

2 Columbia River Estuary Tributaries



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

2.1 Basin Overview

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

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

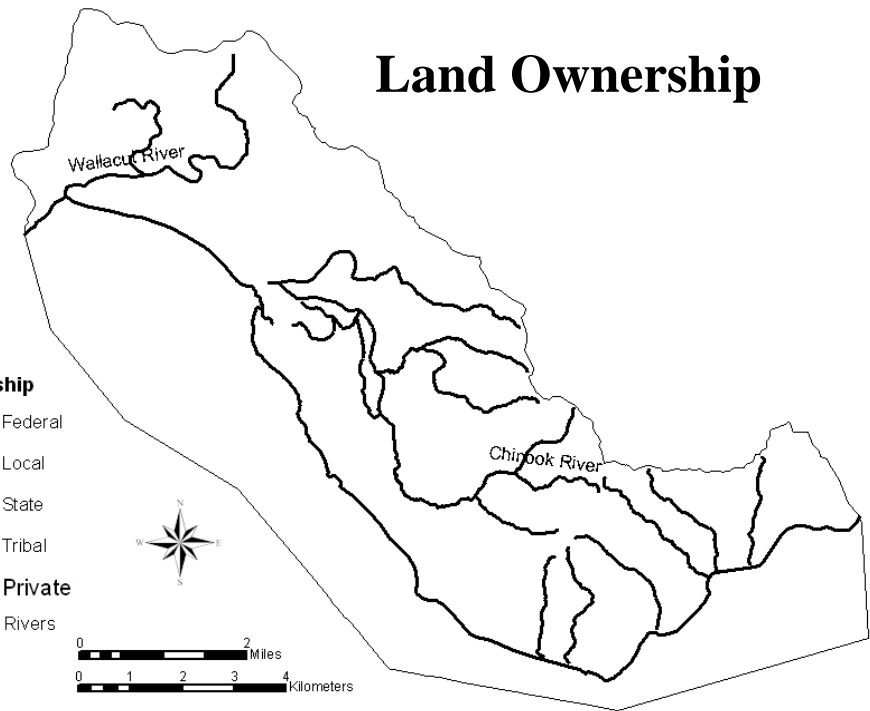
Estuary tributary salmon and steelhead are affected by a variety of in-basin and out-of-basin factors including stream, estuary, and ocean habitat conditions; harvest; hatcheries, and ecological relationships with other species. Analysis has demonstrated that recovery cannot be achieved by addressing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

common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the Estuary tributary subbasin.

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

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

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



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



2.2 Species of Interest

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

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

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

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

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

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

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

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

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

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

2.3 Limiting Factors, Threats and Measures

2.3.1 Hydropower Operation and Configuration

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

2.3.2 Harvest

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

Measures to address harvest impacts are generally focused at a regional level to cover fishery impacts accrued to lower Columbia salmon as they migrate along the Pacific Coast and through the mainstem Columbia River. The regional measures cover species from multiple watersheds which share the same migration routes and timing, resulting in similar fishery exposure. Regional strategies and measures for harvest are detailed in Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest measures that have significant application to the estuary subbasin populations are summarized in the following table:

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

Measure	Description	Comments
F.M18	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	Includes monitoring of naturally-spawning steelhead encounter rates in fisheries and refinement of long-term catch and release handling mortality estimates. Would include assessment of the current monitoring programs and determine their adequacy in formulating naturally-spawning steelhead incidental mortality estimates.
F.M19	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	Regulatory agencies should continue to refine gear, handle and release methods, and seasonal options to minimize mortality of naturally-spawning steelhead in commercial and sport fisheries.
F.M24	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	Mass marking of lower Columbia River coho and steelhead has enabled successful ocean and freshwater selective fisheries to be implemented since 1998. Marking programs should be continued and fisheries monitored to provide improved estimates of naturally-spawning salmon and steelhead release mortality.

2.3.3 Hatcheries

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

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

Table 2-3. Estuary Tributary Hatchery Production.

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

Regional hatchery strategies and measures are focused on evaluating and reducing biological risks and reducing the risks to natural populations. Artificial production programs within the estuary subbasin facilities will be evaluated in detail through the WDFW Benefit-Risk Assessment Procedure (BRAP) relative to risks to natural populations. The resulting program

specific actions will be developed, evaluated, and documented through the Hatchery and Genetic Management Plan (HGMP) for public review and consideration by NOAA Fisheries (details in programs Technical Foundation, Volume IV). Regional hatchery measures identified in Volume I, Chapter 7 with potential applications at facilities within the estuary subbasins are summarized in Table 7.

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

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

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2.3.4 Ecological Interactions

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

2.3.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. A variety of human activities in the mainstem and estuary have decreased both the quantity and quality of habitat used by juvenile salmonids. These include floodplain development; loss of side channel habitat, wetlands and marshes; and alteration of flows due to upstream hydro operations and irrigation withdrawals. Effects are similar for Estuary tributary

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

2.3.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity have significantly altered watershed processes and reduced both the quality and quantity of habitat needed to sustain viable populations of salmon and steelhead. Moreover, with the exception of fall Chinook, stream habitat conditions within the Estuary Tributaries basin have the greatest impact on the health and viability of salmon and steelhead relative to the other limiting factors and threats discussed in this chapter.

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

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

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

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

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

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

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

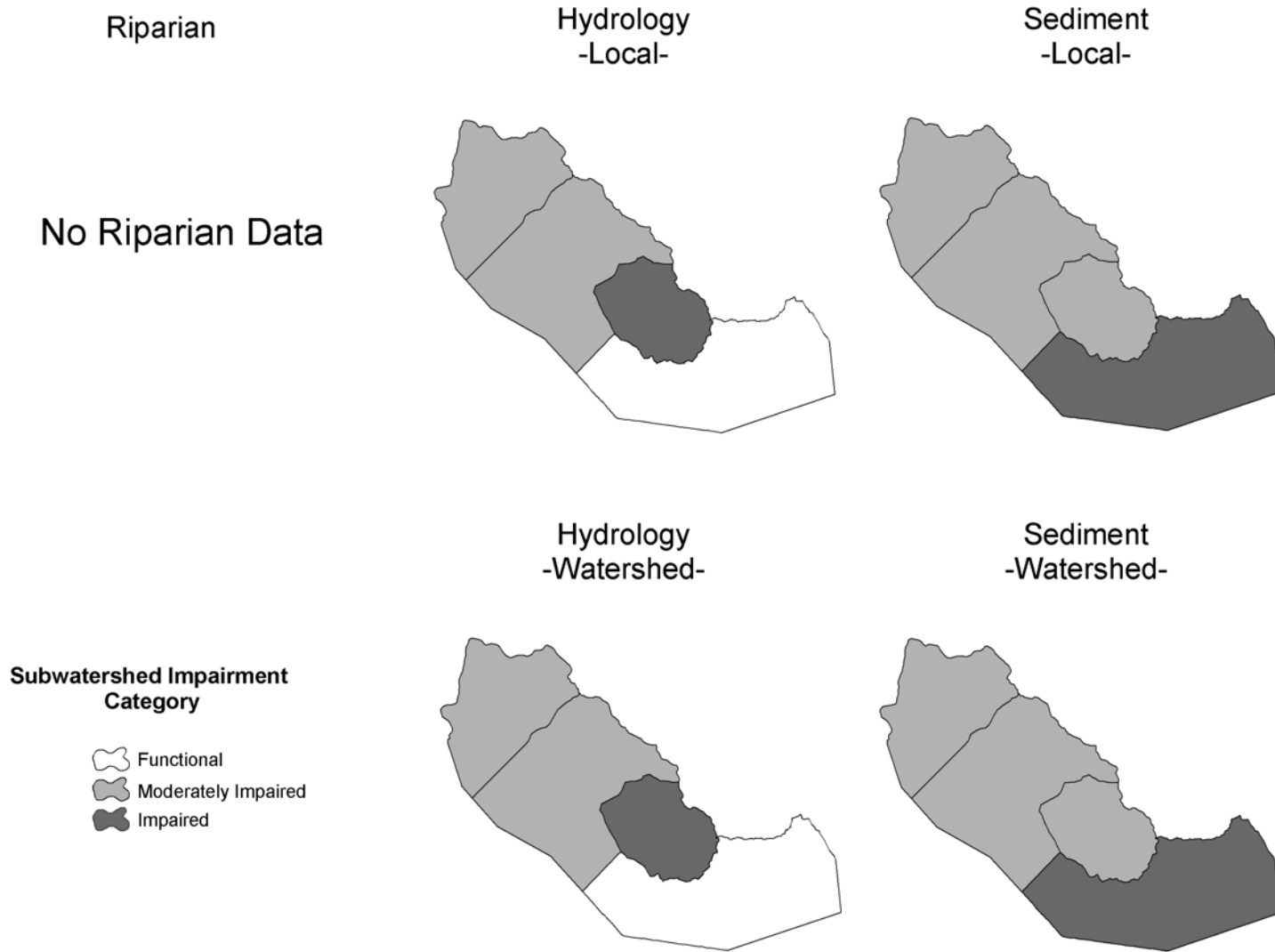


Figure 2-2. IWA subwatershed impairment ratings by category for the Estuary Tributaries Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical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

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

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

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

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
<p>1. Protect and restore floodplain function and channel migration processes A. Set back, breach, or remove artificial channel confinement structures</p>					
<p><i>Chinook River Wallacut River and other small tributaries</i></p>	<ul style="list-style-type: none"> • Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes 	<ul style="list-style-type: none"> • Floodplain filling • Channel straightening • Artificial confinement 	<ul style="list-style-type: none"> • All species 	<p>2-15 years</p>	<p>High potential benefit due to improvements in many limiting factors. This passive restoration approach can allow channel to restore naturally once confinement structures are removed. There are challenges with implementation due to existing infrastructure already in place, private property, potential flood risk to property, large expense, and no regulatory mechanisms in place for this type of restoration.</p>
<p>2. Protect and restore off-channel and side-channel habitats A. Restore historical off-channel and side-channel habitats where they have been eliminated B. Provide access to blocked off-channel habitats C. Create new off-channel or side-channel habitats (i.e., spawning channels)</p>					
<p><i>Chinook River Wallacut River and other small tributaries</i></p>	<ul style="list-style-type: none"> • Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats • Altered habitat unit composition 	<ul style="list-style-type: none"> • Artificial confinement • Channel straightening • Floodplain filling 	<ul style="list-style-type: none"> • Chum • Coho • Winter steelhead 	<p>2-15 years</p>	<p>Good potential benefit especially for chum, which have lost a significant portion of historically available off-channel habitat for spawning. Potential benefit is limited by moderate probability of success with creation of new habitats. There are challenges with implementation due to existing infrastructure already in place, private property, and large expense. No regulatory mechanisms in place for this type of restoration</p>
<p>3. Protect and restore riparian function A. Reforest riparian zones B. Allow for the passive restoration of riparian vegetation C. Livestock exclusion fencing D. Invasive species eradication E. Hardwood-to-conifer conversion</p>					
<p><i>Chinook River Wallacut River and other small tributaries</i></p>	<ul style="list-style-type: none"> • Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream 	<ul style="list-style-type: none"> • Timber harvest – riparian harvests • Riparian grazing • Clearing of vegetation due to rural residential and agricultural 	<ul style="list-style-type: none"> • All species 	<p>20-100 years</p>	<p>High potential benefit due to the many limiting factors that are addressed. Riparian impairment is related to most land-uses and is a concern throughout the basin. Riparian protections on forest lands are provided for under current harvest policy. Riparian restoration projects are relatively inexpensive and are often supported by landowners. The</p>

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

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

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
<p><i>A. Plan growth and development to avoid sensitive areas (e.g., wetlands, riparian zones, floodplains, unstable geology)</i> <i>B. Encourage the use of low-impact development methods and materials</i> <i>C. Apply mitigation measures to off-set potential impacts</i></p>					
<p><i>Entire basin</i></p>	<p><i>Preservation Measure</i> – addresses many potential limiting factors and threats</p>		<ul style="list-style-type: none"> • All species 	<p>5-50 years</p>	<p>The focus should be on management of land-use conversion and continued development in sensitive areas (e.g., wetlands, stream corridors, unstable slopes). Many critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary mechanisms need to be put in place to restore currently degraded habitats.</p>
<p><i>11. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection</i> <i>A. Purchase properties outright through fee acquisition and manage for resource protection</i> <i>B. Purchase easements to protect critical areas and to limit potentially harmful uses</i> <i>C. Lease properties or rights to protect resources for a limited period</i></p>					
<p><i>Entire basin</i></p>	<p><i>Preservation Measure</i> – addresses many potential limiting factors and threats</p>		<ul style="list-style-type: none"> • All species 	<p>5-50 years</p>	<p>Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit where other protection measures such as incentives and regulation do not provide adequate protection. These programs are under-funded and have low landowner participation.</p>

Program Gap Analysis

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

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

Protection Programs

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

Federal Programs

➤ *U.S. Army Corps of Engineers*

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

State Programs

➤ *Department of Natural Resources*

- **State Forest Land HCP:**

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

- **State Forest Practices:**

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

[M.3A; M.3B; M.5A; M.5B; M.6A; M.6B]

➤ ***Washington Department of Fish and Wildlife***

• Washington State Hydraulic Code

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

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

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

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

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

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

Local Government Programs

➤ ***Pacific County***

• Land Use:

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

- **Fisheries Habitat Regulations:**
 - ✓ Pacific County's policy is to protect habitat conservation areas and adopts the DNR's Official Water Type Maps.
 - ✓ *Standard Stream Setback Width Requirements:*
 - Type 1: 100'
 - Type 2: 100'
 - Type 3: 100'
 - Type 4: 50'
 - Type 5: 25'
 - ✓ Prohibited activities within stream setbacks include removal of more than 30% of stream bank tree canopy within any ten years, land filling or grading, and land clearing or vegetation removal that results in exposure of bare earth.
- ***Pacific County Conservation District and NRCS*** offers technical advice, and incentive programs to assist interested landowners in the protection of watershed processes and habitat. (e.g., CREP). [M.3B; M.3C; M.3D; M.4B; M.5C; M.8A; M.8B; M.8C; M.9A; M.11C]

Community Programs

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

Restoration Programs

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

Federal Programs

- ***U.S. Army Corps of Engineers***
 - **Chinook River Restoration:** The Corps of Engineers is active partner in the Chinook River restoration efforts lead by Sea Resources. The Corps provides technical, engineering and design services and funding.
 - **Lower Columbia Ecosystem Restoration General Investigation:** Oregon and Washington have entered into a cooperative agreement with the Corps of Engineers to conduct a study providing a comprehensive engineering and environmental background for restoration actions. The study will serve as a tool for furthering the recovery of ESA listed salmonids and as well as habitat conditions for many non-listed species. The extent to which tributaries will be included in the study will be determined during phase 1 of the study. The study could result in a collaborative cost-share restoration effort.

State Programs

➤ ***Washington Department of Natural Resources***

• State Forest Land HCP:

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

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

➤ ***Washington Department of Fish and Wildlife***

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

➤ ***Washington Department of Transportation***

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

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

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

Local Government Programs

➤ ***Pacific County***

• Passage Restoration:

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

• Wildlife Habitat Regulations:

Fish and wildlife habitat conservation areas include areas with which endangered, threatened, and sensitive species have a primary association, such as commercial and

recreational shellfish beds, kelp and eelgrass beds, and waters of the state. Mitigation actions must address restoration, rehabilitation, and alternatives according to specific requirements.

- ***Pacific Conservation District and NRCS*** work directly with agriculture interests in the Estuary Tributaries through farm planning, and activities associated with the Conservation Reserve Enhancement Program; [M.3A; M.3B; M.3C; M.4A; M.5C, M.8B; M.8C; M.9A]
- ***Pacific County Noxious Weed Control Board***
 - The Board has three primary programs that address weed control in the Estuary Tributaries Basin; [M.3D]
 - ✓ Public education to prevent the spread of noxious weeds;
 - ✓ Survey of the County to assess emerging issues; and
 - ✓ Enforcement of noxious weed control

Regional Programs

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

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

➤ ***Lower Columbia River Estuary Partnership***

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

- Water Quality Monitoring
LCREP administers a water quality monitoring program staffed by its staff and supported by local volunteers.
- Habitat Restoration
LCREP provides guidance and allocates federal funding to implement habitat restoration activities in the estuary. The program has been active in Chinook River protection and restoration efforts.

Community Programs

➤ ***Sea Resources***

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

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

Gap Analysis

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

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

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

Table 2-7. Program Actions to Address Gaps

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