transferred from the Elochoman Hatchery to Grays River Hatchery as eggs and released into the Grays River as smolts. The Elochoman Hatchery steelhead are a composite stock and are genetically different from the naturally-produced steelhead in the Grays River. Winter steelhead produced at the Elochoman Hatchery have been planted in the Grays River since at least the early 1980s; annual release goal is 40,000 winter steelhead (Figure C-16). The main threats from hatchery steelhead are domestication of the naturally-produced steelhead as a result of adult interactions or ecological interactions between natural juvenile salmon and hatchery released juvenile steelhead.

The chum salmon program began collecting adults for broodstock in fall of 1998. While the current annual chum salmon production goal for the Grays River Hatchery is 300,000 chum fry, chum releases to the Grays River in 2002 totaled 555,000 fry (Figure C-16). An additional 150,000 chum fry produced at the Grays River Hatchery are scheduled for annual release in the Chinook River.

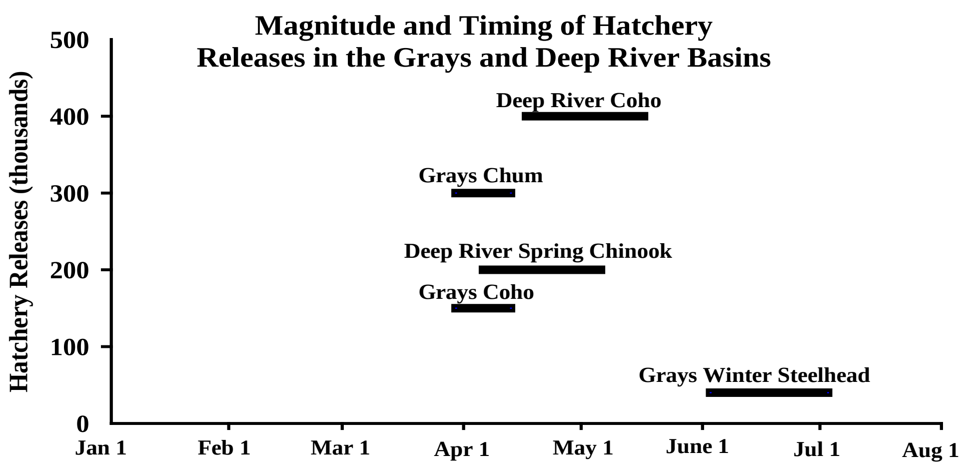


Figure C-16. Magnitude and timing of hatchery releases in the Deep River and Grays River basins by species, based on 2003 brood production goals.

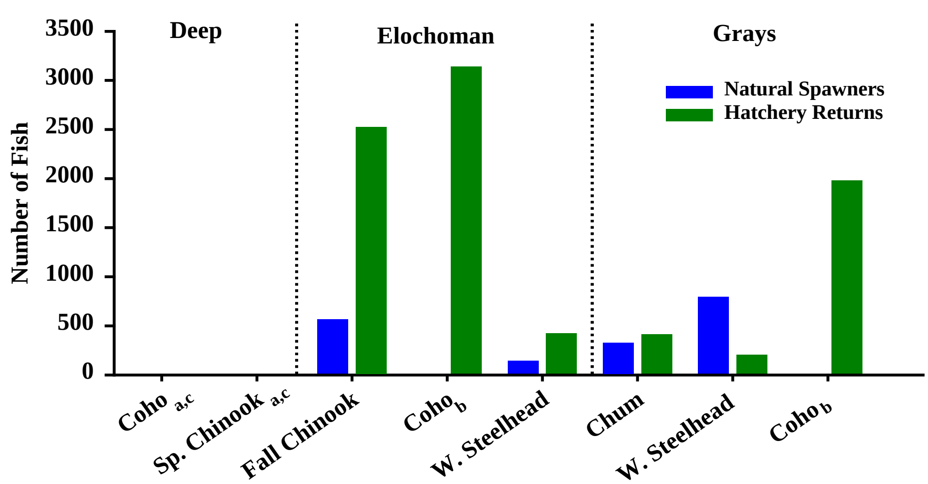


Figure C-17. Recent average hatchery returns and estimates of natural spawning escapement in the Deep, Grays, and Elochoman River basins by species. The years used to calculate averages varied by species, based on available data. The data used to calculate average hatchery returns and natural escapement for a particular species and basin were derived from the same years in all cases. All data were from 1992 to the present. Calculation of each average utilized a minimum of 5 years of data, except for Grays chum (1998–2000) and Grays winter steelhead (1998 and 2000).

Table C-5. Current Grays/Chinook subbasin hatchery production.

Hatchery	Release Location	Fall Chinook	Spring Chinook	Chum	Coho	Winter Steelhead
Grays	Grays River	0	0	300,000	150,000	40,000
	Deep River	0	200,000	0	400,000	

Hatchery Effects: *Genetics*—Broodstock for the new chum salmon hatchery program in the Grays River has been from native Grays River chum stock trapped in Gorley Creek, leading to expectations of minimal genetic effects on wild fish from these releases. Winter steelhead releases in the basin have been from Elochoman and Cowlitz rivers, and include Chambers Creek broodstock. Early coho broodstock is trapped at the Grays River Hatchery. Historical releases have included substantial out-of-basin transfers, although all transfers came from within the lower Columbia basin. The largest donor was Toutle Hatchery early coho. In past years, the discontinued fall Chinook program also collected broodstock at the Grays River Hatchery. The program included substantial transfers from Lower Columbia ESU basins to fill shortfalls. The primary donors to the Grays River fall Chinook program were Spring Creek Hatchery and Kalama Hatchery. The Grays River will be an interesting test case of a lower Columbia stream which will be without first generation local hatchery fall Chinook influence on the spawning grounds beginning in 2003.

Interactions—Specific wild/hatchery fish interactions in the Grays River have not been documented. For chum salmon, wild and hatchery adult fish may interact upon return although the hatchery program is intended to augment runs of wild chum. The amount of hatchery fish spawning in the wild is being monitored by otolith marking of hatchery releases. Recent natural chum returns to the Grays are substantially larger then hatchery returns (Figure C-17). Competition between juvenile wild and hatchery chum may occur as well, although the Grays River is unlikely to be rearing-limited at current production levels. Wild and hatchery chum fry may be susceptible to predation by hatchery coho smolts, as well as numerous other predators. The following hatchery practices are employed to minimize chum fry losses during outmigration: 1) hatchery chum are released during darkness on a falling tide to reduce their visibility and expedite emigration, 2) fish are released in areas away from known concentrations of predatory warm water fishes, and 3) hatchery fish are released during a similar time frame of natural salmonid emigration.

For fall Chinook, a significant portion of past years' spawners in the Grays River were first-generation hatchery fish. Few wild fish were present, so hatchery/wild adult fish interactions likely were limited. With past years' annual releases of fall Chinook usually between 1 and 6 million, there was significant potential for competition between hatchery-released and naturally produced juvenile fall Chinook. However, few natural fall Chinook were produced annually and most hatchery releases are smolts that migrate shortly after release, which minimizes potential freshwater competition. In most years, hatchery-released juvenile fall Chinook considerably outnumbered naturally produced juveniles. Further, because the Grays River Hatchery fall Chinook program stopped releasing smolts in 1998, adult hatchery returns are expected to cease beginning in 2002.

Spawning of wild coho is presumed to be low so there is little interaction between wild and hatchery fish (Figure C-17). Also, indigenous wild coho in the Grays River are believed to be late run coho while the hatchery broodstock has been from early run coho; adult coho interaction therefore is minimized through temporal segregation. Hatchery winter steelhead contribute very little to natural production and interaction between hatchery and wild winter steelhead is expected to be minimal (Figure C-17).

Water Quality/Disease—Water for the Grays River Hatchery is obtained from two sources; Grays River and nearby wells. Grays River water is utilized for holding adults before broodstock collection and for the final stages of rearing before release. Well water is used during incubation and most of the rearing phase; water is supplied to the rearing raceways at a rate of 946 to 1,325 liters/min. Beginning 3 weeks before release, Grays River water is gradually added to the raceway water supply so that fish are exposed to 100% Grays River water for at least 10 days before they are released. Fish health is continuously monitored in accordance with the Co-Manager Fish Health Policy standards. No disease outbreaks occurred during the incubation-to-ponding period of the 1998 brood; mortality levels were lower than the program standards.

Mixed Harvest—There are no directed chum salmon fisheries on lower Columbia River chum stocks. Minor incidental harvest occurs in fisheries targeting fall Chinook and coho. Retention of wild chum salmon is prohibited in lower Columbia River and tributary sport fisheries. There probably is little difference in fishery exploitation rates of lower Columbia River wild and Grays River Hatchery chum salmon. The purpose of the coho and winter steelhead hatchery programs in the Grays River basin is to mitigate the loss of natural salmonid production as a result of hydroelectric and other development in the Columbia River basin and to provide harvest opportunity. Historically, fishery exploitation rates of Grays River Hatchery fall Chinook, coho, and winter steelhead were likely similar to wild fish. However, in recent years, regulations for wild fish release have been in place for coho and steelhead fisheries. All hatchery coho and steelhead are adipose fin-clipped to provide for selective fisheries. Therefore, recent commercial and recreational exploitation rates are higher for Grays River Hatchery coho and winter steelhead than for wild fish.

Passage—The Grays River Hatchery adult collection facility consists of a ladder system; coho salmon collected for broodstock enter the ladder volitionally. Chum salmon for the hatchery program either volunteer into the hatchery adjacent to a temporary weir or are seined from the mainstem and West Fork Grays River from early November to December and transferred to the Grays River Hatchery.

Supplementation— Since 1998, the Grays River Hatchery program goal has been to produce Grays River stock chum to augment and reduce extinction risks to naturally spawning Grays River chum; the hatchery program occurs in conjunction with habitat restoration efforts in the Grays River basin. Recent releases of chum salmon are the largest on record and returning hatchery fish exceeding broodstock needs are allowed to spawn naturally. The fall Chinook hatchery program has been discontinued and the coho program has been reduced to the release of 150,000 smolts annually; this program is not intended for supplementation. Winter steelhead hatchery releases have been from out-of-basin sources and contribute very little to natural spawning; the winter steelhead hatchery program goal provides tributary recreational fishing opportunity rather than supplementation.

Hatchery Program Assessment: The evaluation of hatchery programs and implementation of hatchery reform in the Lower Columbia is occurring through several processes. These include: 1) the LCFRB recovery planning process; 2) Hatchery Genetic Management Plan (HGMP) preparation for ESA permitting; 3) FERC related plans on the Cowlitz River and Lewis River; 4) the federally mandated Artificial Production Review and Evaluation (APRE) process, and 5) the congressionally mandated, Hatchery Scientific Review Group (HSRG) review of all state, tribal and federal hatchery programs in Puget Sound and Coastal Washington, and in the Columbia River Basin. 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 completed a Benefit-Risk Assessment Procedure (BRAP) in 2004 to provide a framework for considerations of hatchery reforms consistent with the Recovery Plan. 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. A policy framework assesses population status of wild populations, develops risk tolerance profiles for all stock conditions, and assign risk tolerance profiles to all stocks. A risk assessment characterizes risk assessments for each hatchery program and identifies appropriate management actions to reduce risk.

Table C-6 identifies hazards levels associated with risks involved with hatchery programs in the Grays River / Columbia Estuary Tributaries Basins.

Table C-7 identifies preliminary strategies proposed to address risks identified in the BRAP for the same populations. The BRAP risk assessments and strategies to reduce risk have been key in providing the biological context to develop the hatchery recovery measures for lower Columbia River sub-basins.

Table C-6. Preliminary BRAP for hatchery programs affecting populations in the Grays River / Columbia Estuary Tributaries Basins.

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

Grays/Chinook Population	Hatchery Program: Name	Release (millions)	Genetic: Effective Population Size	Genetic: Domestication	Genetic: Diversity	Ecological: Predation	Ecological: Competition	Ecological: Disease	Demographic: Survival Rate	Demographic: Reproductive Success	Facility: Catastrophic Loss	Facility: Passage	Facility: Screening	Facility: Water Quality
Fall Chinook	Sea Resources Fall Chinook	0.041	○	○	○	○	?	○	○	?	○	○	○	○
	Deep Net Pens Sp. Chinook 1+	0.330	▒	▒	▒	?	?	○	▒	▒	▒	○	○	○
	Grays Coho 1+	0.150	▒	▒	▒	?	?	○	▒	▒	▒	○	○	○
	Deep Net Pens Coho 1+	0.200	▒	▒	▒	?	?	○	▒	▒	▒	○	○	○
	Grays Winter Steelhead 1+	0.040	▒	▒	▒	?	?	○	▒	▒	▒	○	○	○
	Grays Chum	0.150	▒	▒	▒	○	○	○	▒	▒	▒	○	○	○
	Chinook Chum	0.050	▒	▒	▒	○	○	○	▒	▒	▒	○	○	○
Winter Steelhead	Sea Resources Fall Chinook	0.041	▒	▒	▒	?	?	○	▒	▒	▒	○	○	○
	Deep Net Pens Sp. Chinook 1+	0.330	▒	▒	▒	?	?	○	▒	▒	▒	○	○	○
	Grays Coho 1+	0.150	▒	▒	▒	?	?	○	▒	▒	▒	○	○	○
	Deep Net Pens Coho 1+	0.200	▒	▒	▒	?	?	○	▒	▒	▒	○	○	○
	Grays Winter Steelhead 1+	0.040	○	○	?	?	?	○	▒	▒	▒	○	○	○
	Grays Chum	0.150	▒	▒	▒	○	○	○	▒	▒	▒	○	○	○
	Chinook Chum	0.050	▒	▒	▒	○	○	○	▒	▒	▒	○	○	○
Chum	Sea Resources Fall Chinook	0.041	▒	▒	▒	?	○	○	▒	▒	▒	○	○	○
	Deep Net Pens Sp. Chinook 1+	0.330	▒	▒	▒	?	○	○	▒	▒	▒	○	○	○
	Grays Coho 1+	0.150	▒	▒	▒	?	○	○	▒	▒	▒	○	○	○
	Deep Net Pens Coho 1+	0.200	▒	▒	▒	?	○	○	▒	▒	▒	○	○	○
	Grays Winter Steelhead 1+	0.040	▒	▒	▒	?	○	○	▒	▒	▒	○	○	○
	Grays Chum	0.150	○	○	○	○	○	○	○	?	○	○	○	○
	Chinook Chum	0.050	○	○	○	○	○	○	○	?	○	○	○	○

Table C-7. Preliminary strategies proposed to address risks identified in the BRAP for Grays River / Columbia Estuary Tributaries Basins populations.

Grays/Chinook Population	Hatchery Program: Name	Release (millions)	Address Genetic Risks: Mating Procedure	Address Genetic Risks: Integrated Program	Address Genetic Risks: Segregated Program	Address Genetic Risks: Research/ Monitoring	Address Genetic Risks: Broodstock Source	Address Ecological Risks: Number Released	Address Ecological Risks: Release Procedure	Address Ecological Risks: Disease Containment	Address Ecological Risks: Research/ Monitoring	Address Demographic Risks: Culture Procedure	Address Demographic Risks: Research/ Monitoring	Address Facility Risks: Reliability	Address Facility Risks: Improve Passage	Address Facility Risks: Improve Screening	Address Facility Risks: Pollution Abateme
Fall Chinook	Sea Resources Fall Chinook	0.041	▒	▒	▒	▒	▒										
	Deep Net Pens Sp. Chinook 1+	0.330	▒	▒	▒	▒	▒				●	▒	▒				
	Grays Coho 1+	0.150	▒	▒	▒	▒	▒	●	●		●	▒	▒				
	Deep Net Pens Coho 1+	0.200	▒	▒	▒	▒	▒					▒	▒				
	Grays Winter Steelhead 1+	0.040	▒	▒	▒	▒	▒	●	●		●	▒	▒				
	Grays Chum	0.150	▒	▒	▒	▒	▒					▒	▒				
	Chinook Chum	0.050	▒	▒	▒	▒	▒					▒	▒				

The regional Hatchery Scientific Review Group (HSRG) completed an assessment of lower Columbia River hatcheries in 2009 (http://www.hatcheryreform.us/mfs/welcome_show.action). The HSRG is the independent scientific review panel of the Pacific Northwest Hatchery Reform Project established by Congress in 2000 in recognition that while hatcheries play a legitimate role in meeting harvest and conservation goals for Pacific Northwest salmon and steelhead, the hatchery system was in need of comprehensive reform. The HSRG has reviewed all state, tribal and federal hatchery programs in Puget Sound, Coastal Washington, and the Columbia River Basin. The HSRG concluded that hatcheries play an important role in the management of salmon and steelhead populations in the Columbia River Basin but that hatchery programs must be viewed not as surrogates or replacements for lost habitat, but as tools that can be managed as part of a coordinated strategy to meet watershed or regional resource goals, in concert with actions affecting habitat, harvest rates, water allocation and other important components of the human environment. The HSRG reached several critical, overarching conclusions regarding areas where current hatchery and harvest practices need to be reformed. Recommendation included:

- Manage hatchery broodstocks to achieve proper genetic integration with, or segregation from, natural populations;
- Promote of local adaptation of natural and hatchery populations;
- Minimize adverse ecological interactions between hatchery- and natural-origin fish;
- Minimize effects of hatchery facilities on the ecosystem in which they operate; and
- Maximize the survival of hatchery fish.

The HSRG developed a series of criteria for evaluating hatchery influence on wild populations based on Population Viability objectives identified in the Recovery Plan. Criteria are based on the proportion of effective hatchery-origin spawners (pHOS), the proportion of natural-origin adults in the broodstock (pNOB), and the proportionate natural influences (PNI) which is a product of pHOS and pNOB.

For Primary populations:

- pHOS should be less than 5% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, pNOB should exceed pHOS by at least a factor of two, corresponding to a PNI (proportionate natural influence) value of 0.67 or greater and pHOS should be less than 0.30.

For Contributing populations:

- The proportion of effective hatchery-origin spawners (pHOS) should be less than 10% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, pNOB should exceed pHOS, corresponding to a PNI value of 0.50 or greater and pHOS should be less than 0.30.

For Stabilizing populations:

- The current operating conditions were considered adequate to meet conservation goals. No criteria were developed for proportion of effective hatchery-origin spawners (pHOS) or PNI.

Evaluations of current hatchery programs relative to population recovery objectives and hatchery criteria led the HSRG to provide detailed recommendations for reform of specific hatchery programs for each species and programs. General recommendations are summarized below for each species. More specific recommendations for each hatchery program are detailed, along with analyses of alternatives, in the HSRG report (http://www.hatcheryreform.us/mfs/welcome_show.action). These recommendations inform the hatchery actions identified for this subbasin and hatchery reform implementation planning reflected in WDFW's Conservation and Sustainable Fisheries plans under current development.

For Chinook, the HSRG concluded that a major concern with these programs is the effect hatchery strays have on the long-term fitness of naturally spawning populations. Although programs provide significant harvest benefits, and in some cases, help preserve genetic resources in the ESU, there are many poorly segregated and poorly integrated programs. HSRG recommendations for Chinook hatchery reform included:

- In segregated programs, improve the ability to control hatchery fish on the spawning grounds so that harvest benefits can be maintained while improving natural-origin spawning abundance and productivity for instance, by installing weirs in specific drainages where straying limits the ability to meet conservation goals.
- Move production from some tributaries into larger segregated harvest programs in Select Area Fishery Evaluation areas, where excess hatchery fish can be removed by applying higher harvest rates.
- Reduce reliance of some programs on imported out-of-basin broodstock or rearing to improve homing and increase productivity.
- For integrated programs, increase the proportion of natural-origin fish used in hatchery broodstock and control the contribution of hatchery-origin fish to natural spawning areas. In some cases, meeting the criteria for the population designation requires reducing program size.

For coho, the HSRG concluded that a major concern with these programs is the effect hatchery strays have on the long-term fitness of naturally spawning populations. These programs provide significant harvest benefits, and in some cases, help preserve genetic resources in the ESU. However, the ESU is dominated by many poorly segregated and a few poorly integrated programs. HSRG recommendations for coho hatchery reform included:

- In segregated programs, improve the ability to control hatchery fish on the spawning grounds so that harvest benefits can be maintained while improving natural-origin spawning abundance and productivity for instance, by installing weirs in specific drainages where straying limits the ability to meet conservation goals.
- Move production from some tributaries into larger segregated harvest programs in Select Area Fishery Evaluation areas, where excess hatchery fish can be removed by applying higher harvest rates.
- For integrated programs, increase the proportion of natural-origin fish used in hatchery broodstock and control the contribution of hatchery-origin fish to natural spawning areas. In some cases, meeting the criteria for the population designation requires reducing program size.
- In some cases, harvest benefits could be maintained and conservation improved by developing highly integrated conservation programs with associated segregated harvest programs (stepping-stone programs).
- More emphasis on monitoring and evaluation programs to accurately estimate straying is also recommended.

For chum, the HSRG concluded that hatchery intervention can reduce demographic risk by boosting abundance and additional conservation propagation programs should be promptly initiated within each of the ESU's three geographic strata to reduce this risk. The HSRG had no recommendations to improve on single existing chum program (Grays River) and recommends its continued operation as an important safety net in the lower Columbia.

For steelhead, the HSRG concluded that all populations in this DPS meet or exceed the HSRG criteria for their population designation. No recommendations to change programs were made by the HSRG. However, due to uncertainty about the number of unharvested hatchery-origin fish from segregated programs that remain in the natural environment, the HSRG identified a need for additional monitoring to further clarify these values and to aid in assessing the ecological impacts to the natural populations.

Subbasin Specific Recommendations: The HSRG provided subbasin and population specific advice. For the Grays River, the following recommendations were made:

Grays River – Fall Chinook

The HSRG noted that every possible step be taken to achieve the abundance goal for this population and recommends:

- To sustain the population, uniquely tag, but not adipose clip, fish to avoid selective harvest
- Install a lower river weir to effectively remove strays and collect broodstock
- Update and protect the hatchery water supply

Grays River – Coho

- Mark, with adipose fin-clip, all hatchery-origin fish
- Control the proportion of fish on the spawning grounds at the hatchery intake weir
- Update the water intake weir to better control fish access and to protect the hatchery water supply
- Develop an integrated harvest program for the native component
- Eliminate the use of Grays River hatchery to support the Deep River net pen program

Grays River – Chum

The HSRG noted that broodstock from Grays River could be used to start populations elsewhere. If a best integrated program is adopted, it would still meet the criteria of a Primary population, although releases would need to be reduced by 50%. The HSRG recommends:

- Mark hatchery origin fish, allow them to spawn naturally but monitor them
- Consider using Grays River as a source hatchery for chum salmon conservation programs in the Chinook, MAG and/or Elochoman rivers
- Include a "sunset" clause that would suspend the hatchery program after 3 generations or unless evidence suggests otherwise

Grays River – Winter Steelhead

- Consider establishing a "Wild Steelhead Management Zone" within the Grays River Basin
- Consider the ecological effects of the program on the population. Outplants do not appear to be having a genetic effect, however the HSRG urges caution.
- Consideration should be given to converting this segregated program to an integrated program, which could provide harvest opportunities.

Impacts: Impacts of hatchery fish on local wild populations are estimated in this plan, for the purposes of comparison with the relative magnitude of other factors, based on hatchery fractions and assumed fitness effects estimated by the HSRG. Detailed explanations of these impact estimates may be found in Volume I, Chapter 3 of this Recovery Plan.

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, these effects can result in fewer spawners and can alter age, size, run timing, fecundity, and genetic characteristics. Fewer spawners result in fewer eggs for future generations and diminish marine-derived nutrients delivered via dying adults, now known to be significant to the growth and survival of juvenile salmon in aquatic ecosystems. The degree to which harvest-related limiting factors influence productivity varies by species and location.

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

At the time of interim plan completion, fishing impact rates on lower Columbia River naturally-spawning salmon populations ranges from 2.5% for chum salmon to 45% for tule fall Chinook (Table C-8). These rates include estimates of direct harvest mortality as well as estimates of incidental mortality in catch and release fisheries. Fishery impact rates for hatchery produced spring Chinook, coho, and steelhead are higher than for naturally-spawning fish of the same species because of selective fishing regulations. These rates generally reflect recent year (2001-2003) fishery regulations and quotas controlled by weak stock impact limits and annual abundance of healthy targeted fish. Actual harvest rates will vary for each year dependent on annual stock status of multiple west coast salmon populations, however, these rates generally reflect expected impacts of harvest on lower Columbia naturally-spawning and hatchery salmon and steelhead under current harvest management plans.

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

Table C-8. Approximate annual exploitation rates (% harvested) for naturally-spawning lower Columbia salmon and steelhead under current management controls (represents 2001-2003 fishing period).

	AK./Can. Ocean	West Coast Ocean	Col. R. Comm.	Col. R. Sport	Trib. Sport	Wild Total	Hatchery Total	Historic Highs
Spring Chinook	13	5	1	1	2	**22**	53	65
Fall Chinook (Tule)	15	15	5	5	5	**45**	45	80
Fall Chinook (Bright)	19	3	6	2	10	**40**	Na	65
Chum	0	0	1.5	0	1	**2.5**	2.5	60
Coho	<1	9	6	2	1	**18**	51	85
Steelhead	0	<1	3	0.5	5	**8.5**	70	75

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 Grays/Chinook River sport fisheries. Chum are impacted incidental to fisheries directed at coho and winter steelhead.

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

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.

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 Grays populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook which rear for extended periods in the mainstem and estuary than for steelhead and coho which move through more quickly. Estimates of the impacts of human-caused changes in mainstem and estuary habitat conditions are available based on changes in river flow, temperature, and predation as represented by EDT analyses for the

NPCC Multispecies Framework Approach (Marcot et al. 2002). These estimates generally translate into a 10-60% reduction in salmonid productivity depending on species (Appendix E). Estuary effects are described more fully in the estuary subbasin volume of this Plan (Volume II-A).

Hydropower Construction and Operation

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

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

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 alteration. Effects of non-native species on salmon, effects of salmon on system productivity, and effects of native predators on salmon are difficult to quantify. Strong evidence exists in the scientific literature on the potential for significant interactions but effects are often context- or case-specific.

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

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 are 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 Volume I.

Summary of Human Impacts on Salmon and Steelhead

Stream habitat, estuary/mainstem habitat, harvest, hatchery and ecological interactions have all contributed to reductions in productivity, numbers, and population viability. Pie charts in Figure C-18 describe the relative magnitude of potentially-manageable human impacts in each category of limiting factor for Grays Basin salmon and steelhead. Impact values were developed for a base period corresponding to species listing dates. This depiction is useful for identifying which factors are most significant for each species and where improvements might be expected to provide substantial benefits. Larger pie slices indicate greater significance and scope for improvement in an impact for a given species. These numbers also serve as a working hypothesis for factors limiting salmonid numbers and viability.

This assessment indicates that current salmonid status is the result of large impacts distributed among several factors. No single factor accounts for a majority of effects on all species. Thus, substantial improvements in salmonid numbers and viability will require significant improvements in several factors. Loss of tributary habitat quality and quantity accounts for the largest relative impact on all species except for fall Chinook. Loss of estuary habitat quality and quantity is also relatively important for all species. Fishing harvest has the greatest effect on fall Chinook and coho, but is relatively minor for chum and winter steelhead. Hatchery impacts are moderate for fall Chinook and coho, and relatively low for chum. The main threats of the hatchery program are ecological interactions between potential such as the potential domestication of natural salmon by interbreeding with Grays River Hatchery and Deep River Net Pen salmon. Predation impacts are relatively moderate for all species except for winter steelhead for which they are significant. No dams are operated in the subbasin and hydrosystem impacts are relatively minor and limited to habitat effects in the Columbia River mainstem and estuary.

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

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

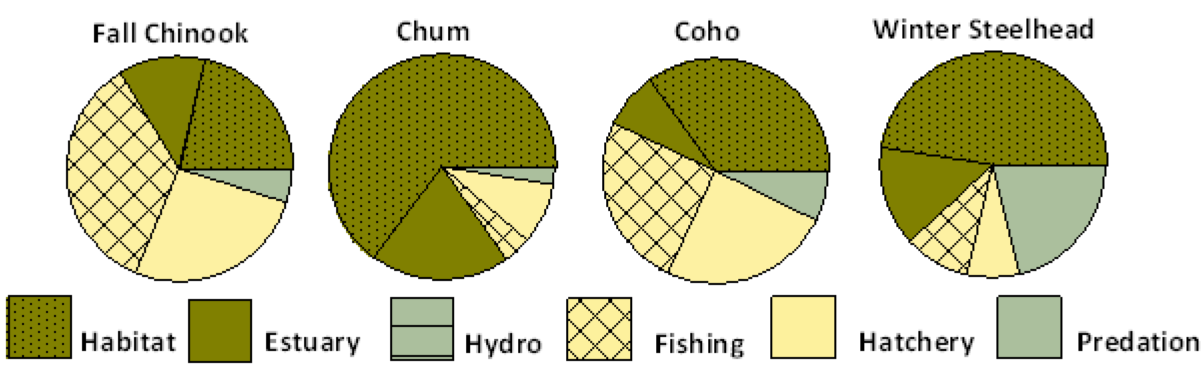


Figure C-18. Relative contribution of potentially manageable impacts on Grays River salmonid populations.

C.4. 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).

C.4.1. Federal Programs

NMFS

NMFS 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. NMFS administers the ESA under Section 4 (listing requirements), Section 7 (federal actions), and Section 10 (non-federal actions).

U.S. 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.

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.

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.

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.

C.4.2. State Programs

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.

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).

Washington Department of Ecology

The Department of Ecology (Ecology) 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 USACE Permits.

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.

Washington Recreation and Conservation Office

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 RCO, provides funding assistance for a broad range of land protection, park development, preservation/conservation, and outdoor recreation facilities.

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.

C.4.3. Local Government Programs

Wahkiakum County

Wahkiakum County is not planning under the State's Growth Management Act in its Comprehensive Planning process. Wahkiakum County manages natural resources primarily through its Critical Areas Ordinance.

Pacific County

Pacific County has been conducting Comprehensive Planning under the State's Growth Management Act since 1998. Pacific County manages natural resources primarily through its Critical Areas Ordinance.

Cowlitz / Wahkiakum Conservation District

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

Pacific Conservation District

Pacific Conservation District provides technical assistance, cost-share assistance, and resource monitoring in Pacific County. Pacific CD assists agricultural landowners in the development of farm plans and in the participation in the Conservation Reserve Enhancement Program.

C.4.4. Non-governmental Programs

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.

Columbia River Estuary Study Taskforce

The Columbia River Estuary Study Taskforce (CREST) is a council of local governments. CREST developed the Columbia River Estuary Regional Management Plan, which was adopted in local comprehensive plans and shoreline master programs. This plan contains an inventory of physical, biological and cultural characteristics of the estuary. Based on data needs identified during the development of the plan, Congress authorized and funded the Columbia River Estuary Data Development Program (CREDDP). This program provided a wealth of information that is still used by the local governments and by state and federal agencies in resource planning.

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.

C.4.5. Tribal Programs

Cowlitz Indian Tribe

The Cowlitz Indian Tribe's Natural Resources program participates in research and restoration efforts in the lower Columbia region. The focus of their fish research and restoration efforts includes salmon, steelhead, eulachon, and lamprey.

C.4.6. NPCC Fish & Wildlife Program Projects

This program project was funded to conduct a watershed and biological assessment of the Grays River watershed to protect and restore chum spawning habitat (Project 200301300).

C.4.7. Washington Salmon Recovery Funding Board Projects

Type	Project Name	Subbasin
Preservation	L. Columbia River Estuary-Grays River Phase 4	Grays/Chinook
Preservation/Restoration	Grays River Estuary Phase 2 Devils Elbow	Grays/Chinook
Preservation	Columbia Estuary: Grays Bay Phase III	Grays/Chinook
Restoration	Lower Columbia River Estuary: Chinook	Grays/Chinook
Restoration	Grays River Estuary Phase 2	Grays/Chinook
Restoration	Chinook River Estuary	Grays/Chinook
Restoration	Columbia Estuary: Deep River	Grays/Chinook
	Lower Columbia River Estuary Grays River	Grays/Chinook
Preservation/Restoration	Lower Columbia River Estuary Grays River – Seal Slough	Grays/Chinook
Restoration	Grays River PUD Bar	Grays/Chinook
Restoration	Grays River LWD Habitat Complexing	Grays/Chinook
Preservation	Crazy Johnson Acquisition	Grays/Chinook
Restoration	Grays River – Mill Road Floodplain Restoration	Grays/Chinook

C.5. Management Plan

C.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; and

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 Grays Subbasin will play a key role in the regional recovery of salmon and steelhead. Natural populations of fall Chinook, winter steelhead, chum, and coho will be restored to medium 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 harvestable surpluses of healthy wild stocks.

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

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

C.5.2. Biological Objectives

Biological objectives for Grays subbasin salmonid populations are based on recovery criteria developed by scientists on the Willamette/Lower Columbia Technical Recovery Team convened by NMFS. 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 Volume I.

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

The Grays subbasin was identified as one of the most significant areas for salmon recovery among Washington coastal subbasins based on fish population significance and realistic prospects for restoration. Recovery goals call for restoring coho and winter steelhead to a high level of viability and chum to a very high level of viability. This level will provide for a 95% and 99% or better probability of population survival over 100 years respectively. Fall Chinook recovery goals are for a medium level of viability which will provide a 75 – 94% or better probability of population survival over 100 years. Cutthroat will benefit from improvements in stream habitat conditions for anadromous species. Lamprey are also expected to benefit from habitat improvements in the estuary, Columbia River mainstem, and Grays subbasin although specific spawning and rearing habitat requirements are not well known. Bull trout do not occur in the subbasin.

C.5.3. Integrated Strategy

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

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

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

Improvement targets were developed for each impact factor based on desired population productivity improvements and estimates of potentially manageable impacts (see Chapter 3). Impacts are estimates of the proportional reduction in population productivity associated with human-caused and other potentially manageable impacts from stream habitats, estuary/mainstem habitats, hydropower, harvest, hatcheries, and selected predators. Reduction targets were driven by the regional strategy of equitably allocating recovery responsibilities among the six manageable impact factors. Given the ultimate uncertainty in the effects of recovery actions and the need to implement an adaptive recovery program, this approximation should be adequate for developing order-of-magnitude estimates to which recovery actions can be scaled consistent with the current best available science and data. Objectives and targets will need to be confirmed or refined during plan implementation based on new information and refinements in methodology.

The following table identifies population and factor-specific improvements consistent with the biological objectives for this subbasin. Per factor increments are less than the population net because factor affects are compounded at different life stages and density dependence is largely limited to freshwater tributary habitat. For example, productivity of Grays River fall Chinook must increase by 190% to reach population viability goals. This requires impact reductions equivalent to a 40% improvement in productivity or survival for each of six factor categories. Thus, tributary habitat impacts on fall Chinook must decrease from a 40% to a 24% impact in order to achieve the required 40% increase in tributary habitat from the current 60% of the historical potential to 86% of the historical potential.

Table C-9. Productivity improvements consistent with biological objectives for the Grays subbasin.

	Net	Per	Baseline impacts					
Species	increase	factor	Trib.	Estuary	Hydro.	Pred.	Harvest	Hatch.
Fall Chinook	500%	61%	0.40	0.23	0.00	0.09	0.65	0.50
Winter steelhead	0%	0%[1]	0.50	0.15	0.00	0.20	0.10	0.08
Chum	0%	0%[1]	0.80	0.25	0.00	0.03	0.05	0.11
Coho	370%	56%	0.70	0.16	0.00	0.14	0.50	0.50

[1] Improvement increments are based on abundance and productivity, however, this population will require improvements in spatial structure or diversity to meet recovery objectives.

C.5.4. Tributary Habitat

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

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

Priority areas, limiting factors and threats were used to develop a prioritized suite of habitat measures. Measures are based solely on biological and physical conditions. For each measure, the key programs that address the measure are identified and the sufficiency of existing programs to satisfy the measure is discussed. The measures, in conjunction with the program sufficiency considerations, were then used to identify specific actions necessary to fill gaps in measure implementation. Actions differ from measures in that they address program deficiencies as well as biophysical habitat conditions. The process for developing measures and actions is illustrated in Figure C-19 and each component is presented in detail in the sections that follow.

Priority Areas, Limiting Factors and Threats

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

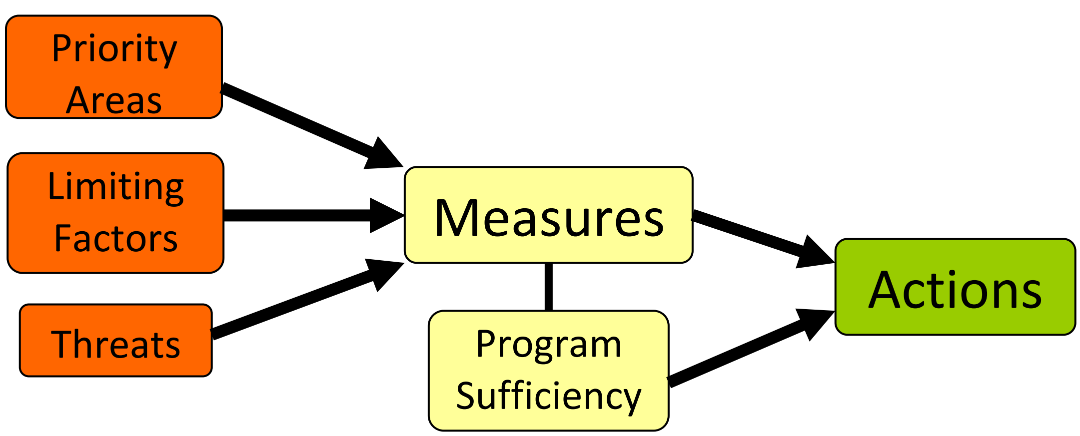


Figure C-19. Flow chart illustrating the development of subbasin measures and actions.

Summary: Decades of human activity in the Grays River Subbasin have significantly altered watershed processes and reduced both the quality and quantity of habitat needed to sustain viable populations of salmon and steelhead. Moreover stream habitat conditions within the Grays Subbasin have a high impact on the health and viability of salmon and steelhead relative to other limiting factors. The following bullets provide a brief overview of each of the priority areas in the basin. These descriptions are a summary of the reach-scale priorities that are presented in the next section. These descriptions summarize the species most affected, the primary limiting factors, the contributing land-use threats, and the general type of measures that will be necessary for recovery. A tabular summary of the key limiting factors and land-use threats can be found in Table C-10.

- **Middle mainstem & tributaries** *(reaches Grays 1F-3; Thadbar Cr lower; King Cr lower; Klints Cr lower; Fossil Cr lower; Gorley Cr 1; Crazy Johnson)* **–** Chum, coho, and fall Chinook are most impacted by conditions within the middle mainstem and the lower portion of middle mainstem tributaries (i.e., Fossil Creek, Crazy Johnson Channel). Agricultural uses dominate the riparian areas and floodplains of these reaches, with forestry activities as the primary use on the surrounding hillslopes. The channel has been altered significantly due to past splash-damming, channel straightening, streambank hardening, and more recent flood control activities. Effective recovery measures in these areas will entail restoring riparian areas, re-connecting floodplains, and addressing sites where mass wasting has contributed to large sediment loads and turbidity problems.
- **Headwaters, SF Grays, EF Grays, and WF Grays** *(reaches Grays 3B-4C; Grays LF; Grays RF; Beaver Cr; EF Grays 1, 3-4, 6; SF Grays 1-3; Blaney Cr 1: WF Grays 1-4) –* The mainstem headwaters, EF Grays River, SF Grays River, and WF Grays River primarily support winter steelhead spawning and rearing. These reaches have been impacted most by recent and historical forest practices (including splash dam logging), which have disrupted riparian function, hydrology, and sediment supply processes. Effective recovery measures will involve the passive restoration of mature riparian and hillslope forests as well as the restoration of sediment supply conditions through addressing the basin-wide road network and mass wasting sites in the stream corridor.

Table C-10. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the middle mainstem & tributaries (MM), headwaters/EF Grays (HW), South Fork Grays (SF), and West Fork Grays (WF). Limiting factors are the biophysical conditions directly impacting aquatic species; threats are the land-use conditions contributing to the limiting factors. Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors	MM	HW	SF	WF
Habitat connectivity				
Blockages to off-channel habitats	✓			
Habitat diversity				
Lack of stable instream woody debris	✓	✓	✓	✓
Altered habitat unit composition	✓	✓	✓	✓
Loss of off-channel and/or side-channel habitats	✓			
Channel stability				
Bed and bank erosion	✓	✓	✓	✓
Channel down-cutting (incision)	✓		✓	
Mass wasting		✓	✓	
Riparian function				
Reduced stream canopy cover	✓	✓	✓	✓
Reduced bank/soil stability	✓	✓	✓	✓
Exotic and/or noxious species	✓			
Reduced wood recruitment	✓	✓	✓	✓
Floodplain function				
Altered nutrient exchange processes	✓			
Reduced flood flow dampening	✓			
Restricted channel migration	✓			
Disrupted hyporheic processes	✓			
Stream flow				
Altered magnitude, duration, or rate of change	✓	✓	✓	✓
Water quality				
Altered stream temperature regime	✓	✓	✓	✓
Excessive turbidity	✓		✓	✓
Bacteria	✓			
Substrate and sediment				
Excessive fine sediment	✓	✓	✓	✓
Embedded substrates	✓	✓	✓	✓

Threats	MM	HW	SF	WF
Agriculture / grazing				
Clearing of vegetation	✓			
Riparian grazing	✓			
Floodplain filling	✓			
Forest practices				
Timber harvests –sediment supply	✓	✓	✓	✓
Timber harvests – impacts to runoff	✓	✓	✓	✓
Riparian harvests (historical)		✓	✓	✓
Forest roads – sediment supply	✓	✓	✓	✓
Forest roads – runoff	✓	✓	✓	✓
Forest roads – riparian/floodplain		✓		
Splash-dam logging (historical)	✓	✓	✓	
Channel manipulations				
Bank hardening	✓			
Channel straightening	✓			
Artificial confinement	✓			
Dredge and fill activities	✓			

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

Spatial priorities were also identified at the subwatershed scale. Subwatershed-scale priorities were directly determined by reach-scale priorities, such that a Group A subwatershed contains one or more Tier 1 reaches. Scaling up from reaches to the subwatershed level was done in recognition that actions to protect and restore critical reaches might need to occur in adjacent and/or upstream upland areas. For example, high sediment loads in a Tier 1 reach may originate in an upstream contributing subwatershed where sediment supply conditions are impaired because of current land use practices. Subwatershed-scale priorities can be used in conjunction with the IWA to identify watershed process restoration and preservation opportunities. The specific rules for designating reach tiers and subwatershed groups are presented in Table C-11. A tabular summary of reach tiers is included in Table C-12. Reach tiers and subwatershed groups are displayed on a map in Figure C-20.

Table C-11. Rules for designating reach tier and subwatershed group priorities. See Biological Objectives section for information on population designations.

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

Table C-12. Reach Tiers in the Grays River Subbasin

Tier 1	Tier 2	Tier 4	
Crazy Johnson Cr	EF Grays 3	Alder Cr	Hull Cr 2
EF Grays 1	Grays 1H tidal	Beaver Cr	Impie Cr 1 (Lower)
EF Grays 2	Grays 3A	Blaney Cr 1	Impie Cr 2
Fossil Cr 1	Grays 4	Blaney Cr 2	Johnson Cr 1
Grays 2	Grays 4A	Blaney Cr LB Trib	Kessel Cr 1 (Lower)
Grays 2A	Grays 4B	Cabin Cr	Kessel Cr 2
Grays 2B	King Cr	EF Grays 4	Klints Cr 2
Grays 2C	LF Headwaters 1	EF Grays 5	LF Headwaters 2
Grays 2D	Mainstem LB trib 1	EF Grays 6	LF Hull Cr 1
Grays 3	Nikka Cr 1 (Lower)	EF Grays LB Trib 1A	Mainstem LB trib 2
Grays 3B	SF Grays 3	EF Grays LB Trib 2	Mainstem LB Trib 3
Klints Cr 1	Thadbar Cr 1	EF Grays RB Trib 1	Malone Cr 1 (Lower)
SF Grays 1	WF Grays 1A	EF Grays RB Trib 2	Malone Cr 2
SF Grays 2	WF Grays 1B	Estuary tidal	Mitchell Cr
WF Grays 3	WF Grays 2	Fossil Cr 2	Nikka Cr 2
		Grays 1 tidal	RF Headwaters
		Grays 1B tidal	RF Hull Cr
		Grays 1C tidal	Seal Cr 1
		Grays 1D tidal	Seal Slough 1A
		Grays 1E tidal	Seal Slough 1B
		Grays 1F tidal	Seal Slough 2
		Grays 1G tidal	SF Grays LB Trib
		Grays 3C	Shannon Cr
		Grays 4C	Sweigiler Cr 1
		Headwaters 1	Thadbar Cr 2
		Honey Cr	WF Grays 4A
		Hull Cr 1A	WF Grays 4B
		Hull Cr 1B	WF Grays 5
			WF Grays RB Trib

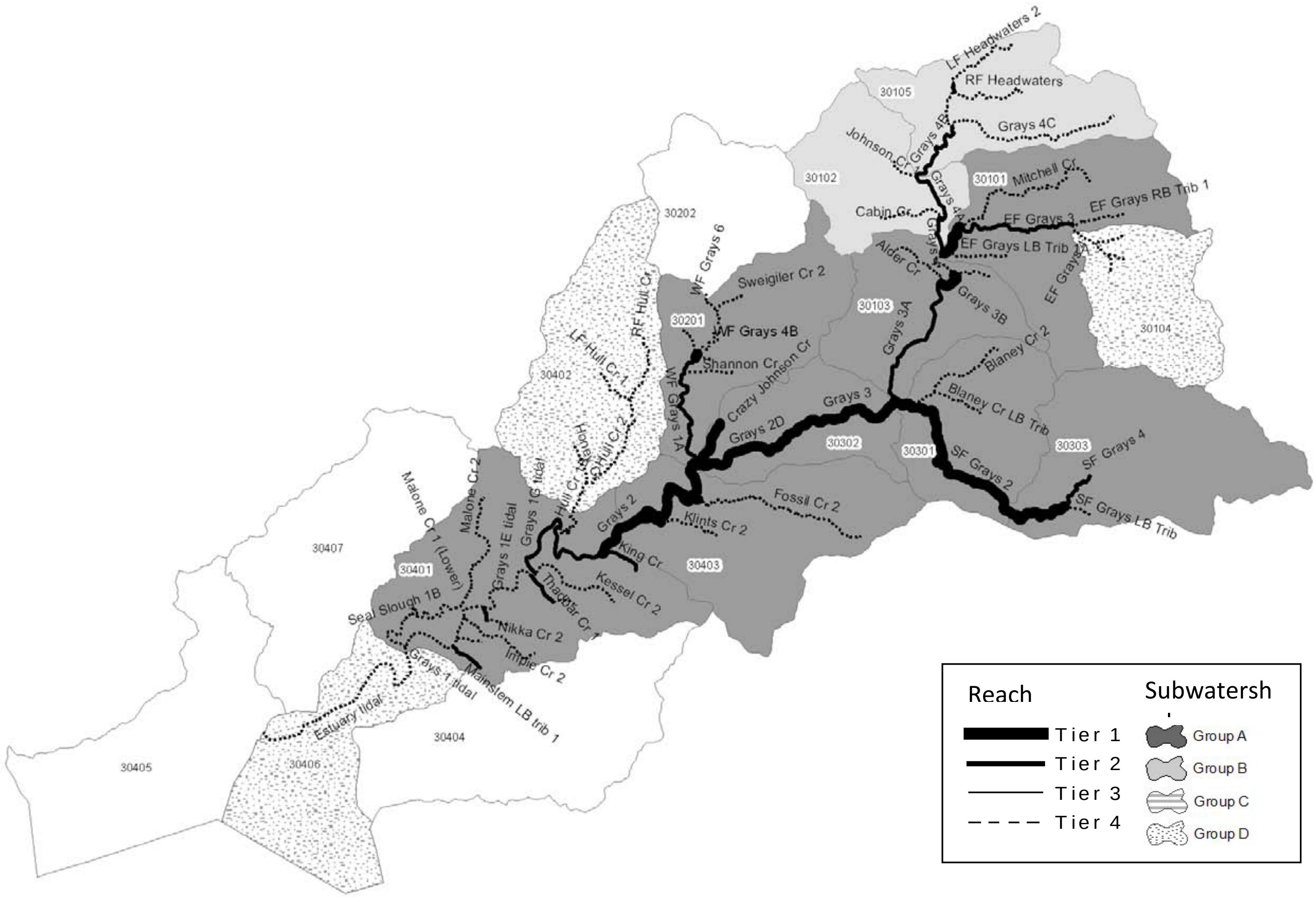


Figure C-20. Reach tiers and subwatershed groups in the Grays Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities at the reach scale are useful for identifying stream corridor recovery measures. Priorities at the subwatershed scale are useful for identifying watershed process recovery measures. Watershed process recovery measures for stream reaches will need to occur within the surrounding (local) subwatershed as well as in upstream contributing subwatersheds.

Habitat Measures

Measures are means to achieve the regional strategies that are applicable to the Grays Subbasin and necessary to accomplish the biological objectives for focal fish species. Measures are based on the technical assessments for this subbasin (Section 3.0) as well as on the synthesis of priority areas, limiting factors, and threats presented earlier in this section. The measures applicable to the Grays Subbasin are presented in priority order in Table C-13. Each measure has a set of submeasures that define the measure in greater detail and add specificity to the particular circumstances occurring within the subbasin. The table for each measure and associated submeasures indicates the limiting factors that are addressed, the contributing threats that are addressed, the species that would be most affected, and a short discussion. Priority locations are given for some measures. Priority locations typically refer to either stream reaches or subwatersheds, depending on the measure. Addressing measures in the highest priority areas first will provide the greatest opportunity for effectively accomplishing the biological objectives.

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

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

Habitat Actions

The prioritized measures and associated gaps are used to develop specific Actions for the subbasin. These are presented in Table C-14. 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 C-13. Prioritized measures for the Grays Subbasin.

#1 – Protect stream corridor structure and function

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Protect floodplain function and channel migration processes B. Protect riparian function C. Protect access to habitats D. Protect instream flows through management of water withdrawals E. Protect channel structure and stability F. Protect water quality G. Protect the natural stream flow regime	Potentially addresses many limiting factors	Potentially addresses many limiting factors	All Species	The lower mainstem reaches provide critically important habitat that has been heavily impacted by adjacent land-uses and channel modifications. Preventing additional habitat degradation in this area is necessary for population persistence. Stream channels in forest lands have been heavily impacted by forest practices including past riparian harvest and past splash-dam logging.

Priority Locations

1st- Tier 1 or 2 reaches with functional riparian conditions according to the IWA (Reach SF Grays 2 & 3)
2nd- Tier 1 or 2 reaches in agricultural lands at risk of further degradation (Reaches: Mainstem LB trib1; Nikka Cr Lower; Thadbar Creek 1; Grays 1G tidal-1H tidal; Grays 2-2D; Grays 3; Crazy Johnson; Gorley Cr; Fossil Cr 1; Klints Cr 1; King Cr)
3rd- Remaining Tier 1 and 2 reaches
4th- All remaining reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
NMFS	ESA Section 7 and Section 10	✓	
U.S. 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, State Forest Practices, Riparian Easement Program	✓	
WA Department of Fish and Wildlife (WDFW)	Hydraulics Projects Approval	✓	
Wahkiakum County	Comprehensive Planning		✓
Pacific County	Comprehensive Planning		✓
Wahkiakum PUD	Water Program		✓
Cowlitz/Wahkiakum Conservation District / NRCS	Agricultural land habitat protection programs		✓
Noxious Weed Control Boards (State and County)	Noxious Weed Education, Control, Education		✓
Lower Columbia River Estuary Partnership	Collaborative habitat efforts	✓	
Non-Governmental Organizations (NGOs) (e.g. Columbia Land Trust) and public agencies	Land acquisition and easements		✓

Program Sufficiency and Gaps

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

#2 – Protect hillslope processes

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

Priority Locations

1st- Functional subwatersheds plus Moderately Impaired subwatersheds contributing to Tier 1 or 2 reaches (functional or moderately impaired subwatersheds for sediment *or* flow according to the IWA – local rating)
Subwatersheds: 30104, 30303, 30105, 30101, 30301, 30103, 30403, 30302, 30401, 30402, 30406, 30405

2nd- All other Moderately Impaired subwatersheds plus Impaired subwatersheds contributing to Tier 1 or 2 reaches
Subwatersheds: 30202, 30102, 30201, 30404

3rd- All other subwatersheds
Subwatersheds: 30407

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	Forest Practices Rules, State Lands HCP	✓	
Wahkiakum County	Comprehensive Planning		✓
Pacific County	Comprehensive Planning		✓
Cowlitz/Wahkiakum CD / NRCS	Agricultural land habitat protection programs		✓

Program Sufficiency and Gaps

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

#3- Restore degraded hillslope processes on forest and agricultural lands with an emphasis on sediment supply conditions

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Upgrade or remove problem forest roads B. Reforest heavily cut areas not recovering naturally C. Employ agricultural Best Management Practices with respect to contaminant use, erosion, and runoff	• Excessive fine sediment • Excessive turbidity • Embedded substrates • Stream flow – altered magnitude, duration, or rate of change of flows • Water quality impairment	• Timber harvest – impacts to sediment supply, water quality, and runoff processes • Forest roads – impacts to sediment supply, water quality, and runoff processes • Agricultural practices – impacts to sediment supply, water quality, and runoff processes	All species	Hillslope runoff and sediment delivery processes have been degraded due to past intensive timber harvest and road building. According to EDT, the sediment impact to egg incubation is the greatest limiting factor for all species. Sediment supply processes must be addressed for reach-level habitat recovery to be successful.

Priority Locations

1st- Moderately impaired or impaired subwatersheds contributing to Tier 1 reaches (mod. impaired or impaired for sediment *or* flow according to IWA – local rating)
Subwatersheds: 30105, 30101, 30104, 30301, 30303, 30403, 30302, 30103, 30102, 30202, 30402, 30401

2nd- Moderately impaired or impaired subwatersheds contributing to other reaches
Subwatersheds: 30404, 30407, 30406, 30405

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	State Lands HCP, State Forest Practices	✓	
WDFW	Habitat Program	✓	
Wahkiakum County	Stormwater Management		✓
Cowlitz/Wahkiakum Conservation District / NRCS	Agricultural land habitat restoration programs		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓

Program Sufficiency and Gaps

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

#4 - Restore floodplain function and channel migration processes in lowland agricultural areas

Submeasures	Table 1. Factors Addressed	Threats Addressed	Target Species	Discussion
A. Set back, breach, or remove artificial confinement structures	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes • Channel incision • Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats	• Floodplain filling • Channel straightening • Artificial confinement	Chum, fall Chinook, coho	There has been significant degradation of floodplain connectivity and constriction of channel migration zones in the agricultural lowlands in the mainstem and mainstem tributaries downstream of the WF Grays River. Selective breaching, setting back, or removing confining structures would help to restore floodplain and CMZ function as well as facilitate the creation of off-channel and side channel habitats. There are feasibility issues with implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense.

Priority Locations

1st- Tier 1 reaches in mixed-use areas with hydro-modifications (can be obtained from EDT ratings)
2nd- Tier 2 reaches in mixed-use areas with hydro-modifications
3rd- Other reaches with hydro-modifications

Key Programs

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

Program Sufficiency and Gaps

There currently are few programs or policy in place that set forth strategies for restoring floodplain function and channel migration processes in the Grays River Basin. Past projects have largely been opportunistic and have been completed due to the efforts of local NGOs; such projects are likely to continue in a spotty fashion as opportunities arise and only if financing is made available. The level of floodplain and CMZ impairment in the Grays Basin and the importance of these processes to listed fish species put an increased emphasis on restoration. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct projects. Floodplain restoration projects are often expensive, large-scale efforts that require partnerships among many agencies, NGOs, and landowners. Building partnerships is a necessary first step toward floodplain and CMZ restoration. The USACE is conducting a Lower Columbia River Ecosystem Restoration Study which may identify and assess potential floodplain restoration projects in the lower Grays River.

#5 - Restore riparian conditions throughout the basin

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

Priority Locations

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

Key Programs

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

Program Sufficiency and Gaps

There are no regulatory mechanisms for actively restoring riparian conditions; however, existing programs will afford protections that will allow for the *passive* restoration of riparian forests. These protections are believed to be adequate for riparian areas on forest lands that are subject to Forest Practices Rules or the State forest lands HCP. Other lands receive variable levels of protection and passive restoration through the Wahkiakum and Pacific Counties Comprehensive Plans. Many degraded riparian zones in agricultural, rural residential, or transportation corridors 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 livestock exclusion, tree planting, road relocation, invasive species eradication, and adjusting current land-use in the riparian zone. Means of increasing restoration activity include increasing landowner participation through education and incentive programs, requiring activities through permitting and ordinances, and increasing available funding for entities to conduct restoration projects.

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

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Exclude livestock from riparian areas B. Increase riparian shading C. Decrease channel width-to-depth ratios D. Reduce delivery of chemical contaminants to streams E. Address leaking septic systems	• Bacteria • Altered stream temperature regime • Chemical contaminants	• Timber harvest – riparian harvests • Riparian grazing • Leaking septic systems • Clearing of vegetation due to rural development and agriculture • Chemical contaminants from agricultural and developed lands	• All species	There are impairments to stream temperature in the basin. Fecal coliform bacteria, while more of a human health concern than a fish health concern, is also a potential problem in some areas. Degraded riparian canopy cover impacts stream temperatures. Excluding livestock from riparian areas is particularly important in the heavily grazed lowland areas. Leaking septic systems may be contributing to bacteria levels in areas with rural residential development. The degree of impact of agricultural pollutants is unknown and needs further assessment.

Priority Locations

1st- Tier 1 or 2 reaches with 303(d) listings
2nd- Other reaches with 303(d) listings
3rd- All remaining reaches

Key Programs

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

Program Sufficiency and Gaps

Ecology's Water Quality Program manages the State 303(d) list of impaired water bodies. There are a few listed stream segments in the Grays Basin for Temperature and several other stream segments are listed as a concern for temperature and fecal coliform bacteria (WDOE 2004). A Water Quality Clean-up Plan (TMDLs) that addresses the temperature impairments is required by the Ecology and it is anticipated that the TMDL will adequately set forth strategies to address temperature concerns. It will be important that the strategies specified in the TMDLs are implementable and adequately funded. The 303(d) listings are believed to address the primary water quality concerns; however, other impairments may exist that the current monitoring effort is unable to detect. Additional monitoring is needed to fully understand the degree of water quality impairment in the basin, especially regarding agricultural pollutants.

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

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore historical off-channel and side-channel habitats where they have been eliminated B. Create new channel or off-channel habitats (i.e. spawning channels)	• Loss of off-channel and/or side-channel habitat	• Floodplain filling • Channel straightening • Artificial confinement	chum coho	There has been significant loss of off-channel and side-channel habitat in the lower and middle mainstem due primarily to agricultural practices. Targeted restoration or creation of these types of habitats would increase available habitat where full floodplain and CMZ restoration is not possible.

Priority Locations

1st- Lower to middle mainstem and lower reaches of mainstem tributaries (Reaches: Grays 1G tidal – Grays 2D; Fossil Creek 1; Klints Creek 1; Crazy Johnson Creek)
2nd- Other reaches that have potential for off-channel habitat restoration or creation

Key Programs

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

Program Sufficiency and Gaps

There are no regulatory mechanisms for creating or restoring off-channel habitat. Past restoration efforts have been conducted by NGOs and government agencies where opportunities have arisen. Two projects in the Grays Basin include Gorley Creek and Crazy Johnson Creek, which are constructed channels designed to provide quality chum spawning habitat. Means of increasing the occurrence of these types of projects include increasing landowner incentives, allowing projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects.

#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	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, particularly in the alluvial reaches downstream of the canyon where channel aggradation combined with flood protection activities have de-stabilized the channel.

Priority Locations

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

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
WDFW	Habitat Program		✓
USACE	Water Resources Development Act (Sect. 1135 & Sect. 206)		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Cowlitz/Wahkiakum Conservation District / NRCS	Agricultural land habitat restoration programs		✓

Program Sufficiency and Gaps

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

#9 – Provide for adequate instream flows during critical periods

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Protect instream flows through water rights closures and enforcement B. Restore instream flows through acquisition of existing water rights C. Restore instream flows through implementation of water conservation measures	• Stream flow – maintain or improve flows in tributaries during low-flow Summer months	• Water withdrawals	All species	Instream flow management strategies for the Grays basin have been identified as part of Watershed Planning for WRIA 25 (LCFRB 2004). Strategies include water rights closures, setting of minimum flows, and drought management policies. This measure applies to instream flows associated with water withdrawals and diversions, generally a concern only during low flow periods. Hillslope processes also affect low flows but these issues are addressed in separate measures.

Priority Locations

Entire Basin

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WRIA 25/26 Watershed Planning Unit	Watershed Planning	✓	
Wahkiakum PUD	Water Supply Program		✓
Washington Department of Ecology	Water Resources Program		✓

Program Sufficiency and Gaps

The Water Resources Program of Ecology, 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 Ecology through a collaborative process. The current status of this planning effort is to adopt a watershed plan by December 2004. Instream flow management in the Grays Basin will be conducted using the recommendations of the WRIA 25/26 Planning Unit, which is coordinated by the LCFRB. Draft products of the WRIA 25/26 watershed planning effort can be found on the LCFRB website: www.lcfrb.gen.wa.us. The recommendations of the planning unit have been developed in close coordination with recovery planning and the instream flow prescriptions developed by this group are anticipated to adequately protect instream flows necessary to support healthy fish populations. The measures specified above are consistent with the planning group's recommended strategies. Ecology should follow the recommendations of the WRIA 25/26 Watershed Planning Unit regarding instream flow management.

#10 – Restore access to habitat blocked by artificial barriers

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore access to isolated habitats blocked by culverts, dams, or other barriers	• Blockages to channel habitats	Dams, culverts, tide-gates, in-stream structures	Coho, winter steelhead	There are few known blockages to fish habitat in the Grays River basin and repair of blockages is not believed to be a major priority in the basin.

Priority Locations

Small tributaries with blockages

Key Programs

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

Table C-14. Habitat actions for the Grays Subbasin.

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
Grays 1. Fully implement and enforce the Forest Practices Rules (FPRs) on private timber lands in order to afford protections to riparian areas, sediment processes, runoff processes, water quality, and access to habitats	Activity is currently in place	WDNR	1, 2, 3, 5, 6 & 10	High: Private commercial timber lands.	High: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats	Medium
Grays 2. Expand standards in local government comprehensive plans to afford adequate protections of ecologically important areas (i.e. stream channels, riparian zones, floodplains, CMZs, wetlands, unstable geology)	Expansion of existing program or activity	Wahkiakum County, Pacific County	1 & 2	Medium: Private lands. Applies primarily to lands in the lower basin in agriculture, rural residential, and forestland uses	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
Grays 3. Prevent floodplain impacts from new development through land use controls and Best Management Practices	New program or activity	Wahkiakum County, Pacific County, Ecology	1	Medium: Private lands currently in agriculture or timber production in lowland areas.	High: Protection of floodplain function, CMZ processes, and off-channel/side-channel habitat. Prevention of reduced habitat diversity and key habitat availability	High
Grays 4. Create and/or restore lost side-channel/off-channel habitat for chum spawning and coho overwintering	New program or activity	LCFRB, BPA (NPCC), NGOs, WDFW, NRCS/WCD, LCFEG	7	Medium: Lower mainstem and lower portion of lower mainstem tributaries	High: Increased habitat availability for spawning and rearing	High
Grays 5. Seize opportunities to conduct voluntary floodplain restoration on lands being phased out of agricultural production. Survey landowners, build partnerships, and provide financial incentives	New program or activity	NRCS/WCD, NGOs, WDFW, LCFRB, USACE, LCFEG	4, 5, 6, 7, &, 8	Medium: Lower mainstem and lower portion of lower mainstem tributaries	High: Restoration of floodplain function, habitat diversity, and habitat availability.	High
Grays 6. Manage future growth and development patterns to ensure the	Expansion of existing	Wahkiakum County, Pacific	1 & 2	Medium: Private lands. Applies	High: Protection of water quality, riparian function, stream channel	High

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
protection of watershed processes. This includes limiting the conversion of agriculture and timber lands to developed uses through zoning regulations and tax incentives	program or activity	County		primarily to lands in the lower basin in agriculture, rural residential, and forestland uses	structure (e.g. LWD), floodplain function, CMZs, wetland function, runoff processes, and sediment supply processes	
Grays 7. 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	Wahkiakum County, Pacific County	1, 3, 5, & 6	Low: Applies to lands under public ownership	Medium: Protection of water quality; greater streambank stability, reduction in road-related fine sediment delivery, restoration and preservation of fish access to habitats	High
Grays 8. Implement the prescriptions of the WRIA 25/26 Watershed Planning Unit regarding instream flows	Activity is currently in place	Ecology, WDFW, WRIA 25/26 Planning Unit	9	High: Entire basin	Medium: Adequate instream flows to support life stages of salmonids and other aquatic biota.	Medium
Grays 9. Increase the level of implementation of voluntary habitat enhancement projects in high priority reaches and subwatersheds. This includes building partnerships, providing incentives to landowners, and increasing funding	Expansion of existing program or activity	LCFRB, BPA (NPCC), NGOs, WDFW, NRCS/WCD, LCFEG	3, 4, 5, 6, 7, 8, & 10	High: Priority stream reaches and subwatersheds throughout the basin	Medium: Improved conditions related to water quality (temperature and bacteria), LWD quantities, bank stability, key habitat availability, habitat diversity, riparian function, floodplain function, sediment availability, & channel migration processes	Medium
Grays 10. Increase technical support and funding to small forest landowners faced with implementation of Forest and Fish requirements for fixing roads and barriers to ensure full and timely compliance with regulations	Expansion of existing program or activity	WDNR	1, 2, 3, 5, 6, & 10	Low: Small private timberland owners	High: Reduction in road-related fine sediment delivery; restoration and preservation of fish access to habitats	Medium
Grays 11. Increase funding available to purchase easements or property in sensitive areas in order to protect watershed function where existing programs may not be able to	Expansion of existing program or activity	LCFRB, NGOs, WDFW, USFWS, BPA (NPCC)	1 & 2	Low: Mixed-use lands at risk of degradation	High: Protection of riparian function, floodplain function, water quality, wetland function, and runoff and sediment supply processes	High

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
adequately protect watershed function						
Grays 12. Increase technical assistance to landowners and increase landowner participation in conservation programs that protect and restore habitat and habitat-forming processes. Includes increasing incentives (financial or otherwise) and increasing program marketing and outreach	Expansion of existing program or activity	NRCS/WCD, WDNR, WDFW, Wahkiakum County, Pacific County	All measures	Medium: Private lands. Applies primarily to lands in the lower basin in agriculture, rural residential, and forestland uses	High: Increased landowner stewardship of habitat. Potential improvement in all factors	Medium
Grays 13. 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	Low: State timber lands in the SF Grays Watershed (approximately 10% of the basin area)	Medium: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats. Response is medium because of location and quantity of state lands	Medium
Grays 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/WCD, LCFEG	1 & 5	Medium: Greatest risk is in lower basin agriculture and residential use areas	Medium: restoration and protection of native plant communities necessary to support watershed and riparian function	Low
Grays 15. Assess, upgrade, and replace on-site sewage systems that may be contributing to water quality impairment	Expansion of existing program or activity	Wahkiakum County, Pacific County, WCD, LCFEG	6	Low: Private agricultural and rural residential lands in lower basin	Medium: Protection and restoration of water quality (bacteria)	Medium

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

C.5.5. Hatcheries

This subbasin plan describes potential hatchery strategies and actions designed to address recovery objectives and hatchery risks detailed in Volume I and in hatchery program assessments described earlier in this Volume II chapter. These strategies and actions are largely based on assessments in the interim planning process that was completed in 2004. Strategies and actions are generally consistent with more recent plans based on HSRG analyses and WDFW's Conservation and Sustainable Fisheries Plan. However, in several cases, the ongoing hatchery reform and planning process has identified revisions to the alternatives presented herein.

Subbasin Hatchery Strategy

The desired future state of fish production within the Grays River Basin includes natural salmon and steelhead populations that are improving on a trajectory to recovery and hatchery programs that either enhance the natural fish recovery trajectory or are operated to not impede progress towards recovery. Hatchery recovery measures in each subbasin are tailored to the specific ecological and biological circumstances for each species in the subbasin. This may involve substantial changes in some hatchery programs from their historical focus on production for mitigation. The recovery strategy includes a mixture of conservation programs and mitigation programs for lost fishing benefits. Mitigation programs involve areas or practices selected for consistency with natural population conservation and recovery objectives. A summary of the types of natural production enhancement strategies and fishery enhancement strategies to be implemented in the Grays River Basin are displayed by species in Table C-15. More detailed descriptions and discussion of the regional hatchery strategy can be found in Volume I.

Table C-15. Summary of potential natural production and fishery enhancement strategies for the Grays River.

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

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

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

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

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

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

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

Not every lower Columbia River hatchery program will be turned into a conservation program. The majority of funding for lower Columbia basin hatchery operations (including the Grays River Hatchery) is for producing salmon and steelhead for harvest to mitigate for lost harvest of natural production due to hydro development and habitat degradation. Programs for fishery enhancement will continue during the recovery period, but will be managed to minimize risks and ensure they do not compromise recovery objectives for natural populations. It is expected that the need to produce compensatory fish for harvest through artificial production will reduce in the future as natural populations recover and become harvestable. There are fishery enhancement programs for winter steelhead and early coho in the Grays Basin. Additionally, the Select Area Fishery Program includes a site at Deep River. Spring Chinook and coho are released from net pens located in Deep River for the purpose of supporting directed fisheries upon their subsequent return as adults. Select Area fisheries have been established in areas of limited natural production capabilities to allow fishing opportunities that have only negligible impacts to listed species, thereby promoting the recovery of listed stocks.

The Grays River Hatchery will be operated to include natural production enhancement strategies for Grays River coho and chum as well as support natural chum enhancement in the Chinook River and natural chum and coho enhancement in coastal tributary streams. The Grays River Hatchery will continue to support winter steelhead and coho fisheries with hatchery releases in the Grays Basin, and also facilitate spring Chinook and coho select-area fisheries in Deep River. Fall Chinook will not be included as a harvest program in the Grays Basin. This plan adds four new conservation programs at the Grays River Hatchery facility (Table C-16).

Table C-16. A summary of conservation and harvest strategies with potential implementation through Grays River Hatchery programs.

		Stock
Natural Production Enhancement	Supplementation	Grays River Chum Grays River Coho √ Chinook River Chum Coastal Trib Coho √ Coastal Trib Chum √
	Hatch/Nat Conservation 1/	
	Isolation	
	Broodstock development	Grays River late Coho √ Grays River Chum
Fishery Enhancement	In-basin releases (final rearing at Grays)	Grays River Early Coho Elochoman Winter Steelhead
	Out of Basin Releases (final rearing at Grays)	Deep River Net Pens: Lewis/Cowlitz Spring Chinook and, Grays River Early Coho

1/ May include integrated and/or isolated strategy over time.

√ Denotes new program

Hatchery Measures and Actions

Hatchery strategies and measures are focused on evaluating and reducing biological risks consistent with the conservation strategies identified for each natural population. Artificial production programs within Grays River facilities have been evaluated in detail through the WDFW Benefit-Risk Assessment Procedure (BRAP) relative to risks to natural populations. The BRAP results were utilized to inform the development of these program actions specific to the Grays River Basin (Table C-17). The Sub-Basin plan hatchery recovery actions were developed in coordination with WDFW and at the same time as the Hatchery and Genetic Management Plans (HGMP) were developed by WDFW for each hatchery program. As a result, the hatchery actions represented in this document will provide direction for specific actions which will be detailed in the HGMPs submitted by WDFW for public review and for NMFS approval. It is expected that the HGMPs and these recovery actions will be complimentary and provide a coordinated strategy for the Grays River Basin hatchery programs. Further explanation of specific strategies and measures for hatcheries can be found in Volume I.

Table C-17. Potential hatchery implementation actions in the Grays River Basin.

Activity	Action	Hatchery Program Addressed	Natural Populations Addressed	Limiting Factors Addressed	Threats Addressed	Expected Outcome
Continue to mass mark steelhead and coho hatchery releases to provide the means to identify hatchery fish for selective fisheries and to distinguish between hatchery and wild fish in the Grays River basin	*Adipose fin-clip mark hatchery released coho and steelhead	Grays River Hatchery coho and steelhead.	Grays River winter steelhead. and coho	Domestication, Diversity, Abundance	In-breeding Harvest	Maintain lower harvest impacts for natural Grays River coho and steelhead compared to harvest rates on hatchery production. Enable visual identification of hatchery and wild returns to provide the means to account for and manage the natural and wild escapement of steehead and coho consistent with biological objectives.
Develop a late coho brood stock using the latest (December-January) arriving late hatchery coho. Utilize existing production and new late stock program to supplement wild production in Grays River and coastal tributaries and for harvest. Continue chum brood stock program utilizing Grays River natural stock for supplementation and risk management. Grays River and Chinook River enhancement programs may be expanded to include other coastal tributaries dependent on DNA analysis.	*Grays River Hatchery facility utilized for supplementation and enhancement of natural chum populations, and **natural coho populations	Grays River Hatchery coho, and chum.	Grays River and Coastal tributary late coho Grays River, Deep River, and coastal tributary chum	Abundance, Spatial distribution	Low numbers of natural spawners Ecologically appropriate natural brood stock	Development of a hatchery coho brood stock similar to the late returning historical populations in the coastal region. Improve abundance and distribution of natural produced coho. Continue propagation of Grays River chum brood stock to supplement and manage risks to Grays River, Chinook River and other local coastal populations. Increase abundance and distribution of coastal chum populations.
Hatchery produced winter steelhead and coho will be scheduled for release during the time when the maximum numbers of fish are smolted and prepared to emigrate rapidly. Juvenile rearing strategies will be implemented to provide a fish	*Juvenile release strategies to minimize impacts to natural populations	Grays River Hatchery winter steelhead and coho	Grays River fall Chinook, chum, and coho	Predation, Competition	Hatchery smolt residence time in the Grays River.	Minimal residence time of hatchery released juvenile resulting in reduced ecological interactions between hatchery and wild juveniles. Displacement of natural fall Chinook from preferred habitat by larger hatchery fall Chinook will be minimized.

Activity	Action	Hatchery Program Addressed	Natural Populations Addressed	Limiting Factors Addressed	Threats Addressed	Expected Outcome
growth schedule which coincides with an optimum release time for hatchery production success and to minimize time spent in the Grays River						Predation on natural chum will be minimal Improved survival of wild juveniles, resulting in increased productivity and abundance
Hatchery effluent discharge complies with NPDES permit monitoring requirements. Fish health monitored and treated as per co-managers fish health policy.	*Evaluate facility operations	All species	All species	Habitat quality	Water Quality	Hatchery fish disease controlled and water quality standards upheld to avoid impact to habitat quality in the West Fork and mainstem Grays River downstream of the hatchery.
Research, monitoring, and evaluation of performance of the above actions in relation to expected outcomes Performance standards developed for each actions with measurable criteria to determine success or failure Adaptive Management applied to adjust or change actions as necessary	**Monitoring and evaluation, adaptive management	All species	All species	Hatchery production performance, Natural production performance	All of above	Clear standards for performance and adequate monitoring programs to evaluate actions. Adaptive management strategy reacts to information and provides clear path for adjustment or change to meet performance standard

* Extension or improvement of existing actions-may require additional funding

** New action-will likely require additional funding

C.5.6. Harvest

Fisheries are both an impact that reduces fish numbers and an objective of recovery. The long-term vision is to restore healthy, harvestable natural salmonid populations in many areas of the lower Columbia basin. The near-term strategy involves reducing fishery impacts on natural populations to ameliorate extinction risks until a combination of actions can restore natural population productivity to levels where fishing targeted on current ESA-listed stocks may resume. The regional strategy for interim reductions in fishery impacts involves: 1) elimination of directed fisheries on natural populations, 2) regulation of mixed stock fisheries for healthy hatchery and natural populations to limit and minimize indirect impacts on natural populations, 3) implement single stock hatchery target fisheries occurring in terminal areas (i.e. ongoing Select area fisheries program) 4) scaling of allowable indirect impacts for consistency with recovery, 5) annual abundance-based management to provide added protection in years of low abundance while allowing greater fishing opportunity consistent with recovery in years with higher abundance, and 6) 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 Grays River (Table C-18). More complete details can be found in the WDFW Sport Fishing Rules Pamphlet.

Table C-18. Summary of regulatory and protective fishery actions in the Grays basin

Species	General Fishing Actions	Explanation	Other Protective Fishing Actions	Explanation
Fall Chinook	Closed to retention	Protects wild fall Chinook. No hatchery produced fall Chinook in Grays	All fisheries closed during fall Chinook spawning time	Further protection of wild fall Chinook spawners
chum	Closed to retention	Protects natural chum. Hatchery chum are not produced for harvest	Winter steelhead fishing opens after most chum have spawned	Steelhead season delayed in chum spawning area to minimize chance of chum handle
coho	Retain only adipose fin-clip marked coho	Selective fishery for hatchery coho, unmarked wild coho must be released	Upper Grays watershed and small tributaries closed to salmon	Protects wild spawners. Hatchery coho released in lower Grays
Winter steelhead	Retain only adipose fin-clip marked steelhead	Selective fishery for hatchery steelhead, unmarked wild steelhead must be released	Steelhead and trout fishing closed in the spring and minimum size restrictions in affect	Spring closure Protects adult wild steelhead during spawning and minimum size protects juvenile steelhead

Regional actions cover species from multiple watersheds which share the same migration routes and timing, resulting in similar fishery exposure. Regional strategies and actions for harvest are detailed in 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 Grays Subbasin populations are summarized in the Table C-19.

Table C-19. Regional harvest actions from with significant application to the Grays River Subbasin populations.

Action	Description	Responsible Parties	Programs	Comments
	Develop a regional mass marking program for tule fall Chinook	WDFW, NMFS, USFWS, Col. Tribes	U.S. Congress, Washington Fish and Wildlife Commission, U.S. v. Oregon, PSC	Retention of salmon is prohibited in Grays River sport fisheries, however marking of other hatchery tule Chinook would provide regional selective fishing options.
	Monitor chum handle rate in winter steelhead and late coho tributary sport fisheries.	WDFW	WDFW Creel Program	State agencies would include chum incidental handle assessments as part of their annual tributary sport fishery sampling plan.
	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	WDFW, ODFW	Columbia River Compact, BPA Fish and Wildlife Program, PFMC	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.
	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	WDFW, ODFW	Columbia River 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.
	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	WDFW, NMFS, ODFW, USFWS	Columbia River Compact, PFMC	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.

C.5.7. Hydropower

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

C.5.8. Mainstem and Estuary

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

C.5.9. Ecological Interactions

For the purposes of this plan, ecological interactions refer to the relationships of salmon and steelhead with other elements of the ecosystem. Regional strategies and measures pertaining to exotic or non-native species, effects of salmon on system productivity, and native predators of salmon are detailed and discussed at length in 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.

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