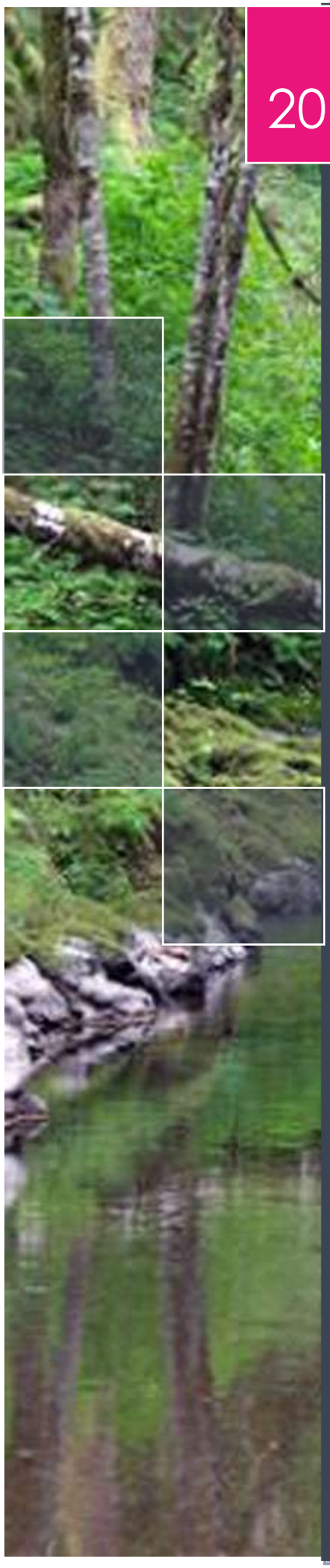

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The Chehalis Basin Salmon Habitat Restoration and Preservation Strategy for WRIA 22 and 23

John M. Kliem and Deborah A. Holden
Creative Community Solutions, Inc.
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The Chehalis Basin Salmon Habitat Restoration and Preservation Strategy for WRIA 22 and 23

Prepared by

Grays Harbor County Lead Entity

Habitat Work Group

With Assistance by

Lee Napier, Lead Entity Coordinator, Grays Harbor County

John Kliem & Deborah A. Holden, Creative Community Solutions, Inc.

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Introduction to the Strategy

The Chehalis Basin Salmon Habitat Restoration and Preservation Strategy is the Lead Entity strategy for providing guidance to project planners and funding agencies in developing, evaluating, and implementing salmon habitat restoration and protection actions within Water Resource Inventory Areas (WRIA) 22 and 23.

The Strategy relies on nine sections to achieve this purpose. The first section, *Goals for Salmon Habitat Restoration and Protection*, outline the guiding thought process involved in developing the document.

Building on these goals are Sections 2 and 3: *A Salmonid Profile for the Chehalis Basin* and *Subbasin Profiles*. These two sections provide direction in determining the sequence of habitat restoration and protection projects and activities within WRIA 22-23 by identifying priority stocks and priority actions that benefit them.

Section 4, *Guidelines for Barrier Projects*, was created to assist project sponsors develop barrier removal projects and help the habitat work group evaluate projects brought for consideration.

Section 5, *Invasive Species*, identifies invasive flora and fauna species found in the Chehalis River Basin, discusses management goals together with management actions. This section provides additional resources to assist project sponsors.

Section 6, *Managing the Salmon Habitat Restoration Process*, is an adaptive management piece that outlines intended future actions of the Lead Entity as it continues towards accomplishing its Strategy goals.

The mechanics of developing, funding, and implementing specific projects is the focus of Sections 7 and 8. The first section, *Project Development, How to Prepare a Proposal, Project Selection, and*

Funding: Strategies for Funding Projects, aims at assisting project developers and sponsors. The audience for *Lead Entity Procedures for Evaluating and Selecting Habitat Project Lists*, on the other hand, is the Habitat Work Group. This section provides guidance to them in their efforts to determine which projects in what order should move forward to funding agencies like the Salmon Recovery Funding Board (SRFB).

Appendix A contains the document *A Framework for Salmon Habitat Restoration in the Chehalis Basin*, which provides background information about federal and state laws and policies give context to the sections of this plan.

The remaining appendices provide results from community surveys taken at the annual Chehalis River Festival in Aberdeen.

Section 1:
Goals for Salmon Habitat Projects & Activities

Although bull trout are the only salmonid listed as "threatened" in the Chehalis Basin, this is not a clean bill of health for WRIAs 22 and 23 by any means. The limiting factors analysis by Smith and Wenger point out that human activity in the watershed has degraded or eliminated aquatic habitats by altering many of the key natural stream processes that support salmonids.

Statewide Vision for Salmon Recovery: "Restore salmon, steelhead, and trout populations to healthy and harvestable levels and improve habitat on which fish rely."

On the other hand, salmonids in the Chehalis Basin have fared far better than in Puget Sound, the Columbia River, and Hood Canal. Comparatively, habitat in the Chehalis Basin is much more intact and has fewer development pressures. For this reason, the Chehalis Basin plays an important role in the long-term success of preserving healthy populations of wild salmonids for the state as a whole. The significance of this fact makes the Chehalis Basin watershed a priority investment for the Salmon Recovery Funding Board (SRFB). They can fund projects and activities here that would have far greater impact in fulfilling the overall statewide vision for salmon recovery that is not possible in other WRIAs.

Wild stocks are fish sustained by natural spawning and rearing in the natural habitat, regardless of parentage (including native).

To this end, the Chehalis Basin Salmon Habitat Restoration and Preservation Strategy for WRIAs 22 and 23 (Strategy) adopts seven strategies, all equal in value, for addressing the most pressing limiting factors identified within the subbasins of WRIAs 22 and 23. Salmon habitat projects and activities must meet one or more of these strategies for inclusion on the Habitat Project List for Salmon Recovery Funding Board consideration. These guiding strategies are:

- **Attain a healthy and diverse population of wild salmonids**

The future for salmon, steelhead, and bull trout in WRIAs 22 and 23 depends on self-sustaining populations of wild stocks. Efforts in this direction will primarily focus on restoration and preservation of priority

stocks listed in *Section Two* of the Strategy. Priority stocks include those listed as "depressed" under SasSI, threatened or endangered under the Endangered Species Act, and extirpated historic runs.

The WRIA still has a lot to learn about how limiting factors impair our achieving healthy populations of wild fish within the Chehalis Basin. Filling these data gaps remains a high priority for fulfilling this strategy.

❖ **Restore, enhance, and protect the Grays Harbor Estuary**

An estuary is an area where fresh and salt water mix at the mouth of a river

Wild salmonids in the Chehalis Basin depend upon the Grays Harbor Estuary for food, rearing, and migration habitat. It is the gathering point for these fish at the beginning and end of their life cycles. As the health of the Grays Harbor Estuary goes, so does that of wild salmonids.

The condition of the estuary today is indicative of the rest of the Chehalis Basin – a mixture of good and fair, although in far better condition in comparison to other similar habitats in the state. The loss of near shore habitat and degraded water quality are the greatest problems that need work. There is also a need to develop an estuary management plan that aims at giving greater guidance at what projects are critical for recovery and protection.

❖ **Restore and preserve properly functioning riparian areas**

Past land use practices as well as urbanization have greatly degraded riparian zones along some of the most productive subbasins in the Chehalis Basin. The Lead Entity needs to expand the number of projects that assist landowners in reducing the impacts of their livestock to riparian areas. There are also many streams and rivers with degraded riparian areas due to a legacy of poor forestry practices in the past. Restoration of these areas is critical.

It is equally important to note that the Chehalis Basin still has many functioning riparian areas that deserve protection. That is why it is critical

to make available the resources and support necessary to implement the Forest and Fish Agreements in order to protect and preserve these riparian zones.

❖ Restore habitat access

Habitat access is the unobstructed upstream and downstream movement of fish at all life stages

Inventories show that the Chehalis Basin is plagued with numerous barriers on public and private lands that create impassible barriers to wild salmonids. This essentially eliminates access by salmonids to what could be many miles of very prime and pristine habitat. Replacing these dysfunctional culverts is therefore a very high priority. Given the high percentage of publicly owned forestlands in the WRIAs, the Lead Entity intends to encourage and support these entities to remove these barriers. The Fish and Forest Agreement should also be a focal point for fixing culverts on private lands.

❖ Restore properly functioning hydrology

Hydrology includes several components of the natural flow regime of streams and rive, that includes:

- Volume – the amount of surface flow;
- Frequency – how often a flow above a given magnitude recurs;
- Duration – the period of time a specific flow condition persists;
- Timing – the regularity or consistency of specific flow conditions; and
- Rate of change – how quickly amount of flow increases or decreases.

All of the components are important to the ecological integrity of rivers, streams, adjacent floodplains, & estuaries.

Years of agriculture, development, and timber management in the Chehalis Basin have negatively affected hydrology in many subbasins. Ditching, filling, and armoring of streambanks in particular have dramatically created extremes of high flows in the winter and low flows in the summers. These abnormal flow conditions scour spawning grounds, restrict access to rearing habitat, and degrade water quality through sedimentation. Downstream flooding and excessive bank erosion also occurs with greater frequency and affect. Reversing this historic manipulation of streams and rivers landscapes will be important for improving wild salmonid habitat.

Increased water use by people within the Chehalis Basin has critically reduced summertime flows in some subbasins. The development of water storage projects that augment stream flows during dry periods is major need for these subbasins. In addition, the Watershed Management Plan will provide more information to better address this overall concern.

❖ **Restore floodplain and stream channel function**

Floodplains are the low areas along a stream or river channel into which water spreads during floods.

Off-channel habitat includes ponds, oxbows, sloughs, and other backwater areas with cover that provide high-quality rearing habitat for juvenile salmonids.

Human modification of streambanks in the Chehalis Basin has seriously affected off-channel habitat for wild salmonids. Levees, dikes, revetments, and roads have disconnected valuable floodplains, off-channel habitat, wetlands, and sloughs for fish. This has drastically affected how rivers function by eliminating areas for water storage for floodwaters and summer flows as well as mechanisms for sedimentation control and incision. For the fish, it is a serious loss of habitat for feeding, spawning, rearing, and refuge from floodwaters.

Salmon habitat projects that restore floodplain functions in subbasins are a major priority. The long-term goal is to remove all unnecessary levees and fortified structures along rivers that block fish access to historic floodplains. This need is so great that the Lead Entity would like to see at least one major floodplain restoration project proposed annually. In the short-term, large woody debris projects are important to implement throughout all subbasins.

❖ **Prioritize habitat projects and activities within subbasins that provide the highest benefit to priority stocks**

Making choices about prioritizing protection and recovery actions within WRIAs 22 and 23 is an unfortunate necessity. The Chehalis Basin watershed is the second largest in the state and has many needs. However, funding resources available through the SRFB are insufficient to cover the needs of all projects within subbasins. The concern rightly exists that spreading these limited resources too thinly across the watershed would render little impact on improving overall salmonid runs in the watershed. Therefore, the Strategy follows the strategy of focusing SRFB funding on habitat projects and activities that have the highest potential for yielding the greatest biological impact to priority stocks.

Section 2:
A Salmonid Profile for the Chehalis Basin

INTRODUCTION

The Salmonid Profile for the Chehalis Basin is a reference tool describing known salmonid species and stocks within WRIA 22 & 23. The salmonids covered include Chinook, chum, coho, cutthroat, steelhead, and bull trout.

The profile relies on existing published information and often contains excerpts taken directly from the published sources as noted.

The salmonid profile is not a comprehensive examination of all species and their stocks within the Chehalis Basin. Furthermore, it does not represent all documentation that exists for the basin. To obtain specific data for a species or a stock, such as escapement numbers, please refer to the original publications.

The Lead Entity intends to review the profile annually to provide the reader with the most recent information available.

Species or stocks listed as "depressed" by SaSI in the Profile are priority stocks for selecting projects. Other priority stocks include ESA-listed species in the watershed or historic extirpated runs within a subbasin.

Table 1: Overview of Known Salmonids with SaSI Ratings in WRIA 22 & 23

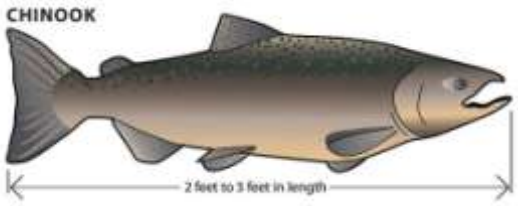
Key: "H" = Healthy, "D" = Depressed, "U" = Unknown Status, CH = Critical Habitat in WF Satsop and CH** Critical Habitat lower reach Chehalis (2006 USFWS Bull Trout Recovery Plan-ESA)*

Subbasin	Fall Chinook	Spring Chinook	Summer Chinook	Coho	Chum	Cutthroat	Winter Steelhead	Summer Steelhead	Bull Trout - ESA
Grays Harbor									
Grays Harbor Estuary	H/D	H	D	H/D	H	U	H/D	U	CH
Humptulips									
Humptulips River	D			H	H	U	D	U	CH
Hoquiam-Wishkah									
Hoquiam River	D			H	H	U	D		
Wishkah River	H			D	H	U	H		CH
Wynoochee									
Wynoochee River	D			H	H	U	H	U	CH
Satsop									
Satsop River	H		D	H	H	U	D	U	CH *
Cloquallum									
Cloquallum Creek	H			H	H	U	H		
Mox Chehalis Creek	H			H		U	H		
Delezene Creek				H		U	H		
Newman/Vance Creek				H		U			
Wildcat Creek	H			H	H	U	H		
Rock/Williams	H			H		U	H		
South Harbor									
Alder Creek				H	H	U			
Charley Creek						U			
Newskah Creek				H		U	U		
Chapin Creek						U			
Campbell Creek				H		U			
Indian Creek				H		U			
Stafford Creek				H		U			
O'leary Creek						U			
John's River	H			H	H	U	U		

Subbasin	Fall Chinook	Spring Chinook	Summer Chinook	Coho	Chum	Cutthroat	Winter Steelhead	Summer Steelhead	Bull Trout - ESA
Elk River				H		U	U		
Andrews Creek				H		U	U		
Black									
Black River	H			H	H	U	H		
Cedar Creek	H			H		U	H		
Waddel Creek	H			H		U	H		
Porter Creek	H			H		U	H		
Lincoln									
Lincoln Creek				H		U	H		
Garrard Creek				H		U	H		
Bunker Creek				H		U	H		
Scammon Creek						U			
Stearns Creek				H		U	H		
Independence Creek				H		U			
Skookumchuck									
Skookumchuck River	H	H		H		U	H		
Scatter Creek				H		U	H		
Newaukum									
Newaukum River	H	H		H		U	H		
Salzer Creek				H		U			
Coal Creek				H		U			
Dillenbaugh Creek				H		U			
Berwick Creek				H		U			
China Creek				H		U			
Boistfort									
Upper Chehalis River	H	H		H		U	H	U	
South Fork Chehalis River	H	H		H		U	H		
Lake Creek				H		U			
Stillman Creek	H	H		H		U	H		
Rock Creek (near Crim Creek)				H		U	H		
Chehalis Mainstem									
Chehalis River Mainstem	H/D	H	D	H	H	U	H/D	U	CH **

Chinook Salmon *(Oncorhynchus tshawytscha)*

Life History Fall Chinook Salmon (Kuttel 2002)



Ocean-type (fall) Chinook typically migrate to sea during the first year of life, normally within three months of emergence. They spend the majority of their life in coastal waters and return to the natal stream in the fall a few days or weeks before spawning.

Although fall Chinook generally prefer deeper and faster spawning areas than other species in the genus *Oncorhynchus*, measurements recorded in the literature do not suggest that Chinook avoid shallow water and low flows. Their large body size may allow them to hold position in faster currents and displace larger spawning substrates than other Pacific salmon, hence the perceived preference for deeper and faster water. Past observations show that Chinook can spawn in water ranging from about 2 inches (5 centimeters) to 15 feet (4.6 meters) deep. They appear to select spawning sites with high subgravel flows. This preference may relate to the increased sensitivity of Chinook eggs to fluctuations in dissolved oxygen levels when compared to other species of Pacific salmon (Chinook produce the largest eggs, yielding a small surface-to-volume ratio) (Healey 1998).

Chinook fry appear to have more difficulty emerging from small substrate than large substrate. Most fry emergence occurs at night. Following emergence the fry move downstream, also principally at night. The fry may continue the downstream migration to the estuary, or take up residence in the stream for a few weeks to a year or more depending upon the life history strategy. Fry migrants typically range in size from 30 to 45 mm fork length. Fingerling migrants are larger, with a range of 50 to 120 mm fork length. While rearing in fresh water, Chinook feed primarily on larval and adult insects and zooplankton (Healey 1998).

Chinook fry feed in estuarine nearshore areas until they reach about 70 mm fork length, whereby they disperse to marine areas. Chinook rearing in estuarine areas are opportunistic feeders and will consume a variety of prey that range from chironomid larvae and zooplankton to mysids (opossum shrimps) and juvenile fish. Most fall Chinook do not migrate more than 1,000 km (about 620 miles) from its home stream during ocean residence. Fish, particularly herring and sand lance, are the primary prey of Chinook during their ocean growth phase. However, invertebrates such as euphausiids (krill), squid, and crab larvae are also important at times (Healey 1998).

Spring and Summer Chinook (Wydoski and Whitney 2003)

Spring and summer Chinook adults return to freshwater systems in preparation for spawning much earlier than fall Chinook. However, all Chinook stocks spawn in the fall, with spring Chinook spawning first, followed by summer Chinook, and then fall Chinook.

Spring Chinook select the upper reaches of tributaries and summer Chinook use the mouths of the tributaries for spawning.

Both spring and summer Chinook display two variations in juvenile life histories. The first life history classification is stream-type, which is typically characteristic of the spring Chinook. Stream-type Chinook normally spend a year in the freshwater system and then rapidly migrate downstream during their second spring. The second juvenile life history classification is ocean-type, which are typically offspring from summer or fall Chinook. Ocean-type juveniles begin a slower downstream migration soon after emerging and reach the ocean by the end of summer of their first year.

Chinook Distribution (Smith Wenger 2001)

The 1994 SASSI report identified seven fall Chinook stocks, one summer Chinook stock, and one spring Chinook stock within WRIA 22 and 23 (WDFW and WWTIT 1994). State and tribal fisheries manage spring Chinook stock for wild production, with spawning occurring in the larger streams of the upper Chehalis drainage in WRIA 23. Summer Chinook stock exist primarily in the Satsop subbasin, but some observations suggest that summer Chinook are also present in the upper Chehalis region (David Hamilton, Regional Enhancement Group, personal communication).

Fall Chinook are designated as separate stocks based upon geography. These stocks include: Humptulips, Hoquiam, Wishkah, Wynoochee, Satsop, Johns/Elk/South Bay Tributaries, and Chehalis fall Chinook. The Chehalis stock includes all fall Chinook upstream of the confluence of the Satsop River. Considerable hatchery releases of fall Chinook, including those of non-native stocks, have occurred in the Humptulips, Satsop, Wynoochee, Johns/Elk/South Bay, and Chehalis fall Chinook areas. The remaining fall Chinook stocks found in the Hoquiam, Wishkah, and Wynoochee drainages are considered to be wild, native fall Chinook stocks, with minimal hatchery influence.

Salmonid Stock Inventory (SaSI) Profiles (2002)

Humptulips Fall Chinook

Stock Status:	Stock status rating is "depressed" in 2002 based on a long-term negative trend in escapements. This trend has increased at a greater rate since 1996. Humptulips fall Chinook escapements have been declining for several years.
Stock Definition:	Humptulips fall Chinook were identified as a stock based on their distinct spawning distribution.

Spawning Distribution:	Most spawning takes place in the Mainstem Humptulips, the East Fork Humptulips (to RM 15.5), the West Fork Humptulips Rivers (to RM 45.8) and in Big, Stevens, Donkey, O'Brien, Newberry, Rainbow, Brittain, and Grouse Creeks.
Spawning Timing:	Spawning generally occurs from October through early December, peaking in late October to early November.
Genetic Analysis:	Fall Chinook sampled at Humptulips Hatchery in 1990 were significantly different from those of other Washington Chinook stocks examined. They were genetically most similar to other Grays Harbor/Chehalis Basin Chinook populations. Although no sample of Humptulips River natural spawners is available, hatchery broodstock has been taken from the local population since the mid- 1980s. Thus the hatchery genetic profile may be representative of the wild spawners (Ashbrook and Fuss 1996).
Stock Origin:	This is a native stock with wild production. Despite introduction of various non-native hatchery stocks into the Humptulips system between the early 1950s and 1984, there is no substantiation of genetic hybridization. The Willapa Hatchery stock released into the Humptulips River is most likely to have hybridized with the native stock. The hatchery population is similar to its nearest neighbors in the Wishkah and Wynoochee Rivers. Due to the genetic similarity of neighboring stocks to the Grays Harbor/Chehalis population group,

such as those from the Naselle Hatchery, it would be difficult to quantify introgression between Willapa and Humptulips natives using allozyme markers. Also, spawn timing of Humptulips River stock is later than the spawn timing of Willapa stock. If hybridization between the native stock and the hatchery stocks has occurred, it is probably insignificant (Anne Marshall, WDFW, pers comm).

Hoquiam Fall Chinook

Stock Status:	Hoquiam fall Chinook are experiencing decreased escapements. Stock status is rated "depressed" in 2002 due to a long-term negative trend in escapement values. Escapement data go back as far as 1985 with an escapement trend declining since the early 1990s and a short-term severe decline beginning in 1998. The 2001 escapement value is the lowest on record.
Stock Definition:	Hoquiam fall Chinook were identified as a stock based on their distinct spawning distribution.
Spawning Distribution:	Most spawning takes place in the East and West Fork Hoquiam rivers. Occasionally spawning is observed in Davis Creek and less often in the Middle Fork Hoquiam River.
Spawning Timing:	Spawning generally occurs from mid-October through early December, with a peak in late October to early November.
Genetic Analysis:	Genetic analysis has not been done on Hoquiam fall Chinook.

Stock Origin:	This is a native stock with wild production.

Chehalis Fall Chinook

Stock Status:	The rating for Chehalis fall Chinook is "healthy" in 2002 due to relatively stable escapement values since 1985. Values have remained within the normal range of variation for this stock.
Stock Definition:	Chehalis fall Chinook were identified as a stock based on their distinct spawning distribution and later river entry timing (early September through October).
Spawning Distribution:	Spawning takes place throughout the Chehalis basin upstream from the Satsop River. Major spawning areas include the mainstem Chehalis River (RM 28 to 67 and RM 88 to 108), Black, Newaukum and Skookumchuck rivers as well as Cloquallum and Porter Creeks. Spawning also takes place in Cedar Creek, Stillman Creek and the South Fork Chehalis River.
Spawning Timing:	Spawning generally occurs from mid-October to early December.
Genetic Analysis:	Genetic analysis has not been done on Chehalis fall Chinook.
Stock Origin:	This is a native stock with wild production. Although various non-native hatchery fall Chinook stocks were introduced into the basin from the early 1950s through the mid-1970s, information regarding these

releases is poor. The potential for hybridization between native and non-native stock did exist.

Wishkah Fall Chinook

Stock Status:	Wishkah fall Chinook have experienced fairly stable escapements ranging from about 300 to 900 spawners, except for 1988 and 1997 when escapements were unusually high. There has been no consistent negative trend. Stock status is rated "healthy" in 2002.
Stock Definition:	Wishkah Chinook were identified as a stock based on their distinct spawning distribution.
Spawning Distribution:	Most spawning takes place in the Mainstem Wishkah River. Fewer spawners are observed in the east and west forks of the Wishkah River.
Spawning Timing:	Spawning generally occurs from mid-October through early December, with a peak in late October to early November.
Genetic Analysis:	Wishkah River fall Chinook spawners were sampled in 1990 and 1993, and allele frequencies were significantly different from those of other Washington Chinook stocks examined, except for Wynoochee River fall Chinook (Marshall 2002).
Stock Origin:	This is a native stock with wild production. In the 1980s native Chinook were collected for hatchery broodstock. That

program ended in late 1980s, and spawning is now entirely wild.

Wynoochee Fall Chinook

Stock Status:	Escapements in 1999 to 2001 are the lowest on record and are considerably lower than the escapements used to rate status in 1992. Therefore, stock status is rated "depressed" in 2002 because of a short-term severe decline from 1999 to 2001.
Stock Definition:	Wynoochee fall Chinook were identified as a stock based on their distinct spawning distribution.
Spawning Distribution:	Most spawning takes place in the mainstem Wynoochee River above RM 10.5 and in Carter, Schafer and Helm Creeks. Small numbers of spawners are seen in Big and Anderson Creeks.
Spawning Timing:	Spawning generally occurs from October to early December, peaking in late October to early November.
Genetic Analysis:	Wynoochee River fall Chinook spawners were sampled in 1990 and 1993 and found to be significantly different from those of other Washington Chinook stocks examined, except for Wishkah River fall Chinook (Marshall 2002).
Stock Origin:	This is a native stock with wild production. There have been three releases of non-native hatchery fall Chinook into the Wynoochee basin. Numbers of fish

released were small. The potential for hybridization between introduced and native Chinook existed but was not very great.

Satsop Fall Chinook

Stock Status:	Although Satsop fall Chinook escapements have declined since 1996, they are still within the normal variation range of escapements when the stock was rated "healthy" in 1992. Consequently, stock status is again rated "healthy" in 2002.
Stock Definition:	Satsop fall Chinook were identified as a stock based on their distinct spawning distribution, later river entry timing (begins in early October) and spawning timing.
Spawning Distribution:	Most spawning takes place in the Mainstem Satsop River, Canyon River and the east and west forks of the Satsop River. Spawning also occurs in Bingham, Decker and Black Creeks as well as unnamed tributaries 22.0366 and 22.0372.
Spawning Timing:	Spawning generally occurs from October to early December, peaking in late October to mid-November.
Genetic Analysis:	East Fork Satsop River fall Chinook spawners sampled in 1993 were found to be significantly different from those of other Washington Chinook stocks examined. They were genetically most similar to other south Washington coast fall-run stocks. Fall Chinook in other Satsop

	Basin areas have not been sampled (Marshall 2002).
Stock Origin:	This is a native stock with composite production. Although there have been extensive releases of non-native fall hatchery Chinook including Humptulips, Willapa Bay, Puget Sound, Columbia River and Oregon coastal stocks, into the Satsop basin since 1952, genetic evidence from the East Fork Satsop River stock indicates a more native profile. There is no lingering evidence of Puget Sound Chinook genetic contribution in the East Fork Satsop River stock sampled. The Oregon and Columbia River stock releases were minor, and no genetic evidence of their contribution has been found (Meyers et al. 1998). Hybridization with the native stock has apparently been insignificant (Marshall 2002).

South Bay Fall Chinook

Stock Status:	There is no abundance trend data with which to rate stock status. Therefore, stock status in 2002 was "unknown."
Stock Definition:	South Bay fall Chinook were identified as a stock based on their distinct spawning distribution.
Spawning Distribution:	Most spawning takes place in the lower Johns River.
Spawning Timing:	Spawning generally occurs from October through November.

Genetic Analysis:	Genetic analysis has not been done on South Bay fall Chinook.
Stock Origin:	This is a non-native stock with wild production. Historical records of salmon utilization in these areas make no mention of fall Chinook presence (Royal 1932). In the early 1950s and late 1960s to early 1970s, releases of imported hatchery stocks similar to those of other Grays Harbor areas were used. The success of releases was not monitored.

Chehalis Spring Chinook

Stock Status:	Chehalis spring Chinook escapements have not exhibited any persistent negative trends, and current spawning distribution appears to be similar to historic distribution. For these reasons stock status is again rated "healthy" in 2002.
Stock Definition:	Chehalis spring Chinook were identified as a stock based on their distinct spawning distribution, early river entry timing (begins in late January to early February) and spawning timing.
Spawning Distribution:	Most spawning takes place in the Skookumchuck, Newaukum, South Fork Chehalis and the mainstem Chehalis rivers (RM 33.3 to 67.0 and RM 81.3 to 113.4). Some spawning occurs in the Black River and in Elk and Stillman Creeks.
Spawning Timing:	Spawning generally occurs from early September to mid-October, peaking in late September.

Genetic Analysis:	Allozyme analysis has shown Chehalis spring Chinook, represented by fish from the Skookumchuck River, to be genetically distinct from Chehalis fall Chinook (Marshall et al. 1995).
Stock Origin:	This is a native stock with wild production. Cowlitz River (lower Columbia River basin) hatchery-origin spring Chinook were released into the Wynoochee River in the mid-1970s. It is unlikely that there was any hybridization with the existing native stock.

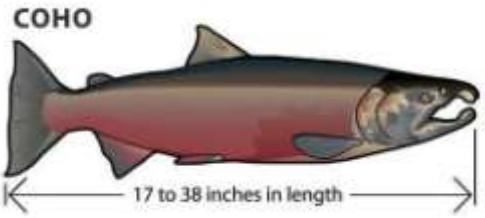
Satsop Summer Chinook

Stock Status:	This stock has not shown improvement in abundance levels and is again rated "depressed" in 2002 due to chronically low escapement values.
Stock Definition:	Satsop summer Chinook were identified as a stock based on their distinct spawning distribution, early river entry timing (begins in late August) and spawning timing.
Spawning Distribution:	Most spawning takes place in the Mainstem East Fork Satsop River. Occasionally a few spawners are seen in Decker Creek, an east fork tributary.
Spawning Timing:	Spawning generally occurs from early September to mid-October.
Genetic Analysis:	Genetic analysis has not been done on Satsop summer Chinook.

Stock Origin: This is a mixed stock with wild production. Several early-timed Chinook hatchery stocks were introduced into the Satsop basin at least from the early 1950s into the 1970s. While the Satsop summer Chinook stock spawns slightly earlier than most of the introduced stocks, the potential for some hybridization still exists.

Coho Salmon *(Oncorhynchus kisutch)*

Life History (Kuttel 2002)



Adult coho begin to enter streams when water temperatures decrease and flows increase, often resulting in short explorations into a stream and then returning to saltwater. Upstream migration typically takes place during the day after a large increase in flow, especially when combined with a high tide. Most coho return to spawn at three years of age. Juveniles typically spend four to six months incubating, up to fifteen months rearing in freshwater, and then sixteen months feeding in the ocean. Coho spawn in a variety of stream-types, including small coastal streams, large rivers, and remote tributaries. They will spawn just about anywhere that suitable gravel (15 cm or smaller in diameter) is present. Coho show particular preference for sites with groundwater seepage. The redd is typically located at the head of a riffle to promote good oxygen circulation. The eggs generally hatch in 40 to 60 days depending upon temperature. The alevins initially move downward in the gravel, likely an adaptation to prevent premature emergence of individuals that hatch close to the surface of the streambed (Sandercock 1998).

Fry about 30 mm in length emerge from the gravel about two to three weeks after hatching. Emergence occurs primarily at night and fry that emerge first are typically larger than later emerging fry. These

individuals tend to make up a large proportion of the fingerling population because they are able to out-compete smaller individuals for territories and prey. Following emergence, the fry hide in the substrate during daylight hours. After a few days they begin to swim along the banks and use whatever cover is available. Backwaters, side channels, and small streams are preferred areas, particularly in shaded areas with overhead cover. The fry may move upstream or downstream and occupy areas inaccessible to adult coho. Some coho rear in lakes, but the majority rear in streams where they establish and aggressively defend territories. They may be found in both pools and riffles, but are best adapted to pool habitat. Trout out-compete coho in riffles. The fry are active during daylight hours, defending their territories and making frequent dashes to capture prey and foreign objects perceived as prey. They settle to the bottom during the night to rest (Sandercock 1998).

Small individuals are often harassed, chased, and nipped by larger ones. Complex instream habitat composed of large rocks, large woody debris, and vegetation is important to rearing coho because production is limited by the number of suitable territories present. Displaced fry often end up in less favorable habitat where they are vulnerable to predation, including downstream at the estuary. Fish that enter the estuary during the first spring or summer of life do not generally survive to adulthood. Coho are visual feeders and prefer food moving in suspension or on the surface. They rarely feed on non-moving food or along the stream bottom. The juveniles usually rear in slower sections of the stream that allow them to capture prey with a minimum of effort. Small streams are the most productive coho areas because they provide more marginal slack water habitat than large streams. The midstream portion of large streams is generally unsuitable for juvenile coho; therefore, any food drifting through this area is unavailable (Sandercock 1998).

Fingerlings move into off-channel habitat when fall freshets begin. Instream cover, side channels, small intermittent streams, and ponds provide shelter from winter storms that could sweep the fish out of the system. They also provide refuge from predators at a time when cold-water temperatures limit fingerlings' swimming ability. Beaver ponds provide shelter to avoid high flows during winter and low flows in the summer. However, small coho in ponds are more susceptible to predation from cutthroat trout. When juvenile coho rear in conditions with moderate water temperatures and abundant prey, they grow rapidly. The fry are about 30 mm long at emergence in March, growing to 60 to 70 mm by September. By March of the second year, the fingerlings are 80 to 95 mm long. The juveniles are about 100 to 130 mm in length by May when they smolt. Exposure to water temperatures of 25°C (77°F) or greater is fatal to juvenile coho (Sandercock 1998).

In freshwater, juveniles are subject to predation by numerous animals including: cutthroat and rainbow trout, char, whitefish, sculpins, fish ducks, herons, mink, and otter. Garter snakes, dippers (water ouzel), robins, and crows are also significant consumers of juvenile coho. Coho smolts begin to migrate downstream in the spring.

Factors identified that trigger migration include fish size, stream flows, water temperature, dissolved oxygen levels, photoperiod, and forage availability (Shapovalov and Taft 1954). Outmigration generally peaks in May, with most movement occurring at night. The fish grow rapidly in the nearshore waters of the estuary, feeding on invertebrates. After attaining a larger size, they shift to feeding on fish, krill, and crab larvae (Sandercock 1998).

Coho Distribution (Smith Wenger 2001)

The Chehalis River and nearby drainages produce more coho smolts (575,000 in 1999) than any other system along the Washington Coast. In 1999, the Chehalis River was the third largest producer of wild

coho smolts in Washington State (Seiler 2000). SASSI reports seven stocks of coho salmon, all relying on the same geographic areas as fall Chinook: Humptulips, Hoquiam, Wishkah, Wynoochee, Satsop, Johns/Elk/South Bay Tributaries, and Chehalis coho, the latter which includes all coho spawners upstream of the confluence of the Satsop River (WDFW and WWTIT 1994). All stocks are composites of hatchery and wild fish, with significant hatchery influence.

In addition to geographic separation, the SASSI report did not incorporate two run timings in defining stocks (WDFW and WWTIT 1994). "Normal" coho are the most numerous and spawn in December throughout the basin (Hiss and Knudsen 1992). "Late" coho salmon spawn from January through February and have been observed in Bingham Creek, Wishkah River, and the upper Wynoochee River. Hiss and Knudsen (1992) suggested that the late run consists of wild fish and the normal run has more hatchery influence.

Salmonid Stock Inventory (SaSI) Profiles (2002)

Humptulips Coho

Stock Status:	Natural escapements continue to be reasonably large, given the basin size and have remained within the normal variations for this stock, therefore stock status is again rated "healthy" in 2002.
Stock Definition:	Humptulips coho were identified as a stock based on their distinct spawning distribution and spawning timing. There has been considerable discussion as to whether the late-spawning component (January-February) represents a separate stock or part of a single Humptulips River stock.

Spawning Distribution:	Spawning takes place in over sixty tributaries scattered throughout the Humptulips watershed. Spawning primarily occurs in Big, Hansen, Fairchild, Stevens, Ellwood, O'Brien, Donkey, and Newbury Creeks. Some spawning also takes place in the lower Mainstem Humptulips and in both the east and west forks of the Humptulips River.
Spawning Timing:	Spawning generally occurs from late October through mid-February.
Genetic Analysis:	Genetic analysis is not available for Humptulips coho.
Stock Origin:	This is a mixed stock with composite production. Releases of hatchery-reared coho have been continuous since the early 1950s. The majority of releases occurred in the Mainstem Humptulips River with stocks that included Soos Creek, Minter Creek, Samish, Dungeness, Sol Duc, and Satsop. This same stock mix is found throughout Grays Harbor tributaries. In 1977, the Humptulips Hatchery began large-scale on- and off-station production releases. Given the historical movement of stocks and the size of yearling release groups, the large numbers of naturally spawning hatchery adults are likely a mixture of native and non-native stocks.

Hoquiam Coho

Stock Status:	Natural escapements continue to be reasonably large, given the basin size, and have remained within the normal variation for this stock, therefore, stock status is again rated "healthy" in 2002.

Stock Definition:	Hoquiam coho were identified as a stock based on their distinct spawning distribution.
Spawning Distribution:	Most spawning takes place in the Mainstem and east and west forks of the Hoquiam River. Spawning also occurs in accessible tributaries such as Berryman, Polson, and Davis Creeks as well as unnamed tributaries 22.0148-0151.
Spawning Timing:	Spawning generally occurs from late October through mid-February.
Genetic Analysis:	Genetic analysis has not been done on Hoquiam coho.
Stock Origin:	This is a mixed stock with composite production. Releases of hatchery-reared coho yearlings were continuous from 1950-1970. In the late 1970s a large-scale fingerling program was carried out utilizing stocks from Soos Creek, Samish, Dungeness, Satsop, Minter Creek, Sol Duc and Humptulips hatcheries. As a result of the historical movement of stocks and the size and frequency of hatchery stock is no longer considered to be native.

Wishkah Coho

Stock Status:	In the 1990s, the average total escapement declined to 50% of the 1987-1991 average. The stock status rating is "depressed" in 2002 due to chronically low escapements.

Stock Definition:	Wishkah coho were identified as a stock based on their distinct spawning distribution.
Spawning Distribution:	Most spawning takes place in the Mainstem and East and West Forks of the Wishkah River. Spawning also occurs in accessible tributaries such as Bear, Big, Cedar, Raney and Hopper Creeks.
Spawning Timing:	Spawning generally occurs from late October through mid-February.
Genetic Analysis:	Genetic analysis has not been done on Wishkah coho.
Stock Origin:	This is a mixed stock with composite production. Releases of hatchery-reared coho yearlings were continuous from 1950 to 1970. In the late 1970s a large-scale fingerling program was carried out utilizing stocks from Soos Creek, Samish, Dungeness, Satsop, Minter Creek, Sol Duc and Humptulips hatcheries. Because of the historical movement of stocks and the size and frequency of hatchery releases, this stock is no longer native.

Wynoochee Coho

Stock Status:	There have been no observations of a downward trend in escapements from 1992 to 1999. Thus, the stock status rating is "healthy" in 2002.
Stock Definition:	Wynoochee coho were identified as a stock based their distinct spawning distribution and spawning timing. There

has been considerable discussion as to whether the late-spawning component represents a separate stock or part of a single Wynoochee River stock.

Spawning Distribution: Most spawning takes place in tributaries such as Black, Bitter, Helm, Carter, Schafer Anderson and Big Creeks. Some spawning also occurs in the upper mainstem and west branch of the Wynoochee River.

Spawning Timing: Spawning generally occurs from late October through February.

Genetic Analysis: Genetic analysis has not been done on Wynoochee coho.

Stock Origin: This is a mixed stock with composite production. Releases of hatchery-reared coho yearlings were continuous in the 1950s. In the late 1970s to 1980s a large-scale fingerling program was carried out utilizing stocks from Soos Creek, Samish, Dungeness, Satsop, Minter Creek and Sol Duc and Humptulips hatcheries. As a result of the historical movement of stocks and the size and frequency of hatchery stock is no longer considered to be native.

Satsop Coho

Stock Status: Escapements have been reasonably large throughout the period of record. Recent year escapements have been below the long-term average, however escapement size is still adequate from both genetic conservation and stock productivity standpoints. The 2002 stock status rating is "healthy."

Stock Definition:	Satsop coho were identified as a stock based on their distinct spawning distribution and spawning timing. There has been considerable discussion as to whether the late-spawning component represents a separate stock or part of a single Satsop River stock.
Spawning Distribution:	Most spawning takes place in tributaries such as Still, Canyon, Smith, Rabbit, Decker, Dry Run, Bingham, Outlet and Stillwater Creeks. Spawning also occurs in the Mainstem, East, and West Forks of the Satsop River.
Spawning Timing:	Spawning generally occurs late October through February.
Genetic Analysis:	Allozyme analysis of Satsop coho samples collected in 1995 have shown this stock to be genetically distinct from other Chehalis basin coho examined (David Teel, NOAA Fisheries, pers comm.).
Stock Origin:	This is a mixed stock with composite production. Each year approximately 300,000 coho smolts are released from the WDFW Bingham Creek Hatchery into the East Fork Satsop River. In addition, juvenile coho from both a "normal-timed" hatchery coho stock and a "late-timed" stock maintained at Bingham Creek are released throughout the Chehalis River basin. Releases of hatchery-reared coho yearlings extend back to the 1930s and 1940s. In the late 1970s and through the 1980s, a large-scale fingerling release program was carried out. Stocks origins for these releases include Soos Creek, Samish, Dungeness, Minter Creek, Sol Duc and

Satsop hatcheries. As a result of the historical movement of stocks and the size and frequency of hatchery releases, this stock is no longer considered to be native.

Chehalis Coho

Stock Status:

Escapements have been reasonably large from the mid 1980s to early 1990s. Recent year escapements are adequate from both genetic conservation and stock productivity standpoints and measured smolt production is consistently substantial. The 2002 stock status rating is again "healthy."

Stock Definition:

Chehalis coho were identified as a stock based on their distinct spawning distribution and spawning timing. There has been considerable discussion whether the late-spawning component (January-February) represents a separate stock or a continuation of a single stock.

Spawning Distribution:

Most spawning takes place in over 195 mainstem rivers and tributaries scattered throughout the Chehalis Basin. Spawning takes place in accessible tributaries such as Delezene, Cloquallum, Mox-Chehalis, Mima, Waddell, Scatter, Hanaford, Lucas, Kearney, Stillman, South Fork Lincoln, Smith and Swem Creeks. Spawning also occurs in the Upper Mainstem and the East Fork of the Chehalis River, Skookumchuck River, and Newaukum River.

Spawning Timing:

Spawning generally occurs from November through February.

Genetic Analysis:	Allozyme analysis of samples collected from the upper Chehalis River from 1994 to 1996 show that considerable genetic heterogeneity exists in the upper watershed (David Teel, NOAA Fisheries, pers comm.).
Stock Origin:	This is a mixed stock with composite production. Releases of hatchery-reared coho yearlings were continuous from 1950 to 1970. In the late 1970s and through the 1980s, a large-scale fingerling release program was carried out utilizing stocks from Soos Creek, Samish, Dungeness, Satsop, Minter Creek, Sol Duc, and Humptulips hatcheries. As a result, of the historical movement of stocks and the size and frequency of hatchery releases, this stock is no longer native.

South Bay Coho

Stock Status:	Escapements have been reasonably large from the mid 1980s to early 1990s. Recent year escapements are adequate from both genetic conservation and stock productivity standpoints and smolt production is consistently substantial. The 2002 stock status rating is "healthy."
Stock Definition:	South Bay coho were identified as a stock based on their distinct spawning distribution and spawning timing. There has been considerable discussion whether the late-spawning component (January-February) represents a separate stock or a continuation of a single stock.
Spawning Distribution:	Most spawning takes place in the mainstem upper Johns River as well as in

	the North and South Fork Johns River. Spawning also occurs in Elk River, the west branch of Elk River and in Newskah and Andrews Creeks.
Spawning Timing:	Spawning generally occurs late October through mid-February.
Genetic Analysis:	Genetic analysis has not been done on South Bay coho.
Stock Origin:	This is a mixed stock with composite production. Releases of hatchery-reared coho yearlings were continuous through the early and mid 1950s. In the late 1970s and through the 1980s, a large-scale yearling release program was carried out utilizing stocks from Soos Creek, Samish, Dungeness, Satsop, Minter Creek, Sol Duc, and Humptulips hatcheries. Most of the yearling releases were into mainstem areas. As a result, of the historical movement of stocks and the size and frequency of hatchery releases, this stock is no longer native.

Chum Salmon *(Oncorhynchus keta)*

Life History Fall Chum Salmon (Kuttel 2002)

Chum enter rivers at the slightest increase instream flow, but late in the spawning season high flows are not essential. Chum are strong swimmers, but not leapers. They often are reluctant to enter long span fish ladders and typically will not travel beyond the first significant barrier on a stream. They prefer to spawn immediately above turbulent areas or in areas of groundwater

upwelling. Eggs are generally buried 20 to 50 cm (~8 to 20 inches) deep in the substrate. Premature emergence occurs when eggs are buried less than 20 cm deep. Chum have adapted to spawn in lesser water depths and velocities than pink salmon and some of the other members of the genius *Oncorhynchus*. Late chum stocks often select spawning sites near springs above 4°C (~39°F), protecting the eggs from freezing and resulting in relatively consistent emergence timing from year to year. Intertidal spawning provides a similar benefit because the redd is warmed by marine waters during each tidal cycle. After hatching, the chum alevins move downward in the gravel. The fish have an elongated body that allows them to move through the substrate better than coho, Chinook, and steelhead alevins. They remain in the gravel from 6 to 25 days (Salo 1998).

Fry emerge from the gravel after about 5 months, typically at night, and immediately head downstream to the estuary, feeding along the way. They linger in the estuary while making the transition from fresh to salt water. The fry do not school strongly and are typically found in a scattered distribution. They typically feed on chironomids, mayfly larvae, caddisfly larvae, and other benthic invertebrates (Salo 1998).

Chum are second only to Chinook in their dependence upon estuaries. The timing of entry to sea water is often correlated with warming of nearshore waters and the associated plankton blooms. The juveniles feed primarily on zooplankton including copepods and amphipods. The fry feed extensively over submerged tide flats. This allows them to exploit both freshwater and marine food webs. Juveniles move offshore when they reach 45 to 55 mm (~1.8 to 2.2 inches) fork length, enabling them to feed on larger prey and avoid predators. Their prey consists of a variety of zooplankton, krill, and fish larvae. Chum mature in the Gulf of Alaska and Bering Sea before returning to spawn as three to five-year-olds. Three and four-year-olds make up the bulk of runs in South Puget Sound streams (Salo 1998).

Chum Distribution (Smith Wenger 2001)

The two fall chum stocks identified in WRIA 22 and 23 are the Humptulips and Chehalis (WDFW and WWTIT 1994). The 1992 SASSI list both stocks in the report as "wild" and "native" (WDFW and WWTIT 1994), but considerable hatchery influence has been noted for chum populations in the Wishkah and Satsop Rivers (David Hamilton, Regional Enhancement Group, personal communication). Chehalis chum consist of all chum spawning in WRIA 22 and 23 streams outside of the Humptulips subbasin. This includes the Hoquiam, Wishkah, Wynoochee, Satsop, Cloquallum, and Black Rivers, as well as some smaller streams. It is noteworthy that the distribution of chum has decreased over time (Phinney and Bucknell 1975).

Chum salmon enter the Humptulips in early October with the run peaking in early November. Spawning takes place in October through early December. Fall chum enter the Satsop from October through mid-November and spawn from November through mid-December (WDFW and WWTIT 1994). Fall chum enter the Wynoochee River in October and spawn during late October to early November (WDFW and WWTIT 1994).

Salmonid Stock Inventory (SaSI) Profiles (2002)

Humptulips Fall Chum

Stock Status:	Humptulips fall chum experienced strong escapements between 1978 and 1993. The escapements since 1994 have been lower, typical of the years before 1977. Shifts in ocean processes and related climate changes most likely caused these changing levels of abundance. Thus, stock status rating for 2002 is ""healthy."

Stock Definition:	Humptulips fall chum were identified as a stock based on their distinct spawning distribution.
Spawning Distribution:	Most spawning takes place in the mainstem Humptulips River (between RM 7.0 and RM 28.1), in the East Fork Humptulips River (to RM 4.0), in the West Fork Humptulips River (to RM 45.8) and in Big, Stevens, O'Brien, Newbury and Grouse Creeks.
Spawning Timing:	Spawning generally occurs late October through mid-December.
Genetic Analysis:	Genetic analysis has shown that Humptulips fall chum stock are not genetically distinct from Satsop fall chum, the only other Grays Harbor fall chum stock yet analyzed (Phelps et al. 1995). Separate stock status is based on the geographic distance among populations and the likely degree of reproductive isolation.
Stock Origin:	This is a native stock with wild production.

Chehalis Fall Chum

Stock Status:	Chehalis fall chum escapements have been strong since 1980, with two very large escapements in 1988 and 1998 (index area spawner densities in excess of 10,000 fish per mile). Stock status rating was "healthy" in 2002.

Stock Definition:	Chehalis fall chum were identified as a stock based on their distinct spawning distribution.
Spawning Distribution:	Most spawning takes place in the mainstem Hoquiam, Wishkah, Wynoochee, Satsop and Black rivers. Fewer spawners are observed in Cloquallum Creek and the lower mainstem Chehalis River.
Spawning Timing:	Spawning generally occurs from late October through mid-December.
Genetic Analysis:	Chum spawning in the Satsop River are not genetically distinct from Humptulips River fall chum. Separate stock status is based on the geographic distance among populations and the likely degree of reproductive isolation (Phelps et al. 1995).
Stock Origin:	This is a native stock with wild production. Numerous releases of non-native chum, mostly from Willapa Bay and Hood Canal, have been made primarily into the Satsop River. These introductions were generally unsuccessful, and it is unlikely that significant impact to the genetic make-up of the native stock has occurred.

Steelhead Trout *(Oncorhynchus mykiss)*

Life History Winter Steelhead Trout (Kuttel 2002)

Adult winter steelhead generally enter freshwater from November through March. Spawning usually takes place within four months of freshwater entry. The majority of returning adult steelhead are three to four years of age. These fish typically display three distinct life histories:

Two years in freshwater and one year at sea (about 50%),

Two years in freshwater and two years in saltwater (about 30%), and

Three years in freshwater and one year at sea (about 10%)

Survival of steelhead to first spawning improves with increased juvenile size at outmigration, hence the prevalence of two or three years of freshwater rearing in the three major life histories. Small groups of adult steelhead enter the stream as water levels rise following storms. The fish generally migrate upstream during daylight hours. Spawning sites are typically located near the head of a riffle (pool tailout). The redd is constructed in medium to small size gravel and is composed of several egg pockets or "pits." Each pit is typically four inches to one foot deep and about 15 inches in diameter. After egg deposition and fertilization the female covers the pit by moving upstream a few feet and excavating another pit. In the process, the disturbed gravel is washed downstream, covering the prior excavation. The completed redd is about 60 square feet in size (Shapovalov and Taft 1954).

Resident rainbow trout (and cutthroat trout, see below) often congregate near spawning steelhead. These fish are commonly thought to be feeding on dislodged eggs, but the majority are sexually mature males that are likely attempting to participate in the spawning act similar

to immature (jack) Pacific salmon. Resident rainbow trout males have been observed spawning with female steelhead in the absence of a male steelhead (Shapovalov and Taft 1954). This behavior may be an important life history strategy that is likely less common today than it was historically (McMillan 2001). Cutthroat trout also readily interbreed with steelhead (e.g. Anon 1921, Hawkins 1997, Johnson *et al.* 1999).

Steelhead are unlike Pacific salmon in that not all die following spawning. Some spawned-out steelhead called "kelts" migrate downstream and return to the ocean. These fish are able to mature and spawn again. Steelhead eggs incubate for 19 to 80 days depending upon water temperature (60°F and 40°F respectively) and in the absence of high substrate embeddedness are believed to have a hatching success of 80 to 90%. The alevins are about 18 mm in length. Fry 23 to 26 mm in length typically emerge from the gravel two to three weeks after hatching. The fry initially congregate in schools, but eventually disperse up and down the stream, with each individual staking out a territory (similar to coho). By late summer, juvenile steelhead have moved to the swifter portions of the stream. During the fall and winter months, they take shelter in backwaters and eddies to prevent being swept downstream in floodwaters. Larval insects are the principal forage of fry and fingerling steelhead. As the juveniles grow, they consume larger prey including fish. Dislodged salmonid eggs are also important food items during the late fall and winter months (Shapovalov and Taft 1954).

Juvenile steelhead have a diverse suite of life histories, with fish migrating downstream from young-of-the-year (YOY) to four years of age. The bulk of downstream migration takes place in the spring and summer. Young-of-the-year through age two juveniles make up the bulk of downstream migrants with age three and four fish only a small proportion of the outmigration. The typical life history involves migration to the ocean at two years of age, but environmental conditions and

sexual development can cause changes in the behavior pattern. Age one and YOY juveniles often remain in the lower portion of the stream or estuary for an additional year prior to migrating to the ocean. Age two and older fish typically migrate to the ocean immediately. The saltwater feeding habits of steelhead are likely similar to coho, with small fish feeding on invertebrates and larger fish feeding on fish (Shapovalov and Taft 1954).

Life History Summer Steelhead Trout (Smith Wenger 2001)

Summer steelhead adults enter the river from about May through October with spawning from about February through April. They enter the river in an immature state and require several months to mature (Burgner et al 1992). Summer steelhead usually spawn farther upstream than winter stocks (Withler 1966) and dominate inland areas such as the Columbia Basin. However, the coastal streams support more winter steelhead populations. Juvenile steelhead can either migrate to sea or remain in freshwater as rainbow or redband trout. In Washington, those that are anadromous usually spend 1-3 years in freshwater, with the greatest proportion spending two years (Busby et al. 1996). Because of this, steelhead rely heavily on the freshwater habitat and are present in streams all year long.

Steelhead Distribution (Smith Wenger 2001)

Eight stocks of winter steelhead trout are listed in the SASSI report, with separate stocks in the Humptulips, Hoquiam, Wishkah, Wynoochee, Satsop, Johns/Elk/South Bay Tributaries, Skookumchuck/Newaukum and Chehalis (all spawners upstream of the confluence of the Satsop River except in the Skookumchuck and Newaukum Rivers) (WDFW and WWTIT 1994). Most of the winter steelhead stocks are native, but the Skookumchuck/Newaukum stock is considered a composite of hatchery and wild returns, and the Wynoochee stock is mixed origin, with hatchery

production. Also, there are questions about the origin of the early portion of Satsop winter steelhead.

Salmonid Stock Inventory (SaSI) Profiles (2002)

Humptulips Winter Steelhead

Stock Status:	The status of Humptulips winter steelhead rating is "depressed" in 2002 because there is a long-term negative trend in escapements. This stock has continued to decline and has met the escapement goal of 1,600 fish in only six of the last twelve years.
Stock Definition:	Humptulips winter steelhead were identified as a stock based on their distinct spawning distribution.
Spawning Distribution:	Most spawning takes place in the Mainstem Humptulips and east and west forks of the Humptulips River. Spawning also occurs in tributaries such as Brittian, Stevens, Donkey and Newberry Creeks.
Spawning Timing:	Spawning generally occurs from mid-February through June.
Genetic Analysis:	Genetic analysis has not been done on Humptulips winter steelhead.
Stock Origin:	This is a native stock with wild production.

Humptulips Summer Steelhead

Stock Status:	There are no adequate abundance trend data with which to assess stock status, so status in 2002 continues to be "unknown." Sport harvest data are now of no value in rating status due to low harvest numbers and season closures.
Stock Definition:	Humptulips summer steelhead were identified as a stock based on their distinct spawning distribution.
Spawning Distribution:	Specific spawning locations in the Humptulips basin are unknown.
Spawning Timing:	Spawning timing is unknown.
Genetic Analysis:	Genetic analysis has not been done on Humptulips summer steelhead.
Stock Origin:	This is a native stock with wild production.

Hoquiam Winter Steelhead

Stock Status:	The status of Hoquiam winter steelhead is "depressed" in 2002 because of a short-term severe decline in escapements from 1998 to 2001. This stock has not met the escapement goal of 450 fish in the last six years. The 2003 escapement value is the lowest on record.
Stock Definition:	Hoquiam winter steelhead were identified as a stock based on their distinct spawning distribution.

Spawning Distribution:	Most spawning takes place in the east and west forks of the Hoquiam River. Spawning also occurs in the middle fork of the Hoquiam River and Davis Creek.
Spawning Timing:	Spawning generally occurs from mid-February through mid-June.
Genetic Analysis:	Genetic analysis has not been done on Hoquiam winter steelhead.
Stock Origin:	This is a native stock with wild production.

Chehalis Summer Steelhead

Stock Status:	Because no adequate abundance trend data exists to assess stock status, Chehalis summer steelhead status in 2002 continues to be "unknown." Escapement is not monitored, and sport harvest data are now of no value in rating status due to low harvest numbers and season closures.
Stock Definition:	Chehalis summer steelhead were identified as a stock based on their distinct spawning distribution.
Spawning Distribution:	Specific spawning locations are unknown.
Spawning Timing:	Spawning timing is unknown.
Genetic Analysis:	Genetic analysis has not been done on Chehalis summer steelhead.

Stock Origin:	This is an unknown stock with wild production. A native stock originally returned to the Chehalis River system, but now there is uncertainty about natural production by hatchery summer steelhead spawning in the wild.

Chehalis Winter Steelhead

Stock Status:	The status of Chehalis winter steelhead is again rated "healthy" in 2002. Escapements have been high and relatively stable from 1992 to 2001. Although this stock has met the escapement goal of 2,700 fish in only four years since 1986, fluctuations in spawner abundance are considered to be within the normal range of variation for the stock.
Stock Definition:	Chehalis winter steelhead were identified as a stock based on their distinct spawning distribution.
Spawning Distribution:	Spawning takes place in more than 70 locations scattered throughout the Chehalis basin. Most spawning takes place in the mainstem Chehalis, East and West Fork Chehalis rivers and in tributaries such as Cloquallum, Porter, Rock, Crim, Cinnabar, Hanlan and Stillman Creeks.
Spawning Timing:	Spawning generally occurs from mid-February through mid-June.
Genetic Analysis:	Genetic analysis has not been done on Chehalis winter steelhead.

Stock Origin:	This is a native stock with wild production.

Wishkah Winter Steelhead

Stock Status:	The status of Wishkah winter steelhead is again rated "healthy" in 2002. Escapement values declined from 1996 to 1998, however escapement values have remained within the normal variation for this stock.
Stock Definition:	Wishkah winter steelhead were identified as a stock based on their distinct spawning distribution.
Spawning Distribution:	Most spawning takes place in the mainstem and in the west and east forks of the Wishkah River. Spawning also occurs in Cedar, Big and Raney Creeks.
Spawning Timing:	Spawning generally occurs from mid-February through June.
Genetic Analysis:	Genetic analysis has not been done on Wishkah winter steelhead.
Stock Origin:	This is a native stock with wild production.

Wynoochee Winter Steelhead

Stock Status:	The status of Wynoochee winter steelhead stock is again rated "healthy" in 2002. Escapements have met the goal of 1,260 adults sixteen out of the last eighteen years and have remained within the normal range of variation for this stock.

Stock Definition:	Wynoochee winter steelhead were identified as a stock based on their distinct spawning distribution.
Spawning Distribution:	Most spawning takes place in the Mainstem Wynoochee River, above and below Wynoochee Lake and in Shafer and Big Creeks. Spawning also occurs in tributaries such as Bitter, Helm, Carter, Anderson and Neil Creeks.
Spawning Timing:	Spawning generally occurs from mid-February through June.
Genetic Analysis:	Genetic analysis has not been done on Wynoochee winter steelhead.
Stock Origin:	This is a mixed stock with composite production. This stock has been supplemented with hatchery smolts including Chambers Creek winter steelhead. Substantial interbreeding between hatchery and wild fish is thought to have occurred since the early 1980s.

Satsop Winter Steelhead

Stock Status:	Status is again rated "depressed" in 2002 due to chronically low abundance levels. Escapement values continue to be low and have met the escapement goal of 2,800 fish in only seven out of the last eighteen years.
Stock Definition:	Satsop winter steelhead were identified as a stock based on their distinct spawning distribution.

Spawning Distribution:	Most spawning takes place in the mainstem Satsop, West Fork Satsop, Middle Fork Satsop, East Fork Satsop and Canyon rivers as well as Decker and Bingham Creeks. Limited spawning also occurs in Dry Run, Phillips, Black, and Rabbit Creeks.
Spawning Timing:	Spawning generally occurs from mid-February through June.
Genetic Analysis:	Genetic analysis has not been done on Satsop winter steelhead.
Stock Origin:	This is a native stock with wild production.

South Bay Winter Steelhead

Stock Status:	Steelhead spawning ground survey data (North Fork Johns River) has been collected by the Quinault Fisheries program from 1987 to 2002. However, the escapement estimates for the South Bay have not been tabulated (Curt Holt, WDFW, personal communication). Status in 2002 continues to be "unknown." No escapement goal has been identified for this stock.
Stock Definition:	South Bay winter steelhead were identified as a separate stock based on their distinct spawning distribution.
Spawning Distribution:	Most spawning takes place in the north and south fork of the Johns River. Fewer spawners are observed in the Elk River and in Andrews, Hall and Newskah Creeks.

Spawning Timing:	Spawning generally occurs mid-February through mid-June.
Genetic Analysis:	Genetic analysis has not been done on South Bay winter steelhead.
Stock Origin:	This is a native stock with wild production.

Skookumchuck/Newaukum Winter Steelhead

Stock Status:	The status of Skookumchuck/Newaukum winter steelhead is rated "healthy" in 2002. The escapement goal is 1,429 adults and has been achieved for three out of the last six years. Most of the increase in abundance has occurred in the Newaukum River. There is still a concern about the abundance of the Skookumchuck River component of this stock.
Stock Definition:	Skookumchuck/Newaukum winter steelhead were identified as a stock based on their distinct spawning distribution.
Spawning Distribution:	Most spawning takes place in the Skookumchuck, Newaukum, North, Middle and South Forks Newaukum rivers. Spawning also takes place in tributaries such as North Hanaford, Thompson, Lucas, Bernier, Mitchell, and Kearney Creeks.
Spawning Timing:	Spawning generally occurs from mid-February through mid-June.

Genetic Analysis:	Genetic analysis has not been done on Skookumchuck/Newaukum winter steelhead.
Stock Origin:	This is a native stock with composite production. Hybridization with hatchery adults originating from native Skookumchuck River fish has likely been occurring since 1976 due to similar spawning timing of native and hatchery stocks in both rivers.

Coastal Cutthroat Trout *(Oncorhynchus clarki clarki)*

Life History (Kuttel 2002)

Coastal cutthroat spawn from late winter through late spring in low gradient reaches of small tributary streams or the lower reaches of larger streams. These streams are typically small with summer low flows often between 0.1 m3/s and 0.3 m3/s (~ 3.5 to 10.6 cfs) (Johnston 1982, cited in Trotter 1997). Pea to walnut size gravel is the preferred spawning substrate. Redds are typically constructed in pool tailouts 15 to 45 cm (~ 6 to 18 inches) deep. The deep water of the pool may be used as escape cover. If larger salmonids such as coho are present, cutthroat will migrate upstream above the reaches used by salmon. Repeat spawning female coastal cutthroat produce more eggs of a larger size than first-spawning females. The larger eggs develop into larger alevins that have higher survival than small alevins. Emergence from the gravel typically peaks in mid-April, but may extend from March through June. Newly emerged fry are about 25 mm (~ 1 inch) long. The juveniles spend their first few weeks in lateral habitats including low- velocity backwaters, side channels, and other areas of cover along the channel margin (Trotter 1997).

During the summer months, young-of-the-year (Age-0) cutthroat prefer to rear in pools and other slow-water habitats. However, if coho

juveniles are present, cutthroat are often displaced into riffles. Coho emerge earlier and at a larger size than cutthroat. They are able to out-compete cutthroat because of their larger size, aggressive behavior, and body morphology better adapted to pool habitat. Juvenile steelhead may displace juvenile cutthroat from riffles in a similar fashion. Steelhead are more aggressive with a body better adapted to riffle habitat than cutthroat. Interactions between young-of-the-year coho, steelhead, and cutthroat during the summer rearing period may set a natural limit on cutthroat production in streams where all three species are present. Stream-rearing juvenile coastal cutthroat may be feeding generalists, consuming whatever prey is available. Age-0 cutthroat consume both benthic (bottom dwelling) and drift organisms. Age-1 and older cutthroat often eat coho fry up to 50 to 60 mm (~ 2 inches). Cutthroat parr, smolts, and kelts (spawned adults) eat a variety of items including: insect larvae, sand shrimp, and small fish. Territoriality and agonistic behavior between juvenile salmonids decreases with the approach of winter. The juveniles overwinter in deep pools associated with large woody debris and undercut banks, as well as boulders and cobbles that provide interstitial cover. Off-channel pools, side channels, and lakes are also used where available (Trotter 1997).

Puget Sound coastal cutthroat typically smolt at age 2 with an average length of 160 mm (~ 6 inches). Seaward migration begins as early as March and continues through mid-July, with a peak in late May to early June. Anadromy is not well developed in coastal cutthroat trout. They spend little time in saltwater and often remain in the tidewater and estuarine reaches of their home streams. While in saltwater, cutthroat generally travel along the shoreline within 50 km (~ 31 miles) of the home stream and are reluctant to cross deep open water. They grow about 25 mm (~ 1 inch) per month while foraging in salt water. Marine survival of coastal cutthroat is as much as 40% higher than other Pacific salmonids. Predation by Pacific hake, spiny dogfish,

harbor seals, and adult salmon likely accounts for the majority of mortality (Trotter 1997).

Coastal cutthroat seldom over winter in salt water. They often return to freshwater the same year they migrated to sea, but not all of these fish are spawners. Few female coastal cutthroat mature sexually before age 4. The immature fish over winter in freshwater then return to saltwater a second time to forage. These fish spawn following their second return to freshwater (Trotter 1997). In Puget Sound only 20 to 27% of first-return females spawned, while nearly all of the first-return males spawned (Johnston 1982, cited in Trotter 1997). In large streams (summer low flows > 1.4 m3/s, ~ 49 cfs) fish enter freshwater from July through November with a peak in September and October. In small streams (summer low flows < 0.6 m3/s, ~ 21 cfs) that flow directly to saltwater, cutthroat enter freshwater from December through March with a peak in December and January. Coastal cutthroat survive spawning quite well (Trotter 1997). Kelts return to saltwater from late March through early April, about one month earlier than cutthroat smolt outmigration. This timing places the adults in position to feed on outmigrating juvenile salmonids, particularly pink and chum salmon (Trotter 1997).

Salmonid Stock Inventory (SaSI) Profiles (2002)

Humptulips Coastal Cutthroat

Stock Status:

The status of the Humptulips stock was "unknown" in 2000. Juvenile densities in Stevens Creek, a Humptulips tributary, are comparable to those of other major river tributaries sampled on the south coast. A local angler reports that the catch rate in Big Creek, a Humptulips tributary, is stable. Based on anecdotal information from local residents, cutthroat population size in the West Fork Humptulips is greatly reduced from historic levels. However, no

quantitative data exist for many of these watersheds.

Stock Definition: The Humptulips River coastal cutthroat stock is believed to be distinct based on its geographic spawning distribution. Grays Harbor is one of the largest estuaries on the west coast of North America and is fed by the Humptulips and Chehalis Rivers.

Spawning Timing: River entry by anadromous fish is from January through April (late entry). Spawning by anadromous and fluvial forms occurs January through April and from February through March for the resident form.

Genetic Analysis: It is possible that cutthroat from the Humptulips River should be included in the Chehalis cutthroat stock complex, but genetic information is lacking to make this determination.

Stock Origin: No hatchery-origin coastal cutthroat have been released into the Humptulips River, however there is some potential for interbreeding with hatchery-origin anadromous cutthroat derived from other native Grays Harbor stocks utilizing the intertidal zone of the Humptulips. The Humptulips stock is considered native and is sustained by wild production.

Chehalis Coastal Cutthroat

Stock Status: The status of the Chehalis stock complex is "unknown." However, based on juvenile density sampling in the upper basin conducted by the Weyerhaeuser

	Corporation and returns to the West Branch Hoquiam River trap operated by the Quinault Indian Nation, it is believed that cutthroat are relatively abundant and widely distributed.
Stock Definition:	The Chehalis coastal cutthroat stock complex is considered distinct based on the geographic distribution of its spawning grounds.
Spawning Distribution:	Cutthroat are present in virtually all perennial tributaries and mainstem reaches of this system in one or more of their life history forms. The anadromous and fluvial forms inhabit mainstem and accessible tributary reaches. The resident form exists both above anadromous barriers and below where they mix with anadromous fish. Adfluvial fish are found in many lakes in the drainage.
Spawning Timing:	River entry is from October through April (early and late entry). Spawning by anadromous and fluvial life history forms occurs from January through mid-March. Adfluvial fish spawn from March through mid-April, and resident fish spawn from February through mid-March.
Genetic Analysis:	The Chehalis coastal cutthroat stock complex includes cutthroat in Johns, Hoquiam, Wishkah, Wynoochee, Satsop, Black, Skookumchuck, and Newaukum rivers, as well as in smaller tributaries and headwaters of the Chehalis. The number of genetically distinct stocks within the Chehalis complex and the relationship of

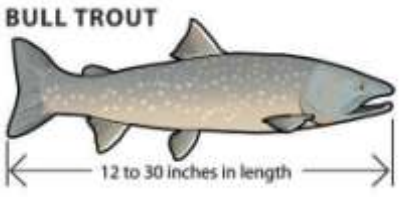
this complex to other stocks and stock complexes are unknown. Because of the variety of habitat types available to cutthroat in the basin, there may be as much genetic variation within this stock complex as there is among other stocks complexes. Further genetic sampling and analysis are needed to make these determinations. Cutthroat from several sites in the Chehalis basin were sampled for genetic analysis in 1995 as part of a coastwide genetics survey of coastal cutthroat conducted by Washington, Oregon, and the National Marine Fisheries Service. The Chehalis stock complex is represented by a collection from Wildcat Creek which was found to be significantly different from other South Coast collections.

Stock Origin:

Until recently the WDFW Aberdeen Hatchery maintained an anadromous coastal cutthroat broodstock derived from native Grays Harbor/Chehalis stocks. Consequently Chehalis coastal cutthroat are considered native with composite production.

Bull Trout *(Salvelinus confluentus)*

Life History (USFWS 1998, 2004)



Bull trout reach sexual maturity at between four and seven years of age and are known to live as long as 12 years. They spawn in the fall after temperatures drop below 48 degrees Fahrenheit (8° C), in streams with cold, unpolluted water, clean gravel and cobble substrate, and gentle stream slopes. Many

spawning areas are associated with cold water springs or areas where stream flow is influenced by groundwater. Bull trout eggs require a long incubation period compared to other salmon and trout (4-5 months), hatching in late winter or early spring. Fry remain in the stream bed for up to three weeks before emerging. Juvenile fish retain their fondness for the stream bottom and are often found at or near it. Some bull trout may live near areas where they were hatched. Others migrate from streams to lakes, reservoirs, or saltwater a few weeks after emerging from the gravel.

Bull Trout Distribution

Bull trout have been historically, or are currently, documented in tributaries west of, and including, the Satsop River in the Chehalis system (Mongillo 1993). Bull trout have been caught by steelhead anglers in the Wynoochee (Keizer 1990; G. Deschamps, Chehalis Tribe, personal communication 1997; T. Hooper, NOAA Fisheries, personal communication, 2004), West Fork Satsop, and Canyon Rivers (Webster, in litt. 2001). Historical observations of bull trout were reported in the Humptulips River during Washington Department of Fish and Wildlife creel checks in 1958 and 1973 (Burley, in litt. 1997). Bull trout have recently been documented in systems that enter into Grays Harbor, such as the Wishkah and Humptulips Rivers (Dachtler, in litt. 2001; Ereth, in litt. 2002). Bull trout were reported in Grays Harbor surveys targeting other salmonids from 1966 through 1981 (Jeanes et al. 2003), but no additional observations of bull trout were reported from 1981 to 2001. In 2002, beach seine surveys that targeted bull trout located the species in Grays Harbor (Jeanes et al. 2003). Bull trout have been documented in the Chehalis River from its mouth upstream to Garrard Creek (Brix 1974; Keizer 1990; Jeanes et al. 2003). In April 2003, a single bull trout was captured in the lower Chehalis River and surgically implanted with a sonic tag. Preliminary data indicated that this fish left the Chehalis River system shortly after it was tagged and did not return to the basin

(Jeanes, in litt. 2003). It is not understood how bull trout in these rivers and the harbor interact or relate either to one another or to bull trout in the coastal core areas.

Based on the professional judgment and experience of members of the recovery team, Grays Harbor, the Chehalis River upstream to and including the Satsop River, and portions of the Wishkah, Wynoochee, and Humptulips Rivers used by salmon and steelhead, have been identified as either current or suspected bull trout foraging, migration, and overwintering habitat important for bull trout recovery in the Olympic Peninsula (Olympic Peninsula Recovery Team, in litt. 2003 b,c). The Satsop River has also been identified as a research area to determine the feasibility of reestablishing bull trout in the West Fork Satsop River. There are no records of bull trout use in the Hoquiam River, and bull trout use of the Hoquiam River has been identified as a research need.

Salmonid Stock Inventory (SaSI) Profiles (2002)

The following information is from the 1998 Salmonid Stock Inventory (SaSI) – Bull Trout and Dolly Varden:

Stock Name:	Chehalis/Grays Harbor Bull Trout/Dolly Varden
Stock Number:	8348
ESU/RU Name:	Olympic Peninsula Bull Trout
Species:	Bull Trout/Dolly Varden
Run Timing:	Unspecified
Origin:	Native
SASI Status:	Unknown
ESA Status:	Threatened
ESA Listing Date:	11-01-1999
Status Rating Criteria:	Not applicable
Spawning Timing:	Data not available
Production Type:	Wild
Data Quality:	No Data
Data Source:	SASI database, 1998

Section 3:
Subbasin Profiles

Conceptual Model for Subbasin Profiles

The goal of the Lead Entity is to identify short- and long-term voluntary restoration and protection actions that improve or protect natural processes within subbasins that create healthy habitat for salmonids.

The interaction of natural processes on both a subbasin and reach level creates and sustains salmon habitat (Beechie and Bolton 1999). Minimally, habitat-forming processes in a subbasin include:

- Sediment supply
- Hydrological regime
- Organic matter inputs
- Nutrient chemical inputs
- Light/heat inputs
- Gross stream morphology

Geology, climate, vegetation, and gross reach morphology are the four primary controls that directly influence habitat-forming processes. The balance between these four controls shifts constantly to create a naturally dynamic ecosystem. Salmon in turn have evolved successfully to adapt within the operating context of such an environment (Beechie et al. 2003).

However, the introduction of land uses within ecosystems has disrupted the normal balance among habitat-forming processes in a way detrimental to the fitness and survival of salmon. Land use has its most significant impact on vegetation, a control that is susceptible to accelerated change over years or decades as opposed to centuries or millennia as with geology, climate, and gross morphology. The impacts

of vegetation on natural processes also are more noticeable over smaller areas and dramatically determine habitat conditions. For example, land use activities that decrease forest cover negatively alter salmon habitat by increasing sediment supply, reducing wood recruitment, and raising water temperatures.

Figure 1 shows the relationships between controls, processes, habitat effects (limiting factors), and fish population response (Beechie et al. 2003).

Natural processes changed by land use can result in habitat effects detrimental to salmonids (limiting factors). Table 2 lists the most common limiting factors in WRIA 22-23 and their impact to physical processes and salmon.

Successful restoration efforts recognize that limiting factors to salmon are symptoms of a larger, underlying problem of disrupted habitat-forming processes and functions at the watershed and/or reach level. Thus, the more effective long-term goal of the Lead Entity is to focus efforts that restore natural processes and functions that create and sustain habitat. However, projects that artificially enhance instream habitat may be necessary as interim measures until habitat-forming processes are fully functional.

Figure 1: Relationships between controls, processes, habitat effects (limiting factors), and fish population response (Beechie et al. 2003)

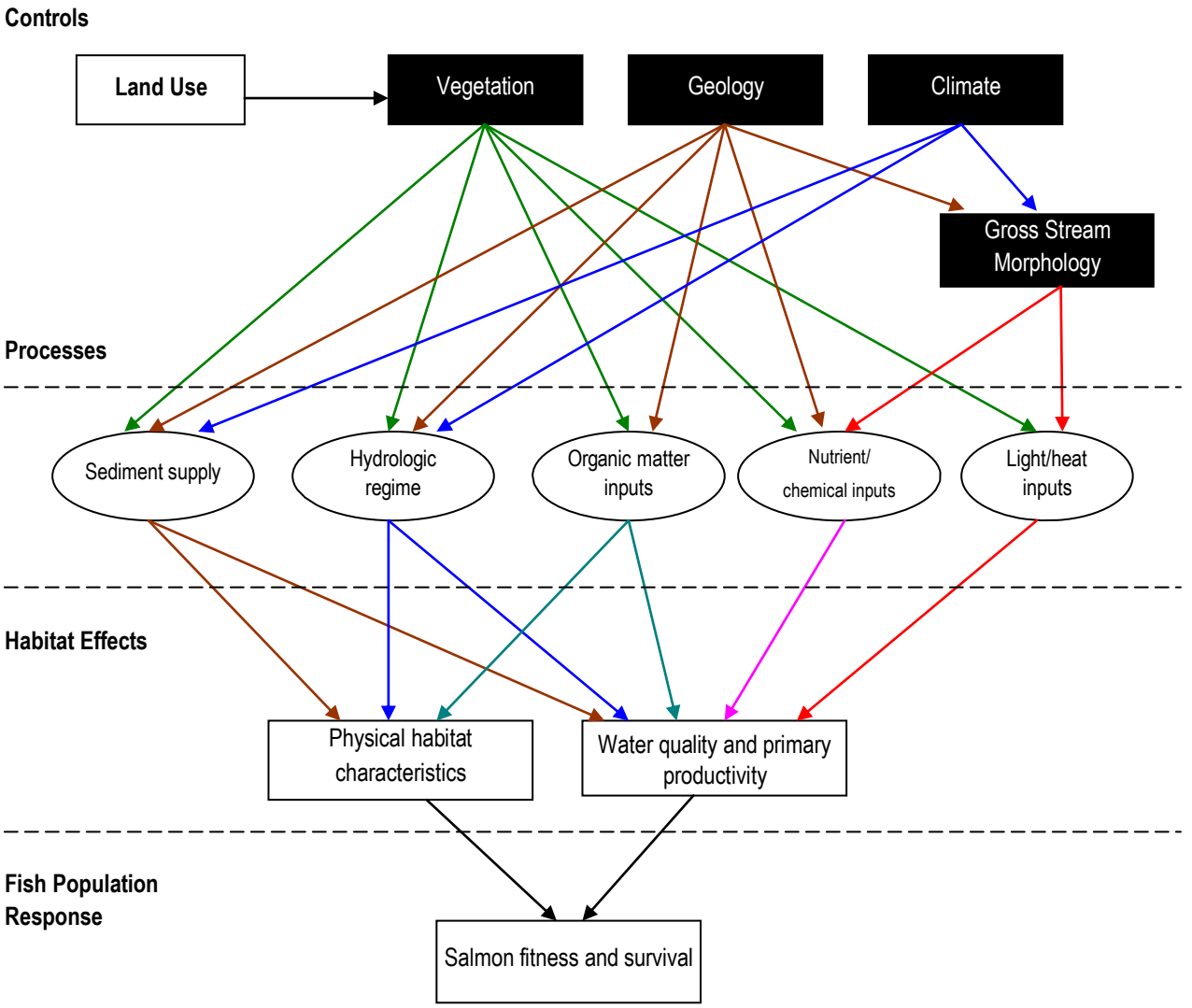


Table 2: Common limiting factors in WRIA 22-23 and their impact to physical processes and salmon.

Limiting Factor	Physical Process Effects	Effects on Fish
Sediment	High contributions of sediment are typically associated with land use management practices. Common sources are usually logging roads, landscapes void of vegetation, landslides, and areas of excessive streambank erosion. High amounts of sediment can cause excessive aggradation downstream and alter substrate composition.	High amounts of fine sediment can suffocate salmonid eggs laid in the gravel substrate. Increased sedimentation can change invertebrate assemblages, which juvenile salmonids prey upon. Excessive sedimentation can cause accelerated instream aggradation resulting in altered physical habitat features such as: filling of pools and rearing areas. Excessive sedimentation can alter the substrate composition to a less suitable quality for salmonid spawning.
Fish Passage	Poor fish passage conditions are typically a result of improperly sized water crossing structures. Undersized stream crossing structures do not allow for adequate transport of substrate, LWD, or fish. In many cases the area immediately upstream of undersized crossing structures accumulates sediment and LWD and the area immediately downstream is scoured. These symptoms are a direct result of altered stream flow in the specific location of the crossing.	Undersized stream crossing structures restrict salmon access to upstream habitat for spawning and rearing. The inability for fish to access upstream habitat reduces the system's productivity (carrying capacity and nutrient cycling). The inadequate transport of substrate and LWD through stream crossing structures can decrease habitat characteristics needed for salmonid survival. Some examples are: • LWD for cover • Substrate for spawning • Scour downstream channel
Floodplain	Floodplain impacts typically are a result of floodplain filling, dike and levee construction, and streambank armoring. Floodplain impacts such as dikes and levees reduces the amount of food water storage capacity, which concentrates the flow and its energy to a more confined area. This concentration of flow and energy contributes to scour, channel incision, and streambank erosion.	The installation of dikes and levees reduces the amount of accessible off-channel habitat for juvenile salmonid rearing. The installation of dikes and levees also reduces the amount of water storage in a system. This water storage is critical for adequate stream flows, for salmonids, during the summer months when less precipitation occurs.

Limiting Factor	Physical Process Effects	Effects on Fish
Riparian	Poor riparian conditions are typically the result from intentional removal of vegetation. This is usually associated with land use conversion or active timber harvest management. Lack of riparian cover contributes to increased water temperatures. Increased water temperature decreases the amount of dissolved oxygen the water can hold. An insufficient riparian corridor does not adequately filter surface water runoff which can allow sediment and pollutants to enter the stream/river. An inadequate riparian corridor, such as hardwood dominant or void of vegetation, does not provide adequate long term LWD recruitment (see LWD section below).	Increased water temperatures cause physical stress on salmonids. Increased water temperature decreases the amount of dissolved oxygen the water can hold, which is critical for salmonid survival. A riparian corridor lacking in vegetation does not provide organic matter needed help support macroinvertebrate survival (juvenile salmonid prey).
LWD	LWD deficiencies are usually the result of poor riparian conditions and removal of LWD from the channel. Insufficient amount of LWD does not allow for adequate substrate retention and gravel sorting and can contribute to channel scour and incision. Low levels of LWD do not provide instream channel complexity (cover, pools, and riffles). Low levels of LWD do not supply associated nutrients.	Low levels of LWD do not provide instream channel complexity needed to create the various habitat attributes for the various life stages of salmonids (cover, pools, riffles). Cover for protection Sort substrate for more ideal spawning conditions Create holding areas for adult and juvenile salmonids Low levels of LWD limits the amount of nutrient input into a system indirectly needed for salmonid survival.
Water Quality	Poor water quality is typically associated with water temperature, suspended solids, and chemical composition. Impacts usually result from poor riparian conditions and stormwater runoff problems.	High amounts of sediment can suffocate salmonid eggs laid in the gravel substrate, which reduces egg survival. Increased water temperatures can cause a physical stress on salmonids jeopardizing their survival. Low summer flows concentrate instream toxins that can adversely affect salmonids.

Limiting Factor	Physical Process Effects	Effects on Fish
Water Quantity	Low summer flows are typically a result of an altered hydrology (landscape manipulation that allows rapid surface runoff). In non-glacial systems summer flows are maintained by groundwater connectivity, wetland discharges, and precipitation. The combination of altered hydrology and the removal of instream structure contribute to channel incision and disconnection from floodplains and adjacent wetlands which results in the inability to store water for summer flows. High peak flows also contribute to accelerated bank erosion and movement of substrate downstream. Low summer flows are susceptible to becoming too warm, low in dissolved oxygen, and have a higher concentration of other pollutants, all of which affect salmonid survival.	Low flows tend to have higher temperatures that decrease its ability to hold dissolved oxygen. High water temperatures and low dissolved oxygen impose physical stress on salmonids. Low flows can inhibit upstream salmonid migration and reduce the amount of available instream habitat for rearing.

Establishing Subbasin Priorities

For a definition and list of priority stocks, see Table 1, Section 2.

The Habitat Work Group for WRIA 22-23 analyzed conditions within each subbasin and prioritized those limiting factors that impose the most limiting factors affecting the fitness and survival of priority stocks. Identifying these priorities in turn provides WRIA 22-23 with subbasin strategies that sequence recovery and protection actions that render the most significant benefit to priority stocks.

Prioritization Process

The process of developing the strategy began with an extensive effort by the Habitat Work Group to prepare individual draft profiles of each subbasin in WRIA 22-23. Members of the Habitat Work Group collected data on general features of the subbasin, type and status of anadromous fish stocks, land use activities, and a limiting factors analysis. This latter piece focused on

- The symptom(s) of each limiting factor (what conditions exist that indicate a limiting factor),
- The cause of the limiting (what is the root problem or problems that lead to the symptom), and
- The general recovery actions addressing the cause of the symptom that ultimately will lead to the restoration of natural processes within the subbasin.

Data for each profile came from the best information currently available specific to a subbasin and in some cases the professional observation/judgment of the profile preparer. References used follow at the end of each profile.

The second step in the strategy development process was to have each profile undergo peer review. A peer group solely consisting of conservation specialists reviewed each profile for accuracy and clarity. Often, the reorganization and more material were added to

each profile at this stage. This eventually became a second draft of each subbasin profile.

Once the second draft profile was complete, another peer review group analyzed the results and prioritized the degree of impact created by each limiting factor on the fitness and survival of targeted stocks. This was done by assigning each limiting factor within a subbasin to one of three tier concerns. Tier 1 Concerns represented the most pressing limiting factors impacting the viable salmonid population (VSP) parameters of abundance, productivity, diversity, and spatial structure. For a definition of each VSP parameter, see Figure 2.

If community values support the general recovery actions, the preference of the Lead Entity is that Tier 1 Concerns ordinarily would be first in line for implementation due to their potential impact in providing the greatest benefit to fish. Tiers 2 and 3 follow in the same vein, although decreasingly reduced in priority due to their lesser benefit to fish.

It is important to note that even though Tier 1 Concerns will scientifically render the greatest benefit to fish, community values may not always endorse them as a priority. In some subbasins or along certain reaches, it may be possible only to implement Tier 2 and 3 general recovery actions. The Lead Entity maintains that such projects in many cases may be the best or only socially acceptable alternatives available. They also may provide related benefit to fish in ways not solely restricted to habitat restoration, such as public outreach and education in support of salmon recovery.

Figure 2: Viable Salmonid Population Parameters

Abundance:	A population should be large enough to survive, and be resilient to, environmental variations and catastrophes such as fluctuations in ocean conditions, local contaminant spills or landslides.
	Population size must be sufficient to maintain genetic diversity.
Productivity:	Natural productivity should be sufficient to reproduce the population at a level of abundance that is viable.
	A viable salmon population should not exhibit sustained declines that span multiple generations.
	A viable salmon population that includes naturally spawning hatchery-origin fish should exhibit sufficient productivity from spawners of natural origin to maintain the population without hatchery subsidy.
	Productivity should be sufficient throughout freshwater, estuarine and nearshore life stages to maintain viable abundance levels, even during poor ocean conditions.
Spatial Structure:	Habitat patches should not be destroyed faster than they are naturally created.
	Human actions should not increase or decrease natural rates of straying among salmon sub-populations.
	Habitat patches should be close enough to allow the appropriate exchange of spawners and the expansion of a population into underused patches. Some habitat patches may operate as highly productive sources for population production and should be maintained.
	Due to the time lag between the appearance of empty habitat and its colonization by fish, some habitat patches should be maintained that appear to be suitable or marginally suitable, even if they currently contain no fish.
Diversity:	Human-caused factors such as habitat changes, harvest pressures, artificial propagation and exotic species introduction should not substantially alter variation in traits such as run timing, age structure, size, fecundity (birth rate), morphology, behavior, and genetic characteristics.
	The rate of gene flow among populations should not be altered by human-caused factors.
	Natural processes that cause ecological variation should be maintained.

Excerpted from Puget Sound Salmon Recovery Plan, Shared Strategy for Puget Sound, 2007
http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Puget-Sound/upload/Chapter4.pdf
For a thorough discussion of VSP parameters, see McElhany et. al (2000) at the following address:
http://www.nwfsc.noaa.gov/assets/25/5561_06162004_143739_tm42.pdf

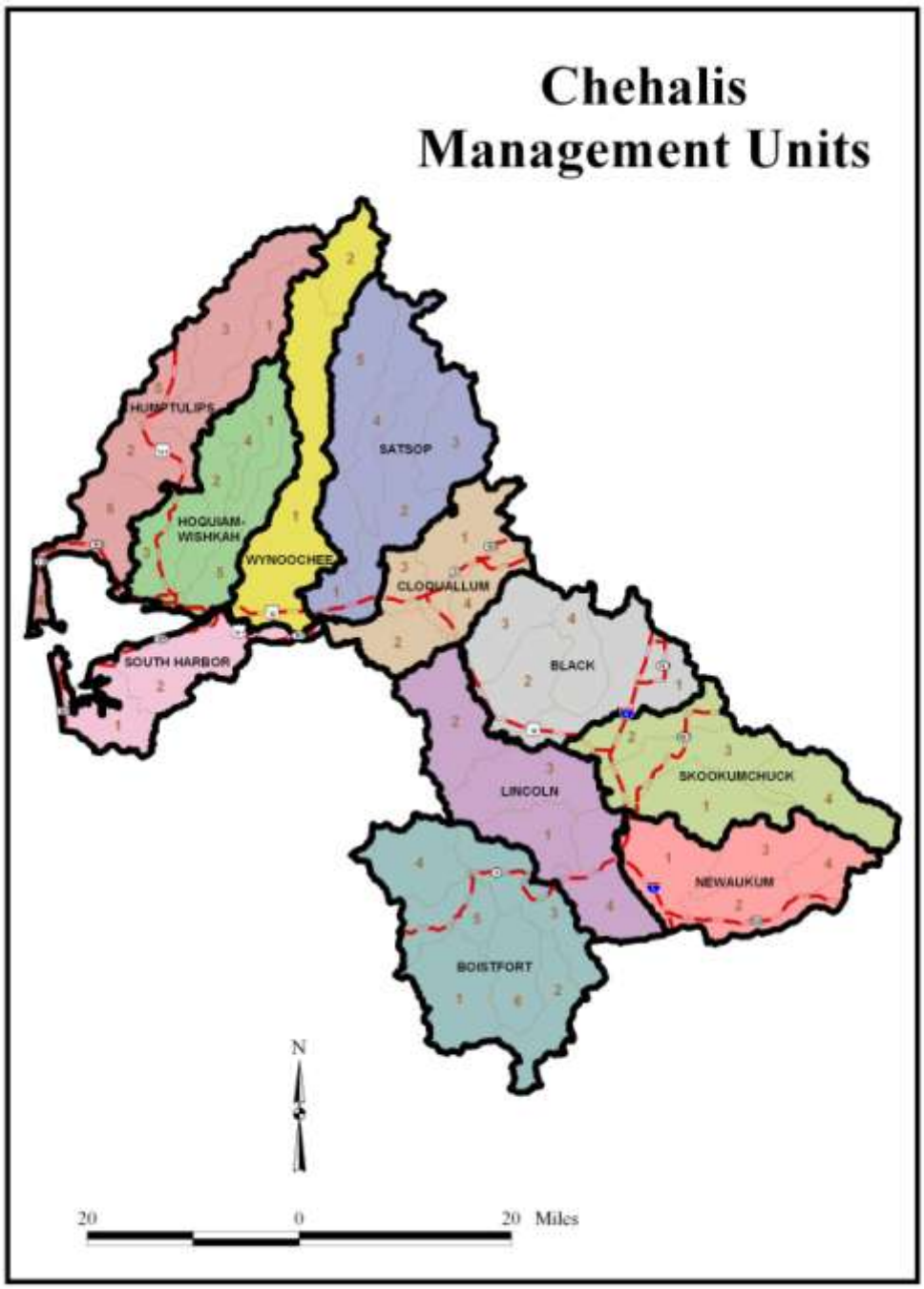
Layout of Subbasin Profiles

Each profile begins with a brief description of the subbasin and lists major tributaries, land uses, and anadromous fish stocks.

The heart of the profile is the Tiered (prioritized) Watershed Analysis section, which is displayed in a matrix format.

Tier 1 Concerns have a green heading, Tier 2 Concerns have a blue heading, and Tier 3 Concerns have a red heading.

Figure 3: Chehalis Basin Subbasins



BLACK RIVER MANAGEMENT UNIT

BLACK RIVER

Description:

The Black River watershed drains an area of 144 square miles. The mainstem is 25 miles long and its tributaries provide another 84 stream miles. Starting at an elevation of 144 feet at Black Lake, the river meanders gradually over its lowland course before merging with the Chehalis River at RM 47. The gradient over most of the river's course drops an average of nine inches per mile, steepening only at Littlerock. The width of the river varies from 15 to 120 feet.

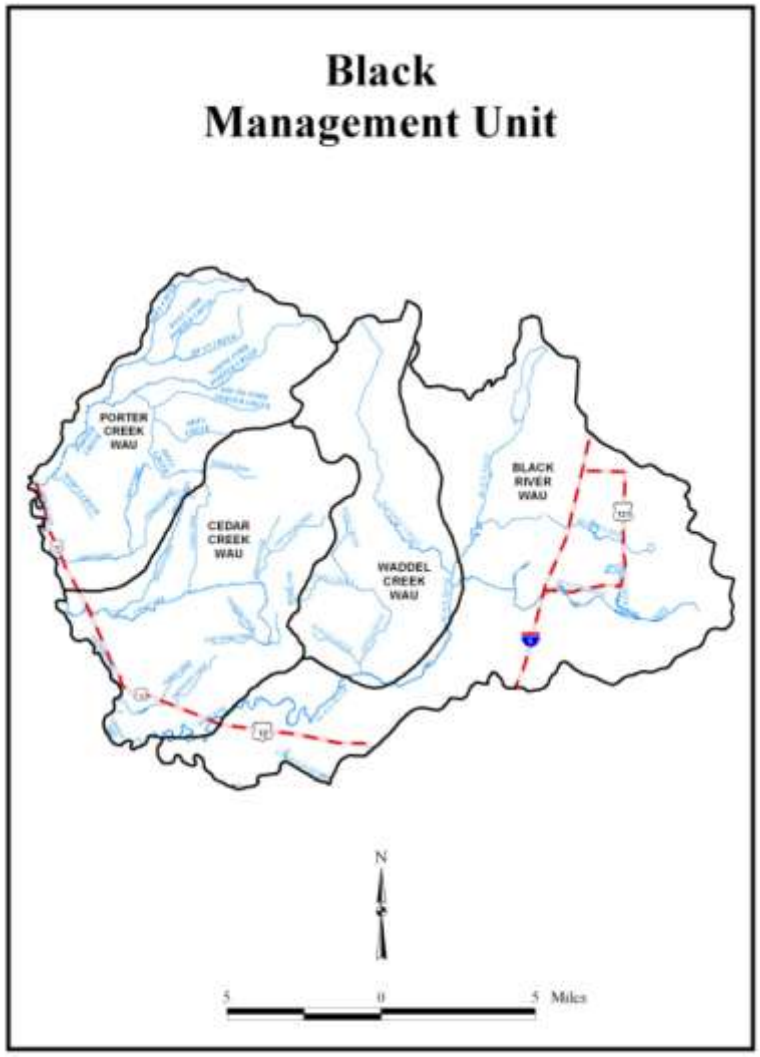
The slow descent for most of the river allows an accumulation of mud, sand, and decomposing organic material that provides for abundant aquatic and semi-aquatic plant life. The Black River valley is a broad floodplain containing numerous wetlands, lakes, ponds, swamps, and bogs. The upper reaches of the mainstem (RM 25 to RM 20) have relatively intact riparian corridors. Construction of a gas pipeline in the 1960s left sporadic mounds of excavation spoils in the river and surrounding wetlands. Subsequent beaver dams connected these mounds, thereby creating a vast wetland that has become an important habitat for fish, amphibians, and migratory birds. A section of gravel/cobble streambed occurs in the lower reaches of the river by Littlerock.

From RM 20 to RM 17, the Black River flows through residential and agricultural development with disturbed riparian conditions. However, from RM 17 to RM 9, riparian conditions improve as the river flows yet again through a long stretch of swamp, marsh, bogs, sloughs, and other wetlands. Vegetation within this section consists of grasses, rushes, sedges, willow, black cottonwood, and red alder. Riparian conditions deteriorate in the lower reach of the Black River (RM 9 to RM 1), which is skirted by intensive agricultural development and buffered only by a narrow strip of trees.

Major Tributaries: Black River, Beaver Creek, Waddell Creek, Salmon Creek, and Mima Creek

Land Uses: Forestry, agricultural, and rural residences

Anadromous Fish Stocks: Fall Chinook, coho, chum, cutthroat, and winter steelhead



Black River Tier 1 Concerns

Black River Tier 1 Concern	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ The river has a deep stretch with naturally low dissolved oxygen levels in the lower zone of the stratified reach, increasing the risk of anoxia in the lower Black River. ➡ Low DO due to high temperatures during the summer (303d List for temperature).	➡ Low dissolved oxygen levels. The low gradient and long reaches of wetlands drained by the Black River creates a unique palustrine river that stratifies similar to a lake. This condition has been magnified from land use practices along the river which became apparent during the 1989 Black River fish kill, which resulted in the death of adult Chinook salmon.	➡ Control point-source contamination from dairy farms ➡ Identify specific degraded riparian areas for restoration needs ➡ Implement TMDL recommendations ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Revegetate open riparian areas with native plants

Black River Tier 1 Concern	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The lower nine miles of the mainstem are “poor”, but the remaining areas have “good” riparian conditions.	➡ Undisturbed habitat. Mainstem has large expanses of swamp, marsh, and sloughs surrounded by a relatively undisturbed riparian habitat. ➡ Vegetation loss data indicated: • 23 miles throughout the watershed. • 4.9 miles on Porter Creek. • 2.2 miles on Cedar and Gibson Creeks. • 6.4 miles within Black River drainage (82 recorded bank erosion sites). ➡ Bank erosion sites were numerous throughout Mima, Waddell, Salmon, and lower Beaver Creeks. In the smaller Porter drainage, 72 (2.6 miles) sites of bank erosion were noted, and 52 sites (3088 feet) were recorded in the Gibson and Cedar Creek subbasins. ➡ Invasive species on tributaries	➡ Control of invasive species on Lower Black, Bloom’s Ditch, and Stoney and Beaver Creeks. See Section 5. ➡ Identify specific degraded riparian areas for restoration needs ➡ Implement alternative methods of bank stabilization (bioengineering) in locations of excessive erosion ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Protect areas of mid-to-late seral stage riparian corridors with priority given to older stands (applicable to lands that do not have current protection and outside of FPA regulations). ➡ Revegetate open riparian areas with native plants, especially conifers; revegetate stream and river banks for added protection from erosion

Black River Tier 1 Concern	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Water quantity is considered poor in the river and does not meet minimum instream flows.	➡ Poor water quantity occurs naturally on the Black River due to its general character; however, loss of water from the pipeline crossing and increased water withdrawals (irrigation) has contributed to this. ➡ Fish farming practices. Fish farm south of Black River Ranch has indirectly contributed to water quantity issues. It is suspected that the fish farm's timing of shutting its operation down in summer contributed to the 1989 fish kill due to a lack of input of ground water from the farm into the river. ➡ Agricultural practices. Withdrawals within Beaver Creek drops water quantity below set minimum instream flows.	➡ Conduct study on unregulated/regulated withdrawals, especially gravel mines ➡ Determine if water withdrawals are being followed in accordance with current water rights ➡ Increase education and outreach in the watershed to inform about water withdrawals. ➡ Reduce water withdrawals from surface sources.

Black River Tier 2 Concerns

Black River Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ Mainstem and tributaries lack LWD.	➡ Low levels of LWD. Riparian areas have poor LWD recruitment potential due to a lack of large conifers.	➡ Develop LWD supplementation plan that will install logjams to improve instream channel structure and habitat diversity ➡ Educate landowners on importance of leaving LWD in river ➡ Identify specific degraded riparian areas for restoration ➡ Install large wood pieces in conjunction with other projects ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Revegetate open riparian areas with native plants

Black River Tier 2	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish access to spawning and rearing habitat is restricted ➡ Loss of access to Black Lake (Smith and Wenger).	➡ High density of roads with barrier culverts ➡ Natural gas pipeline	➡ Change pipeline and river crossing ➡ Correct barrier culverts. See Section 4 for guidelines.

Black River Tier 3 Concerns

Black River Tier 3	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Floodplain along mainstem is well connected and extensive. ➡ Without quantifiable data, the floodplain ratings for many of these watersheds cannot be rated. Salmon Creek, Beaver Creek, Bloom's Ditch, and Allen Creek, have substantial off-channel loss and channelization - impacts are rated "poor".	➡ Highly developed residential lands surround Black Lake and agricultural lands are adjacent to the lower 10 miles of Black River, Beaver Creek, Salmon Creek and Blooms Ditch. Commercial timberlands lie along Dempsey, Waddell, Porter, Cedar and Gibson Creeks.	➡ Assess floodplain conditions and identify impacts ➡ Reconnect, enhance, and/or restore potential off-channel, floodplain, and wetland habitat

Black River Tier 3	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Livestock activities are contributing to increased sediment input within agricultural areas. ➡ Loss of riparian areas has led to erosion and sediment input. • Waddel Creek has good gravel above the mouth in places; the bottom is scoured in places. • Salmon Creek lacks spawning substrate. • Allen Creek lacks a sediment source. ➡ Drainages with higher road densities have a higher potential of increased delivery of sediment to streams - road run-off ➡ Roads can serve as a conduit for transport of fine sediment to the streams at stream crossings ➡ Based on road densities, sedimentation conditions are “poor” in the Black River and “fair” in the Porter and Cedar and Gibson Creek subbasins.	➡ Livestock access to streams was documented for nearly 1 mile in the Porter Creek watershed, 2.6 miles in Cedar and Gibson Creeks, and 23.9 miles in the Black River drainage (Wampler et al., 1993). ➡ Timber harvest. Bank vegetation loss from timber harvest and unknown sources has the potential of creating sediment input to streams by exposing more soils to erosive sources. Road-related sediment transport results from exposed soil, such as clear-cuts and landings. ➡ Gravel mines ➡ High road densities. Road densities are high in these drainages, ranging from over 4.5 miles of road per square mile in Black River to just under 3 miles per square mile in Porter and Cedar Creeks (Lunetta et al. 1997). ➡	➡ Correct cross drains that may trigger mass wasting on geologically sensitive slopes ➡ Identify sources that are contributing to sediment loading ➡ Implement alternative methods of bank stabilization (bioengineering) in locations of excessive erosion ➡ Install riparian fencing to exclude or reduce livestock access ➡ Livestock exclusion projects and the closure of two major dairy farms have reduced some of the sediment inputs. ➡ Reduce sediment loading by reducing road densities ➡ Relocate gravel mines away from shorelines and floodplain. ➡ Revegetate stream and river banks for added protection from erosion ➡ Upgrade logging roads to comply with Forest and Fish Agreement (1999)

PORTER CREEK

Description:

Porter Creek is a right bank tributary to the Chehalis River with its headwaters originating in the Black Hills and draining into the Chehalis at river mile 38.5 (Smith Wenger 2001). While the upper reaches are in forestry, the lower reaches consist of floodplain with some residential development and agriculture.

Major Tributaries: WF Porter Creek, SF Porter Creek, NF Porter Creek, Cedar Creek

Land Uses: Forestry, agriculture and rural residences

Anadromous Fish Stocks: Fall Chinook, spring Chinook, coho, cutthroat, and winter steelhead

Watershed Analysis: Black River Management Unit, Porter Creek

Porter Creek Tier 1 Concerns

Porter Creek Tier 1	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ Data gap for LWD. Although data is lacking for LWD, it is likely the effects of historical splash dam activity on the South Fork Porter Creek.	➡ Splash dams. Historically, there were 3 splash dams located on the South Fork Porter Creek (Smith Wenger 2001).	➡ Determine LWD levels in Porter Creek. ➡ Develop LWD supplementation if LWD levels are low. ➡ Install logjams and single piece key placement using large conifer if possible.

Porter Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Numerous road crossings are undersized and do not allow adequate fish passage upstream because of water velocity or perched outfall. Undersized structures also inhibit the movement of streambed material downstream and usually contribute to channel scour directly downstream.	➡ Passage barriers. Placement of undersized stream crossing structures restricts fish passage and natural processes (streambed material transport). Streambed scour may have also caused a passage barrier at a location without road crossings (Smith Wenger 2001).	➡ Correct barrier culverts. See Section 4 for guidelines.

Porter Creek Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ Data gap for riparian. Although more data is needed, riparian is rated as poor: • 39% – Hardwoods • 16% – Non forested • 40% – Mid seral stage • 6% – early seral stage	➡ Riparian degradation and loss. 1.2 miles of canopy loss was recorded (Smith Wenger 2001).	➡ Identify specific degraded riparian areas for restoration needs. ➡ Install riparian fencing to exclude or reduce livestock access. ➡ Interplant conifers in deciduous dominant areas where appropriate. ➡ Remove invasive species. See Section 5. ➡ Revegetate open riparian areas with native plants.

Porter Creek Tier 2 Concerns

Porter Creek Tier 2	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Data gap for sediment. ➡ The current road density warranted a "fair" rating and the bank erosion and livestock access impacts were identified as "moderate". (Smith Wenger 2001). ➡ There are approximately 72 sites totaling 2.6 miles of streambank erosion (Smith Wenger 2001).	➡ Livestock access. There is approximately 1 mile of livestock access to Porter Creek (Smith Wenger 2001). ➡ Moderate road densities. Vehicle activity in the Porter Creek drainage is moderate with a little less than 3 miles of road per square mile of drainage (Smith Wenger 2001).	➡ Determine if sedimentation is a problem in Porter Creek. ➡ Identify contributing sources if sediment is a problem. ➡ Work with landowners to reduce livestock access to Porter Creek

Porter Creek Tier 2	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Data gap for floodplain (Smith Wenger 2001). ➡ Although data is lacking for the floodplain condition, it is likely the effects of the historical splash dam activity on the South Fork Porter Creek that can still be observed today.	➡ Porter Creek has 8 sites of riprap (Smith Wenger 2001). ➡ Road densities. Porter Creek has county roadways located in the floodplain in the lower 3 miles, but the impact has not been quantified (Smith Wenger 2001). ➡ Splash dams. Historically, there were 3 splash dams located on South Fork Porter Creek (Smith Wenger 2001).	➡ Assess floodplain conditions and identify impacts. ➡ Implement alternative methods of bank stabilization (bioengineering). ➡ Reconnect, enhance, and/or restore potential off-channel, floodplain, and wetland habitat.

Porter Creek Tier 3 Concerns

Porter Creek Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Data gap for water quantity. ➡ Land cover vegetation in the Porter Creek watershed is primarily mid-late seral stage and is rated "good" for hydrologic maturity.	➡ Agricultural practices. There are two potential water withdrawals in Porter Creek (Smith Wenger 2001).	➡ Determine if instream flows are a problem in Porter Creek. ➡ Determine if water withdrawals are being followed in accordance with current water rights.

Porter Creek Tier 3	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Data gap for water quality.		➡ Determine water quality conditions in Porter Creek.

BOISTFORT MANAGEMENT UNIT

UPPER CHEHALIS RIVER

Description:

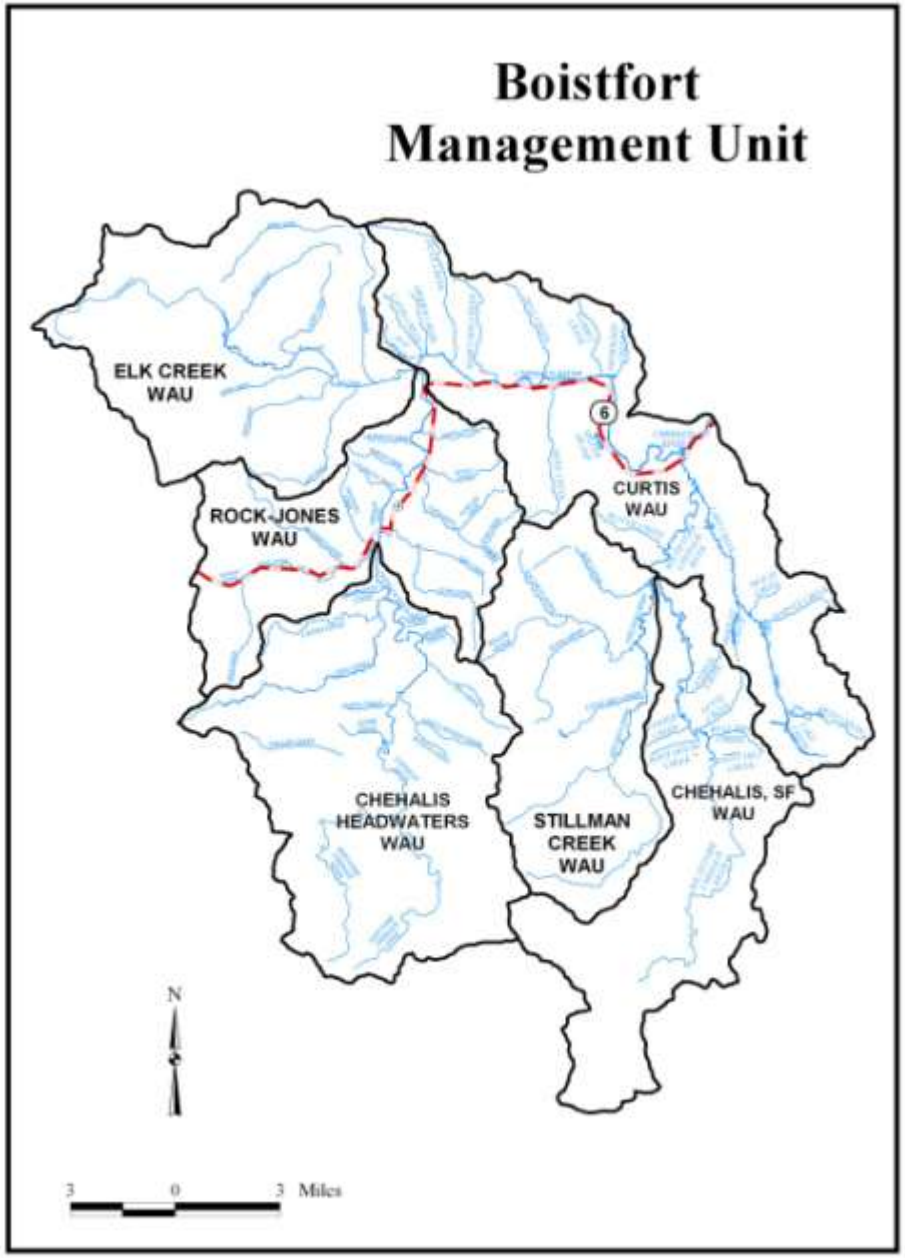
The Upper Chehalis Basin includes the mainstem Chehalis River upstream of the confluence of the South Fork Chehalis River and the East and West Fork Chehalis River. The headwaters begin in the southeast corner of Lewis County and flows at a low gradient through steep-sided valleys until the confluence with Elk Creek, where the valley opens. This entire area is in timber production and has an extensive road network that predates Forest Practices regulations. There were two splash dams built on the Chehalis River, one above Fisk Falls and the other below the confluence of Crim Creek. In each of these areas, the impact of the splash dams result in channels incised and scoured with a lack of gravel and large woody debris. Downstream of Pe Ell, timber production remains the dominant feature, but farms and rural residences are scattered throughout this reach.

Most of the small tributaries are moderately steep with cascades near their mouths. The larger tributaries have moderate gradients. Most of these subbasins are forested, although farmlands frequent the lower reaches of Elk Creek.

Major Tributaries: Elk, Rock Crim, Big, Thrash, and Cinnebar Creeks and the West Fork Chehalis River.

Land Uses: Forestry and agriculture

Anadromous Fish Stocks: Fall Chinook, Spring Chinook, coho, cutthroat trout, and winter steelhead



Upper Chehalis River Tier 1 Concerns

Upper Chehalis River Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish passage is limited by barrier culverts and natural barriers	➡ 43 of 72 assessed culverts had barriers. ➡ A blockage was noted in the East Fork Chehalis where the river was rerouted for a road. Other problems include failed road crossings that led to debris jams in upper George, upper Thrash, and in an unnamed tributary to the East Fork Chehalis River. Elk Creek has a fishway at natural barrier. ➡ Roads and field crossings have been built with improperly installed culverts	➡ Correct barrier culverts. See Section 4 for guidelines. ➡ Improve fish passage at fishways and add fishway to those structures that do not have them

Upper Chehalis River Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Extensive erosion exists in Elk Creek and in three major tributaries to Elk Creek, Crim, Nine, and Smith Creek. Erosion and two debris torrents were documented in Ludwig Creek. ➡ Sediment is high from the Rock Creek subbasin ➡ In the past, fine sediment problems have been identified in Crim, Lester, Browns, lower Big, Roger and tributaries, Alder, Thrash, Mack, lower Sage, George, and Cinnabar Creeks. Fine sediment levels are also high in the East Fork and upper West Fork Chehalis Rivers ➡ Hope Creek and the mainstem Chehalis River near Hope Creek had additional sites of erosion.	➡ In those areas with moderate to steep slopes, landslides from roads are one of the greatest problems, and sidecast roads pose a notable risk. ➡ Road density is especially high in the Upper Chehalis (6.4 mi roads/sq mi watershed) ➡ The Rock Creek WAU has a very high road density (4.8 miles of road/sq mi watershed) ➡ Landslides are the main source of sediment in the Upper Chehalis subbasin. From 1955 to 1991, 675 landslides were identified in the area upstream of Pe Ell. Road-related landslides account for 65% of the total, and most of those failures were sidecast roads after large storms. Many of the other landslides developed from recent timber harvest on steep slopes. The greatest sediment loads are found in Big, Thrash, and Sage Creeks. Thrash and Sage have extremely high road densities, both around 7.6 miles/sq. mile watershed. Road density in Big Creek is 4.6 mi/sq.mi. These road densities result in a “poor” habitat rating for sediment quantity.	➡ Abandon roads on steep geologically sensitive areas ➡ Correct cross drains that may trigger mass wasting on geologically sensitive slopes ➡ Identify those roads that are contributing to sediment loading ➡ Implement alternative methods of bank stabilization (bioengineering) in locations of excessive erosion ➡ Reduce sediment loading by reducing road densities (abandon/decommission) ➡ Upgrade all logging roads to comply with Forest and Fish Agreement (1999)

Upper Chehalis River Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
	➡ Thrash and Sage Creeks have extremely high road densities, both around 7.6 miles/sq. mile watershed. ➡ Road density in Big Creek is 4.6 mi/sq mi ➡ Most likely cause of high sediment in the East and upper West Fork Chehalis River is bank failure	

Upper Chehalis River Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ Riparian conditions of the mainstem Chehalis are rated as 1.5. A rating of 1 is a forested riparian zone 0-25 ft wide on either bank where riparian zone occurs (<30% of watershed). A rating of 2 is a forested riparian zone typically 25-50 ft wide (30-50% of watershed). ➡ Streamside vegetation loss was especially noteworthy throughout the mainstem Chehalis River between the confluence with the South Fork Chehalis and Pe Ell. Other riparian losses were documented in Elk Creek, Rock Creek and McCormick Creek. Lower Elk Creek, lower Hope Creek, and parts of Marcuson Creek rate “poor” for riparian conditions ➡ Riparian conditions are thought to be "good" in Elk Creek from about RM 3 through 7.6 and "good" in the lower reaches of Eight Creek ➡ “Poor" riparian exists in lower Brown, lower Big, Thrash, lower Hope, lower Elk, parts of Lester and Crim, Roger, lower Alder, and lower Sage Creeks. ➡ Areas that rate “poor” are the mainstem Chehalis from the West Fork to Cinnabar and near the Browns Creek area, and also lower to middle Thrash Creek.	➡ In areas where the riparian has had trees and vegetation removed the main cause is logging ➡ Limited riparian width due to agriculture use in some areas ➡ Limited agriculture and logging practices	➡ Control invasive species. See Section 5. ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Protect key properties of riparian habitat ➡ Revegetate open areas with native plants

Upper Chehalis River Tier 2 Concerns

Upper Chehalis River Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ Low levels of LWD are a major problem, and are rated "poor" in lower Hope Creek, parts of Marcuson Creek, the lower mainstem Elk Creek, and lower Rock Creek. Some reaches of Marcuson Creek rate "fair", and Eight Creek rates "good" for LWD. Many tributaries to Elk Creek appear to have "good" LWD levels, while upper Elk Creek is recovering from past logging. Upper Elk Creek has instream wood comprised of smaller trees that form jams and complexes (20 to 30 year old trees), with very few large key pieces of wood. These jams and complexes do not appear to be stable, and most likely move or are periodically dismantled, causing additional scour and streambed disruption. The mainstem Chehalis River from the confluence with the South Fork to the headwaters are rated "poor" for LWD. ➡ The lower to middle Thrash Creek rank is poor ➡ EDT rated LWD as 3-4 for the mainstem Chehalis with zero representing pristine conditions and four representing severely impaired condition. ➡ Narrow corridors of larger trees are present ➡ Areas that are currently "poor" for near-term LWD recruitment potential include Crim, Rogers, Alder, and Mack Creeks, and scattered sections in Lester, Thrash, Cinnabar, and George Creeks. Parts of the mainstem Upper Chehalis River, as well as the West and East Forks of the Chehalis River also rate "poor" for near-term LWD recruitment potential.	➡ In areas where the riparian has had trees and vegetation removed the main cause is logging ➡ Limited riparian width due to agriculture use in some areas ➡ Recruitment potential is good for most areas of the mainstem Chehalis from the West Fork to Cinnabar and near the Browns Creek area	➡ Determine ways to keep LWD in system ➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity ➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity ➡ Educate landowners on the importance of leaving LWD in the stream ➡ Install LWD pieces in conjunction with other restoration projects ➡ See riparian actions for planting trees for future recruitment

Upper Chehalis River Tier 2	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Warm water temperatures and low dissolved oxygen levels have been documented in the Upper Chehalis subbasin. ➡ The Washington Department of Ecology (DOE) has recommended one segment of the mainstem Chehalis River (13N5W12, near the town of Dryad) for inclusion on the 303(d) List because of high water temperatures and fecal coliform ➡ The lack of deep pool habitat potentially worsens the effect of high water temperature problems in the Upper Chehalis subbasin, as less refuge from high water temperatures are available. ➡ In 1987, Thrash Creek had several temperature exceedances above 16 oC in the summer, which could impact salmonids ➡ The following stream reaches were noted as potential high water temperature areas: the mainstem Chehalis River, the lower West Fork Chehalis River, the upper East Fork Chehalis River, upper Crim Creek, Cinnabar Creek, lower Mack Creek, and portions of George, Lester, and Thrash Creek	➡ The known causes of poor water quality problems in the Upper Chehalis subbasin are riparian loss or conversion, livestock waste, sedimentation, decreased flows, industrial inputs, and urban stormwater. It is also likely that the reduction in wetlands has contributed to degraded water quality. ➡ In general, 47% of the waters had lower than target levels of canopy closure through watershed analysis ➡ The lack of pools is a likely outcome of excessive sediment supply and transport coupled with the lack of LWD ➡ The known causes of the poor water quality problems in the Upper Chehalis are riparian loss or conversion, livestock waste, sedimentation, decreased flows, industrial inputs, and urban stormwater. It is also likely that the reduction in wetlands has contributed to degraded water quality. ➡ In general, 47% of the waters had lower than target levels of canopy closure through watershed analysis ➡ The known causes of the poor water quality problems in the Upper Chehalis are riparian loss or conversion, livestock waste, sedimentation, decreased flows, industrial inputs, and urban stormwater. It is also likely that the reduction in wetlands has contributed to degraded water quality. ➡ In general, 47% of the waters had lower than target levels of canopy closure through watershed analysis	➡ Abandon roads on steep geologically sensitive areas ➡ Correct cross drains that may trigger mass wasting on geologically sensitive slopes ➡ Determine if water withdrawals are being followed in accordance with water rights ➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity; install LWD pieces in conjunction with other restoration projects ➡ Identify specific degraded riparian areas for restoration needs ➡ Implement TMDL recommendations ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Protect key properties of habitat by a fee simple or easement ➡ Reconnect, enhance, and/or restore potential off-channel, floodplain, and wetland habitat ➡ Reduce sediment loading by reducing the road densities (abandon/decommission) ➡ Remove invasive species. See Section 5. ➡ Revegetate open riparian areas with native plants; revegetate streams and riverbanks for added protection from erosion ➡ Upgrade logging roads to comply with Forest and Fish Agreement (1999)

Upper Chehalis River Tier 3 Concerns

Upper Chehalis River Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Subjected to high flows	➡ About half of the Upper Chehalis subbasin lies in a rain-on-snow zone ➡ Timber harvest can account for some of the increased flow, but increased precipitation is an even greater contributor.	➡ Implement approved nutrient enhancement efforts
➡ In the upper region of this subbasin, low flows have been noted above a few of the large logjams in tributaries, and have resulted in dewatered redds. The areas of impact include upper Alder Creek, upper Thrash Creek, and portions of the East Fork Chehalis River	➡ Logjams trap sediment	➡ Remove logjams on site-specific basis
➡ Hope Creek is closed to additional water consumption beyond the rights granted prior to 1973	➡ Hope Creek water rights have been over allocated	➡ Reduce water withdrawals from surface sources
➡ The Elk Creek WAU was over 53% hydrologically mature using data from the early 1990s. Rates poor for water quantity ➡ The Rock Creek/Jones Creek WAU is over 74% hydrologically immature, which is a "poor" rating	➡ Logging is believed to have decreased the hydrologic maturity of the Elk Creek subbasin. It also has numerous water withdrawal sites ➡ The Rock Creek/Jones Creek WAU is over 74% hydrologically immature	➡ Determine if water withdrawals are being followed in accordance with current water rights ➡ Identify specific degraded riparian areas for restoration ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Protect by fee simple or easement key properties of riparian habitat ➡ Remove invasive species. See Section 5. ➡ Revegetate open riparian areas with native plants ➡ Comply with Forest and Fish Agreement (1999) ➡ Remove invasive species. See Section 5.

Upper Chehalis River Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Upper Crim Creek has the highest level of immature vegetation (22% immature). ➡ A major problem limiting salmonid production in the Upper Chehalis subbasin is the lack of summer rearing habitat. In most of the surveyed areas, the quantity of pools rate "poor"; they were found to be widely spaced, shallow and lacking in overhead cover and LWD. Streams with documented "poor" ratings for pools include: Thrash, Sage, Crim, Big, George, Mack, Cinnabar, Roger, and Lester Creeks, as well as the upper West Fork Chehalis River. All of these streams except Crim Creek, Roger Creek, and the upper West Fork Chehalis River had shallow pools, if any. The East Fork Chehalis River, Alder Creek, and Browns Creek were mentioned as being low in pool habitat.	➡ Timber harvest can account for some of the increased flow, but increased precipitation is an even greater contributor. Under current hydrological maturity, there is an expected 6% increase in a 2-year event flow, a 4% increase in a 10-year peak flow, and a 3% increase in a 100-year event flood.	➡ Identify specific degraded riparian areas for restoration needs ➡ Implement activities that lead to natural recharge of aquifers ➡ Implement approved nutrient enhancement efforts ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Protect by fee simple or easement key properties of riparian habitat ➡ Remove invasive species. See Section 5. ➡ Revegetate open riparian areas with native plants

Upper Chehalis River Tier 3	FLOODPLAIIN	
Symptom	**Cause**	**General Actions**
➡ Areas rated "good" for floodplain conditions ➡ Floodplain connectivity limited in some areas ➡ Down cutting and channel incision has reduced lateral habitat ➡ Elk Creek is rated "poor" ➡ Rock Creek is unknown for floodplain conditions, except Upper Rock Creek which is incised	➡ Crim, Thrash, and Cinnabar Creeks, and the East Fork Chehalis River, are incised due to natural conditions. Incision in other areas is human caused ➡ Fourteen instances of riprap were found in the Crim Creek/ Rock Creek watershed, impacting 3214 linear feet of stream. Numerous sites of riprap were documented along the mainstem Chehalis between the South Fork Chehalis confluence and Pe Ell. Hope Creek, Elk Creek, Crim Creek, and Rock Creek had a few areas of riprap ➡ Roger, Mac, and George Creeks are rated poor due to past logging practices ➡ Elk Creek had 13 riprap sites that impact 125 linear stream feet.	➡ Further assessment needed on Elk and Rock Creeks for floodplain conditions ➡ Further assessments or off-channel work should be selective, based on site-specific conditions on Crim, Thrash, and Cinnabar Creeks as well as the East Fork Chehalis River ➡ Reconnect and enhance (add LWD to streams) and/or restore potential off-channel floodplain and wetland habitat ➡ Remove hard armoring (riprap) or implement bioengineering techniques in place of hard armoring

South Fork Chehalis River

Description:

The South Fork Chehalis River enters the mainstem at RM 88.3. The river has a low gradient from its mouth until RM 16.8, where it narrows substantially. The lower reach is agriculture while the upper reaches are in commercial forestry. The unincorporated communities of Curtis and Boistfort are in the lower valley.

Major Tributaries: Lake and Stillman Creeks

Land Uses: Forestry and agriculture

Anadromous Fish Stocks: Fall Chinook, Spring Chinook, coho, cutthroat trout, and winter steelhead

South Fork Chehalis River Tier 1 Concerns

South Fork Chehalis River Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ Riparian degradation is extensive in the Chehalis Basin with the South Fork Chehalis specifically identified as a degraded area.	➡ The subbasin has 14.4 stream miles of impaired riparian due to agriculture, 19.2 miles by logging, (2.1 unknown) ➡ Black Creek-extensive loss of tree canopy due to agriculture ➡ Riparian is primarily deciduous lacking in late seral conifers ➡ Recruitment is low; some local landowners remove wood	➡ Control invasive species. See Section 5. ➡ Identify specific degraded riparian areas for restoration ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Revegetate open areas with native plants

South Fork Chehalis River Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Erosion is a problem in most areas ➡ The South Fork is one of the major contributors of sediment in the Chehalis Basin	➡ Agriculture is identified as a cause ➡ The South Fork Chehalis WAU has a high road density, 3.7 miles of roads/sq. mi. watershed ➡ Logging in the headwaters	➡ Abandon roads on steep geologically sensitive areas ➡ Correct cross drains that may trigger mass wasting ➡ Identify sources that are contributing sediment loading ➡ Implement alternative methods of bank stabilization ➡ Reduce sediment loading by reducing road densities ➡ Revegetate streams and riverbanks for erosion protection ➡ Upgrade logging roads - Forest and Fish Agreement (1999)

South Fork Chehalis River Tier 1 FISH PASSAGE		
➡ Fish passage is limited by barrier culverts	➡ Several tributary streams have barrier culverts; of the 42 culverts assessed, 21 were barriers ➡ Roads and field crossings have improperly installed culverts	➡ Correct barrier culverts. See Section 4.

South Fork Chehalis River Tier 2 Concerns

South Fork Chehalis River Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ Instream levels of LWD are generally low, where levels are known. ➡ The quantity of LWD in Beaver Creek, a Lake Creek tributary, is believed to be "fair"	➡ Recruitment is low; local landowners remove wood in some areas ➡ Lack of late seral conifers	➡ Educate landowners on importance of LWD in streams ➡ Revegetate open areas with native plants ➡ Interplant conifers in deciduous dominant areas ➡ Install riparian fencing to exclude or reduce livestock access ➡ Identify specific degraded riparian areas for restoration

South Fork Chehalis River Tier 2	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ A portion of the South Fork Chehalis River and the lower part of the Lost Creek tributary is on the 303d List for pH	➡ The known causes of the poor water quality problems in these subbasins are riparian loss or conversion, livestock waste, sedimentation, decreased flows, industrial inputs, and urban stormwater. It is also likely that the reduction in wetlands has contributed to degraded water quality. ➡ Poor forestry practices	➡ Implement TMDL recommendations ➡ See riparian actions
➡ Warm water temperatures and low dissolved oxygen levels are a problem in the mainstem of the Chehalis River above Porter Creek. One of the priority areas to address these problems has been identified as the South Fork Chehalis River.	➡ The known causes of the poor water quality problems in these subbasins are riparian loss or conversion, livestock waste, sedimentation, decreased flows, industrial inputs, and urban stormwater. It is also likely that the reduction in wetlands has contributed to degraded water quality. ➡ Poor forestry practices	➡ Abandon roads on steep geologically sensitive areas ➡ Correct cross drains that may trigger mass wasting on ➡ Identify specific degraded riparian areas for restoration ➡ Implement TMDL recommendations ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas

South Fork Chehalis River Tier 2	WATER QUALITY	
Symptom	**Cause**	**General Actions**
		➡ Reduce sediment loading by reducing road densities ➡ Revegetate open riparian areas with native plants; revegetate streams and riverbanks for added protection from erosion ➡ Upgrade logging roads - Forest and Fish Agreement (1999)

South Fork Chehalis River Tier 3 Concerns

South Fork Chehalis River Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Low stream flows are an increasing problem in the mainstem Chehalis, and the problem extends throughout many of the tributaries. The South Fork Chehalis, and the tributary Beaver Creek, has been closed to further water right allocations due to concerns that base flows are not being met. ➡ High flows can be a problem	➡ Loss of watershed vegetative cover due to logging and agriculture ➡ Over allocated water rights ➡ Loss of watershed vegetative cover due to logging and agriculture	➡ Determine if water withdrawals are being followed in accordance with current water rights ➡ Identify specific degraded riparian areas for restoration ➡ Implement approved nutrient enhancement efforts ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Reduce water withdrawals from surface sources ➡ Revegetate open areas with native plants

South Fork Chehalis River Tier 3	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Most tributaries are confined ➡ The mainstem South Fork Chehalis River rates “fair” for floodplain conditions due to the numerous riprap sites throughout	➡ A thorough inventory of floodplain conditions has not been done in this area. ➡ Numerous riprap sites in the South Fork Chehalis River	➡ Assess floodplain conditions to identify impacts ➡ Remove hard armoring (riprap) or implement bioengineering techniques in place of hard armoring ➡ Reconnect, enhance, and/or restore potential off-channel, floodplain, and wetland habitat

Lake Creek

Description:

Lake Creek is a low gradient stream surrounded by farmland. It empties into the South Fork Chehalis River at RM 1.4. Major tributaries include Barney and Deep Creeks. The basin has abundant winter rainfall that could result in hydrological stress.

Major Tributaries: Barney and Deep Creeks

Land Uses: Agriculture and forestry

Anadromous Fish Stocks: Coho, cutthroat, and winter steelhead

Lake Creek Tier 1 Concerns

Lake Creek Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian buffer in the majority of the lower basin consists of a narrow strip of deciduous trees and shrubs	➡ Much of the land in the lower watershed has been cleared for agricultural uses	➡ Conservation Reserve Enhancement Program is option ➡ Control invasive species. See Section 5. ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Revegetate open riparian areas with native plants

Lake Creek Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Sediment is a problem in the basin	➡ The source is unknown ➡ The WAU that includes Lake Creek has a high road density (4.2 miles of roads/sq. mi. watershed)	➡ Identify sources that are contributing to sediment loading ➡ Install riparian fencing to exclude or reduce livestock access ➡ Reduce sediment loading by reducing road densities ➡ Revegetate stream and riverbanks for erosion protection ➡ Upgrade logging roads to comply with Forest and Fish Agreement (1999)

Lake Creek Tier 1	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ The lower section of Lake Creek is on the 303d List for pH ➡ The water quality rating for Lake Creek is "suspected poor"	➡ Agriculture has been identified as a cause. Other causes are unknown.	➡ Identify specific degraded riparian areas for restoration ➡ Implement TMDL recommendations ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Revegetate open areas with native plants

Lake Creek Tier 2 Concerns

Lake Creek Tier 2	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Rates a "poor" for water quantity	➡ Lake Creek watershed has immature land cover (74.1%)	➡ Protect and plant trees and shrubs in agricultural areas

Lake Creek Tier 2	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish passage is limited by barrier culverts	➡ Several tributary streams have barrier culverts ➡ Roads have been built with improperly installed culverts	➡ Barrier culvert corrections on Barney Creek ➡ Correct barrier culverts. See Section 4 for guidelines.

Lake Creek Tier 3 Concerns

Lake Creek Tier 3	LARGE WOODY DEBRIS	
Symptom	**Cause**	**General Actions**
➡ Barney Creek has fair LWD ➡ There is a lack of LWD in Lake Creek	➡ Lack of trees to recruit for LWD ➡ Much of the land in the lower watershed has been cleared for agricultural uses	➡ Install LWD pieces in conjunction with other projects ➡ Install riparian fencing to exclude or reduce livestock access ➡ Identify specific degraded riparian areas for restoration; interplant conifers; revegetate open areas with native plants

Lake Creek Tier 3	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Most areas connected to the floodplain, most tribs confined	➡ Logging may have contributed to channel incision on tribs	➡ Reconnect the floodplain and former off-channel habitat

Stillman Creek

Description:

Stillman Creek joins the South Fork Chehalis River at RM 5.1. The upper watershed consists of narrow valleys and steep hills with moderate to steep gradients. In the lower reaches, agriculture and rural residences are the primary land uses. The upper watershed is commercial timberland; most of the watershed was harvested by 1959. A splash dam used in the 1940s is located at below the confluence of Little Mill Creek.

Major Tributaries: Lost, Halfway, Keller, and Little Mill Creeks

Land Uses: Forestry and agriculture

Anadromous Fish Stocks: Fall Chinook, Spring Chinook, coho, cutthroat trout, and winter steelhead

Stillman Creek Tier 1 Concerns

Stillman Creek Tier 1	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ The lower part of Stillman Creek is on the303d List for temperature. Water temperatures exceed 20°C in half way Creek and Killer Creek, and exceed 18°C in Lost Creek, the middle Stillman Creek, and Slide Creek.	➡ Heat generated by sunlight reaching the screen provides energy to raise water temperatures. In-vegetation reduces temperature by blocking sunlight from reaching the stream. Human caused activities which contribute to degrade riparian vegetation conditions include residential and urban development, and agricultural and silvaculture activities. ➡ Two other factors that influence the distribution of heat are instream flow and channel morphology. Low flows may contribute to high temperatures by reducing the volume of water that can absorb incoming heat. Channel morphology may also influence heat distribution. With increased sediment loads, stream channels may become wider and shallower, allowing more thermal radiation to be absorbed by the water surface. ➡ Agriculture has been identified as a possible cause	➡ Identify specific degraded riparian areas for restoration ➡ Implement TMDL actions ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Revegetate open areas with native plants

Stillman Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish passage is limited by barrier culverts	➡ There are no culverts on the mainstem. A few of the tributaries have barrier culverts. Of the 40 culverts assessed, 17 were barriers ➡ Roads and field crossings have improperly installed culverts	➡ Correct barrier culverts. See Section 4.

Stillman Creek Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ In most areas of the Stillman Creek watershed, fine sediment (<0.85 mm) levels were generally low to moderate ➡ Landslides are a major problem, creating debris torrents. WF Stillman, Slight, and the upper mainstem Stillman are especially vulnerable. Ranks poorly for sediment quantity. ➡ Lost Creek has a sediment problem ➡ Sediment is transported from the southern watershed to Half Way Creek and the mainstem Stillman Creek	➡ The northern third of the Stillman Creek watershed consists of soft sedimentary rock that decomposes quickly to fines, creating low quality spawning habitat in those tributaries. ➡ Most shallow landslides are related to old roads on steep slopes during winter storms ➡ Sediment in Lost Creek is caused by channel incision. Most of the impacting roads are mainline roads close to streams; for example, the 4000 Road next to Slide Creek. Overall road density is very high in the Stillman Creek WAU, act 4.5 miles of road per square mile watershed	➡ Abandon roads on steep geologically sensitive areas ➡ Reduce sediment loading by reducing road densities ➡ Upgrade logging roads to comply with Forest and Fish Agreement (1999)

Stillman Creek Tier 2 Concerns

STILLMAN CREEK TIER 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ Current levels of LWD are low. In-channel LWD was rated as below target for 140 out of 143 sampled sites.	➡ Debris torrents and dam break floods have scoured channels and removed LWD, particularly in the West Fork Stillman Creek. ➡ Red alder and other deciduous trees cannot supply adequate LWD. ➡ Historic splash dams ➡ Lack of late seral conifers	➡ Educate landowners on the importance of leaving LWD in the stream ➡ Install LWD pieces in conjunction with other restoration projects ➡ See riparian actions

STILLMAN CREEK TIER 2	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ Most riparian areas along salmon producing streams in the Stillman Creek watershed are dominated by red Alder. ➡ Stands of mature conifer exist in the riparian areas of the mainstem Stillman (between Little Mill Creek and Raccoon Creek), some areas of Little Mill Creek, and Lower Half Way Creek. In these areas LWD recruitment potential is high. ➡ Some areas are lacking in vegetation	➡ The riparian corridor is degraded due to logging, agricultural clearing, and forest fires. ➡ The riparian corridor is degraded due to logging, agricultural clearing, and forest fires.	➡ Control invasive species. See Section 5. ➡ Identify specific degraded riparian areas for restoration ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Protect, fee simple/easement, key properties riparian habitat ➡ Revegetate open riparian areas with native plants

Stillman Creek Tier 3 Concerns

STILLMAN CREEK TIER 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ High flows can be a concern ➡ Low water flows have been an identified concern in Lost Creek where most of the Creek dries up in summer ➡ The majority of the Stillman Creek subbasin is hydrologically mature. Results in a "good" rating	➡ Peak flows are a concern due to a lack of LWD and high sediment ➡ Low flow on Lost Creek in the summer is thought to be a natural condition	➡ Abandon roads on steep geologically sensitive areas; reduce sediment loading by reducing road densities; correct cross drains that may trigger mass wasting; identify sources that are contributing to sediment loading; upgrade logging roads - Forest and Fish Agreement (1999) ➡ Develop LWD supplementation plan to install logjams in key places to improve instream channel structure and habitat diversity; install LWD pieces in conjunction with projects ➡ Implement alternative methods of bank stabilization; revegetate stream and riverbanks for erosion protection ➡ See LWD actions; see Sediment actions

STILLMAN CREEK TIER 3	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Lower Stillman Creek has a well-developed floodplain; Stillman Creek rates fair for floodplain conditions based on side channel losses and the channel incision in Lost Creek, which is important winter refuge habitat for coho salmon. ➡ Lower mainstem Stillman Creek has decrease in sinuosity	➡ The steeper portions have been damaged by debris torrents	➡ Reconnect, enhance, and/or restore potential off-channel floodplain and wetland habitat

CHEHALIS MAINSTEM MANAGEMENT UNIT

MAINSTEM CHEHALIS RIVER

Description:

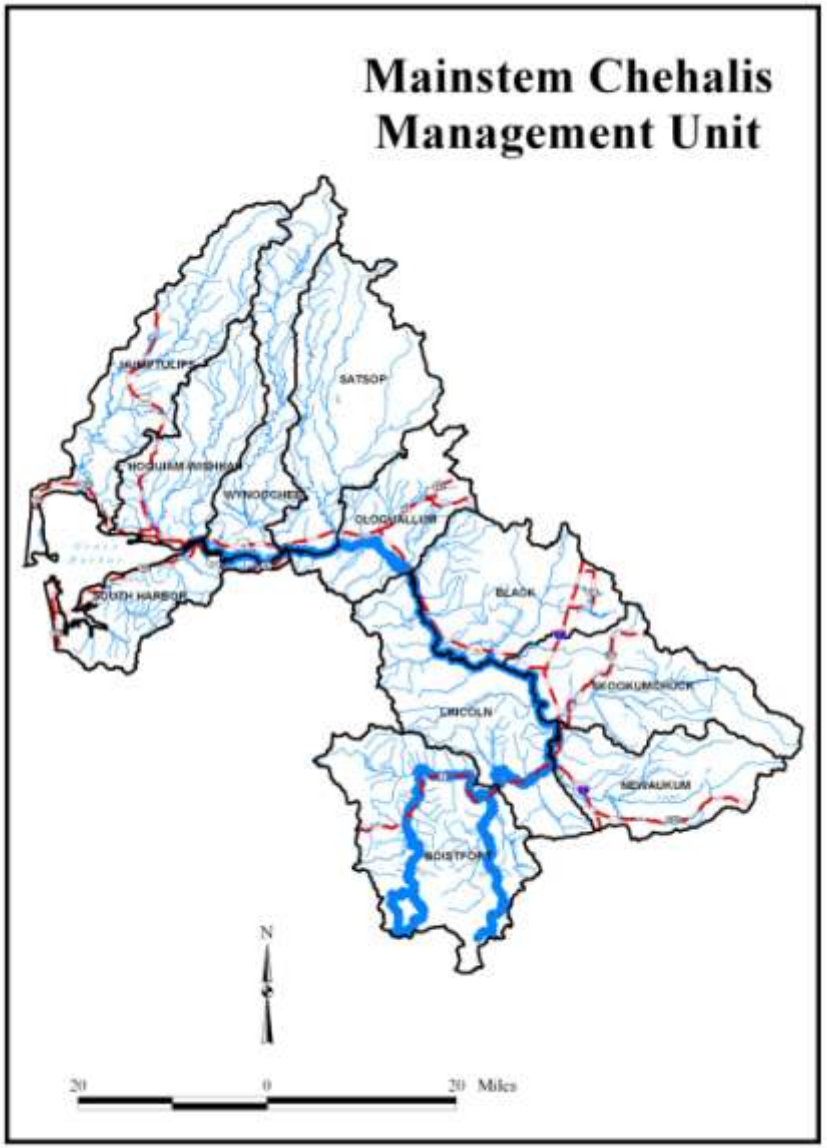
The Chehalis River Mainstem originates at the confluence of the East Fork Chehalis River and the West Fork Chehalis River at river mile 118.9. The mainstem has numerous tributaries with headwaters originating in the Olympic Mountains, Willapa Hills, Bald Hills, Black Hills, and a spur of the Cascade Mountains. It flows near several towns and cities including Pe Ell, Chehalis, Centralia, Oakville, Elma, and Montesano before it eventually drains into the Grays Harbor Estuary at Aberdeen.

The upper mainstem is confined to a low-to-moderate gradient with a land use dominated by forestry. As it nears the Newaukum River confluence, the floodplain broadens and the main land use is agriculture. The reach flowing near Centralia and Chehalis is incised and primarily developed for urban and industrial land uses. Downstream of Centralia, the mainstem again borders agricultural land. From Montesano to the mouth of the mainstem, the river is tidally influenced and contains several sloughs (Smith Wenger 2001).

Major Tributaries: Wynoochee River, Satsop River, Black River, Scatter Creek, Skookumchuck River, Newaukum River, South Fork Chehalis River, Elk Creek, Lincoln Creek, and Bunker Creek

Land Uses: Forestry, Agriculture, Urban and Industrial

Anadromous Fish Stocks: Fall Chinook*, spring Chinook, summer Chinook*, coho, fall chum, cutthroat, winter steelhead*, summer steelhead, and bull trout* (*denotes priority stock)



Chehalis River Mainstem Tier 1 Concerns

Chehalis River Mainstem Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ 105 miles have reduced shade canopy (Smith Wenger 2001).	➡ Urbanization is the cause of riparian vegetation loss in the lower reach and the Centralia-Chehalis reach (Smith Wenger 2001). ➡ Agriculture is the largest contributor to riparian loss throughout the Chehalis River Mainstem (Smith Wenger 2001).	➡ Control invasive species. See Section 5. ➡ Identify specific degraded riparian areas for restoration ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Protect by fee simple or easement key properties of riparian habitat. ➡ Revegetate open riparian areas with native plants.

Chehalis River Mainstem Tier 1	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Many reaches in the Chehalis Mainstem are on the 303d List for temperature, fecal coliform, and dissolved oxygen (Smith Wenger 2001). ➡ The segments with temperature problems are scattered between RM 33.8 and RM101.7 and one segment located near RM 13. Within these areas the most impacted are: • Between the Newaukum and Skookumchuck. • Between the Skookumchuck and Scatter Creek. • Between Scatter Creek and Porter (Smith Wenger 2001). ➡ The segments with dissolved temperature problems are near the mouth of the Satsop River and from Porter to the confluence of the East and West Forks of the Chehalis River (Smith Wenger 2001). Priority areas (DOE) for dissolved oxygen in the mainstem are: • RM 70.0 • RM 77.6 – RM 97.9.	➡ Riparian degradation and loss. Lack of adequate riparian vegetation to provide shade is a likely contributor to high temperature levels. ➡ Excessive aggradations of sediment has caused poor width-to-depth ratios which is an indicator of poor channel conditions that cause temperature problems (Smith Wenger 2001). ➡ Causes of low dissolved oxygen in the Chehalis Mainstem are: • From Porter to Scammon Creek – livestock waste. • From Scammon Creek to Newaukum River – urban stormwater, food processing plants, and upriver dairies. • From Newaukum River to Rock Creek – livestock waste. • From Rock Creek to the confluence of the East Fork and West Fork Chehalis River – livestock waste and sewage discharge (Pe Ell) (Smith Wenger 2001).	➡ Identify specific degraded riparian areas for restoration ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Protect by fee simple or easement key properties of riparian habitat. ➡ Remove invasive species. See Section 5. ➡ Revegetate open riparian areas with native plants ➡ TMDL implementation – temperature, pH, fecal coliform

Chehalis River Mainstem Tier 1	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ The areas near the confluences of the Skookumchuck River, Newaukum River, Salzer Creek, and the SF Chehalis are rated as having "poor" conditions because of extensive riprap (Smith Wenger 2001). ➡ RM 1-11 is rated as having "good" floodplain conditions (Smith Wenger 2001). ➡ RM 13-20 has lost some off-channel habitat (Smith Wenger 2001). ➡ RM 20-57 (Satsop – Grand Mound) has been identified as having areas of channel incision, but this reach is less impacted than the reaches above it (Smith Wenger 2001). ➡ RM 57-79 (Grand Mound – Stearns Creek) the mainstem appears to be incised and disconnected from floodplain and off-channel habitat. More data needed on channel incision from RM 57-79 (Smith Wenger 2001).	➡ Riprap and other bank protection. 8.1 miles of the 118 miles have been armored with riprap. The riprap is concentrated in the areas near the confluences of the Skookumchuck River, Newaukum River, Salzer Creek and the SF Chehalis (Smith Wenger 2001). ➡ Past practices of removing large woody debris from the mainstem have likely contributed to the channel incision. ➡ Splash dams. Historically, there were 7 splash dams located on the on the Chehalis Mainstem located upstream of the confluence of Bunker Creek. The effects of these splash dams are known to have had long lasting effects of channel incision (Smith Wenger 2001). ➡ Low recruitment potential from riparian corridor has likely contributed to channel incision (Smith Wenger 2001).	➡ Assess floodplain conditions and identify impacts. ➡ Assessment to focus upstream of RM 20. ➡ Implement alternative methods of bank stabilization (bioengineering). ➡ Protect by fee simple or easement key properties to facilitate natural channel migration and reconnection to the floodplain ➡ Reconnect and restore off-channel habitat identified in USACE (2002) and Ralph and Peterson (1994). ➡ Relocate gravel mining away from shorelines and 100-year floodplain. ➡ See LWD section.

Chehalis River Mainstem Tier 2 Concerns

Chehalis River Mainstem Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ Data gap for LWD. ➡ Although detailed data is lacking for LWD quantities in the Chehalis Mainstem, the effects of historical splash dam activity, LWD removal, and poor recruitment potential from the riparian corridor caused the condition to be rated poor.	➡ Splash dams. Historically, there were 7 splash dams on the Chehalis Mainstem located upstream of the confluence of Bunker Creek (Smith Wenger 2001). ➡ Low levels of LWD. Low recruitment potential from riparian corridor has contributed to the low levels of LWD.	➡ Determine LWD levels in Chehalis Mainstem. ➡ Develop LWD supplementation plan if LWD levels are low. ➡ Install logjams and single key piece placement using large conifer if possible.

Chehalis River Mainstem Tier 2	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Data from the Porter gauge and the Grand Mound gauge indicate poor water quantity conditions for the Chehalis River Mainstem (Smith Wenger 2001).	➡ Records show water rights on the Chehalis River Mainstem exceed summer instream flows by 400% (Smith Wenger 2001).	➡ Determine if water withdrawals are being followed in accordance with current water rights.

Chehalis River Mainstem Tier 2	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
	➡ Landscape manipulations that cause quick surface water runoff do not allow for aquifer recharge (groundwater). Groundwater is the main source of water for the Chehalis River, especially during the summer months.	➡ Implement activities for natural aquifer recharge ➡ Increase hydrologic continuity – reduce impervious surfaces ➡ Reduce stormwater discharge directly to streams ➡ Reduce water withdrawals from surface sources ➡ Restore wetlands for water storage

Chehalis River Mainstem Tier 3 Concerns

Chehalis River Mainstem Tier 3	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Sediment transport appears to be a major problem in the Chehalis Mainstem (Smith Wenger 2001).	➡ High sediment loading and lack of LWD. Excessive sediment transport is primarily a result of high sediment loading from tributaries and a lack of LWD. The main sediment contributors are the Satsop River, Wynoochee River, Newaukum, SF Chehalis River, and Mainstem above Doty (Smith Wenger 2001). ➡ A mass wasting site along the left bank of the mainstem at RM 11.5- 21. ➡ A high potential soil erosion site located at RM 11.5-18. ➡ Landslides. Shallow rapid landslides primarily in tributaries are a result of failing sidecast constructed roads and clearcuts on steep slopes (Smith Wenger 2001). ➡ Bank erosion from RM 57 to RM 79 is likely due to lack of riparian vegetation coupled with land use practices including agriculture and urbanization (Smith Wenger 2001).	➡ Implement alternative methods of bank stabilization ➡ Revegetate stream/river banks for added erosion protection ➡ Implement corrective actions in tributaries to decrease sediment delivery into mainstem • Satsop • Wynoochee • Newaukum • Upstream of Doty ➡ Reduce road densities to reduce sediment loading • Upstream of Doty • Tributaries with high sediment contributions ➡ Upgrade all logging roads to comply with Forest and Fish Agreement (1999) • Upstream of Doty • Tributaries with high sediment contributions

Chehalis River Mainstem Tier 3	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ No man-made fish passage barriers on mainstem.		

CLOQUALLUM MANAGEMENT UNIT

CLOQUALLUM CREEK

Description:

Cloquallum Creek and its tributaries have a drainage area of 70 square miles. The headwaters begin in the low hills of the southern Olympic Mountains and flow through broad valleys. The Cloquallum flows through Stump Lake at RM 12; Star and Arrowhead Lakes connect to the river by small tributaries.

Cloquallum, Mox-Chehalis, and Newman Creeks have low-to-moderate gradient except in the headwaters. The tributaries have excellent pool-to-riffle ratios. Gravel is the predominant bottom material in the Cloquallum drainages, although Newman and Workman Creeks have sandy bottoms with some gavel in those areas with long pools and riffles. Delezene and Workman Creeks are short, northerly flowing streams that are generally confined to narrow ravines except in the lower reaches.

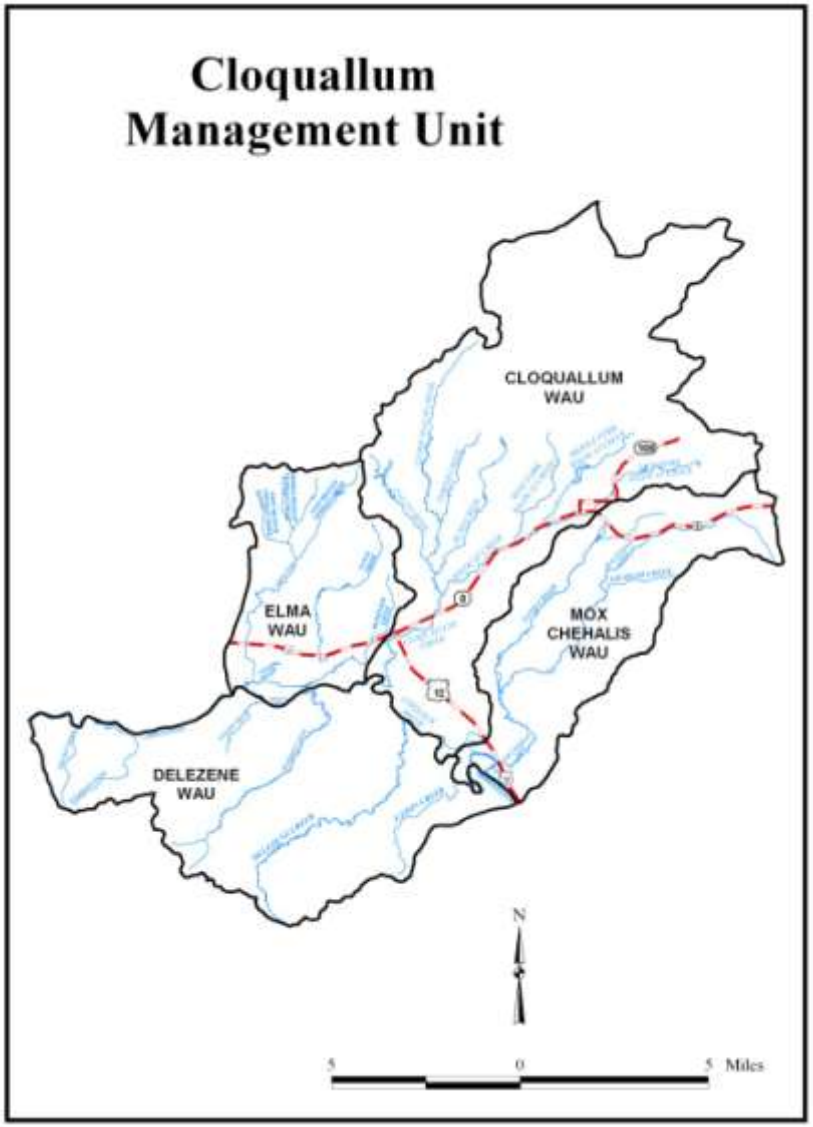
Most of the hills are in timber production. Livestock production and rural residential uses are scattered through the low, flat valleys. Recreational properties are developing around Star and Arrowhead Lakes. Newman and Vance Creeks are heavily impacted by agricultural and residential development, with extensive riparian removal and channelization.

Chum distribution is greatly reduced from historic use, although the run is still listed as healthy. Coho escapements declined in the 1990's. WDF blasted the falls on upper Delezene Creek to provide upstream habitat in the headwaters.

Major Tributaries: Mox-Chehalis, Newman, Vance, McDonald, Falls, Bush, Delezene, Workman, and Wildcat Creeks

Land Uses: Forestry, Agriculture, and Rural Residences

Anadromous Fish Stocks: Fall Chinook, coho, chum, cutthroat, and winter steelhead



Cloquallum Creek Tier 1 Concerns

Cloquallum Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Log jams and log booms block minor portions of the Mox-Chehalis watershed. ➡ There is no inventory except for portions of the Cloquallum WAU in Mason County which identifies 107 barriers (0, 33%, 67% passable) and 15 sites with unknown passability.	➡ High road densities. Road densities are very high in this area. Miles of road per square mile indicated: • Cloquallum – 4.5 • Workman – 4.6 • Vance – 4.7 • Delezene – 4.6 • Newman – 4.7 • Mox-Chehalis – 4.7	➡ Correct barrier culverts. See Section 4 for guidelines.

Cloquallum Creek Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian habitat in the Cloquallum subbasin is considered to be in poor condition and will not significantly contribute LWD. ➡ Cloquallum Creek riparian areas contain predominantly alder re-growth with a sparse distribution of conifers.	➡ The Newman, Vance, Cloquallum, and Mox Chehalis Creek areas have 44.4 miles of vegetation loss and 7.2 miles of tree canopy loss. ➡ Riparian degradation and loss. There is extensive habitat degradation from loss of vegetation and tree canopy. The cause of riparian loss is greatly unknown; however, some loss is attributed to agriculture (9%) and logging (7.4%). ➡ Cloquallum data: • RM 0-1.5 – Agricultural • RM 1.5-7 – Rural Residential • RM 7-upstream – Managed Timberlands	➡ Control invasive species. See Section 5. ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas when appropriate ➡ Protect (fee simple or easements) key properties of riparian habitat ➡ Restore riparian corridor in the Cloquallum subbasin (identify specific degraded areas for restoration needs) ➡ Revegetate open riparian areas with native plants

Cloquallum Creek Tier 1	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Data gap for stream flow. Specific stream flow data are lacking for streams in this area. All regions rated poor for ecological maturity. ➡ Stream flow during summer months is low in Delezene and Workman Creeks. ➡ Mox Chehalis and Wildcat Creeks are closed to further consumptive water appropriations.	➡ Riparian degradation and loss as well as timber harvesting ➡ Landscape manipulations that cause quick surface water runoff do not allow for aquifer recharge. Poor ratings (hydrologically immature) are indicated: • Newman – 89% • Delezene – 74% • Cloquallum – 73% • Vance – 89% • Mox-Chehalis – 77%	➡ Determine if water withdrawals are being followed in accordance with current water rights ➡ Implement activities that lead to natural aquifer recharge ➡ Increase hydrologic continuity – reduce impervious surfaces ➡ Reduce stormwater discharge directly to streams ➡ Restore wetlands for water storage.

Cloquallum Creek Tier 2 Concerns

Cloquallum Creek Tier 2	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ The floodplains in the lower reaches of Newman, Vance, Cloquallum, and Mox Chehalis, do not accommodate natural channel migration or flood storage.	➡ The historic lowest mile of Mox Chehalis Creek is an abandoned oxbow channel that has been filled for croplands and re-routed. ➡ Agricultural and rural residential use. The City of McCleary is located at RM 5.1 of Wildcat Creek. ➡ Riprap and other bank protection. Flood control through the use of bank protection has been documented in Newman, Vance, Cloquallum, and Mox-Chehalis (2.2 miles), and in Workman and Delezene (40 linear feet). ➡ Channel incision is likely to occur due to past splash dam activities. Splash dams are present on streams, including: • Cloquallum – 3 • Workman – 1 • Mox Chehalis – 1 • Delezene – 7 • Vance – 2 • Wildcat Creek – 3	➡ Assess floodplain conditions and identify impacts ➡ Protect key properties (fee simple or easements) to facilitate natural channel migration and reconnection to the floodplain ➡ Reconnect, enhance, and/or restore potential off-channel, floodplain, and wetland habitat ➡ Remove hard armoring (riprap) or implement bioengineering techniques in place of riprap.

Cloquallum Creek Tier 2	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ There is a limited amount of poor quality spawning areas in Newman Creek and its tributaries. A fair amount of spawning gravel is evident in Delezene and Workman Creeks. ➡ Excessive sediment and bank erosion • Excessive sediment is apparent for 16 miles of Newman, Vance, Cloquallum, and Mox Chehalis subbasins. There are 10.5 miles of bank erosion in this area. • Excessive sediment is apparent for 16.2 miles of Workman Creek. • Delezene Creek has 0.3 miles of bank erosion.	➡ High road densities. Road densities are very high in this area. Miles of road per square mile indicated: • Cloquallum - 4.5 • Workman - 4.6 • Vance - 4.7 • Delezene - 4.6 • Newman - 4.7 • Mox Chehalis - 4.7 ➡ Landslides. Although the Newman, Vance, Cloquallum, and Mox Chehalis Creeks rate low risk for landslides, there exists a higher risk for Workman and Delezene Creeks. ➡ Livestock access. Livestock is prevalent near the mouths of Delezene, Workman, Cloquallum, Wildcat, and Mox Chehalis Creeks.	➡ Abandon roads on steep geologically sensitive areas ➡ Identify sources that are contributing to sediment loading ➡ Implement alternative methods of bank stabilization through bioengineering. ➡ Minimize motor vehicle access to streams ➡ Revegetate stream and riverbanks for added protection from erosion ➡ Upgrade all logging roads to comply with Forest and Fish Agreement (1999)

Cloquallum Creek Tier 2	SEDIMENT	
Symptom	**Cause**	**General Actions**
	➡ Off-road vehicle activity. Off-road vehicle activity is present in Cloquallum and Wildcat Creek areas. ➡ The frequent release of high water from splash dams accelerated channel scouring and streambank erosion where riparian logging destabilized banks. ➡ Log delivery using splash dams reduced the amount of LWD in the system that in turn reduced the ability to store and retain spawning gravel and fine sediment. ➡ Channel incision is likely to occur due to past splash dam activities. Splash dams are present on streams, including: • Cloquallum – 3 • Workman – 1 • Mox Chehalis – 1 • Delezene – 7 • Vance – 2 • Wildcat Creek – 3	

Cloquallum Creek Tier 3 Concerns

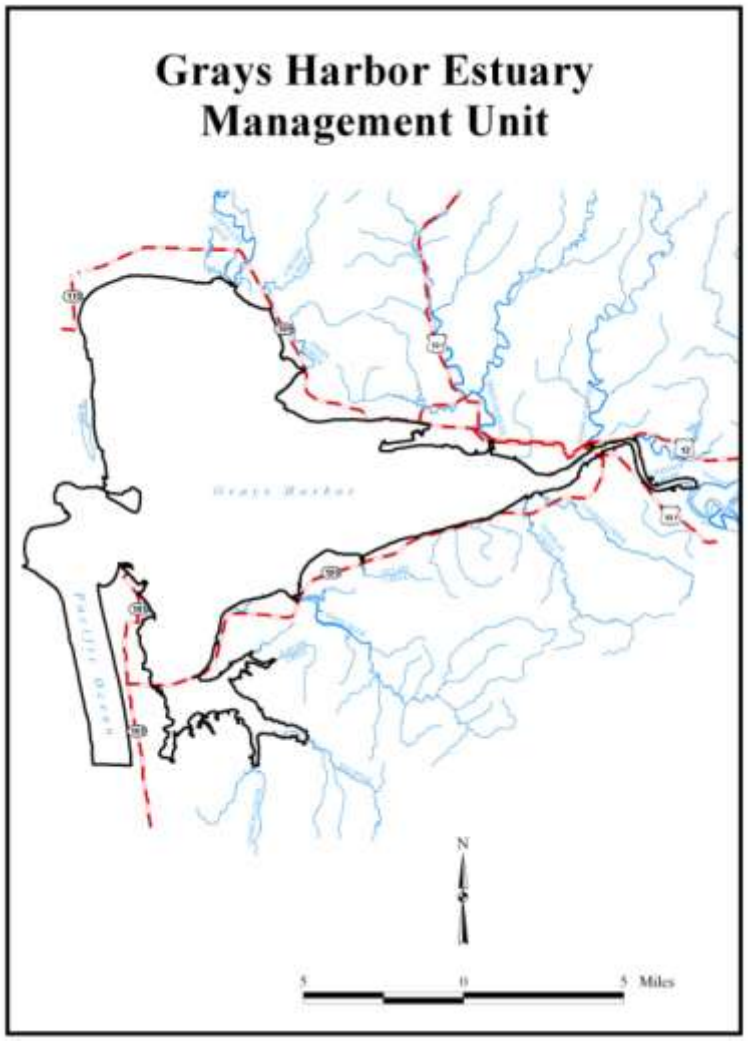
Cloquallum Creek Tier 3	LARGE WOODY DEBRIS	
Symptom	**Cause**	**General Actions**
➡ There are estimated low levels of LWD in the Cloquallum subbasin.	➡ Low estimated levels of LWD due to past splash damming activities, LWD removal, and poor riparian recruitment.	➡ Determine LWD levels in Cloquallum subbasin ➡ Develop LWD supplementation plan that will increase LWD by installing logjams and single key piece placement using large conifer when possible ➡ Educate landowners on the importance of leaving LWD (not taking for firewood)

Cloquallum Creek Tier 3	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Elevated stream temperatures are apparent in Wildcat Creek (303d listed stream).	➡ Conversion of mature conifer vegetation to non-forest uses, i.e., agriculture and urbanization, are most pronounced in Newman, Vance, and Wildcat drainages. Conversion to open spaces and deciduous trees is problematic in the area.	➡ Determine water quality conditions ➡ TMDL Implementation – Temperature, pH, fecal coliform

Cloquallum Creek Tier 3	WATER QUALITY	
Symptom	**Cause**	**General Actions**
	➡ Road run-off. Wildcat Creek noted 4 sites of road run-off; Mox Chehalis and Sand Creeks noted 5 sites. ➡ Livestock access. Livestock activity has been documented at 6 sites in Cloquallum and 3 sites in Wildcat Creek. Numerous livestock waste inputs are apparent in lower Mox-Chehalis Creek.	

GRAYS HARBOR ESTUARY MANAGEMENT UNIT

GRAYS HARBOR ESTUARY



Description:

The Grays Harbor Estuary is a bar-built estuary that was formed by the combined processes of sedimentation and erosion caused by both the Chehalis River and the Pacific Ocean. Historically, during low flows in the Chehalis River, sediment accumulated forming a bar across a portion (or potentially all) of the estuary mouth; this sediment is thought to have primarily originated from the Columbia River plume. As river flows increased, the sediment bars likely impeded direct mixing with near shore ocean waters until the force of the downstream flow began to erode the sediment bar. This dynamic process likely resulted in a constantly shifting channel in the lower Chehalis River.

Land use in the immediate riparian areas was historically dominated by surge plain ecosystems. Vegetation in the intertidal region was dominated by dense eel grass beds. The primary factor that determined riparian land cover was the vertical distance above the average high tide line. Plant communities nearest the average high tide line were comprised salt tolerant species, and the presence of salt tolerant species decreased with increasing vertical distance from the high tide line. Currently 70% of the historically available estuary habitat is considered intact. The majority of land that has been converted from the historical cover is now dominated by urban development.

The estuary is considered to be in fair condition. Historically the estuary was considered the primary bottleneck for salmon survival in the basin, but recent advances in water quality treatment are thought to have improved this condition. A study is currently underway to assess juvenile use of the estuary (Grays Harbor Juvenile Assessment).

Major Tributaries: None

Land Uses: Urban development, rural residences, transportation infrastructure

Anadromous Fish Stocks: Spring Chinook, fall Chinook*, summer Chinook*, coho*, chum, and winter steelhead*, and bull trout* (* denotes priority stock)

Grays Harbor Estuary Tier 1 Concerns

Grays Harbor Estuary Tier 1	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Water quality has been thought to be the primary factor limiting salmon productivity in the Grays Harbor estuary ➡ Water quality was thought to be impaired by acidic discharges from pulp mills and thought to contribute to increased incidence of infestation by a parasitic fluke ➡ Pulp mill effluent treatment was increased in the 1990s, and water quality is thought to have subsequently increased. Limited empirical evidence of water quality improvement. ➡ Water quality is may be compromised by the accumulation of dioxin-like chemicals in the sediments (and biota through bioaccumulation). ➡ Other chemical contaminants of concern include polycyclic aromatic hydrocarbon (PAHs), likely stemming from wood preservation and petroleum disposal, and butyltin derivatives from shipping and boat manufacturing. ➡ Chemical pollutants (e.g., pesticides) have been identified that stem from pest control in the timber, agricultural and oyster industry. These toxins have an impact on fish survival and productivity in laboratory experiments; limited empirical demonstration of this relationship.	➡ Degraded water quality has primarily stemmed from discharge of complex effluents from wastewater treatment facilities and pulp and paper mills ➡ Chemical usage for pest control and wood preservation usage	➡ Data Gap Assessment ➡ Enhance water quality: (1) Sediment dredging and/or capping; (2) phytoremediation; (3) pier removal ➡ Evaluate current water quality conditions and the impact of effluent treatment technologies ➡ In situ biomonitoring ➡ Minimize chemical usage in estuary and upland habitat ➡ Reduced effluent discharge

Grays Harbor Estuary Tier 1	TOTAL ESTUARY HABITAT LOSS	
Symptom	**Cause**	**General Actions**
➡ Total estuary habitat is thought to have been reduced by approximately 30% (or 14,579 acres) over historical levels	➡ Loss of habitat has been primarily from diking and filling to promote urban development shipping and railroad access.	➡ Grays Harbor Juvenile Assessment ➡ Reclaim developed estuary habitat

Grays Harbor Estuary Tier 2 Concerns

Grays Harbor Estuary Tier 2	EXOTIC SPECIES	
Symptom	**Cause**	**General Actions**
➡ Spartina is considered the primary exotic species of concern. Infestations have been increasing since 1991, but control efforts have reduced the rate of growth. Spartina is thought to negatively impact salmon productivity by increasing sediment retention and outcompeting native eelgrass.	➡ Accidental exotic species transport from Willapa Bay	➡ Control invasive species. See Section 5. ➡ Minimize the spread of non-native Spartina

Grays Harbor Estuary Tier 2	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ High rates of sediment deposition in the estuary. Increased turbidity from dredging is also thought to have significantly reduced eelgrass beds and benthic fauna abundance /diversity, although quantitative data is relatively limited. ➡ Although anthropogenic sources of sediment have increased, natural sources of sediment have decreased. Reduced rates of natural sedimentation have resulted in increased coastal erosion, particularly near Half-moon Bay. To compensate, dredging has increased in the outer harbor. ➡ Increased rates of sedimentation potentially impact the osmoregulatory function in salmon, particularly coho.	➡ High rates of sediment disturbance in the upper watershed ➡ Increased dredging and reductions in natural sediment deposition ➡ Increased sediment retention by dams on the Columbia River ➡ Estuary sedimentation/turbidity is enhanced by dredging of the navigation channel	➡ Reduce sediment re-suspension via dredging

Grays Harbor Estuary Tier 2	TRIBUTARY CONNECTIVITY	
Symptom	**Cause**	**General Actions**
➡ Connectivity to stream habitat throughout the estuary is generally reduced and is rated poor to fair. Loss of connectivity is particularly pronounced in the South Bay watersheds (particularly John's and Elk River subbasins). Many stream crossings are impassible at all life stages. Many migration barriers are present down-stream of most reaches preventing all upstream migration and promoting sediment retention; particularly of concern for primary tributaries directly discharging into mainstem or estuary habitat.	➡ Highest road densities	➡ Enhance estuary connectivity by removing migration barriers ➡ Evaluate current estuary habitat usage and distributions of life-history patterns among salmonid stocks

Grays Harbor Estuary Tier 2	SURGE PLAIN	
➡ Connectivity to the tidally influenced surge plain habitat is relatively poor in the South Bay, lower Wishkah/Hoquiam watershed. Chehalis mainstem has good connectivity to surge plain habitat except near Montesano (stream diking) and the Satsop Development Park.	➡ High road density and lateral diking	➡ Enhance access to off-channel habitat

Grays Harbor Estuary Tier 3 Concerns

Grays Harbor Estuary Tier 3	OCEAN CONNECTIVITY	
Symptom	**Cause**	**General Actions**
➡ Increased ocean connectivity as a result of dredging and damming of the Columbia	➡ Dredging and reduced sediment transport from the Columbia River plume	

Grays Harbor Estuary Tier 3	LARGE WOODY DEBRIS	
Symptom	**Cause**	**General Actions**
➡ LWD concentrations are thought to be highly reduced over historic levels. Reduced levels are thought to reduce smolt survival	➡ Reduced downstream transport from headwater streams ➡ Removal for navigation purposes	➡ Increased LWD in mud flats

Grays Harbor Estuary Tier 3	CHANNEL STABILITY	
Symptom	**Cause**	**General Actions**
➡ Channel stability has been significantly altered throughout the estuary. The stream channel is more confined than in pre-development conditions.	➡ Primarily as a result of dredging in the navigation channel	
➡ Loss of eelgrass is thought to be a major factor limiting rearing habitat for juvenile salmonids.	➡ Eel grass has also been directly removed for oyster culture	➡ Enhance eel grass bed density

HOQUIAM-WISHKAH MANAGEMENT UNIT

HOQUIAM RIVER

Description:

The confluence of the West and Middle Forks of the Hoquiam River form the mainstem Hoquiam River. The mainstem is seven miles long and has 124 miles of tributaries. The watershed drains an area of 90 square miles.

The upper reaches lie in flat, brushy valleys surrounded by low hills. The entire mainstem watershed is of a relatively low gradient and is intertidally influenced up to its main tributaries, the West and Middle Forks. The substrate of the mainstem is predominately mud and silt. Tributaries lying beyond the intertidal zone have a gravel and rubble base except for the Little Hoquiam, which remains primarily sediment-based throughout its length.

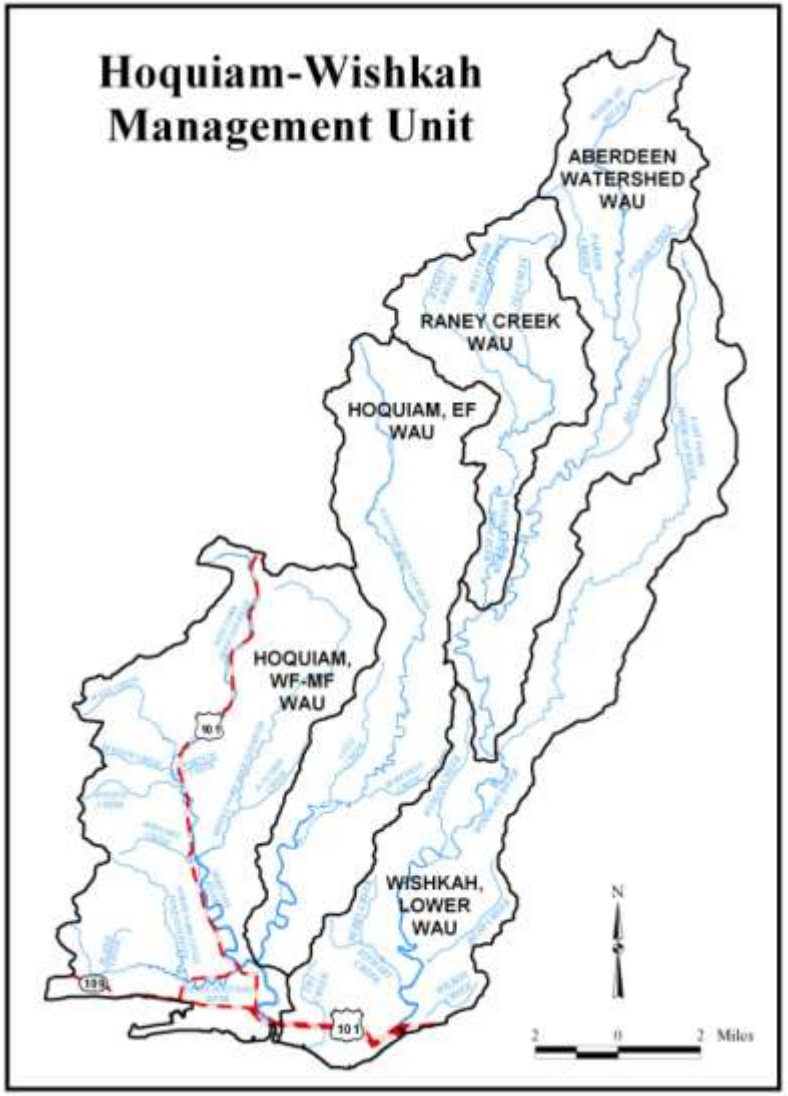
The City of Hoquiam straddles the lower mainstem while rural residences and some agricultural lands lie along the river and its major tributaries beyond the city limits. However, the Middle Fork and its subbasin are in second growth timber production. Davis Creek, Little North Fork Hoquiam, and West Fork Hoquiam have diversion dams. The East Fork has an industrial diversion.

The Mason Conservation District Barrier Assessment observed 298 culverts in the watershed. Of this number, 94 are not in fish-bearing streams, 20 are 100% passable, 45 were not assessed, and 139 had varying levels of passability (0%, 33%, and 67%).

Major Tributaries: West Fork Hoquiam, North Fork Hoquiam, East Fork Hoquiam, Middle Fork Hoquiam, Little Hoquiam River, Polson Creek, Hoover Creek, and Barnard Creek

Land Uses: Forestry, Industrial, Urban and Rural Residences

Anadromous Fish Stocks: Fall Chinook*, coho, chum, cutthroat, winter steelhead (* denotes priority stock)



Hoquiam River Tier 1 Concerns

Hoquiam River Tier 1	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ The lower Hoquiam has Class B waters ➡ Hoquiam River is recorded as a significant contributor to fecal coliform in Grays Harbor	➡ The periodic flushing of the dams most likely affects water quality during the flushing. ➡ The Class B Ecology rating is due to industrial and residential development. ➡ Sediment loading. Water quality diminishes during high flows due to sediment loading from extensive road systems, sediment trapped behind dams, and lower river sediment substrate. ➡ The Class B Ecology rating is due to industrial and residential development. ➡ The data regarding water quality is limited.	➡ Abandon roads on steep geologically sensitive areas; implement alternative methods of bank stabilization (bioengineering) in locations of excessive erosion/sediment input; reduce sediment loading by reducing road densities (abandon/decommission); upgrade logging roads to comply with Forest and Fish Agreement (1999) ➡ Adjust sediment flushing through dams to occur only during high flow events; develop improved methods of flushing sediment from the municipal dams ➡ Determine water quality conditions; implement TMDL recommendations ➡ Identify specific degraded riparian areas for restoration; revegetate open riparian areas with native plants; revegetate riverbanks for added protection from the erosion ➡ Protect, fee simple/easement key properties riparian habitat
➡ High summer water temperatures	➡ Lack of riparian vegetation, logging practices, and development	➡ Identify specific degraded riparian areas for restoration ➡ Implement activities that lead to natural recharge of aquifers • Reduce storm water discharge directly to streams • Restore wetlands for water storage ➡ Increase hydrologic continuity - reduce impervious surfaces ➡ Interplant conifers in deciduous dominant areas; revegetate open riparian areas with native plants

Hoquiam River Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish access to spawning/rearing habitat is restricted	➡ High density of roads with barrier culverts. The EF Hoquiam has 114 miles of logging roads, Middle and W. Fork has 212 miles of roads.	➡ Consider providing access to past natural barriers on case-by-case basis

Hoquiam River Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
	➡ Dams with inefficient laddering systems or no laddering. Municipal diversions exist on Davis Cr., and W. Fork Hoquiam. Fishways have been installed on Davis Cr. and the W. Fork while the N. Fork remains a total barrier. ➡ Natural barriers on the EF, WF, upper Polson, Hoover, and Barnard Cr. Load in system	➡ Correct barrier culverts. See Section 4 for guidelines. ➡ Improve fish passage at the dam fishways and add fishways to those dams that do not have them

Hoquiam River Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ In the lower 5.2 miles of the mainstem Hoquiam and the last mile of the E. Fork, the riparian area has been developed and is rated as poor riparian conditions. ➡ Riparian conditions in the E. Fork Hoquiam are poor with 70% of the riparian area consisting of deciduous or non-forested use ➡ The middle and W. Fork Hoquiam has poor conditions with 62% classified as non-forested, open or deciduous and 36% classified as conifer or mixed conifer in mid to late seral stages.	➡ Commercial and residential development in the lower reaches.	➡ Identify specific degraded riparian areas for restoration ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Protect by fee simple or easement key properties of riparian habitat ➡ Remove invasive species. See Section 5. ➡ Revegetate open riparian areas with native plants
➡ In the upper reaches above the dense residential area, the drainage has fair and poor riparian conditions consisting of mixed conifer and deciduous with areas lacking any vegetation. ➡ The Little Hoquiam, and N. Fork Hoquiam are undeveloped, but the riparian is rated as fair as it recovers from past logging practices.	➡ Timber harvest. Past logging practices of not leaving riparian buffers.	➡ Identify specific degraded riparian areas for restoration ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Protect, fee simple/easement key properties riparian habitat ➡ Remove invasive species. See Section 5. ➡ Revegetate open riparian areas with native plants

Hoquiam River Tier 2 Concerns

Hoquiam River Tier 2	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Severely degraded fish habitat with channel incision, low levels of LWD, scoured streambed gravels, and blocked access to off-channel habitat. ➡ Restricted floodplain connectivity	➡ Splash dams. The historic logging practices utilized 21 splash dams to transport timber upstream to mills. ➡ High density of roads. Highway 101 borders the mainstem Hoquiam and W. Fork Hoquiam periodically for 16 miles with localized areas confining the river migration. ➡ Commercial and residential development in the lower reaches restricts floodplain function	➡ Assess floodplain conditions and identify impacts ➡ Protect, fee simple or easement, key properties to facilitate natural channel migration and reconnection to the floodplain ➡ Reconnect, enhance, and/or restore potential off-channel, floodplain, and wetland habitat ➡ Remove hard armoring / implement bioengineering

Hoquiam River Tier 2	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Complete evaluation cannot be done at this time. ➡ There are no sedimentation studies on the Hoquiam.	➡ Soil types in the lower EF and extreme upper EF Hoquiam have high surface erosion potential. The remainder of the drainage has medium erosion potential. Low gradient and tidal influences are natural contributors. ➡ Logging and unpaved roads constructed in areas geologically sensitive and prone to sediment transport. • Fine sediment can originate from the erosion of roads. • Road ditches can serve as pathways for sediment coming from exposed cut slopes adjacent to roads. ➡ Landslides. Sidecast roads in combination with soil types conducive to erosion can trigger mass wasting/landslides contributing sediment to streams in the basin. Sediment loading, primarily attributed to logging road densities, is poor in the MF and WF, (< 3mi/sq. mi); fair in the EF Hoquiam. ➡ Roads not constructed or maintained to current standards ➡ Periodic releases of sediment that degrades spawning and rearing habitat downstream. ➡ Dam operations. Municipality reservoirs (dams) trapping and flushing sediment downstream is a maintenance practice detrimental to fish and habitat conditions.	➡ Conduct studies similar to that done on Upper Wishkah River to determine sediment loading and reduction ➡ Correct cross drains that may trigger mass wasting on geologically sensitive slopes ➡ Develop improved methods of flushing sediment from municipal dams ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Reduce road densities by abandoning and/or decommissioning roads to reduce sediment loading ➡ Reduce sediment loading by reducing road densities (abandon/decommission) ➡ Remove dams where feasible ➡ Revegetate open riparian areas with native plants ➡ Upgrade to logging roads to comply with Forest and Fish Agreement (1999)

Hoquiam River Tier 3 Concerns

Hoquiam River Tier 3	LARGE WOODY DEBRIS	
Symptom	**Cause**	**General Actions**
➡ LWD is generally lacking.	➡ Splash dams and timber harvest. Most of the LWD in the lower reaches was eliminated during the early logging periods when 21 splash dams were used to transport timber to the mills. ➡ Timber harvest, land use and dam operations. Recruitment is reduced by past logging practices, commercial and residential use, agricultural development, and the presence of dams in three of the main branches of the river hindering LWD transport. ➡ Riparian degradation and loss. With the riparian areas rated from fair to poor through-out most of the watershed the near term potential is fair to poor for LWD recruitment. ➡ Lack of late seral canopy within the riparian areas for LWD recruitment throughout the watershed.	➡ Determine LWD quantities ➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity ➡ Install LWD pieces in conjunction with other restoration projects ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Protect by fee simple or easement key properties of riparian habitat ➡ Revegetate open riparian areas with native plants

Hoquiam River Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ The land cover conditions for the E. Fork, W. & Middle Forks of the Hoquiam WAUs have 21% to 37% land cover in mid-to-late seral. This equates to a poor rating for water quantity.	➡ The lack of vegetation cover is due to logging and development.	➡ Identify specific degraded riparian areas for restoration ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Protect (fee simple or easement) key properties of riparian ➡ Revegetate open riparian areas with native plants
➡ The quantity of water for fish is generally low during low flow summer months.	➡ The City of Hoquiam owns water rights within 7500 acres of the Davis Cr. and W. Fork Hoquiam watersheds, but would not make information available on flows and withdrawals.	➡ Adjust dam flows to better accommodate fish ➡ Determine if water withdrawals are being followed in accordance with current water rights ➡ Implement activities that lead to natural recharge of aquifers ➡ Increase hydrologic continuity - reduce impervious surfaces

WISHKAH RIVER

Description:

The Wishkah River originates in the foothills of the southern Olympic Mountains and drains a 102 square mile area. The mainstem, East, and West Forks comprise the Wishkah River system. The river flows directly into the north side of Grays Harbor near the mouth of the Chehalis River. The Wishkah River is tidally influence for eight miles upstream.

The lower 3 miles of the river are in intensive urban development. The remaining 5 miles of tidily influenced River are undeveloped, characterized by a mature alder and conifer. From RM 8 to RM 23, agriculture dominates the floodplain with the mix of rural residences. Upstream from RM 23, the watershed is intensively managed for timberlands at various stages of growth.

Most spawning occurs above RM 14. Long live the king's operates a hatchery at RM 25.75. A high Falls at RM 29.4 blocks upstream fish passage. Malinowski Dam at RM 32.2 forms a 15-acre reservoir that provides domestic water supply for the City of Aberdeen.

Major Tributaries: East and West Forks Wishkah River

Land Uses: Forestry, rural residences, and urban development

Anadromous Fish Stocks: Fall Chinook, coho*, chum, cutthroat, winter steelhead, and bull trout* (* denotes priority stock)

Wishkah River Tier 1 Concerns

Wishkah River Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ The lower Wishkah has high quantities of fine sediments.	➡ Early logging used splash dams degrading stream complexity and substrate ➡ Poorly constructed roads, lack of cross drains, road ditches directed to cross streams, and poor road surface quality. ➡ Two main haul roads contribute the majority of the sediment loading; A-line Mayr Bros. Rd, and the Weyco G-line ➡ Road densities are rated fair in upper basin and poor in the lower basin due to increased recent logging in the upper basin. ➡ High landslide potential in upper basin due to geologically sensitive areas.	➡ Correct cross drains that may trigger mass wasting on geologically sensitive slopes ➡ Develop improved methods of flushing sediment from municipal dams ➡ Gravel enhancement downstream of dams and weirs to decrease scouring an incision ➡ Identify sources that are contributing to loading ➡ Identify specific degraded riparian areas for restoration ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas

Wishkah River Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
	➡ Mass wasting, road building, logging geologically sensitive areas, agriculture, and development in the lower reaches. ➡ Older abandoned logging roads not in use and not maintained, failing culverts on unmaintained or abandoned roads. ➡ Dam operations may affect sediment transport.	➡ Revegetate streams and riverbanks for erosion protection ➡ Upgrade logging roads to comply with Forest and Fish Agreement (1999) ➡ Upper watershed above RM 28.5 included in a sediment model analysis completed by Rayonier NW Timber Resources. Reduce sediment loading by reducing road densities (abandoned/decommissioning)

Wishkah River Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian corridor condition is poor in the lower Wishkah, W. Fork, and half of the upper Wishkah.	➡ The riparian corridor is considered to have a low LWD recruitment potential because it is dominated by hardwoods. ➡ Substantial industrial-residential development in the first three river miles with poor riparian habitat. ➡ The lower reach to RM 3 contains little riparian vegetation due to land conversions, from RM 3-7.5 the riparian corridor is dominated by red alder. ➡ From RM 7.5- 20 the riparian corridor is dominated by hardwoods or is lacking vegetation due to harvesting or agricultural practices. Agriculture and residential development in the 3 to 7.5 mile reach has eliminated much of the riparian corridor. ➡ Above RM 20, the land use is primarily forestry and conditions vary depending on the harvesting practices. ➡ Agricultural, residential activities in the 7.5 -20 RM that had mixed conifer and hardwood and is now mostly hardwood.	➡ Control invasive species. See Section 5. ➡ Identify specific degraded riparian areas for restoration needs ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Protect by fee simple or easement key properties of habitat ➡ Revegetate open riparian areas with native plants

Wishkah River Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish access to spawning/rearing habitat is restricted	➡ Barrier culverts under the main county roads and forestland roads.	➡ Consider providing access over natural barriers on a case-by-case basis

Wishkah River Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
	➡ The east side of Middle and Upper Wishkah has limited access to tributaries because of high rocky banks and waterfalls impassible to fish. ➡ High road densities 3.36 mi./sq. mi., some with fish barrier culverts	➡ Correct barrier culverts. See Section 4 for guidelines.

Wishkah River Tier 2 Concerns

Wishkah River Tier 2	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ The floodplain rating for the Wishkah is poor for the lower watershed and fair-to-good for the upper watershed.	➡ The floodplain is disconnected in the lower basin due to channel incision and bordering road restrictions. ➡ The Wishkah had 34 splash dams for timber harvest. Splash dam use and historic logging practices straightened that channel and incised lower river. ➡ Much of the floodplain in the middle and upper east side of the basin is cut off by high, steep rocky banks. ➡ Portions of the upper Wishkah have incised and disconnected from the floodplain due to frequent high peak flows caused from extensive harvesting of watershed and early seral canopy cover.	➡ Assess floodplain conditions and identify impacts ➡ Protect, fee simple / easement, key properties to facilitate natural channel migration and reconnection to the floodplain ➡ Reconnect, enhance, and/or restore potential off-channel, floodplain, and wetland habitat ➡ Remove hard armoring (riprap) or implement bioengineering techniques in place of hard armoring

Wishkah River Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ The Wishkah Basin has low levels of LWD. Areas surveyed show low levels LWD and the near-term recruitment potential is low due the hardwood dominated riparian corridor.	➡ In the lower three-mile reach, riparian buffer and LWD recruitment are non-existent due to heavily industrially developed areas. ➡ In the middle to upper Wishkah River, agricultural and rural residential development has removed much of the conifer riparian cover allowing hardwoods to dominate the stream edges thus decreasing recruitment potential of large long term LWD.	➡ Develop LWD supplementation plan that will install log jams to improve instream channel structure and habitat diversity ➡ Identify specific degraded riparian areas for restoration ➡ Install LWD pieces in conjunction with restoration projects ➡ Interplant conifers in deciduous dominant areas ➡ Revegetate open riparian areas with native plants

Wishkah River Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ The instream LWD rating in some of the tributaries in the Upper Wishkah were rated as good, but the LWD was in an advanced stage of decay. The good rating may therefore decline.	➡ Logging practices until recent times allowed riparian corridors to be logged, thus removing long-term conifer recruitment potential of LWD.	➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity ➡ Install LWD pieces in conjunction with restoration projects ➡ Interplant conifers in deciduous dominant areas

Wishkah River Tier 3 Concerns

Wishkah River Tier 3	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Increased temperatures continue to be a problem in portions of the mid to lower basin during the summer months.	➡ Long Live the Kings / Mayr Bros. hatchery in the upper basin is in the process of collecting temperature data, but no information has been documented as yet. ➡ Due to industrial, residential and agricultural development there is poor land cover vegetation in the Lower and West Fork Wishkah causing poor water quality	➡ Adjust dam flows to better accommodate fish ➡ Determine if water withdrawals are being followed in accordance with current water rights ➡ Reduce water withdrawals from surface sources

Wishkah River Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ In the Lower Mainstem and West Fork Wishkah, the water quantity is poor. The upper Wishkah has good vegetative land cover and the water quantity is good.	➡ Riparian degradation in land use limits water table recharge, lowering summer flows ➡ Recent logging and clear-cut operations the upper basin have reduced water retention, lowering summer flows. ➡ Development-related water withdrawals ➡ Dam operations	➡ Adjust dam flows to better accommodate fish ➡ Determine if water withdrawals are being followed in accordance with current water rights ➡ Implement activities that lead to natural recharge of aquifers (reduce storm water discharge directly to streams, restore wetlands water storage, increase hydrologic continuity) ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Protect, fee simple/easement, key riparian habitat properties ➡ Reduce water withdrawals from surface sources ➡ Revegetate open riparian areas with native plants

HUMPTULIPS MANAGEMENT UNIT

HUMPTULIPS RIVER

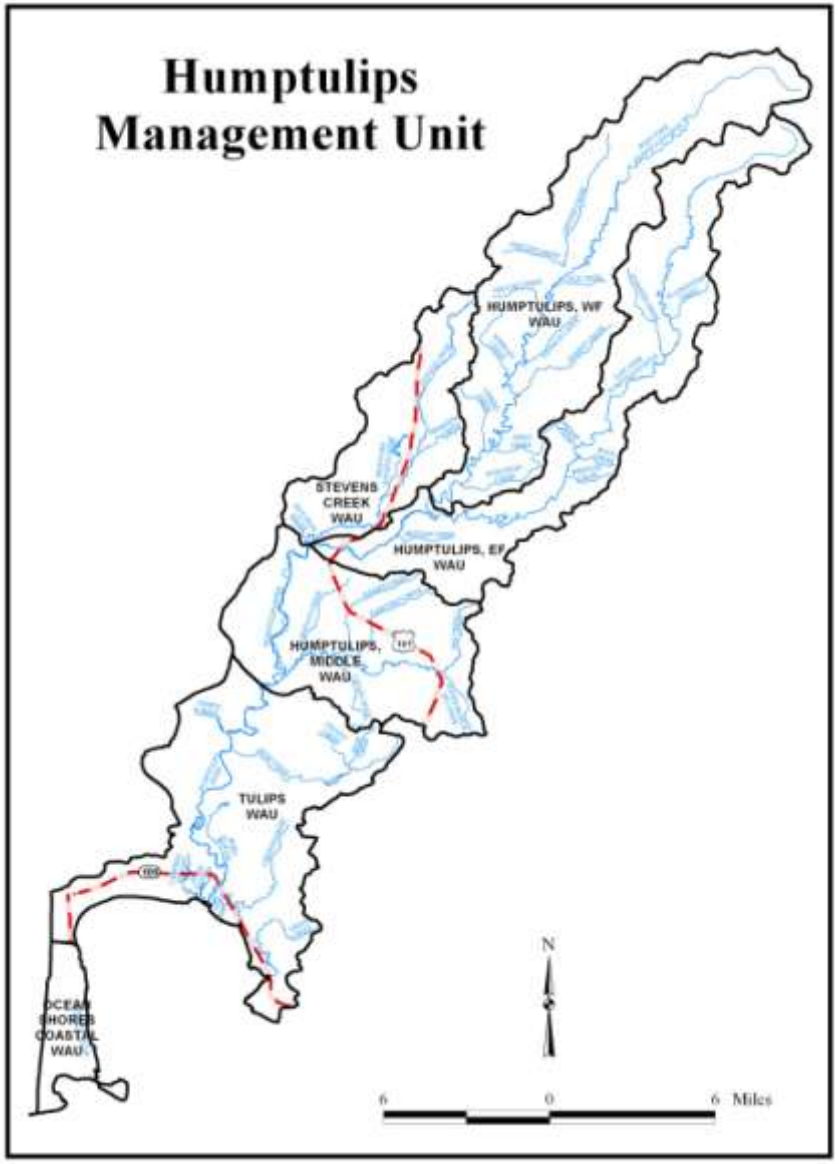
Description:

The Humptulips Watershed has 320 stream miles with over 160 miles of anadromous fish habitat.

The Humptulips River mainstem branches into the West Fork at RM 28.11 and the East Fork at RM 28.2. The lower portion of the Humptulips has a low gradient that flows through farmlands and timbered areas. Although most sloughs in this section are tidally influenced, including Gillis, Campbell, and Jesse Slough, Burg Slough is not. The Humptulips Hatchery is at the confluence of Stevens Creek and the mainstem (RM 22.5).

The lower Humptulips has three primary tributaries: Big Creek, Stevens Creek, and Deep Creek. Of the three, Deep Creek is the most important tributary in the lower basin. Deep Creek, is 7.8 miles long and flows through partially cleared areas, averages 9 meters in width, and has two falls. Failor Lake dam lies above both falls. Deep Creek enters the mainstem at RM 9.6. Big Creek is an 11.5-mile long tributary entering the mainstem at RM 15.4. It has a moderate-to-low gradient, ample spawning gravels, and good canopy cover. Cedar Creek, one of its tributaries, has a dam. Another tributary, Fairchild Creek, has a fishway under highway 101 at RM 1.6.

The East Fork Humptulips starts at RM 28.2 and has 29.9 stream miles. Another 19 tributaries add 31.4 stream miles. Altogether, the East Fork watershed drains 46.4 square miles. The East Fork originates in the foothills of the Olympic Mountains between steep hills, eventually flowing into a river valley that gradually broadens. The East Fork has a good balance of pools and riffles with numerous falls and cascades at the upper end. Fish use occurs in the lower 17 miles; however, the addition of a fish ladder at the falls below the confluence with Flat Bottom Creek will open another mile of habitat. All the tributaries of the East Fork are short and steep with fish habitat being concentrated at the lower ends. Most of the East Fork lies within forestland subject to past and current logging.



The West Fork Humptulips starts at RM 28.11 and is 17.3 miles long. Thirteen tributaries add another 35.8 stream miles. This watershed drains an area of approximately 46 square miles. The West Fork originates in the Olympic Mountains in forested areas with steep gradients. It flows through a narrow gorge at RM 45.4 through 45.9, creating cascades that form a natural barrier. Further downstream, the main channel has a low to moderate gradient with a series of high cut banks before entering a broad river valley. Most of the watershed is in forestland with no agricultural or residential development. The principal tributaries include Chester, Grouse, Newbury, Donkey, Furlough, Elk, and O'Brien Creeks. These tributaries are generally steep in their upper reaches and do not moderate in gradient until their confluence with the West Fork. Most of the tributaries have falls within a mile of their mouth.

Major Tributaries: Big Creek, Stevens Creek, and Deep Creek

Land Uses: Forestry and rural residences

Anadromous Fish Stocks: Fall Chinook*, spring Chinook, coho*, chum, cutthroat, winter steelhead*, summer steelhead, and bull trout (* denotes priority stock)

Humptulips River Tier 1 Concerns

Humptulips River Tier 1	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ The mainstem Humptulips is on the 1998 303(d) list for warm water temperatures. Warm water temperatures have also been recorded in the East and West Forks. Temperatures at the WDOE monitoring site at RM 23.6 have a mean monthly temperature frequency exceeding 15.6 degrees C. in the summer months.	➡ Riparian degradation and loss. The frequency of high temperatures in the lower reaches of the East and West Forks and mainstem river are due to increased riparian harvests and degraded riparian vegetation.	➡ Determine water quality conditions ➡ Identify specific degraded riparian areas for restoration ➡ Implement TMDL recommendations ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Revegetate open riparian areas with native plants
➡ The mainstem has a rating of "poor" for water quality.	➡ High rain events and sediment loading from logging roads most likely diminishes the water quality during the high peak flow events.	➡ Abandon roads on steep geologically sensitive areas ➡ Correct cross drains that may trigger mass wasting ➡ Minimize motor vehicle access to streams ➡ Reduce sediment loading by reducing road densities ➡ Upgrade logging roads to comply with Forest and Fish Agreement (1999)
➡ Recent TMDLs of fecal coliform indicates the Humptulips produces 13% of the fecal coliform delivered to the Chehalis Basin.	➡ No non-point sources are identified, but speculated that failing septic systems, livestock waste and wild game waste may be the cause.	➡ Implement TMDL recommendations ➡ Install riparian fencing to exclude or reduce livestock access

Humptulips River Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish access to spawning / rearing habitat is restricted	➡ Humptulips has over 851 culverts based on recent assessment in the basin by Mason Conservation District: • 369 - 33-67% passable • 96 - Unknown passability ➡ High road density. There are 837 miles of roads in the Humptulips watershed: 212 on National Forest lands, 177 on non-forest lands in the East and West Forks, 104 on non-forest lands in Stevens Creek, and 344 on non-forest lands downstream of the Forks, including the Big Creek drainage.	➡ Correct barrier culverts. See Section 4. ➡ Improve fish passage at fishways and add a fishway to those structures without ones

Humptulips River Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Excessive bedload transports high quantities of fine sediment and reduces spawning gravel in the system. ➡ Substrate embeddedness is high in O'Brien Creek and the W. Fork. These reaches are rated "poor" for sediment delivery.	➡ Watershed analysis identified 55 channel segments with increased fine sediment delivery in the following reaches; East Fork, West Fork, Chester and Donkey Creek. ➡ High road densities. There are 837 mi. of roads in the Humptulips watershed; 212 on National Forest lands, 177 on non-forest lands in the E. and W. Forks, 104 on non-forest lands in Stevens Creek, and 344 on non-forest lands downstream of the Forks, including the Big Creek drainage. ➡ Timber management, gravel bar mining and splash dams have modified sediment delivery and substrate composition in the Humptulips. ➡ Timber harvest. All sediment delivery is related to logging roads. ➡ Surface erosion. Of 14 bridges in the East and West Fork Humptulips, 8 pose a high vulnerability to mass wasting. ➡ Landslides. Of 286 landslides surveyed, 17.3% were caused by timber harvest, 46.9% by roads, and 35.7% by natural events.	➡ Abandon roads on steep geologically sensitive areas ➡ Develop improved methods of flushing sediment from the municipal dams ➡ Implement alternative methods of bank stabilization (bioengineering) in locations of excessive erosion ➡ Reduce sediment loading by reducing road densities (abandon/decommission) ➡ Correct cross drains that may trigger mass wasting on geologically sensitive slopes ➡ Minimize motor vehicle access to streams ➡ Upgrade logging roads to comply with Forest and Fish Agreement (1999)

Humptulips River Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Accelerated channel scouring and streambank erosion.	➡ Splash dams. • The frequent release of high water from splash dams accelerated channel scouring and streambank erosion where riparian logging destabilized the banks. • Log delivery using splash dams reduced the amount of LWD in the system that in turn reduced the ability to store and retain spawning gravels and fine sediments. ➡ Landslides. Of 286 landslides surveyed, 17.3% were caused by timber harvest, 46.9% by roads, and 35.7% by natural events. ➡ In five areas with road densities between 3 and 5.4 miles per square mile road, erosion delivered 95% to 237% of natural background erosion. These stream sections are rated poor: • W. Fork upstream of Chester Creek. • The area upstream of Donkey Creek. • The Lower West Fork Humptulips. • Donkey Creek. • The lower East Fork.	➡ Abandon roads on steep geologically sensitive areas ➡ Correct cross drains that may trigger mass wasting on geologically sensitive slopes ➡ Develop improved methods of flushing sediment from the municipal dams ➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity ➡ Implement alternative methods of bank stabilization (bioengineering) in locations of excessive erosion ➡ Install LWD pieces in conjunction with other restoration projects ➡ Minimize motor vehicle access to streams ➡ Reduce sediment loading by reducing road densities (abandon/decommission) ➡ Upgrade logging roads to comply with Forest and Fish Agreement (1999)

Humptulips River Tier 2 Concerns

Humptulips River Tier 2	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The majority of the riparian zone downstream of the East and West Forks are poor. The agricultural lands on the lower mainstem have riparian zones that are generally sparsely stocked and narrow.	➡ The channel widths in this area are generally wide and difficult to shade, so this area is low for shade cover. ➡ Regenerated areas on the private lands are predominately hardwoods, and those areas in the natural migration zones frequently disturbed by high peak flows have added to the increased dominance of hardwoods. ➡ The Lower Mainstem has a high proportion of agricultural and rural residential land use. ➡ Timber harvest. Logging since the late 1800s has affected the Humptulips watershed. • Before 1930, concentrated harvesting occurred near the lower mainstem river, East and West Forks, and the large tributaries because the only method of log transport was by splash dam. • Early logging practices did not protect riparian habitat and by 1960 the majority of the private forestlands had been harvested including the majority of the riparian areas.	➡ Control invasive species. See Section 5. ➡ Identify specific degraded riparian areas for restoration needs ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Revegetate open riparian areas with native plants
➡ The lower tributaries of the East and West Fork have poor riparian shade and LWD recruitment, but the upper areas within the Forest Service lands are mostly unmanaged and have good riparian shade.	➡ Big Creek has some rural residential, but primarily forestlands. ➡ Timber harvest. Logging since the late 1800s has affected the Humptulips watershed. • Before 1930, concentrated harvesting occurred near the lower mainstem river, East and West Forks, and the large tributaries because the only method of log transport was by splash dam. • Early logging practices did not protect riparian habitat and by 1960 the majority of the private forestlands had been harvested including the majority of the riparian areas.	➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity ➡ Identify specific degraded riparian areas for restoration ➡ Install LWD pieces in conjunction with other restoration projects ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Revegetate open riparian areas with native plants

Humptulips River Tier 2	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Some restriction of natural stream migration, especially in the mainstem.	➡ Riprap and other bank protection. • The Humptulips Valley Dike Road at RM 6.9 in the mainstem. The dike does not appear to have cut off any historic side-channels or sloughs, but has prevented the natural migration from creating side-channel and margin habitat in this reach. • There are three other sections of riprap along the mainstem which were placed to reduce bank erosion and there is riprap placed near the three boat ramps. ➡ The only adjacent road confinement is Ocean Beach Road, where .4 of a mile of the stream is impacted at RM 6.	➡ Assess floodplain conditions and identify impacts ➡ Reconnect, enhance, and/or restore potential off-channel, floodplain, and wetland habitat ➡ Remove hard armoring (riprap) or implement bioengineering techniques in place of hard armoring
➡ There is an absence of side-channels in the floodplains of confined, low gradient reaches within the East and West Forks.	➡ Splash dams. Suggests a long-term effect of splash dams. The extensive use of splash dams between the 1890s and the 1930s may have had a greater impact on the natural functions of the floodplain than more recent impacts, but it would be difficult to quantify those effects. The frequent release of high flows during log drives removed natural woody debris, and accelerated channel incision. In those areas where splash damming did not occur, the rating is considered "good." Because side-channels were blocked off to prevent logs from being stranded, the down cutting on the side-channels would not have occurred at the same rate, resulting in isolation from the main channel. The consequential reduction of side-channels and LWD resulted in reduced juvenile habitat for rearing. ➡ Low levels of LWD. Until the 1980s, riparian harvest and stream cleaning reduced the recruitment of LWD to stream channels preventing the natural formation of debris jams that create new side channels.	➡ Determine LWD quantities ➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Revegetate open riparian areas with native plants

Humptulips River Tier 3 Concerns

Humptulips River Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Direct measurements of stream flows ceased in 1979 with no flow trends to establish a base for current flows. Indicators show decrease in hydrological maturity. The Humptulips suffers from rapid flow increases during heavy rains and quickly returns to seasonal flows after the rain event, suggesting hydrology impacts to the stream and the floodplain. High peak flows increase bank erosion and input of fine sediments, causes stream incision with channel scour, separates the floodplain and impacts fish in all life stages of development	➡ Riparian degradation and loss and timber harvest. • The middle Humptulips is rated "poor" for hydrologic maturity; 63% of the land in hardwoods or lacking trees. • The lower Humptulips has a significant loss of mature conifer, but the rating was just under the "poor" rating. • The Lower Humptulips is more impacted overall than the East and West Forks for land cover and vegetative type. • The middle Humptulips is rated "poor" for water quantity because of the low quantity of mature conifer for land cover. Other areas are rated "good" with the lower river barely missing the "poor" rating. Changes of land use from timber to other uses will lower the "good" rating. • Both the East and West Forks are rated "good" for water quantity, but continued logging in these basins may have decreased these ratings.	➡ Identify specific degraded riparian areas for restoration needs ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Protect by fee simple or easement key properties of riparian habitat ➡ Revegetate open riparian areas with native plants

Humptulips River Tier 3	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ Existing LWD densities were surveyed in 31% of the 320 miles of streams in the East and West Forks; 29.6 miles had poor densities, 6.9 miles had fair densities and 24.9 miles had good densities. ➡ All good LWD densities were in the mainstem East and West Forks and all tributaries of these mainstems had poor densities except for Rainbow Creek and an unnamed tributary of the West Fork. ➡ Areas in the upper reaches of both branches on Forest Service lands have good LWD densities and recruitment potential because of the amount of late seral conifers. ➡ No densities were measured in the Lower Mainstem.	➡ Riparian degradation and loss. The overall potential for LWD recruitment below the East and West Forks in the mainstem river are poor due to no vegetation, hardwood dominated or previously logged riparian zones ➡ Long-term LWD recruitment potential has improved for the majority of the watershed because of the buffer protections which started in the mid-1980s and followed up with Timber Fish and Wildlife rules adopted into law in 2001. ➡ Timber harvest, agricultural and rural residential use. In the lower mainstem and lower portions of the East and West Forks where agriculture and rural residential areas predominate, and where the riparian has been logged, the near term potential is poor for LWD recruitment.	➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity ➡ Identify specific degraded riparian areas for restoration needs ➡ Install LWD pieces in conjunction with other restoration projects ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Revegetate open riparian areas with native plants

LINCOLN MANAGEMENT UNIT

LINCOLN CREEK

Description:

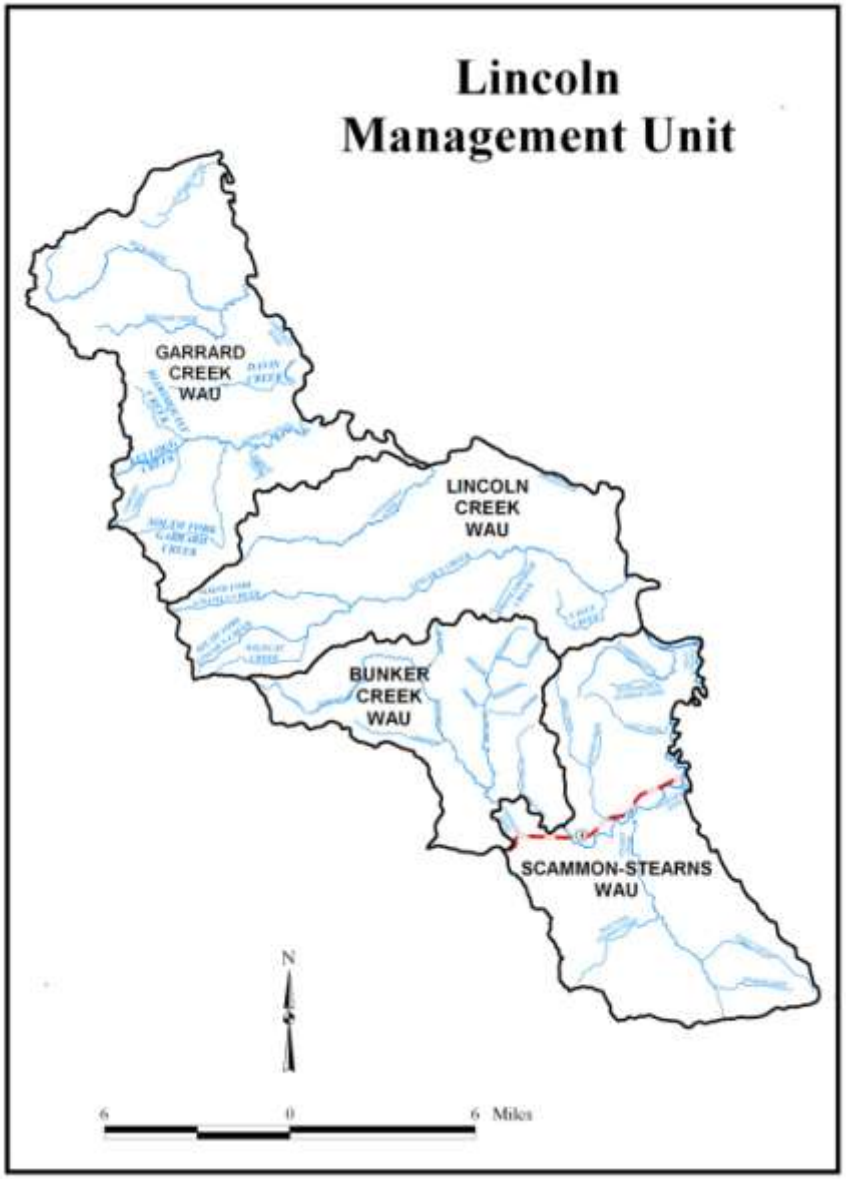
Lincoln Creek joins the Chehalis River at RM 61.9 near the city of Centralia. Several tributaries provide habitat for coho salmon including Eagle Creek, Sponenberg Creek, Wildcat Creek, and the North and South Fork Lincoln Creeks (Phinney and Bucknell 1975).

The headwaters of Lincoln Creek start in the Willapa Hills. The upper reaches are generally confined, while the lower reaches flow through broad valleys (Phinney and Bucknell 1975). The land use in this subbasin is a mix of timber use, agriculture, and rural residences. Coho are present in the Lincoln Creek subbasin but there is very limited steelhead use. In the past, chum salmon have used this area, but are now uncommon.

Major Tributaries: Eagle, Sponenberg, Wildcat, and North and South Fork Lincoln Creeks, Garrard Creek, Gaddis Creek, Rock/Williams Creek, Bunker Creek, Scammon, Mill, Stearns Creek

Land Uses: Forestry, Agriculture, and Rural Residences

Anadromous Fish Stocks: Coho, winter steelhead, and cutthroat



Lincoln Creek Tier 1 Concerns

Lincoln Creek Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Ecosystem Diagnosis and Treatment (EDT) model shows sedimentation as a major problem in Lincoln Creek	➡ Sedimentation is likely the product of bank erosion, roads, and livestock access. (Wampler et al. 1993).	➡ Determine the extent roads are contributing sediment. ➡ Work with landowners in the lower reaches to reduce livestock access to Lincoln Creek.

Lincoln Creek Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian condition in the Lincoln Creek subbasin is poor. The riparian corridor along Lincoln Creek is sparsely vegetated with deciduous vegetation up to RM 7.5. From RM 7.5 – RM 10.2 the corridor is mixed with some areas containing conifer (Smith Wenger 2001). ➡ In Lincoln Creek WAU over 40% of the WAU is considered open hardwood and over 30% is considered non-forested.	➡ Conversion of land use from forestry to agriculture or rural residential has contributed to degraded riparian corridors (primarily lower and middle Lincoln Creek subbasin reaches). ➡ Past timber harvesting practices have impacted riparian corridors (primarily upper Lincoln Creek subbasin reaches)	➡ Control invasive species. See Section 5. ➡ Protect and preserve riparian habitat in Lincoln Creek subbasin (Chehalis EDT model rated Lincoln Creek preservation #2 for Chehalis coho benefit). ➡ Restore riparian corridor along Lincoln Creek. Use Wampler et al. 1993 document to identify potential restoration sites.

Lincoln Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Numerous road crossings are undersized and do not allow adequate fish passage upstream because of water velocity or perched outfall. These undersized structures also inhibit the movement of streambed material downstream and usually contribute to channel scour directly downstream.	➡ Placement of undersized stream crossing structures restricts fish passage and natural processes (streambed material transport). Streambed scour may have also caused a passage barrier at a location without road crossings (Smith Wenger 2001).	➡ Correct barrier culverts. See Section 4.

Lincoln Creek Tier 2 Concerns

Lincoln Creek Tier 2	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Lincoln Creek is incised in the middle and lower reaches (C. Stussy, personal observation)	➡ Logjams have been removed from Lincoln Creek according to the Phinney and Bucknell (1975).	➡ Develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain.

Lincoln Creek Tier 2	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
	➡ Riprap is documented in upper Lincoln Creek and Wildcat Creek. (Smith Wenger 2001).	➡ Implement soft armoring techniques where riprap occurs using Integrated Streambank Protection Guidelines manual (see Wampler et al. 1993 for riprap locations).

Lincoln Creek Tier 2	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Lincoln Creek is on the 303d List for temperature. Lincoln Creek also has high fecal coliform levels and low dissolved oxygen levels. (Smith Wenger 2001)	➡ The high temperatures are likely caused by the poor riparian corridor condition. The high fecal coliform levels are likely caused from failing septic systems and livestock (Smith Wenger 2001).	➡ Restore riparian corridor (see 'riparian' actions) ➡ Work with landowners to correct failing septic systems. ➡ Work with landowners to exclude livestock from accessing Lincoln Creek and its tributaries.

Lincoln Creek Tier 3 Concerns

Lincoln Creek Tier 3	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ LWD levels are likely low. ➡ The Chehalis Ecosystem Diagnosis and Treatment (EDT) model indicates Lincoln Creek needs improved habitat diversity	➡ LWD levels are likely low since riparian conditions are rated poor for the Lincoln Creek subbasin and past practices have removed LWD from Lincoln Creek. (C. Stussy, professional opinion).	➡ Develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain. The Chehalis EDT model indicates habitat diversity improvements are most needed in Lincoln Creek reaches 1-3, 9-12, NF Lincoln Creek, Wildcat Creek and Eagle Creek. ➡ Revegetate riparian corridor using Wampler et al. 1993 to identify project sites.

Lincoln Creek Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Low summer flows were noted as a limiting factor in Lincoln Creek (Phinney and Bucknell 1975).	➡ Phinney and Bucknell (1975) note that water withdrawals may have a significant impact on the water quantity in Lincoln Creek.	➡ Determine if water withdrawals are being followed in accordance with current water rights. ➡ Implement forest practice rules in forested headwaters to eliminate ditchwater connection to live streams.

Lincoln Creek Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
		➡ In the lower and middle reaches of Lincoln Creek recreate wetlands for water storage and off-channel habitat. ➡ Lincoln Creek is closed to further water appropriations (Smith Wenger 2001). ➡ Protect and preserve wetlands and springs in Lincoln Creek subbasin (Chehalis EDT model rated Lincoln Creek preservation #2 for Chehalis coho benefit).

Independence Creek

Description:

Independence Creek's headwaters are in the Willapa Hills and it enters the Chehalis River at RM 51.5. It has several unnamed tributaries that likely provide coho salmon habitat in addition to habitat in the mainstem. The lower reaches of the mainstem consist of a sand and silt bottom. Coho salmon spawning habitat is more common upstream of RM 4.0, where gravel is found (Smith Wenger 2001). Upstream of RM 6.0, the gradient steepens and salmon use is questionable.

Major Tributaries: None

Land Uses: Forestry, Agriculture, and Rural Residences

Anadromous Fish Stocks: Coho and cutthroat

Independence Creek Tier 1 Concerns

Independence Creek Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Extensive bank erosion was documented in the middle reaches of Independence Creek and two of its tributaries (23.0705 & 23.0712 (Smith Wenger 2001). ➡ Heavy sedimentation	➡ Sedimentation is likely the product of both bank erosion and roads. Road densities are high in the Lincoln Creek WAU, which Independence Creek is in, with 3.4 miles of road per square mile of drainage (Smith Wenger 2001). ➡ Livestock access is an issue in the lower reaches of Independence Creek (Smith Wenger 2001).	➡ Identify extent roads are contributing sediment. ➡ Identify possible solutions to reduce erosion at the sites identified by Wampler and Knudsen (1993). Locations are primarily in the middle and upper reaches. ➡ Work with landowners in the lower reaches to reduce livestock access to Independence Creek.

Independence Creek Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian corridor is in poor condition up to RM 7 (Smith Wenger 2001). ➡ Several tributaries contain poor riparian corridor conditions (23.0697, 23.0705, 23.0707, and 23.0712) (Smith Wenger 2001).	➡ Agriculture, rural residences, and past logging are primary causes for reduced riparian vegetation and canopy loss (Andy Carlson, personal communication). ➡ Chehalis EDT model rated Independence Creek preservation of good riparian habitat as a level 'A' for Chehalis coho benefit.	➡ Control invasive species. See Section 5. ➡ Protect and preserve riparian habitat in Independence Creek subbasin ➡ Restore riparian corridor along Independence Creek. Use Wampler et al. 1993 document to identify potential restoration sites.

Independence Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Numerous road crossings are undersized and do not allow adequate fish passage upstream because of water velocity or perched outfall. These undersized structures also inhibit the movement of streambed material downstream and usually contribute to channel scour directly downstream.	➡ Placement of undersized stream crossing structures restrict fish passage and natural processes (streambed material transport). Streambed scour may have also caused a passage barrier at a location without road crossings (Smith Wenger 2001).	➡ Correct barrier culverts. See Section 4.

Independence Creek Tier 2 Concerns

Independence Creek Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ LWD levels are low	➡ LWD levels are likely low since riparian conditions are rated poor for Lincoln Creek WAU, past practices have likely removed LWD from Independence Creek. (C. Stussy).	➡ Develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain.

Independence Creek Tier 2	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Low dissolved oxygen in Independence Creek (Smith Wenger 2001).	➡ The suspected cause of low dissolved oxygen in Independence Creek is livestock (Smith Wenger 2001).	➡ Restore riparian corridor (see 'riparian' actions). ➡ Work with landowners to exclude livestock from accessing Independence Creek and its tributaries.

Independence Creek Tier 3 Concerns

Independence Creek Tier 3	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Lower Independence Creek has riprap in lower reaches. (Smith Wenger 2001)		➡ LWD supplementation plan; install LWD to retain bedload, elevate streambed, allow better connection to floodplain.

Independence Creek Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Low summer flows were noted as a limiting factor in Independence Creek (Phinney and Bucknell 1975).	➡ Water withdrawals worsen the low flow conditions during summer low flow periods (Smith Wenger 2001).	➡ Determine if water withdrawals are being followed in accordance with current water rights.

Independence Creek Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
		➡ Implement forest practice rules in forested headwaters to eliminate ditchwater connection to live streams. ➡ Protect and preserve wetlands and springs in Independence Creek subbasin (Chehalis EDT model rated Independence Creek preservation as a level 'A' for Chehalis coho benefit).

Garrard Creek

Description:

Garrard Creek is a medium sized drainage 45.5 miles long and enters the Chehalis River at RM 45. The larger tributaries within the Garrard Creek basin include Kellogg Creek, South Fork Garrard Creek, and Bloomquist Creek. Garrard Creek's headwaters originate in the Willapa Hills; the upper reaches are generally confined, while the lower reach flows through a broad valley (Phinney and Bucknell 1975). Land uses in the Garrard Creek basin consist of a mix of forestland, agriculture, and rural residences. Garrard Creek currently supports coho and a limited amount of steelhead production. In the past, chum salmon have used the Garrard Creek subbasin, but their presence today is uncommon. It is assumed that coho salmon use all accessible areas for rearing, but these areas have not been mapped or documented. In general, data on salmon and steelhead distribution and production is very limited for this region. (Smith Wenger 2001)

Major Tributaries: Davis, Bloomquist, Kellogg, SF Garrard Creek, Forest

Land Uses: Forestland, agriculture and rural residences

Anadromous Fish Stocks: Coho, winter steelhead, and cutthroat

Garrard Creek Tier 1 Concerns

Garrard Creek Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Extensive bank erosion has been documented in the upper reaches of Garrard Creek and Kellogg Creek (Wampler)	➡ Sedimentation is likely caused by bank erosion because of the "fair" road density rating (Smith Wenger 2001)	➡ Reduce stream reach erosion at sites identified by Wampler et al. (1993). Locations are primarily in the upper reaches.

Garrard Creek Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ Riparian corridor condition is poor; 53% of riparian corridor is hardwood dominant; 25% converted to non forest use (Lunetta et al.). Low potential for LWD recruitment because of current conditions (Smith Wenger 2001)	➡ The riparian corridor in the Garrard Creek basin has been heavily impacted and the following sites are areas of documented degradation: RM 1.4-3.1; RM 4-5.2, & RM 6.5-7.6 (Smith Wenger 2001)	➡ Control invasive species. See Section 5. ➡ Restore riparian corridor at RM 1.4-3.1, RM 4-5.2, and RM 6.5-7.6

Garrard Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish Passage barrier status is not fully known; assumption is barriers exist that hinder fish passage and impede natural	➡ Placement of undersized stream crossing structures and natural processes (streambed material) restrict fish passage	➡ Correct barrier culverts. See Section 4.

Garrard Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
processes. Preliminary investigations show there are several barriers existing on county and private properties in the Garrard Creek subbasin		

Garrard Creek Tier 2 Concerns

Garrard Creek Tier 2	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Data need	➡ Several sites have been identified where livestock have direct access to the creek (Luneta et al. 1993)	➡ Work with landowners in the lower reaches to reduce livestock access to Garrard Creek

Garrard Creek Tier 2	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Base flows have not been met and are closed to further appropriations (Smith Wenger 2001). Low summer flows were noted as a limiting factor in Garrard Creek (Phinney and Bucknell 1975)	➡ The Garrard Creek basin has 14% of forest cover converted to other uses and 47% existing as hardwoods (data from Lunetta et al. 1997). These areas rate "poor" for water quantity due to a likely impact on peak flow events.	➡ Implement forest practice rules in forested headwaters to eliminate ditchwater connection to live streams. ➡ In the lower and middle reaches of Garrard Creek recreate wetlands for water storage and off-channel habitat

Garrard Creek Tier 3 Concerns

Garrard Creek Tier 3	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ In some areas, the floodplain is not able to function properly, i.e., meandering, due to streambank riprap. (Smith Wenger 2001)	➡ Riprap is situated throughout the Garrard Creek basin. (Smith Wenger 2001).	➡ Replace riprap with soft armoring techniques (see Wampler et al. 1993 for riprap locations). ➡ See LWD section

Garrard Creek Tier 3	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ The general assumption is that LWD levels are low	➡ Poor riparian conditions ➡ Possible past practices of LWD removal from Garrard Creek	➡ Determine LWD levels and then develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain

Gaddis Creek

Description:

The headwaters of Gaddis Creek originate in the Willapa Hills. The upper reaches are generally confined and steep, while the lower reaches flow through the broad Chehalis Valley (Phinney and Bucknell 1975). Land uses in the Gaddis Creek subbasin are a mix of timber, agriculture, and rural residences. There are approximately 4.9 miles of salmonid habitat in Gaddis Creek (Phinney and Bucknell 1975) and coho are the only documented salmon using it (WDFW Salmonscape 2006). In the past, chum salmon may have also used this subbasin, but are now uncommon (Smith Wenger 2001). It is assumed that coho salmon use all accessible areas for rearing, but many of these areas have not been specifically mapped or documented. In general, salmon and steelhead distribution and production data is very limited in this region (Smith Wenger 2001).

Major Tributaries: None named

Land Uses: Timber, agriculture, rural residences

Anadromous Fish Stocks: Coho and cutthroat

Gaddis Creek Tier 1 Concerns

Gaddis Creek Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Extensive bank erosion was documented in Gaddis Creek. These streams are rated "poor" for sediment quantity, with a note that more information regarding sediment inputs are needed. (Smith Wenger 2001)	➡ Sedimentation is likely the product of both bank erosion and roads. Additional information is needed to understand road contributions of sediment in Gaddis Creek. (Smith Wenger 2001). ➡ Livestock access is an issue in the lower reaches of Gaddis Creek (Smith Wenger 2001).	➡ Identify extent that roads are contributing sediment. ➡ Identify and implement possible solutions to reduce erosion at the sites identified by Wampler and Knudsen (1993). Locations are primarily in the middle and upper reaches. ➡ Work with landowners in the lower reaches to reduce livestock access to Gaddis Creek.

Gaddis Creek Tier 1	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Rock, Williams, and Gaddis Creeks have incised channels (L. Crumley, LWC Consulting, personal communication). These streams are rated "poor" for floodplain conditions; further assessment of this impact is necessary. (Smith Wenger 2001)	➡ Poor LWD recruitment from riparian corridor. ➡ Possible LWD removal from Gaddis Creek	➡ Develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain.

Gaddis Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish Passage barrier status is unknown in Gaddis Creek subbasin. However, even though a comprehensive inventory has not been completed, the assumption is that barriers do exist that hinder fish passage and impede natural processes. This assumption mirrors findings in other subbasins within the Chehalis Basin. Preliminary investigations show there are several barriers existing on county and private properties in the Garrard Creek subbasin.	➡ The placement of undersized stream crossing structures has restricted fish passage and impeded natural processes (streambed material transport).	➡ A formal inventory is needed to comprehensively identify barrier status within the Gaddis subbasin. ➡ Correct barrier culverts. See Section 4.

Gaddis Creek Tier 2 Concerns

Gaddis Creek Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ LWD levels are likely low since Gaddis Creek is incised (see floodplain section)	➡ Since riparian conditions are rated poor for the Garrard Creek WAU (Gaddis Creek is in this WAU) future LWD recruitment will likely be low (C. Stussy, professional opinion).	➡ Develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain. ➡ More information is needed

Gaddis Creek Tier 2	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian corridor condition in the Garrard Creek WAU, which Gaddis Creek is in, rates poor with 53% of the riparian corridor being hardwood dominant and 25% converted to non-forest use. Garrard Creek is also considered to have a low potential for LWD recruitment because of the current conditions (Smith Wenger 2001).	➡ A loss of canopy cover was recorded in Gaddis Creek from RM 2.5-3 (Smith Wenger 2001). ➡ Wampler and Knudsen (1993) identify agriculture and logging as causes for reduced riparian vegetation and canopy loss.	➡ Control invasive species. See Section 5. ➡ Further assessment is needed to identify additional areas of impacted riparian habitat. ➡ Restore riparian corridor along Gaddis Creek primarily in the middle and lower reaches that consist primarily of agricultural lands.

Gaddis Creek Tier 3 Concerns

Gaddis Creek Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Low summer flows were noted as a limiting factor in Gaddis Creek (Phinney and Bucknell 1975).	➡ The Garrard Creek WAU (which includes Gaddis Creek) has had 14% of its forest cover converted to other uses, 47% of which is in hardwoods. These areas rate "poor" for water quantity due to the likely impacts caused by vegetation conversion that influence peak flow events (Smith Wenger 2001).	➡ Implement forest practice rules in forested headwaters to eliminate ditchwater connection to live streams. ➡ In the lower and middle reaches of Gaddis Creek, recreate wetlands for water storage and off-channel habitat. ➡ More information is needed

Gaddis Creek Tier 3	WATER QUALITY	
Symptom	**Cause**	**General Actions**
	➡ Livestock access to Gaddis Creek has been identified in the lower reach (Smith Wenger 2001).	➡ More information is needed ➡ Work with landowners in the lower reaches to reduce livestock access to Gaddis Creek.

ROCK/WILLIAMS CREEK

Description:

The headwaters of Rock/Williams Creek originate in the Willapa Hills and has 32.2 miles of stream (Phinney and Bucknell 1975). The upper reaches are generally confined, while the lower reach flows through the broad Chehalis River valley (Phinney and Bucknell 1975). The land use in Rock/Williams subbasin is comprised of timber, agriculture, and rural residences (Smith Wenger 2001). Rock Creek drains into the Chehalis River at RM 39.3. Both Rock creek and its major tributary Williams Creek provide habitat for coho spawning and rearing. Fall Chinook salmon have also been documented in Rock Creek (Smith Wenger 2001). Chum salmon have used these areas in the past, but are uncommon now (Smith Wenger 2001).

Major Tributaries: Williams Creek

Major Land Uses: Timber, Agriculture, and Rural Residences

Anadromous Fish Stocks: Fall Chinook, spring Chinook, coho, winter steelhead, cutthroat

Rock / Williams Creek Tier 1 Concerns

Rock / Williams Creek Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Extensive bank erosion was documented in Williams Creek and was rated as poor for sediment quantity. It was also note that more information regarding sediment inputs are needed. (Smith Wenger 2001)	➡ Sedimentation is likely the product of both bank erosion and roads. (Smith Wenger 2001). ➡ Livestock access is an issue in the lower reaches of Rock Creek and Williams Creek (Smith Wenger 2001).	➡ Identify extent roads are contributing sediment. ➡ Identify possible solutions to reduce erosion at the sites identified by Wampler and Knudsen (1993). Locations are primarily in the middle and upper reaches. ➡ Work with landowners in the lower reaches to reduce livestock access to Rock Creek and Williams Creek.

Rock / Williams Creek Tier 1	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Rock Creek and Williams Creek have incised channels and Rock Creek has riprap in its lower reach. This subbasin is rated "poor" for floodplain conditions, but quantification of these impacts is needed. (Smith Wenger 2001)		➡ Develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain.

Rock / Williams Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish Passage barrier status is unknown in Rock/Williams Creek subbasin. However, even though a comprehensive inventory has not been completed it is assumed barriers exist that hinder fish passage and impede natural processes. This assumption is based on the current awareness of at least two existing blockages.	➡ Placement of undersized stream crossing structures restrict fish passage and natural processes (streambed material transport). Streambed scour may have also caused a passage barrier at a location without road crossings (Smith Wenger 2001).	➡ Correct barrier culverts. See Section 4.

Rock / Williams Creek Tier 2 Concerns

Rock / Williams Creek Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ LWD levels are likely low since Rock/Williams is incised (see floodplain section). More data needed.	➡ Since riparian conditions are rated poor for the Garrard Creek WAU (Gaddis Creek is in this WAU) future LWD recruitment will likely be low (C. Stussy, prof. opinion).	➡ Develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain.

Rock / Williams Creek Tier 2	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian corridor condition in the Garrard Creek WAU, which the Rock/Williams subbasin is in, rates poor with 53% of the riparian corridor as hardwood dominant and 25% converted to non-forest use.	➡ A loss of riparian vegetation was noted along Rock Creek from RM 1.5-2.9 and in two reaches of Williams Creek (RM 0-1, RM 2.2-3.8). (Smith Wenger 2001). ➡ Wampler and Knudsen (1993) identify agriculture and logging as causes for reduced riparian vegetation & canopy loss.	➡ Control invasive species. See Section 5. ➡ Restore riparian corridor along Rock Creek from RM 1.5-2.9 and Williams Creek from RM 0-1 and RM2.2-3.8).
➡ Garrard Creek is also considered to have a low potential for LWD recruitment because of the current conditions (Smith Wenger 2001).	➡ Poor riparian condition	➡ Restore riparian corridor

Rock / Williams Creek Tier 3 Concerns

Rock / Williams Creek Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Low summer flows were noted as a limiting factor in Gaddis Creek (Phinney and Bucknell 1975).	➡ The Garrard Creek WAU (Rock/Williams Creek is in this WAU) has 14% of forest cover converted to other uses and 47% existing as hardwoods. These areas rate "poor" for water quantity due to a likely impacts vegetation conversion has on peak flow events. (Smith Wenger 2001)	➡ Implement forest practice rules in forested headwaters to eliminate ditchwater connection to live streams. ➡ In the lower and middle reaches of Rock /Williams Creek recreate wetlands for water storage and off-channel habitat.

Rock / Williams Creek Tier 3	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Data need	➡ Livestock access to Rock/Williams Creek has been identified in the lower reach (Smith Wenger 2001).	➡ Work with landowners in the lower reaches to reduce livestock access to Rock Creek and Williams Creek.

Bunker Creek

Description:

Bunker Creek and its largest tributary, Deep Creek, provide habitat for both coho salmon and steelhead trout. Bunker Creek joins the Chehalis River at RM 84.8 from the left bank and has a low gradient. The entire watershed lies within farmland and rural residences. Little is known about fish habitat and distribution in Van Ornum Creek, which enters the Chehalis River at RM 84 (Smith Wenger 2001).

Major Tributaries: Deep Creek; Van Ornum Creek (an independent tributary to the Chehalis River)

Land Uses: Agriculture and rural residences

Anadromous Fish Stocks: Coho, winter steelhead, and cutthroat

Bunker Creek Tier 1 Concerns

Bunker Creek Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ According to the Diagnosis and Treatment (EDT) model, sedimentation is a major problem in Bunker Creek.	➡ The Bunker Creek WAU has a high road density of 4.4 miles of road per sq mile of drainage (Smith Wenger 2001). ➡ Livestock access was also noted in the middle reaches of Deep Creek and Bunker Creek (Smith Wenger 2001). ➡ Sedimentation is likely the product of bank erosion (primarily Bunker Creek), roads, and livestock access. (Smith Wenger 2001).	➡ Determine the extent roads are contributing sediment and identify corrective actions. ➡ Reduce stream reach erosion at the sites identified by Wampler et al. (1993). Locations are primarily in the lower reaches of Bunker Creek. ➡ Work with landowners to exclude livestock access to streams especially in Bunker Creek and Deep Creek.

Bunker Creek Tier 1	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Floodplain conditions in the Bunker Creek subbasin are in fair condition with most of the floodplain connectivity impacts occurring in Deep Creek and lower Bunker Creek. ➡ Van Ornums's floodplain condition is good (Smith Wenger 2001).	➡ Primary cause of floodplain disconnection (channel incision) is past splash damming activities that removes instream structure and does not retain streambed substrate. ➡ Many roads are located along Deep Creek and the lower reaches of Bunker Creek. ➡ Little riprap documented in Bunker Creek subbasin.	➡ Develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain.

Bunker Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Numerous road crossings are undersized and do not allow adequate fish passage upstream because of water velocity or perched outfall. These undersized structures also inhibit the movement of streambed material downstream and usually contribute to channel scour directly downstream.	➡ Placement of undersized stream crossing structures restricts fish passage and natural processes (streambed material transport). Streambed scour may have also caused a passage barrier at a location without road crossings (Smith Wenger 2001).	➡ Correct barrier culverts. See Section 4.

Bunker Creek Tier 2 Concerns

Bunker Creek Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ The Chehalis EDT model indicates Bunker Creek needs improved habitat diversity, although more data is needed	➡ LWD levels are likely low since riparian conditions are rated poor for the Bunker Creek WAU (C. Stussy, professional opinion).	➡ Determine LWD needs for the drainages in the Bunker Creek WAU. ➡ Develop LWD supplementation plan and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain.

Bunker Creek Tier 2	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian condition is poor in Bunker Creek and Deep Creek. Only the upper reaches of Bunker and Deep Creeks were considered to have intact riparian corridors (Smith Wenger 2001).	➡ In the Bunker Creek WAU over 27% of the WAU has been converted to non-forest uses and 47% consists of hardwoods (Smith Wenger 2001).	➡ Control invasive species. See Section 5. ➡ Restore riparian corridor along Bunker Creek and Deep Creek. Use Wampler et al. 1993 document to identify potential restoration sites.

Bunker Creek Tier 3 Concerns

Bunker Creek Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Low summer flows were noted as a limiting factor in the Bunker Creek WAU (Phinney and Bucknell 1975). ➡ Bunker and Van Ornum Creeks are rated as 'poor' for water quantity (Smith Wenger 2001).	➡ Phinney and Bucknell (1975) note that water withdrawals may have a significant impact on the water quantity in the Bunker Creek WAU.	➡ Bunker Creek is closed to further water appropriations (Smith Wenger 2001). ➡ Determine if water withdrawals are being followed in accordance with current water rights.

Bunker Creek Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
		➡ Identify potential sites to recreate wetlands for water storage and off-channel habitat (Bunker Creek and Deep Creek should be first priority in the Bunker Creek WAU).

Bunker Creek Tier 3	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Bunker Creek is on the 1998 303d List for low dissolved oxygen (Smith Wenger 2001). ➡ Fecal coliform is a problem in Bunker Creek (Smith Wenger 2001).	➡ Livestock access to Bunker Creek is listed as the probable cause of low dissolved oxygen (Smith Wenger 2001). ➡ The high fecal coliform levels are likely caused from failing septic systems and livestock (Smith Wenger 2001).	➡ Implement TMDL recommendations for Bunker Creek. ➡ Restore riparian corridor (see 'riparian' actions) ➡ Work with landowners to correct failing septic systems in Bunker Creek. ➡ Work with landowners to exclude livestock access to streams especially in Bunker Creek and Deep Creek.

Scammon, Mill, and Stearns Creeks

Description:

These small- to medium-sized streams provide valuable habitat for coho salmon. In past years, these creeks also supported small runs of chum salmon (Phinney and Bucknell 1975).

Scammon Creek is a left bank tributary that drains into the Chehalis River at RM 65.9. The lower reaches lie within the City of Centralia, while rural residences and agriculture surround the upper reaches (Smith Wenger 2001). The stream bottom of Scammon Creek consists of sand with very little spawning gravels. No known salmon use has been documented in this creek, but it is very likely that coho salmon use the stream for rearing. Coal Creek enters the Chehalis River at RM 71.8 and, like Scammon Creek, is probably used for coho rearing (Smith Wenger 2001).

Mill Creek drains into the Chehalis River at RM 77.85. Mill Creek is low gradient and contains sand and gravel substrate (Phinney and Bucknell 1975). It is mentioned as a "major coho spawning area" by Phinney and Bucknell (1975) and probably provides rearing habitat. Access to the creek is problematic in low flow conditions (Smith Wenger 2001).

Stearns Creek drains into the Chehalis River at RM 78.1. It is a low gradient stream with its lower reaches channelized and void of significant riparian vegetation (Smith Wenger 2001). The middle to lower reaches are surrounded by land used for agriculture and rural residences, with some forested lands in the upper reaches. Coho salmon and winter steelhead trout are documented within Stearns Creek and several of its upper tributaries (Smith Wenger 2001).

Major Tributaries: South Branch Scammon (Scammon Creek), West Fork Stearns, Ripple Creek Coal Creek (Stearns Creek), Wisner Creek (Mill Creek)

Land Uses: Agriculture and rural residences in middle and lower reaches, forestry in the upper reaches

Anadromous Fish Stocks: Coho, winter steelhead, and cutthroat

Scammon Creek, Mill Creek, Stearns Creek Tier 1 Concerns

Scammon Creek, Mill Creek, Stearns Creek Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ According to the Ecosystem Diagnosis and Treatment (EDT) model, sedimentation is a major problem in Stearns Creek. ➡ Bank erosion is a major sediment contributor ➡ Scammon and Coal Creeks have naturally low levels of spawning gravel (Smith Wenger 2001).	➡ In the Scammon-Stearns WAU the road density is 4.9 miles of road per 1 square mile of drainage. This is a high road density - likely contributes sediment (Smith Wenger 2001). ➡ Sedimentation is likely the product of bank erosion in upper reaches of Stearns Creek and roads (Smith Wenger 2001). ➡ Mill Creek was noted as having excessive amounts of livestock access to the stream (Smith Wenger 2001)	➡ Determine the extent roads are contributing sediment. ➡ Reduce erosion in the upper reaches of Stearns Creek as identified by Wampler et al. (1993). ➡ Work with landowners along Mill Creek to reduce livestock access.

Scammon Creek, Mill Creek, Stearns Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Numerous road crossings are undersized and do not allow adequate fish passage upstream because of water velocity or perched outfall. These undersized structures also inhibit the movement of streambed material downstream and usually contribute to channel scour directly downstream.	➡ Placement of undersized stream crossing structures restricts fish passage and natural processes (streambed material transport). Streambed scour may have also caused a passage barrier at a location without road crossings (Smith Wenger 2001).	➡ Correct barrier culverts. See Section 4.

Scammon Creek, Mill Creek, Stearns Creek Tier 1	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Stearns Creek is on the 1998 303d List for low dissolved oxygen (Smith Wenger 2001). ➡ Low dissolved oxygen levels have also been recorded in Coal Creek (Smith Wenger 2001). ➡ Data Gap for Mill, Coal, and Scammon Creeks.	➡ Livestock access is thought to be the likely cause of low dissolved oxygen in Stearns Creek (Smith Wenger 2001).	➡ Determine water quality conditions for Mill, Coal, and Scammon Creeks. ➡ Implement TMDL recommendations for Stearns Creek. ➡ Work with landowners to exclude livestock from accessing Stearns Creek and Mill Creek.

Scammon Creek, Mill Creek, Stearns Creek Tier 2 Concerns

Scammon Creek, Mill Creek, Stearns Creek Tier 2	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian condition in the Scammon-Stearns WAU is highly degraded (Smith Wenger 2001). ➡ Over 40% of the WAU is considered open hardwood and over 30% is considered non-forested (Smith Wenger 2001).	➡ Conversion of forestlands to agriculture or rural residences has contributed to degraded riparian corridors in Scammon-Stearns WAU. 53% riparian corridor has been converted to agriculture or urban development. 36% riparian corridor has been converted to hardwoods (Smith Wenger 2001).	➡ Control invasive species. See Section 5. ➡ Restore riparian corridor in the Scammon-Stearns WAU. Use Wampler et al. (1993) and Lunetta et al. (1997) documents to identify potential restoration sites.

Scammon Creek, Mill Creek, Stearns Creek Tier 2	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Low flows are identified as a limiting factor for Stearns and Mill Creeks and have been closed to further water appropriations (Smith Wenger 2001).	➡ Loss and change in vegetation cover (38% of land cover in the Scammon-Stearns WAU has been converted to agriculture and urban development, 43% has been converted to deciduous vegetation) (Smith Wenger 2001).	➡ Determine if water withdrawals are being followed in accordance with current water rights. ➡ Identify potential sites to recreate wetlands for water storage and off-channel habitat; Stearns Creek first priority in WAU)

Scammon Creek, Mill Creek, Stearns Creek Tier 3 Concerns

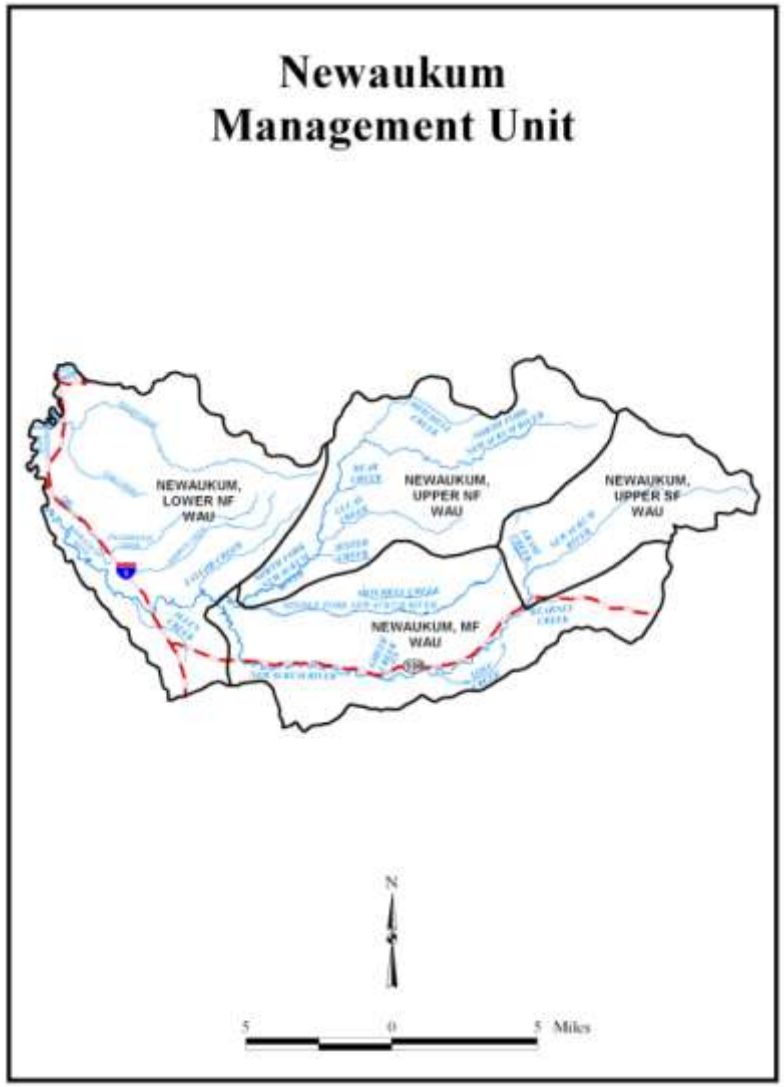
Scammon Creek, Mill Creek, Stearns Creek Tier 3	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Stearns Creek is disconnected from its floodplain in the lower reach. ➡ Mill Creek's floodplain condition is rated as fair (Smith Wenger 2001). ➡ Coal Creek and Scammon Creek are data gaps.	➡ The lower reach of Stearns Creek has been channelized primarily for agricultural purposes (Smith Wenger 2001). ➡ Areas of riprap are noted in reaches of Stearns Creek. ➡ Pleasant Valley Road impacts the floodplain in the upper and middle reaches of Stearns Creek (Smith Wenger 2001).	➡ Develop LWD supplementation plan for Stearns Creek and install LWD where appropriate. This will retain bedload and elevate streambed level to allow better connection to floodplain.

Scammon Creek, Mill Creek, Stearns Creek Tier 3	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ The Chehalis EDT model indicates Stearns Creek needs improved habitat diversity, although not much data is available	➡ LWD levels are probably low since riparian conditions are rated poor for the Scammon-Stearns WAU (C. Stussy, professional opinion).	➡ Develop LWD supplementation plan and install LWD where appropriate. This action should start in Stearns Creek because of its potential spawning habitat. ➡ Determine LWD needs.

NEWAUKUM MANAGEMENT UNIT

NEWAUKUM RIVER

Description:



The Newaukum subbasin drains 158 square miles with an average annual discharge of 1,600 cfs. The mainstem Newaukum River enters the Chehalis River near RM 75.2 just south of the City of Chehalis. It has a low gradient and runs through farmland. Spring, summer, and fall Chinook salmon spawn, rear, and transport in the mainstem, while coho salmon and steelhead trout use the mainstem for rearing and transportation. Two small tributaries, Allen and Taylor Creeks, provide habitat for coho salmon and steelhead trout. Cutthroat trout use the entire system. The North Fork Newaukum River and the South Fork Newaukum River join at RM 10.8 to form the mainstem Newaukum River.

The North Fork Newaukum River originates in steep hills and then flows into a broad valley in its lower reaches. Stream gradient in the upper North Fork watershed is steep; it is moderate in the lower ten miles. Private timber management dominates the middle and upper watershed; land use in the lower ten miles is primarily agriculture. Spring and fall Chinook spawn up to RM 12.5, and coho and steelhead have been documented to RM 18.5. The larger tributaries to the North Fork Newaukum River include the Middle Fork Newaukum River, and Lucas, Bear, Mitchell, and Johns Fork Creeks. Coho salmon, cutthroat trout, and steelhead trout have been documented in each of these streams.

The South Fork Newaukum River is about 26.5 miles long. The upper watershed is in the steep terrain of the Cascade Mountain Range and the upper stream reaches have steep gradients. As the river heads in Newaukum Lake near RM 30, the terrain begins to broaden and the gradient moderates. The upper reaches are under private timber management, while farmland, rural residences, and small towns surround the lower reaches. Spring, summer, and fall Chinook salmon spawn up to RM 31 and coho salmon and steelhead and cutthroat trout have been documented to RM 32.2. In the upper South Fork watershed, Bernier, Beaver, Frase, and Kearney Creeks provide or have potential habitat for coho salmon, cutthroat trout, and steelhead trout. In the lower reaches, the coho, cutthroat trout, and steelhead producing tributaries include Gheer and Lost Creeks. Gheer Creek contains Carlisle Pond, which is used for coho salmon supplementation.

Throughout the Newaukum subbasin, private land ownership dominates (over 95%). Another major land use issue is a dam constructed on the NF Newaukum at RM 12.5 to allow water to be diverted for Centralia and Chehalis. This dam blocked all passage to salmon until 1970. The City of Chehalis continues to use this facility as part of their water supply.

Major Tributaries: Taylor, Allen, Gheer, Lucas, Kearney, Mitchell, and Johns Fork Creeks

Land Uses: Private forestlands, agriculture, and rural residential

Anadromous Fish Stocks: Spring Chinook, fall Chinook, coho, winter steelhead, and cutthroat

Newaukum River (Mainstem and Tributaries) Tier 1 Concerns

Newaukum River (Mainstem and Tributaries) Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ Poor riparian quality along the mainstem reach consisting of little to no riparian vegetation (Smith Wenger 2001). ➡ In the Mainstem Newaukum approximately 90% of the riparian corridor is considered 'open/hardwood' or 'non-forested' (Smith Wenger 2001).	➡ Impacts to riparian corridors along the mainstem are mostly attributed to the conversion from forestland to agriculture and rural residences. Bank vegetation loss is the largest impact in the whole Newaukum subbasin. (Smith Wenger 2001)	➡ Control invasive species. See Section 5. ➡ Identify specific degraded riparian areas for restoration ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Protect by fee simple or easement key properties ➡ Revegetate open riparian areas with native plants (Use Wampler et al. 1993 document to identify restoration sites)

Newaukum River (Mainstem and Tributaries) Tier 1	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ The mainstem Newaukum is on the 303d List for high temperatures and fecal coliform.	➡ The high temperatures are likely a result of poor riparian canopy conditions (Jennings and Pickett 2000). ➡ High fecal coliform: livestock access, failing septic systems	➡ Implement TMDL recommendations ➡ See Riparian actions ➡ Work with landowners to correct failing septic systems

Newaukum River (Mainstem and Tributaries) Tier 1	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Base flows are not being met for an average of 59 days per year at the gauging station near Chehalis (Smith Wenger 2001). There has also been an increase in peak flows and water volume within the Newaukum subbasin (Clark 1999)	➡ Likely contributors to the water quantity problems in the Newaukum subbasin are water withdrawals, changes in land coverage, and loss of wetlands (Smith Wenger 2001).	➡ Determine if water withdrawals are being followed in accordance with current water rights ➡ Implement activities that lead to natural recharge of aquifers ➡ Reduce water withdrawals from surface sources

Newaukum River (Mainstem and Tributaries) Tier 2 Concerns

Newaukum River (Mainstem and Tributaries) Tier 2	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish access to spawning / rearing habitat is restricted	➡ Many culverts at road crossings on tributaries to the MS are undersized and do not allow adequate fish passage upstream due to high water velocity or perched outfall. These undersized structures also inhibit the movement of streambed material and LWD downstream and usually contribute to channel scour directly downstream.	➡ Correct barrier culverts. See Section 4.

Newaukum River (Mainstem and Tributaries) Tier 2	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Mainstem Newaukum floodplain conditions have not been quantified but are likely impacted based on the information noted by Wampler et al. 1993. ➡ Data Need ➡ In areas, the floodplain is restricted	➡ Past gravel removal operations from the Newaukum River to construct the I-5 freeway may have contributed to channel incision. I-5 also acts as a dike in the lower reach of the Newaukum. (Andy Carlson personal communication) ➡ The placement of riprap along the banks of the river has restricted its ability to meander within the floodplain. The construction of dikes and roads within the floodplain and the loss of stream adjacent wetlands restricts the flood water storage capacity. There has also been a noted decline in beaver activity (dams), which aid in connecting the river and streams with its floodplain.	➡ Assess floodplain conditions and identify impacts ➡ Reconnect, enhance, and/or restore potential off-channel, floodplain, and wetland habitat ➡ Remove hard armoring (riprap) or implement bioengineering techniques in place of hard armoring

Newaukum River (Mainstem and Tributaries) Tier 3 Concerns

Newaukum River (Mainstem and Tributaries) Tier 3	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Estimated high levels of sediment input in the mainstem Newaukum. ➡ Data need	➡ The high amount of sediment is likely due to the high road densities, landslides caused by roads, and high amounts of bank erosion. (Smith Wenger 2001)	➡ Abandon roads on steep geologically sensitive areas ➡ Correct cross drains that may trigger mass wasting on geologically sensitive slopes ➡ Identify sources that are contributing to sediment loading ➡ Reduce sediment loading by reducing low densities

Newaukum River (Mainstem and Tributaries) Tier 3	SEDIMENT	
Symptom	**Cause**	**General Actions**
		➡ Implement alternative methods of bank stabilization (bioengineering) in locations of excessive erosion ➡ Revegetate stream/river banks for added erosion protection ➡ Upgrade logging roads to comply with Forest and Fish Agreement (1999)

Newaukum River (Mainstem and Tributaries) Tier 3	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ Likely poor LWD quantities in the Newaukum mainstem. The mainstem Newaukum has not been inventoried for LWD and additional data are needed to quantify its condition.	➡ Low quantities of LWD in the mainstem Newaukum are likely due to past practices of instream wood removal and the low LWD recruitment potential from the existing riparian corridor.	➡ Determine LWD quantities ➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity; install LWD pieces in conjunction with other restoration projects ➡ Identify specific degraded riparian areas for restoration ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Revegetate open areas with native plants

Newaukum River (North Fork and Tributaries) Tier 1 Concerns

Newaukum River (North Fork and Tributaries) Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The upper NF Newaukum has good riparian conditions while the middle and lower NF contain poor riparian conditions. The lower and middle NF reaches contain open and hardwood dominant riparian corridors. Lucas Creek contains riparian corridors with good and fair conditions. ➡ In the upper NF, approximately 70% of the riparian corridor is considered 'open/hardwood' or 'non-forested' and in the lower North Fork it is about 90% (Smith Wenger 2001).	➡ Impacts to riparian corridors along the NF are mostly attributed to the conversion from forestland to agriculture and rural residences. Bank vegetation loss is the largest impact in the entire Newaukum subbasin. (Smith Wenger 2001) ➡ Some areas in the Lower NF and Lucas Creek have naturally open riparian areas of prairie and wetland coupled with degraded riparian conditions (Smith Wenger 2001)	➡ Control invasive species. See Section 5. ➡ Identify specific degraded riparian areas for restoration ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Protect by fee simple or easement key properties of riparian ➡ Revegetate open riparian areas with native plants (Use Wampler et al. 1993 to identify potential restoration sites)

Newaukum River (North Fork and Tributaries) Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish access to spawning / rearing habitat is restricted	➡ Many culverts at road crossings on tributaries to the MS are undersized and do not allow adequate fish passage upstream due to high water velocity or perched outfall. These undersized structures also inhibit the movement of streambed material and LWD downstream and usually contribute to channel scour directly downstream.	➡ Correct barrier culverts. See Section 4 for guidelines. ➡ Improve fish passage at fishways and add a fishway to those structures that do not have them ➡ Remove dams where feasible

Newaukum River (North Fork and Tributaries) Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Estimated high levels of sediment input in the NF Newaukum. Good gravel quality was measured in the upper reaches and no measurement was done in the lower reach where the sediment would likely settle out (Smith Wenger 2001). More data is needed to quantify the impacts of sediment in the NF Newaukum.	➡ The high amount of sediment is likely due to the livestock access, high road densities, landslides caused by roads, and high amounts of bank erosion (Smith Wenger 2001).	➡ Abandon roads on steep geologically sensitive areas ➡ Correct cross drains that may trigger mass wasting on geologically sensitive slopes ➡ Identify sources that are contributing to sediment loading ➡ Implement alternative methods of bank stabilization (bioengineering) in locations of excessive erosion ➡ Install riparian fencing to exclude or reduce livestock access ➡ Reduce sediment loading by reducing low densities (abandon/decommission) ➡ Revegetate stream/river banks for added erosion protection ➡ Upgrade logging roads to comply with Forest and Fish Agreement (1999)

Newaukum River (North Fork and Tributaries) Tier 2 Concerns

Newaukum River (North Fork and Tributaries) Tier 2	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ High summer water temperatures and high turbidity exist in the NF Newaukum (Pickett 1992).	➡ The high water temperature is likely a result of poor riparian canopy conditions coupled with low summer flows. Turbidity is likely caused by the same problems identified in the Sediment section.	➡ Determine if water withdrawals are being followed in accordance with current water rights ➡ Identify specific degraded riparian areas for restoration

Newaukum River (North Fork and Tributaries) Tier 2	WATER QUALITY	
Symptom	**Cause**	**General Actions**
		➡ Implement approved nutrient enhancement efforts ➡ Implement TMDL recommendations ➡ Interplant conifers in deciduous dominant areas ➡ Protect by fee simple or easement key properties of riparian ➡ See Sediment actions

Newaukum River (North Fork and Tributaries) Tier 2	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Base flows are not being met for an average of 59 days per year in the Newaukum River at the gauging station near Chehalis (Smith Wenger 2001). There has also been an increase in peak flows and water volume within the Newaukum subbasin (Clark 1999)	➡ Contributors to water quantity problems in the Newaukum subbasin are water withdrawals, changes in land coverage, and some loss of wetlands (Smith Wenger 2001). ➡ The lower NF has greatly altered land cover and the upper NF has good hydrologic maturity (Smith Wenger 2001).	➡ Determine if water withdrawals are being followed in accordance with current water rights ➡ Reduce water withdrawals from surface sources ➡ Restore wetlands for water storage ➡ See Riparian actions

Newaukum River (North Fork and Tributaries) Tier 3 Concerns

Newaukum River (North Fork and Tributaries) Tier 3	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ Parts of NF have poor quantities of LWD. Lucas Creek also has poor levels of LWD. Upper reaches in the NF have good quantities of LWD. (Smith Wenger 2001, and Weyerhaeuser 1998)	➡ Low quantities of LWD in the NF Newaukum are likely due to past practices of instream wood removal and the limited LWD recruitment potential from the existing riparian corridor.	➡ Determine LWD quantities ➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity ➡ Identify specific degraded riparian areas for restoration ➡ Install LWD pieces in conjunction with other projects ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Revegetate open and areas with native plants

Newaukum River (North Fork and Tributaries) Tier 3	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ The NF Newaukum is moderately restricted from fully utilizing its floodplain for channel meandering and floodwater storage (Smith Wenger 2001).	➡ The placement of riprap along the banks of the river has restricted its ability to meander within the floodplain. The construction of stream adjacent parallel roads within the floodplain (N. Fork Rd and Lucas Creek Rd) and the loss of wetlands restricts the flood water storage capacity. There has also been a noted decline in beaver activity (dams), which aid in floodplain connectivity. (Smith Wenger 2001).	➡ Reconnect, enhance, and/or restore potential off-channel, floodplain, and wetland habitat ➡ Remove hard armoring (riprap) or implement bioengineering techniques in place of hard armoring

Newaukum River (Middle Fork and Tributaries) Tier 1 Concerns

Newaukum River (Middle Fork and Tributaries) Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ Poor riparian conditions along the lower reach and fair riparian conditions in the middle and upper reaches. Riparian corridor is predominately (approximately 90%) 'open/hardwood' and 'non-forested' (Smith Wenger 2001)	➡ Impacts to riparian corridors along the MF are mostly attributed to the conversion from forestland to agriculture and rural residences. Bank vegetation loss is the largest impact in the entire Newaukum subbasin. (Smith Wenger 2001)	➡ Control invasive species. See Section 5. ➡ Identify specific degraded riparian areas for restoration ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Revegetate open riparian areas with native plants (Use Wampler et al. 1993 document to identify potential restoration sites)

Newaukum River (Middle Fork and Tributaries) Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish access to spawning / rearing habitat is restricted	➡ Many culverts at road crossings on tributaries to the MS are undersized and do not allow adequate fish passage upstream due to high water velocity or perched outfall. These undersized structures also inhibit the movement of streambed material and LWD downstream and usually contribute to channel scour directly downstream.	➡ Correct barrier culverts. See Section 4.

Newaukum River (Middle Fork and Tributaries) Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Estimated high levels of sediment input in the MF Newaukum based on information from Wampler et al. 1993.	➡ The high amount of sediment is likely due to the livestock access, high road densities, landslides caused by roads, vehicle activity, and high amounts of bank erosion (Smith Wenger 2001).	➡ Abandon roads on steep geologically sensitive areas ➡ Correct cross drains that may trigger mass wasting on geologically sensitive slopes ➡ Identify sources that are contributing to sediment loading ➡ Implement alternative methods of bank stabilization (bioengineering) in locations of excessive erosion ➡ Reduce sediment loading by reducing low densities (abandon/decommission) ➡ Revegetate stream/river banks for added protection from erosion ➡ Upgrade logging roads to comply with Forest and Fish Agreement (1999)

Newaukum River (Middle Fork and Tributaries) Tier 2 Concerns

Newaukum River (Middle Fork and Tributaries) Tier 2	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Estimated to have high summer water temperatures ➡ Data need	➡ This assumption is based on the poor riparian conditions within the MF Newaukum. More information should be obtained to verify water quality issues.	➡ Determine water quality conditions ➡ Implement TMDL recommendations ➡ See Riparian actions

Newaukum River (Middle Fork and Tributaries) Tier 2	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Base flows are not being met for an average of 59 days per year in the Newaukum River at the gauging station near Chehalis (Smith Wenger 2001). There has also been an increase in peak flows and water volume within the Newaukum subbasin (Clark 1999). ➡ The lower reach of the MF often turns to isolated pools during the late summer (Smith Wenger 2001).	➡ Likely contributors to the water quantity problems in the Newaukum subbasin are water withdrawals, changes in land coverage, and loss of wetlands (Smith Wenger 2001).	➡ Determine if water withdrawals are being followed in accordance with current water rights ➡ Reduce water withdrawals from surface sources ➡ Restore wetlands for water storage

Newaukum River (Middle Fork and Tributaries) Tier 3 Concerns

Newaukum River (Middle Fork and Tributaries) Tier 3	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ Data Need	➡ Data Need	➡ Determine LWD quantities ➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity ➡ Install LWD pieces in conjunction with other restoration projects

Newaukum River (Middle Fork and Tributaries) Tier 3	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Symptom	➡ Cause	➡ General Actions
➡ Data Need	➡ Data Need	➡ Assess floodplain conditions and identify impacts

Salzer Creek

Description:

Salzer Creek drains into the Chehalis River at RM 69.4 just south of the Centralia city limits. Salzer Creek originates in the low-lying hills east of Centralia and Chehalis and drains and area of 24.5 Square miles. The watershed has a maximum elevation of approximately 800 feet. Coal Creek drains into Salzer at RM 0.8.

Major Tributaries: Coal Creek

Land Uses: Highly developed for residential and commercial uses in the lower third of its length. Primarily forestlands and agriculture.

Anadromous Fish Stocks: Coho and cutthroat

Salzer Creek Tier 1 Concerns

Salzer Creek Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Ecosystem Diagnosis and Treatment (EDT) model demonstrates sedimentation is a major problem in Salzer Creek	➡ Adjacent land use practices are the major contributor to sedimentation in the Salzer Creek subbasin. ➡ Sedimentation is likely the product of bank erosion, roads, and livestock access to the creek. (Wampler et al. 1993).	➡ Correct cross drains that may trigger mass wasting on geologically sensitive slopes ➡ Implement alternative methods of bank stabilization (bioengineering) in locations of excessive erosion ➡ Install riparian fencing to exclude or reduce livestock access ➡ Reduce sediment loading by reducing road densities (abandon/decommission) ➡ Revegetate stream/river banks for added protection from erosion ➡ Upgrade logging roads to comply with Forest and Fish Agreement (1999)

Salzer Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish access to the habitat restricted	➡ High percentage of forestland and logging roads, many with undersized culverts and road crossings	➡ Correct barrier culverts. See Section 4 for guidelines.

Salzer Creek Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian condition in the Salzer Creek subbasin is poor. The riparian corridor along Salzer Creek is sparsely vegetated with deciduous vegetation (Smith Wenger 2001).	➡ Conversion of land use from forestry to agriculture or rural residential has contributed to degraded riparian corridors (primarily lower Salzer Creek subbasin reaches). ➡ Past timber harvesting practices have impacted riparian corridors reducing vegetation (primarily upper Salzer Creek subbasin reaches)	➡ Control invasive species. See Section 5. ➡ Identify specific degraded riparian areas for restoration ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Revegetate open riparian areas with native plants

Salzer Creek Tier 2 Concerns

Salzer Creek Tier 2	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Channelization; loss of side channel, off-channel and pool habitat	➡ Logjams have been removed from Salzer Creek according to the Phinney and Bucknell (1975). ➡ Levee at airport impedes natural channel migration.	➡ Assess floodplain conditions and identify impacts ➡ Reconnect, enhance, and/or restore potential off-channel, floodplain, and wetland habitat

Salzer Creek Tier 2	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Salzer Creek is on the 303(d) list for temperature and low DO (Smith Wenger 2001). ➡ Low DO and fecal coliform levels were observed as the main water quality problems.	➡ The causes cited were: ➡ Poor farm management practices and leachate infiltration from the Centralia Municipal landfill. "...heavily affected by several sources, including stormwater runoff from a drainage sump" (SW WA fairgrounds) ➡ Urban and residential sources ➡ Livestock activities and possibly other unidentified sources	➡ Currently undergoing corrective action as a federal Superfund site ➡ Implement TMDL recommendations ➡ See Riparian actions ➡ Work with landowners to correct failing septic systems.

Salzer Creek Tier 3 Concerns

Salzer Creek Tier 3	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ No logjams present.	➡ Recorded historic settlement activities included land	➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and

Salzer Creek Tier 3	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ Observations suggest that LWD availability and presence is extremely limited.	clearing and removal of jams and large wood from channel.	habitat diversity ➡ Identify specific degraded riparian areas for restoration ➡ Install LWD pieces in conjunction with other restoration projects ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Revegetate open riparian areas with native plants

Salzer Creek Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Low summer flows were noted as a limiting factor in Salzer Creek (Phinney and Bucknell 1975). ➡ Salzer Creek is closed to further water appropriations (Smith Wenger 2001). ➡ Increased peak flows, i.e., bank erosion and riverbed scour	➡ Low flows are a problem and many of the withdrawals are for agricultural purposes. ➡ The loss or change of vegetative cover contributes to an increase in peak flows, resulting in increased bank erosion and riverbed scour.	➡ Determine if water withdrawals are being followed in accordance with current water rights. ➡ Reduce water withdrawals from surface sources

Coal Creek

Description:

Coal Creek (WRIA-23-0872) is a short stream that flows from the east, just north of Chehalis, and enters Salzer Creek between Chehalis and Centralia. The lower reaches of Coal Creek are heavily developed with commercial enterprises. The stream bed is low gradient and primarily silt and sand. The upper reaches are in a narrow valley bordered by rural home sites, with adjacent slopes in timber production.

Major Tributaries: None named

Land Uses: Forestry, agriculture, and rural residences

Anadromous Fish Stocks: Coho and cutthroat

Coal Creek Tier 1 Concerns

Coal Creek Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ Reduced canopy and riparian vegetation ➡ The riparian corridor is in poor condition (Chehalis River Council)	➡ Agriculture, rural residences and past logging are primary causes for reduced riparian vegetation and canopy (Chehalis River Council). ➡ Channel stability is documented as high for reduced conditions by the Ecosystem Diagnosis and Treatment (EDT) model (2003)	➡ Control invasive species. See Section 5. ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Protect, fee simple/easement key properties of riparian ➡ Revegetate open riparian areas with native plants

Coal Creek Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Extensive bank erosion was documented in the middle reaches of Coal Creek and two of its tributaries (23.0705 & 23.0712 (Smith Wenger 2001)).	➡ Sedimentation is likely the product of both bank erosion and roads. ➡ Livestock access is an issue in the lower reaches of Coal Creek (Smith Wenger 2001).	➡ Abandon roads on steep geologically sensitive areas; correct cross drains that may trigger mass wasting; identify sources that are contributing to sediment loading; implement alternative methods of bank stabilization (bioengineering) in locations of excessive erosion ➡ Revegetate stream and riverbanks ➡ Upgrade logging roads - Forest and Fish Agreement (1999)

Coal Creek Tier 1	WATER QUANTITY	
➡ Data gap. Some evidence of low summer flows.	➡ Water withdrawals worsen the low flow conditions during summer low flow periods (Smith Wenger 2001).	➡ Determine if water withdrawals are being followed in accordance with current water rights ➡ Restore wetlands for water storage

Coal Creek Tier 2 Concerns

Coal Creek Tier 2	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Restricted fish passage ➡ Limited materials transport	➡ Placement of undersized culverts under roads at stream crossings	➡ Correct barrier culverts. See Section 4 for guidelines.

Coal Creek Tier 2	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Water quality problems have been documented in Coal Creek. Rates "poor" for water quality based on warm water temperatures and low DO.	➡ Elevated water temperatures (intermediate concern); dissolved oxygen levels, reduced benthos, toxicants (intermediate concern)	➡ Implement TMDL recommendations ➡ See riparian actions

Coal Creek Tier 3 Concerns

Coal Creek Tier 3	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ LWD levels are observed as low. ➡ The Chehalis EDT model indicates this reach needs improved habitat diversity	➡ LWD levels are likely low since riparian conditions are rated poor for the Salzer Creek and past practices have likely removed LWD from Coal Creek. (C. Stussy, professional opinion).	➡ Determine LWD quantities; develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity; install LWD pieces in conjunction with other projects ➡ Identify specific degraded riparian areas for restoration ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Revegetate open riparian areas with native plants

DILLENBAUGH CREEK

Description:

Dillenbaugh Creek enters the Chehalis River from the east at Centralia. It originates in the steep foothills southeast of Chehalis, and drains an area of approximately 15 square miles. The gradient of Dillenbaugh Creek in its upper reaches is steep, falling about 70 feet per mile. After the stream flows out onto the Newaukum River floodplain, the gradient drops as Dillenbaugh Creek parallels the Newaukum for nearly 3 miles before entering the Chehalis River. The lower reaches of Dillenbaugh Creek collect much of the storm drainage from the City of Chehalis.

Major Tributaries: Berwick Creek

Land Uses: Agriculture, industry, and urban development

Anadromous Fish Stocks: Coho and cutthroat

Dillenbaugh Creek Tier 1 Concerns

Dillenbaugh Creek Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Erosion and multiple sediment sources are identified in the Dillenbaugh subbasin (Wampler et al. 1993). ➡ According to the Ecosystem Diagnosis and Treatment (EDT) model channel stability is a major problem in the reach containing Dillenbaugh Creek.	➡ Livestock access is noted in sections of Dillenbaugh Creek (Wampler et al. 1993). ➡ Stream reach erosion is primarily a concern in the middle reaches of the Dillenbaugh Creek subbasin (Wampler et al. 1993; Envirovision, 2000)	➡ Identify sources that are contributing to sediment loading ➡ Implement alternative methods of bank stabilization (bioengineering) in locations of excessive erosion ➡ Install riparian fencing to exclude or reduce livestock access ➡ Revegetate stream/riverbanks for added erosion protection

Dillenbaugh Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish access to rearing and spawning habitat is restricted	➡ Placement of undersized stream crossing structures restricts fish passage and natural processes (streambed material and LWD transport).	➡ Correct barrier culverts. See Section 4 for guidelines.

Dillenbaugh Creek Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian condition in the Dillenbaugh Creek subbasin is poor. The riparian corridor along Dillenbaugh Creek is sparsely vegetated with minimal deciduous vegetation (Smith Wenger 2001). ➡ Loss of riparian vegetation through development has also altered ecological function of the creek (HDR internal memo, 2005).	➡ Conversion of land-use from forestry to agriculture or rural residential has contributed to degraded riparian corridors. ➡ Past timber harvesting practices have impacted riparian corridors.	➡ Control invasive species. See Section 5. ➡ Identify specific degraded riparian areas for restoration ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Protect, fee simple/easement, key properties of riparian habitat ➡ Revegetate open riparian areas with native plants

Dillenbaugh Creek Tier 2 Concerns

Dillenbaugh Creek Tier 2	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ "Poor" based on the extensive 303(d) listing of mainstem reaches for warm water temperatures and low DO. This is priority segment for dissolved oxygen impacts.	➡ Causes of low DO come from a wide variety of sources: farming activities, a dairy feedlot, failing septic systems adjacent to the creek and industries in the Chehalis Industrial Park that contributed to increased temperatures 303(d) listed for FC, DO and Temp. ➡ Septic and agricultural inputs contribute to elevated nitrates and poor water quality.	➡ Implement TMDL recommendations ➡ Protect by fee simple or easement key properties of riparian habitat ➡ See Riparian actions ➡ Work with landowners to correct failing septic systems

Dillenbaugh Creek Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ LWD levels are observed low.	➡ Recorded historic settlement activities included land clearing and removal of jams and large wood from channel. ➡ LWD levels are likely low since riparian conditions are rated poor for the Dillenbaugh Creek subbasin and past practices have removed LWD from the Creek.	➡ Determine LWD quantities ➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity ➡ Identify specific degraded riparian areas for restoration ➡ Install LWD pieces in conjunction with other restoration projects

Dillenbaugh Creek Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
		➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Revegetate open riparian areas with native plants

Dillenbaugh Creek Tier 3 Concerns

Dillenbaugh Creek Tier 3	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ The lower reaches flow through urbanized areas, while residences and farmland surround the upper reaches. Lower Dillenbaugh flows through marsh habitat.	➡ Logjams have been removed from Dillenbaugh Creek according to Phinney and Bucknell (1975). ➡ Levees placed on portions of Dillenbaugh Creek have affected water storage in off-channel habitat (Smith and Wegner, 2001; USACE, 2003).	➡ Assess floodplain conditions and identify impacts ➡ Reconnect, enhance, and/or restore potential off-channel, floodplain, and wetland habitat ➡ Remove hard armoring (riprap) or implement bioengineering techniques in place of hard armoring

Dillenbaugh Creek Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Low flows are a problem and many of the withdrawals are for agricultural purposes. ➡ Increase in peak flows result in increased bank erosion and riverbed scour. ➡ Assessments reveal that the Chehalis River is not meeting base flow standard	➡ Phinney and Bucknell (1975) note that water withdrawals may have a significant impact on the water quantity in Dillenbaugh Creek. ➡ Agricultural withdrawal ➡ Loss or change of vegetative cover ➡ Water rights/claims exceed natural stream flow in many instances during the summer months	➡ Determine if water withdrawals are being followed in accordance with current water rights ➡ Restore wetlands for water storage

Berwick Creek

Description:

Berwick Creek is located in Lewis County approximately two miles southeast of the town of Chehalis in the upper Chehalis Basin. This 7.1 mile long creek is a tributary to Dillenbaugh Creek, which drains to the Chehalis River. Primary land uses in the area include industry in the lower basin, and agriculture, rural residential, and forestry in the in the upper basin. A number of dairies are adjacent to Berwick Creek as well as livestock rearing operations.

Major Tributaries: None named

Land Uses: Forestry, agriculture, and rural residences

Anadromous Fish Stocks: Coho and cutthroat

Watershed Analysis: Newaukum Management Unit, Berwick Creek

Berwick Creek Tier 1 Concerns

Berwick Creek Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ Stream canopy reduced by agriculture in lower Berwick Creek. ➡ Dillenbaugh and its tributary Berwick Creek have gravel bottoms except in their low gradient areas. Dillenbaugh and Berwick have adequate streamside vegetation (Stream Catalog).	➡ Agriculture, rural residences and past logging are primary causes for reduced riparian vegetation and canopy loss.	➡ Control invasive species. See Section 5. ➡ Identify specific degraded riparian areas for restoration ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Revegetate open riparian areas with native plants

Berwick Creek Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish access spawning and rearing habitat is restricted	➡ Placement of undersized stream crossing structures restrict fish passage and natural processes (streambed material and LWD transport).	➡ Correct barrier culverts. See Section 4 for guidelines.

Berwick Creek Tier 1	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Septic and agricultural inputs contribute to elevated nitrates and poor water quality. ➡ Kills of coho in Dillenbaugh and Berwick Creeks. ➡ 303(d) listed for fecal coliform.	➡ The suspected cause of low dissolved oxygen and high fecal coliform in Berwick Creek is livestock and septic (Smith Wenger 2001) ➡ Agricultural pollution linked to coho kills	➡ See riparian actions ➡ Work with landowners to correct failing septic systems

Berwick Creek Tier 2 Concerns

Berwick Creek Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ LWD levels are considered very low.	➡ Recorded historic settlement activities included land clearing and the removal of jams and large wood from the channel.	➡ Develop LWD supplementation plan to install logjams in key places to improve instream channel structure and habitat diversity ➡ Install LWD in conjunction with other restoration projects

Berwick Creek Tier 2	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Low flows are a problem and many of the withdrawals are for agricultural purposes. ➡ Increase in peak flows result in increased bank erosion and riverbed scour.	➡ Water withdrawals worsen the low flow conditions during summer low flow periods (Smith Wenger 2001) ➡ The loss or change of vegetative cover	➡ Determine if water withdrawals are being followed in accordance with current water rights. ➡ Implement activities that lead to natural recharge of aquifers ➡ Protect by fee simple or easement key properties of riparian ➡ See riparian actions

Berwick Creek Tier 3 Concerns

Berwick Creek Tier 3	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ The lower reaches flow through urbanized areas, while residences and farmland surround the upper reaches. ➡ Alteration of natural water storage processes	➡ Levees placed on portions of Berwick Creek have affected water storage in the subbasin (Smith and Wegner, 2001; USACE, 2003).	➡ Assess floodplain conditions and identify impacts ➡ Reconnect, enhance, and/or restore potential off-channel, floodplain, and wetland habitat

Berwick Creek Tier 3	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Livestock access to stream considered most important habitat problem (Envirovision, 2001).	➡ Livestock access is noted in sections of Berwick Creek (Wampler et al. 1993). ➡ Stream canopy reduced by agriculture, forest practices, and other causes. ➡ Bank vegetation destruction by livestock: lower Berwick Creek.	➡ Correct cross drains that may trigger mass wasting on geologically sensitive slopes ➡ Identify sources that are contributing to sediment loading ➡ Install riparian fencing to exclude or reduce livestock access ➡ Revegetate stream and riverbanks for added protection from erosion ➡ Upgrade logging roads to comply with Forest and Fish Agreement (1999)

China Creek

Description:

China Creek is a short, small watershed that flows through Centralia and empties into the Chehalis River just upstream of the Skookumchuck River at RM 67.3. Its surrounding floodplain is heavily modified. Its watershed encompasses approximately 6 square miles. Most of the channel consists of pipes and culverts where the stream runs through Centralia. Much of the watershed is moderately steep.

Major Tributaries: None

Land Uses: Industrial, forestry, agriculture, and rural residences

Anadromous Fish Stocks: Coho and cutthroat

China Creek Tier 1 Concerns

China Creek Tier 1	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Poor; warm water temperatures, high turbidity. (Smith Wenger 2001).	➡ High riparian loss, sedimentation, reduced canopy (Smith Wenger 2001).	➡ Implement TMDL recommendations ➡ See riparian actions

China Creek Tier 1	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Low flows are a problem and many of the withdrawals are for agricultural purposes. ➡ Increase in peak flows result in increased bank erosion and riverbed scour (Smith Wenger 2001).	➡ Water withdrawals worsen the low flow conditions during summer low flow periods (Smith Wenger 2001) ➡ The loss or change of vegetative cover	➡ Determine if water withdrawals are being followed in accordance with current water rights. ➡ Implement activities that lead to natural recharge of aquifers ➡ Protect and preserve wetlands and springs. ➡ See riparian actions

China Creek Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ 93% vegetation loss; 36% reduced tree canopy (Smith Wenger 2001).	➡ Agriculture, rural residences and past logging are primary causes for reduced riparian vegetation and canopy loss.	➡ Control invasive species. See Section 5. ➡ Identify specific degraded riparian areas for restoration ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas ➡ Revegetate open riparian areas with native plants

China Creek Tier 2 Concerns

China Creek Tier 2	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Excessive sediment in stream bed in upper China Creek, identified by Wampler and Knudsen (1993).	➡ Sedimentation is likely the product of both bank erosion and roads. 93% vegetation loss; 36% reduced tree canopy (Smith Wenger 2001).	➡ Correct cross drains that may trigger mass wasting ➡ Identify sources that are contributing to sediment loading ➡ Implement alternative methods of bank stabilization (bioengineering) in locations of excessive erosion ➡ Install riparian fencing to exclude or reduce livestock access ➡ Reduce sediment loading by reducing road densities (abandon/decommission); upgrade logging roads to comply with Forest and Fish Agreement (1999) ➡ Revegetate stream /river banks for added erosion protection

China Creek Tier 2	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish access to spawning and rearing habitat is restricted	➡ Heavily urbanized along the banks as it bisects Centralia (Terrain Navigator). ➡ The lower 2 miles of China Creek consist mostly of long culverts and concrete and rock line channels	➡ Correct barrier culverts. See Section 4.

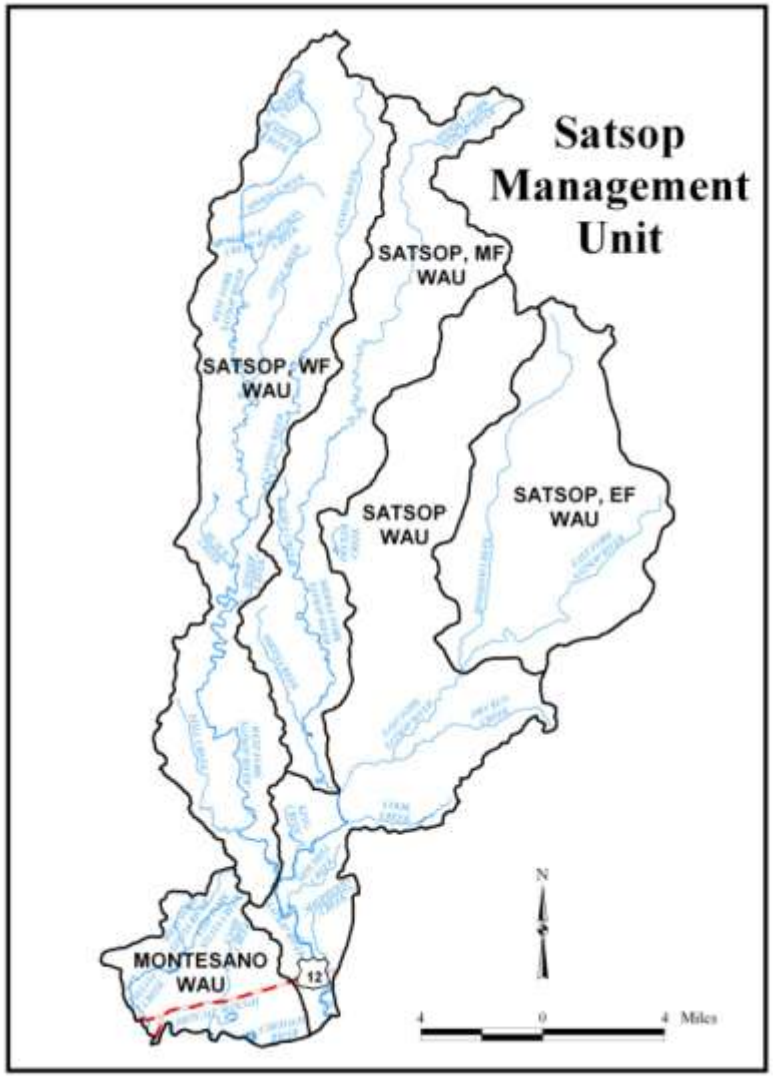
China Creek Tier 3 Concerns

China Creek Tier 3	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Floodplain connectivity is restricted	➡ Nearly 2 miles are entirely surrounded by the city of Centralia; impervious surfaces and hardened channels. ➡ Lower China Creek has riprap in lower reaches and is heavily channelized through the city of Centralia.	➡ Reconnect, enhance, and restore potential off-channel, floodplain, and wetland habitat ➡ Remove hard armoring (riprap) or implement bioengineering techniques in place of hard armoring

China Creek Tier 3	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ LWD levels are low	➡ LWD levels are likely low since riparian conditions are rated poor for the China Creek subbasin and past practices have removed LWD from the creek. ➡ Recorded historic settlement activities included land clearing and the removal of jams and large wood from the channel.	➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity ➡ Identify specific degraded riparian areas for restoration needs ➡ Install LWD pieces in conjunction with other restoration projects ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Revegetate open riparian areas with native plants

SATSOP MANAGEMENT UNIT

SATSOP RIVER



Description:

The Satsop River basin is one of the largest tributaries to the Chehalis River that drains over 192,000 acres. The main drainages that comprise the Satsop basin are the West Fork Satsop, Middle Fork Satsop, and East Fork Satsop. These three main forks drain from the Olympic Mountains, with the East Fork Satsop considered a continuation of the mainstem (Smith Wenger 2001). Mean annual precipitation ranges from over 160 inches in the headwaters to about 80 inches in the lower reaches (Weyerhaeuser and Simpson Timber Co 1995).

Currently, the lower reaches flow mainly through agricultural land and the middle and upper watersheds are still predominantly managed for timber harvest. The East Fork Satsop River flows through low hills and flat valleys, and has several major tributaries, such as Decker Creek, Dry Run Creek, and Bingham Creek, each supporting salmon populations (Smith Wenger 2001).

The Middle Fork Satsop River joins the East Fork Satsop River at RM 11. Its headwaters are located in the foothills of the Olympic Mountains, and it flows southerly through steep valleys and canyons until about RM 23.8. The surrounding land then changes to prairie and valleys. Most of the land has been under active forest management (Smith Wenger 2001).

The West Fork Satsop empties into the Mainstem Satsop at RM 6.3, and is a glacial stream with flow patterns and turbidity that differ from the remaining Satsop subbasin. Its headwaters are in the steep foothills of the Olympic Mountains. In the Middle West Fork, the landform changes to moderate and low relief with short, steep tributaries. The geology changes to materials that break down quickly to gravels, sands, silts, and clays (Smith Wenger 2001).

The Satsop drainages contain 237.6 miles of anadromous fish habitat.

Major Tributaries: Bingham, Cook, Dry Run, Decker, Baker, Rabbit, Smith, Black, and Still Creeks; Middle Fork Satsop, West Fork Satsop, East Fork Satsop Rivers

Land Uses: Forestry, Agriculture, and Rural Residences

Anadromous Fish Stocks: Fall Chinook, summer Chinook*, coho, cutthroat, winter steelhead*, chum, and bull trout (* denotes depressed stocks, SaSI)

Satsop River Mainstem Tier 1 Concerns

Satsop River Mainstem Tier 1	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Recently, the mainstem has seen more degradation, resulting in channel incision.	➡ Partially attributed to gravel harvesting; more information needed. ➡ An estimated 10,000 cubic yards of gravel moves through the mainstem annually. In the past, this amount of material had contributed to aggradation. ➡ Timber harvest and development within the riparian zone have altered the physical characteristics and connectivity of many off-channel features. ➡ The former gravel pit site, located off Keys Road, has a perimeter dike and stockpiled soil that prohibit flooding of approximately 40 acres. ➡ Extensive amounts of riprap occur in the lower reach of the mainstem.	➡ Protect, fee simple or easement, key properties to facilitate natural channel migration and reconnection to the floodplain ➡ Reconnect, enhance, and/or restore potential off-channel, floodplain, and wetland habitat. • Projects identified in the report prepared by Ralph et al. 1995 • Five locations along the lower 6 miles of the mainstem have been identified as potential off-channel restoration projects. The quality and accessibility of these sites has been negatively impacted. ➡ Remove hard armoring (riprap) or implement bioengineering techniques in place of hard armoring ➡ Relocate gravel mining/harvesting away from shorelines, 100-year floodplains, and stream channels. • Restore former gravel pit site located along Keys Road in the lower reach of the Satsop mainstem
➡ The floodplain in the lower reach of the Satsop mainstem does not accommodate natural channel migration patterns or flood storage.	➡ Extensive amounts of riprap in lower reach of the mainstem. ➡ The former gravel pit site, located off Keys Road, has a perimeter dike and stockpiled soil that prohibit flooding of approximately 40 acres.	➡ Reconnect, enhance, and/or restore potential off-channel, floodplain, and wetland habitat • Projects identified in the report by Ralph et al. 1995 ➡ Protect, fee simple / easement, key properties to facilitate natural channel migration and floodplain reconnection. ➡ Relocate gravel mining/harvesting away from shorelines, 100-year floodplains, and stream channels. ➡ Remove hard armoring (riprap) or implement bioengineering techniques in place of hard armoring ➡ Restore former gravel pit site located along Keys Road in the lower reach of the Satsop mainstem

Satsop River Mainstem Tier 1	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Listed as threatened by DOE for siltation and suspended solids.	➡ The source of siltation and suspended solids is identified as unspecified non point sources. ➡ See the Sediment section above for the effects of high levels of siltation and sedimentation.	➡ Address sediment input sources in WF, MF, EF Satsop ➡ Reduce road densities to reduce sediment loading ➡ Reduce exposed soils by improved logging practices.

Satsop River Mainstem Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian condition for the mainstem Satsop is considered to be in poor condition and will not significantly contribute LWD. See Grays Harbor County 2002 Riparian Assessment for additional information.	➡ 79% of the mainstem Satsop riparian corridor is lacking vegetation or is dominated by hardwoods. These impacts are attributed to past land use practices associated with agriculture and forestry.	➡ Control invasive species. See Section 5. ➡ Protect by fee simple or easement key properties of riparian habitat; use Chehalis Basin Lead Entity's Riparian Assessment report (2003) to identify specific locations ➡ Revegetate open riparian areas with native plants; use Chehalis Basin Lead Entity's Riparian Assessment report (2003) to identify specific locations

Satsop River Mainstem Tier 2 Concerns

Satsop River Mainstem Tier 2	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Numerous road crossings are undersized and do not allow adequate fish passage upstream because of water velocity or perched outfall. These undersized structures also inhibit the movement of streambed material downstream and usually contribute to channel scour directly downstream.	➡ Placement of undersized stream crossing structures (see Mason Conservation District 2004 Fish Passage Inventory for detailed information).	➡ Correct barrier culverts. See Section 4 for guidelines.

Satsop River Mainstem Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ Estimated low levels of LWD in the mainstem Satsop.	➡ Low levels of LWD are estimated in the mainstem Satsop because of past splash damming activities, LWD removal from channel, and poor riparian recruitment potential.	➡ Determine LWD levels in the Satsop mainstem. ➡ Develop LWD supplementation plan that will install logjams to improve instream channel structure and habitat diversity ➡ Educate landowners on the importance of leaving LWD

Satsop River Mainstem Tier 3 Concerns

Satsop River Mainstem Tier 3	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ The mainstem is considered incised, however, it is also the largest contributor of sediment to the Chehalis River. ➡ According to the EDT model, sediment is one of the main problems.	➡ High road densities in the Satsop WAU (4.1 miles of road per square mile of drainage). ➡ WF, MF, and EF contribute high amounts of sediment to the Satsop mainstem. ➡ Extensive logging of watershed causes high peak flows.	➡ Address sediment input sources in WF, MF, EF Satsop ➡ Reduce road densities by abandoning and/or decommissioning roads to reduce sediment loading. ➡ Reduce exposed soils by improved logging practices.

Satsop River Mainstem Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ In recent years, the Satsop River has not met established base flows for an average of 63 days per year. ➡ The increase in peak flows shows a higher average-month-per-year flow in recent years.	➡ Both summer low flows and high peak flows are likely attributed to land use practices since precipitation correlations have been ruled out. However, further data is needed to determine actual cause.	➡ Determine if water withdrawals are being followed in accordance with current water rights. ➡ Implement activities that lead for natural aquifer recharge ➡ Implement forest and fish rules pertaining to logging. ➡ Increase hydrologic continuity – reduce impervious surfaces. ➡ Obtain data needed to determine cause. Investigate current agricultural practices. ➡ Reduce stormwater discharge directly to streams ➡ Restore wetlands for water storage.

West Fork Satsop River Tier 1 Concerns

West Fork Satsop River Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Numerous road crossings are undersized and do not allow adequate fish passage upstream because of water velocity or perched outfall. These undersized structures also inhibit the movement of streambed material downstream and usually contribute to channel scour directly downstream.	➡ Placement of undersized stream crossing structures (see Mason Conservation District 2004 Fish Passage Inventory).	➡ Correct barrier culverts. See Section 4.

West Fork Satsop River Tier 1	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ In recent years, the Satsop River has not met established base flows for an average of 63 days per year.	➡ Both low summer flows and high peak flows are likely attributed to land use practices since precipitation correlations have been ruled out. However, more data is needed to determine actual cause.	➡ Determine if water withdrawals are being followed in accordance with current water rights ➡ Protect wetlands and springs in WF Satsop drainage
➡ The increase in peak flows shows a higher average-month-per-year flow in recent years.	➡ Data needed.	➡ Determine cause of higher average-month-per-year flow.

West Fork Satsop River Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ High sediment delivery rate and low level of quality spawning habitat.	➡ The West Fork Satsop has a high level of sediment input from landslides and road surfaces. It also lacks sufficient LWD to retain and sort substrate materials.	➡ Upgrade all logging roads to comply with Forest and Fish Agreement (1999) on Swinging Bridge Creek, middle and upper Canyon River, Lower Little River, Save Creek and Robertson Creek
➡ WF Satsop is also listed as threatened by DOE for siltation and suspended solids.	➡ Most landslide contribution originates from the upper 1/3 of the basin and most of the road surface contribution originates from Swinging Bridge Creek, middle and upper Canyon River, Lower Little River, Save Creek and Robertson Creek (Clark 1995).	➡ Upgrade all logging roads to comply with Forest and Fish Agreement (1999) on: • Swinging Bridge Creek, middle and upper Canyon River, Lower Little River, Save Creek and Robertson Creek

West Fork Satsop River Tier 2 Concerns

West Fork Satsop River Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ Low level of LWD does not allow for the retention of courser substrate materials suitable for spawning or provide instream structure in WF Satsop. ➡ Low levels of LWD contribute to predicted channel incision.	➡ In the lower reach of the WF, near-term LWD recruitment is low to moderate and long-term potential is low. ➡ In the middle reach of the WF, near-term LWD recruitment varies from low to high and long-term LWD recruitment potential is low. ➡ Widespread conversion of the riparian zone from conifer to deciduous, particularly in the middle and lower West Fork Satsop watershed (Smith Wenger 2001).	➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity ➡ Interplant conifers in deciduous dominant areas where appropriate. ➡ Protect by fee simple or easement key properties of riparian habitat (use the 2003 Lead Entity Riparian Assessment to identify specific locations).

West Fork Satsop River Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
		➡ Restore riparian corridors in the WF Satsop drainage (use the 2003 Lead Entity Riparian Assessment to identify specific locations). ➡ Revegetate open riparian areas with native plants

West Fork Satsop River Tier 2	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian condition for the WF Satsop is considered to be in poor condition and will not significantly contribute LWD. Poor riparian conditions exist in approximately 52% of the WF Satsop. • The lower reaches of the WF Satsop have a "poor" LWD recruitment potential because of hardwood dominated species composition and poor riparian conditions (lack of vegetation). • The middle reaches of the WF have a "poor" long term LWD recruitment potential because 40% of the riparian corridor consists of mature alder. • The upper reaches of the WF Satsop have a "good" rating for long term LWD recruitment because of the conifer dominated riparian corridor.	➡ Widespread conversion of the riparian zone from conifer to deciduous, particularly in the middle and lower West Fork Satsop watershed (Smith Wenger 2001). • The lower WF has naturally low levels of shade and the land uses are agriculture, rural residence, and commercial forestry with riparian corridors dominated by red alder. • The middle reaches of the WF are primarily dominated by dense hardwood and mixed stands. • The upper reaches of the WF are conifer dominated. These impacts are attributed to past land use practices.	➡ Control invasive species. See Section 5. ➡ Interplant conifers in deciduous dominant areas where appropriate. ➡ Protect by fee simple or easement key properties of riparian habitat (use the 2003 Lead Entity Riparian Assessment to identify specific locations). ➡ Restore riparian corridors in the WF Satsop drainage (use the 2003 Lead Entity Riparian Assessment to identify specific locations). ➡ Revegetate open riparian areas with native plants

West Fork Satsop River Tier 3 Concerns

West Fork Satsop River Tier 3	FLODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Low drainage density that indicates off-channel habitat may be limited. ➡ The West Fork Satsop is considered likely to have a disconnected floodplain based on past land use practices implemented in this basin.	➡ Natural geomorphology in basin. ➡ Channel incision is likely to occur due to the estimated low levels of LWD and past splash damming activities on Canyon Creek, Still Creek, and Robertson Creek	➡ Off-channel habitat enhancement. ➡ Assess floodplain conditions and identify impacts ➡ See LWD section.

West Fork Satsop River Tier 3	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Listed as threatened by DOE for siltation and suspended solids.	➡ The source of siltation and suspended solids is identified as unspecified non point sources. ➡ The West Fork Satsop has a high level of sediment input from landslides and road surfaces. It also lacks sufficient LWD to retain and sort substrate materials. ➡ Most landslide contribution originates from upper 1/3 of the basin and road surface contribution originates from Swinging Bridge Creek, middle and upper Canyon River, Lower Little River, Save Creek and Robertson Creek (Clark 1995).	➡ Upgrade all logging roads to comply with Forest and Fish Agreement (1999) on: • Swinging Bridge Creek, middle and upper Canyon River, Lower Little River, Save Creek and Robertson Creek.

Middle Fork Satsop River Tier 1 Concerns

Middle Fork Satsop River Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Numerous road crossings are undersized and do not allow adequate fish passage upstream. These structures inhibit the movement of streambed material downstream and usually contribute to channel scour directly downstream.	➡ Placement of undersized stream crossing structures (see Mason Conservation District 2004 Fish Passage Inventory).	➡ Correct barrier culverts. See Section 4 for guidelines.

Middle Fork Satsop River Tier 1	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ In recent years, the Satsop River has not met established base flows for an average of 63 days per year. ➡ The increase in peak flows shows a higher average-month-per-year flow in recent years.	➡ Both low summer flows and high peak flows are likely attributed to land use practices since precipitation correlations have been ruled out. However, further data is needed to determine actual cause.	➡ Determine if water withdrawals are being followed in accordance with current water rights ➡ Implement activities that lead to natural aquifer recharge ➡ Implement forest and fish rules pertaining to logging. ➡ Increase hydrologic continuity– reduce impervious surfaces. ➡ Obtain data needed to determine cause of flow problems. ➡ Reduce stormwater discharge directly to streams ➡ Restore wetlands for water storage.

Middle Fork Satsop River Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian condition is considered to be in poor condition and will not significantly contribute LWD (See Grays Harbor County 2002 riparian assessment for additional information).	➡ Overall, 61% of the Middle Fork Satsop riparian reaches are either lacking in trees or dominated by hardwoods. Primary riparian loss is identified in the lower and middle reaches of the MF and Rabbit Creek. These impacts are attributed to past land use practices.	➡ Control invasive species. See Section 5. ➡ Interplant conifers in deciduous dominant areas where appropriate. ➡ Protect by fee simple or easement key properties of riparian habitat ➡ Restore riparian corridors in the MF Satsop drainage (use the 2002 Lead Entity Riparian Assessment to identify specific locations). ➡ Revegetate open riparian areas with native plants

Middle Fork Satsop River Tier 2 Concerns

Middle Fork Satsop River Tier 2	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Estimated high amount of sediment delivery. ➡ More data needed on high sediment delivery.	➡ High number of debris torrents (9) located in the upper reaches of the Middle Fork. ➡ A high road density of 4.4-road miles/square mile contributes high amounts of sediment to the MF Satsop. ➡ Instream vehicle activity in the stream channel is also a noted problem in the MF Satsop.	➡ Abandon roads on steep geologically sensitive areas ➡ Educate public about driving in streams ➡ Eliminate motor vehicle access to streams. ➡ Fill data gaps by identifying all sources of input. ➡ Reduce road densities by abandoning and/or decommissioning roads to reduce sediment loading

Middle Fork Satsop River Tier 2	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Rabbit Creek is on the 303d List for water temperature.	➡ High water temperatures in Rabbit Creek are likely associated to riparian conditions. ➡ See Riparian section for information pertaining to riparian conditions.	➡ Reduce water temperatures – use riparian assessment to identify specific locations in Rabbit Creek.

Middle Fork Satsop River Tier 3 Concerns

Middle Fork Satsop River Tier 3	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Low drainage density indicates that off-channel habitat may be limited.	➡ Natural geomorphology in basin. ➡ Channel incision is likely to have occurred in the Middle Fork Satsop due to the estimated low levels of LWD, and past splash damming activities.	➡ Assess floodplain conditions and identify impacts. ➡ Enhance off-channel habitat
➡ Disconnected floodplain likely.	➡ This is the result of past land use practices implemented in this basin. Channel incision is likely to have occurred in the Middle Fork Satsop due to the estimated low levels of LWD, and past splash damming activities.	➡ Determine LWD levels. ➡ Develop LWD supplementation plan that will install logjams to improve instream channel structure and habitat diversity. ➡ More data is needed to assess floodplain conditions and identify impacts

Middle Fork Satsop River Tier 3	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ LWD levels estimated to be low - more data is needed.	➡ Low levels of LWD may be a result of past splash damming activities, LWD removal from channel, and poor riparian recruitment potential.	➡ Determine LWD levels. ➡ Develop and implement LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity.

East Fork Satsop River Tier 1 Concerns

East Fork Satsop River Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Numerous road crossings are undersized and do not allow adequate fish passage upstream because of water velocity or perched outfall. These undersized structures also inhibit the movement of streambed material downstream and usually contribute to channel scour directly downstream.	➡ Placement of undersized stream crossing structures (see Mason Conservation District 2004 Fish Passage Inventory).	➡ Correct barrier culverts. See Section 4 for guidelines.

East Fork Satsop River Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian condition is considered to be in poor condition and will not significantly contribute LWD (see Grays Harbor County 2002 riparian assessment for additional information).	➡ About 57% of the riparian buffers are either open or dominated by hardwoods. These impacts are attributed to past land use practices.	➡ Control invasive species. See Section 5. ➡ Interplant conifers in deciduous dominant areas where appropriate. ➡ Protect by fee simple or easement key properties of riparian ➡ Protect/preserve intact habitat ➡ Restore riparian corridors in the EF Satsop drainage (2002 Lead Entity Riparian Assessment for specific locations). ➡ Revegetate open riparian areas with native plants

East Fork Satsop River Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Listed as threatened by WDOE for sediment and siltation. (More data needed).	➡ High road densities (4.4 road miles /square mile) are considered to contribute high levels of sediment to the EF Satsop. ➡ Vehicle activity in the stream channel is a noted problem for Decker Creek and the lower East Fork Satsop.	➡ Abandon roads on steep geologically sensitive areas. ➡ Educate landowners. ➡ Minimize motor vehicle access ➡ Reduce road densities by abandoning and/or decommissioning roads to reduce sediment loading

East Fork Satsop River Tier 2 Concerns

East Fork Satsop River Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ Estimated low levels of LWD; more data is needed.	➡ Low levels of LWD because of past splash damming activities, LWD removal from channel, and poor riparian recruitment potential. ➡ More data is needed.	➡ Determine LWD levels. ➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity. ➡ Interplant conifers in deciduous dominant areas ➡ Protect by fee simple or easement key properties of riparian habitat

East Fork Satsop River Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
		➡ Protect/preserve intact habitat ➡ Restore riparian corridors in the EF Satsop drainage (use the 2002 Lead Entity Riparian Assessment to identify specific locations). ➡ Revegetate open riparian areas with native plants

East Fork Satsop River Tier 2	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Listed as threatened by DOE for siltation and suspended solids.	➡ The source of siltation and suspended solids is identified as "unspecified non point sources" (Smith Wenger 2001). ➡ See the Sediment section above for the effects of high levels of siltation and sedimentation.	➡ Abandon roads on steep geologically sensitive areas. ➡ Determine if sedimentation is a problem. ➡ Educate landowners. ➡ Reduce road densities by abandoning and/or decommissioning roads to reduce sediment loading.

East Fork Satsop River Tier 3 Concerns

East Fork Satsop River Tier 3	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Natural channel migration zone inhibited, along with the ability to create new off-channel rearing habitat. However, the EF is considered to have an abundant amount of off-channel habitat because of its high drainage density.	➡ Extensive amounts of riprap bank protection.	➡ Protect by fee simple or easement key properties to facilitate natural channel migration and reconnection to the floodplain. ➡ Remove hard armoring (riprap) or implement bioengineering techniques in place of hard armoring (See Wampler 1993)
➡ It is estimated that there is some channel incision, which disconnects the river channel from the floodplain within the EF Satsop.	➡ Channel incision is likely to exist and may be caused from past splash damming on Decker Creek, and probable lack of instream LWD (more data needed).	➡ Determine LWD levels. ➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure, habitat diversity, and channel connection to floodplain. ➡ Protect by fee simple or easement key properties to facilitate natural channel migration and reconnection to the floodplain.

East Fork Satsop River Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ In recent years, the Satsop River has not met established base flows for an average of 63 days per year. ➡ The increase in peak flows shows a higher average-month-per-year flow in recent years.	➡ Both low summer flows and high peak flows are likely attributed to land use practices since precipitation correlations have been ruled out. However, further data is needed to determine actual cause. ➡ Both low summer flows and high peak flows are likely attributed to land use practices since precipitation correlations have been ruled out. However, further data is needed to determine actual cause.	➡ Determine if water withdrawals are being followed in accordance with current water rights ➡ Implement activities that lead to natural recharge of aquifers: ➡ Increase hydrologic continuity, reduce impervious surfaces. ➡ Protect key wetlands, springs, groundwater fed channels and sloughs in EF Satsop ➡ Protect key wetlands, springs, groundwater fed channels and sloughs in EF Satsop. ➡ Reduce stormwater discharge directly to streams (rapid runoff). ➡ Restore wetlands for water storage.

SKOOKUMCHUCK MANAGEMENT UNIT

SKOOKUMCHUCK RIVER

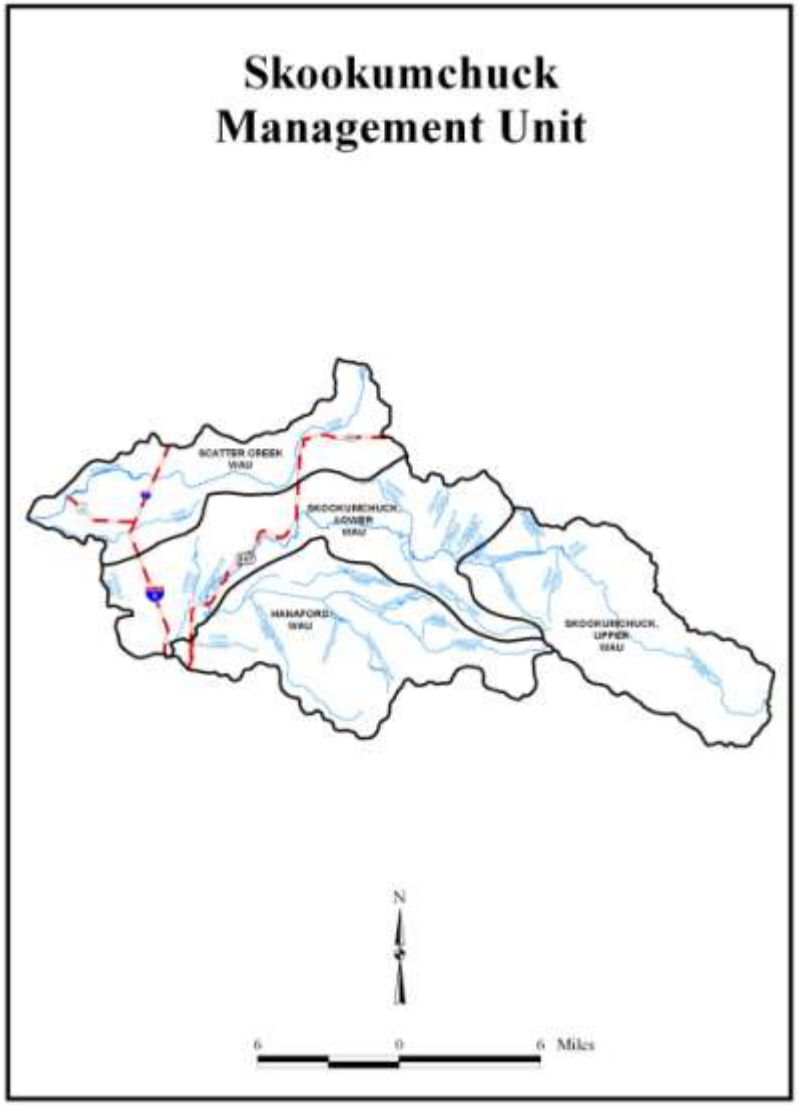
Description:

The Skookumchuck River, located in northern Lewis and southern Thurston Counties, drains a watershed of 181 square miles. The headwaters originate in the foothills of the Mt. Baker-Snoqualmie National Forest (elevation 3,000 feet) and flow for approximately 35 miles before joining the Chehalis River at RM 67.3. The mainstem has a steep gradient of 19 feet per mile from the headwaters to Bucoda, where it then lessens to five feet per mile or less until the confluence with the Chehalis. The mean annual rainfall of the watershed ranges from 40 to 80 inches. The headwaters have slopes moderately susceptible to erosion and the streambed consists of large, medium, and small gravels. Natural barriers include a low flow blockage for Chinook near RM 25.5 and a falls at RM 28.9.

Land use in the watershed is primarily forestry in the headwaters and agriculture in the lower reaches. The urban centers of Bucoda (RM 11) and Centralia (from RM 3 to the mouth) continue to grow, creating more impermeable surfaces. Located at RM 21.9, Skookumchuck Dam provides some minor flood control and has a storage capacity of 34,800 acre-feet with surface area of 550 acres when full. Two protected areas exist, one is at Shafer Park in the lower reach; the other is a state preserve in the headwaters. TransAlta removes 54 cfs at RM 7.2. When natural inflow drops below 95 cfs, the dam contributes up to 50 cfs to maintain minimum flows to compensate for the withdrawal.

Historic timber harvest practices have significantly altered habitat in the watershed. Three splash dams constructed in the 1920's located at River Miles 3.7, 11.5, and 23.8, blocked an estimated 50 to 90 percent of fish runs. The dams also washed out gravel, leaving incised channels and reducing access to off-channel habitat.

The largest tributary of the Skookumchuck is Hanaford Creek, which drains 58 square miles with an annual flow of 85 cfs that is highly altered coal mining activities. Rural residences and farms are predominant land uses in the lower nine miles of the tributary.



Major Tributaries: Hanaford, Thompson, Johnson, Salmon, Bloody Run, Fall, Pheeny, Baumgard, Laramie, Eleven, Twelve, Three, and Hospital Creeks

Land Uses: Forestry, Agriculture and Rural Residences

Anadromous Fish Stocks: Coho*, cutthroat, winter steelhead*, Spring Chinook*, and Fall Chinook (* denotes priority stock)

Skookumchuck River Tier 1 Concerns

Skookumchuck River Tier 1	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Loss of floodplain function: (74 of 185 miles) in Skookumchuck subbasin.	➡ Ditching and channel realignment that does not allow for floodwater storage (36 miles in lower watershed – Skookumchuck MS, Coffee Creek, Salmon Creek, and Johnson Creek) (Smith Wenger 2001). ➡ Construction of "floodplain" roads that inhibit floodplain functions (3 miles lower Skookumchuck, 0.8 miles Salmon Creek, 2 miles Johnson Creek), 3.4 miles Thompson Creek) (Smith Wenger 2001). ➡ Development in the floodplain has limited mobility of the river. ➡ Riprap is located in the Skookumchuck mainstem from RM 3 to RM 6 and is located in parts of Hanaford Creek. (Smith Wenger 2001). ➡ Flooding occurs in Bucoda due to restriction of the channel.	➡ Assess floodplain for off-channel and wetland habitat ➡ Determine extent of impact "floodplain" roads have on floodplain functions • 3 miles in the lower Skookumchuck, 0.8 miles Salmon Creek, 2 miles Johnson Creek), 3.4 miles Thompson Creek have 'floodplain' roads. • Floodplain roads are in upper Skookumchuck (above dam) on Weyerhaeuser Mainline from RM 27-36.2 and Twelve Creek, Laramie Creek, and Range Creek. ➡ Reconnect, enhance, and/or restore potential off-channel, floodplain, and wetland habitat • 36 miles in lower watershed – Skookumchuck, Coffee Creek, Salmon Creek, and Johnson Creek. ➡ Protect (fee simple/easement) key properties to facilitate natural channel migration and reconnection to the floodplain ➡ Relocate gravel mining/harvesting away from shorelines, 100-year floodplains, and stream channels ➡ Remove hard armoring (riprap) or implement bioengineering techniques in place of hard armoring • Skookumchuck RM 3 – RM 6. ➡ See LWD section
	➡ Hanaford Creek floodplain has been highly impacted by activities of the steam plant and agriculture. Lower 8.25 miles has inaccessible settling ponds (Smith Wenger 2001).	➡ Determine feasibility of restoring floodplain in Hanaford Creek

Skookumchuck River Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ The riparian condition for the lower reaches is considered to be in poor condition and will not significantly contribute LWD. Areas identified as riparian being the number one impact are (Smith Wenger 2001): • Lower Skookumchuck • Thompson Creek • Johnson Creek • Salmon Creek • Hanaford Creek • South Hanaford Creek ➡ Riparian conditions in the Upper Skookumchuck are rated as being in poor condition (Smith Wenger 2001). • Young dense deciduous - 25% • Mature conifer - 15% • Conifer of all ages - 30% • Mixed deciduous with conifer - 26%	➡ Riparian vegetation removal by agriculture (primary), urban/suburban development, logging in the lower Skookumchuck and its tributaries (Smith Wenger 2001). ➡ Riparian conditions in the upper Skookumchuck drainage have been converted from primarily conifer to a mix of conifer and deciduous dominant as a result of logging. ➡ 66% of assessed streams above the dam are below target shade levels and 79% of the mainstem above the dam are below target levels (Smith Wenger 2001).	➡ Control invasive species. See Section 5. ➡ Interplant conifers in deciduous dominant areas where appropriate in upper Skookumchuck ➡ Protect by fee simple or easement key properties of riparian habitat ➡ Revegetate open riparian areas with native plants and interplant confer in deciduous dominant areas where appropriate • Lower Skookumchuck, Thompson Creek, Johnson Creek, Salmon Creek, Hanaford Creek, South Hanaford Creek. ➡ Riparian fencing to exclude or reduce livestock access • At the 9 sites identified in the LFA (40 miles).

Skookumchuck River Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Skookumchuck dam is the only major artificial barrier blocking 3.6 miles of Chinook and 8 miles of coho habitat. Steelhead are trucked above the dam (Smith Wenger 2001). ➡ Smaller barriers, such as culverts, exist throughout the system.	➡ Construction of the TransAlta dam at RM 21.9. ➡ Placement of undersized stream crossing structures.	➡ Continue steelhead supplementation provided by TransAlta. Evaluate adding coho and Chinook supplementation ➡ Correct barrier culverts. See Section 4 for guidelines. ➡ Improve fish passage at fishways and add a fishway to those structures that do not have them ➡ Remove dams where feasible

Skookumchuck River Tier 2 Concerns

Skookumchuck River Tier 2	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Low flows are a problem during the summer. Instream flows are not met on the Skookumchuck for an average of 33 days per year. ➡ Flooding has been an ongoing problem within the Skookumchuck subbasin (Smith Wenger 2001). ➡ More data is needed.	➡ TransAlta removes water for industrial purposes. Trans Alta has a water right for 54 CFS at RM 7.2 (Smith Wenger 2001). Up to 50 cfs are added to natural inflow with the goal of maintaining minimum flows of 95 cfs below the dam at RM 21.9. Higher flows of 140 cfs are provided during Chinook migration. ➡ Irrigation water rights account for 893 acre feet (Smith Wenger 2001). ➡ In 1993 there were 22 active water pumping locations within the Skookumchuck subbasin (Smith Wenger 2001). ➡ Water is also used for mining, gravel quarries, and livestock watering (Smith Wenger 2001). ➡ Past land use practices have contributed to the high peak flows of the Skookumchuck River including timber harvest and manipulated drainage.	➡ Determine if water withdrawals are being followed in accordance with current water rights ➡ Evaluate dam flows to determine if they need to be adjusted to better accommodate fish ➡ Reduce water withdrawals from surface sources ➡ See "floodplain" section for natural flood storage actions.

Skookumchuck River Tier 2	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ The lower mainstem Skookumchuck is rated poor for water quality and is on the 1998 303(d) List for temperature, pH, and fecal coliform near the mouth (Smith Wenger 2001). ➡ South Hanaford, lower Salmon, lower Johnson, Baungard, Bigwater, Three Forks, Deer, Deep, Eleven, and Twelve creeks are rated poor for water quality because of existing poor riparian conditions (Smith and Wenger). ➡ Hanaford Creek was recorded as having high temperatures and low DO levels in the early 1990's (Smith Wenger 2001).	➡ Loss of riparian areas likely contributes to high temperatures (Smith Wenger 2001). ➡ Livestock access likely contributes to fecal coliform (Smith Wenger 2001). ➡ Urban stormwater runoff (Smith Wenger 2001). ➡ See sediment section	➡ See Riparian actions ➡ See Sediment actions ➡ TMDL Implementation – Temperature, pH, fecal coliform

Skookumchuck River Tier 3 Concerns

Skookumchuck River Tier 3	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Sediment is estimated to be high. Actual estimates have not been made since the 1970's (Smith Wenger 2001): • Skookumchuck RM 0-7.2 - 26% • Skookumchuck RM 7.2-22.1 - 19% • Salmon Creek - 50% • Johnson Creek - 33% • Thompson Creek - 30% ➡ Reduced transport of sediments, high fines, gravels below dam. ➡ Hanaford Creek was noted as having a clay streambed in the 1970's, it is not known if it is natural or human induced (lower 8.9 miles) (Smith Wenger 2001). ➡ The tribs in upper portion of the Skookumchuck are primarily transport reaches and do not have much LWD for instream structure/substrate retention (Smith Wenger 2001).	➡ High road densities of 5.4 m/sq miles of drainage in the Skookumchuck drainage and 6.0 miles of road per square mile in the Hanaford subbasin (Smith Wenger 2001). ➡ In the past, the 2000 Mainline Road contributed up to 50% road surface sediment to the Skookumchuck River (Smith Wenger 2001). ➡ Bigwater and Drop Creeks are noted as having mass wasting problems associated with roads. ➡ Livestock access was noted at nine sites along the Skookumchuck totaling 40 miles (Smith Wenger 2001). ➡ Dam obstructs natural transport processes. ➡ Coal mining operations and high road densities of 6 m/sq miles in the Hanaford subbasin are likely contributors (Smith Wenger 2001).	➡ Determine if sedimentation is a problem in Hanaford Creek ➡ Identify those roads that are contributing to sediment loading ➡ Install riparian fencing to exclude or reduce livestock access ➡ Placement/input of gravels below dam ➡ Reduce road densities by abandoning and/or decommissioning roads to reduce sediment loading ➡ Upgrade all logging roads to comply with Forest and Fish Agreement (1999) • Check on 2000 Mainline Road upgrades.

Skookumchuck River Tier 3	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ The upper Skookumchuck drainage indicates poor LWD levels (Smith Wenger 2001). Areas of poor pool habitat are: • Pheeney Creek • Lower Fall Creek • Drop Creek • Laramie Creek ➡ Channel incision in the Skookumchuck headwaters, Eleven, Twelve, Drop, Deer, Three Forks, Bigwater, Range, and Pheeney Creeks does not allow for adequate utilization of floodplain (Smith Wenger 2001). ➡ LWD levels in the lower Skookumchuck are estimated to be low because of poor LWD recruitment potential.	➡ In the 1920s, 3 splash dams were constructed at RM 3.7, RM 11.5, and RM 23.8. The last splash dam was not removed until 1969 (Smith Wenger 2001). ➡ Between 1970's - 1990's 19 dam break floods impacted an estimated 15 miles of channel in Drop, Deer, Three Forks, Eleven, Twelve, Bigwater, Range, Fall, & Pheeney Creeks ➡ These areas have naturally low levels of LWD: • Upper mainstem to confluence of Eleven Creek • Lower Baumgard Creek • Lower Pheeney Creek • Hospital Creek • Fall Creek ➡ Current riparian conditions do not contribute adequate LWD; LWD is removed at Skookumchuck Dam at RM 21.9	➡ Determine LWD quantities ➡ Develop agreement with dam managers to collect LWD at dam, and place it downstream rather than remove it from system ➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity. ➡ Install LWD pieces in conjunction with other restoration projects. ➡ See Riparian actions

Scatter Creek

Description:

The Scatter Creek mainstem is approximately 20 miles in length and drains an area of 43 square miles. The mouth of Scatter Creek is at RM 55.2 on the Chehalis River. Hydrological sources for the creek are ground and surface waters. Occasionally flowing subsurface, the entire system is shallow, with some pools and refuges throughout. From 1993 to 1999, the mean annual flow near the mouth was 79 cfs, with maximum and minimum flow of 1362 cfs and 2.9 cfs respectively. The streambed consists of a mixture of large, medium, and small gravels. There are moderately erodible gravel slopes in the headwaters.

The primary land uses in the watershed are agriculture in the lower basin and forestry in the headwaters. Urban development is occurring throughout the watershed with increasing coverage of impermeable surfaces. There are several protected properties in the watershed, which includes Heernett Foundation (800 acres), The Nature Conservancy (650 acres), and the State of Washington (450 acres).

Major Tributaries: Several unnamed tributaries

Land Uses: Forestry, agriculture, and rural residences

Anadromous Fish Stocks: Fall Chinook, coho, cutthroat, and winter steelhead

Scatter Creek Tier 1 Concerns

Scatter Creek Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ Riparian corridor condition in the Scatter Creek subbasin is poor with 50% being open or hardwoods and about 40% converted to non-forest uses. Invasive species exist. ➡ Prairie Creek was identified as having poor levels of riparian vegetation in the lower reach (Smith & Wenger 2001).	➡ Much of the riparian corridor along the Scatter Creek mainstem has riparian loss due to land conversion (Smith & Wenger 2001).	➡ Control invasive species. See Section 5. ➡ Riparian fencing to exclude or reduce livestock access. ➡ Revegetate open riparian areas with native plants, with wider buffers. • RM 1, 5, 8, 9, and 12.5 are priority areas

Scatter Creek Tier 1	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Scatter Creek is on the 303(d) List for temperature, fecal coliform, and pH.	➡ The primary cause of warm temperatures is likely poor riparian conditions. Livestock access is a likely contributor of some of the fecal coliform in the Scatter Creek subbasin (Smith Wenger 2001).	➡ TMDL Implementation – Temperature, pH, fecal coliform.

Scatter Creek Tier 1	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Scatter Creek is not meeting base flow requirements and is closed to further appropriations. Scatter Creek has some segments that go dry during the summer months.	➡ Summer low flows are a result of water withdrawal (surface and shallow aquifer) and natural conditions (Smith Wenger 2001). Data is needed to understand the effects of withdrawals and land cover changes in this prairie subbasin. ➡ Atlantic salmon fish hatchery and development may contribute to upper basin withdrawal.	➡ Conduct a water balance study. ➡ Reduce water withdrawals from surface sources.

Scatter Creek Tier 2 Concerns

Scatter Creek Tier 2	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Sediment quantity and quality are considered poor in the Scatter Creek basin. Four out of five sampled segments (RM 1, 8, 11.5, and 12.5) contained sediment amounts exceeding 17% and one was documented as 44.9%.	➡ Sedimentation is likely the product of surface runoff from the high density of roads in the basin (5.3 miles of road per square mile) (Lunetta et al. 1997). ➡ Gravely unstable slopes in headwaters create mass wasting ➡ Sedimentation is also caused by the 11.7 miles of wild stock access to the streambanks.	➡ Erosion control treatments along forest roads, i.e., revegetation, bioengineering, and willow cuttings to reduce mass wasting. ➡ Reduce road densities by abandoning and/or decommissioning roads to reduce sediment loading. ➡ Riparian fencing to exclude or reduce livestock access.

Scatter Creek Tier 2	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Several road crossings within Scatter Creek drainage are undersized and do not allow adequate fish passage. These structures also inhibit transport of streambed material downstream and can cause channel scour directly downstream.	➡ Placement of undersized stream crossing structures. Refer to Lewis County Conservation District Culvert Inventory 2004 for specific locations and Thurston Conservation District SC stream assessment.	➡ Correct barrier culverts. See Section 4 for guidelines.

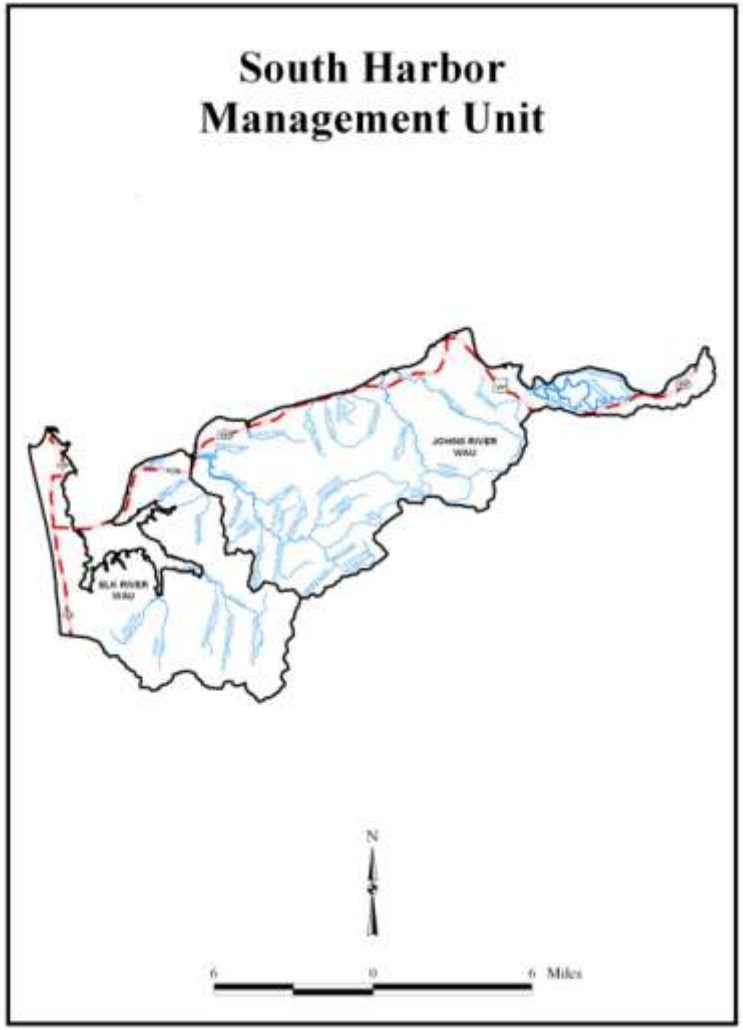
Scatter Creek Tier 3 Concerns

Scatter Creek Tier 3	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Little off-channel habitat exists in basin. Floodplain habitat in Scatter Creek subbasin is considered to be in good condition due to limited bank hardening and channelization.	➡ Naturally limited side-channel habitat except at RM 11-12. Limited floodplain impacts but these activities may be more profound because of naturally limiting off-channel habitat.	➡ Assess floodplain for off-channel and wetland habitat. ➡ Implement alternative methods of bank stabilization (bioengineering).

Scatter Creek Tier 3	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ LWD surveys indicated levels to be fair-good in the Scatter Creek subbasin between RM 1-12.5, with poor LWD quantities at RM 9.	➡ Although current LWD levels are fair-good, current riparian conditions will not provide much LWD recruitment. Historically riparian areas were mostly deciduous trees (oak and ash) with low recruitment ability.	➡ Determine LWD quantities ➡ Develop LWD supplementation plan to install logjams to improve instream channel structure and habitat diversity ➡ Install LWD pieces in conjunction with restoration projects ➡ See riparian actions

SOUTH BAY MANAGEMENT UNIT

SOUTH BAY TRIBUTARIES



Description:

The South Bay tributaries area includes the two larger drainages of the Elk and Johns River and six smaller, independent drainages (O'Leary, Stafford, Indian, Chapin, Newskah, and Charlie Creeks) that enter Grays Harbor between John's River and the mouth of the Chehalis River. The elk and John's Rivers had extensive estuaries that support oyster farms. The remainder of the Elk River drainage is managed as commercial timberlands.

The John's River estuary has a cranberry processing plant located at the mouth. The estuary was diked and drained to develop crop lands, but a recent project breach the Dyke in two locations on the east side of the river. The installation of a tidal gate increased function in access to fish habitat. The John's River Astoria is part of the John's Rivers State wildlife area. Rural residences lie along John's River Road between RM 4 and 6. The uplands throughout the drainage are in commercial timberland production.

Newskah Creek is the third largest drainage in the South Bay region. The diked estuary was breached as part of an off-site mitigation project for the construction of Stafford Creek Correctional Facility. Located in the lower watershed are rural residential development and a large rock quarry. All other land in the drainage is for commercial timber production.

The small independent drainages of O'Leary, Stafford, Indian, Chapin, Newskah, and Charlie Creeks are short basins that have minimal spawning habitat due to sedimentation from timber harvesting activities from the 1930s on. Rural residences lie along Highway 105, which crosses all of the Creeks, but the estuaries and floodplains are mostly undisturbed. The upland surrounding these creeks is exclusively commercial timberlands. The only other notable development along these Creeks was the Stafford Creek Correctional Facility completed in 1999.

Primary Subbasins: Elk and John's River

Secondary Subbasins: Alder, Charley, Newskah, Chapin, Campbell, Indian, Stafford, and O'Leary Creeks

Land Uses: Commercial timberlands, aquaculture, conservation areas, scattered rural residences, and correctional facility

Anadromous Fish Stocks: Fall Chinook, coho, chum, cutthroat, and winter steelhead

South Bay Tributaries Tier 1 Concerns

South Bay Tributaries Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ Fish passage is limited by barrier culverts	➡ South Bay watersheds (particularly John's and Elk River) have among the highest road densities in Chehalis Basin. Many stream crossings are impassible to salmonids at all life stages. Migration barriers are present in down-stream reaches preventing all upstream migration and promoting sediment retention; this is of concern for primary subbasins directly discharging into mainstem or estuary habitat.	➡ Correct barrier culverts. See Section 4 for guidelines.

South Bay Tributaries Tier 1	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ Significantly increased sediment delivery, especially fine sediments located upstream of blockages ➡ Highly embedded stream reaches ➡ Substrate consisting of smaller than average particle size	➡ Extensive timber harvests in the majority of the South Bay watersheds (headwaters to mouth). The Elk River Natural Resources Conservation Area (NRCA) protects the mid- and lower-reaches of the John's and Elk River watersheds; NRCA protection does not extend to secondary subbasins. ➡ Runoff from logging roads ➡ Removal of riparian corridor and loss of LWD inputs	➡ Reduce sediment loading by reducing road densities ➡ Revegetate streams/riverbanks for added erosion protection ➡ See LWD actions ➡ See Riparian actions ➡ Upgrade logging roads to comply with Forest and Fish Agreement (1999)

South Bay Tributaries Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ Most headwater reaches have riparian buffers that are relatively small, narrow, and homogenous in plant species composition. ➡ Riparian tree species composition is relatively homogenous in the mid and lower reaches. ➡ Increased presence of codgrass and spartina	➡ Riparian areas in headwater streams that are confined by steep hillsides have been most affected by timber harvest. ➡ Riparian areas in mid and lower reaches are comparatively well maintained and currently protected in Elk River NRCA. ➡ Elk and Johns River estuaries are among the most pristine estuaries on the west coast; preservation s a high priority. ➡ Introduced exotic species	➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Identify specific degraded riparian areas for restoration needs ➡ Protect (fee simple or easements) key properties of riparian habitat ➡ Remove invasive species

South Bay Tributaries Tier 2 Concerns

South Bay Tributaries Tier 2	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ LWD is highly variable throughout the South Bay tributaries.	➡ In headwater reaches, LWD is present at an elevated frequency due to increased blow down frequency in steep-sloped riparian areas. Elevated LWD frequency in headwater reaches also contributes to stream blockages associated with undersized or outdated culverts. ➡ In mid and lower reaches, LWD frequency is relatively reduced because of high road densities, stream blockages, and direct LWD removal. Reduced LWD frequency is of particular concern in the mid and lower reaches where LWD functions to collect spawning gravel, retain nutrients and promote channel formation.	➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity ➡ Install LWD pieces in conjunction with other restoration projects ➡ See riparian actions

South Bay Tributaries Tier 2	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ Floodplain connectivity limited in the upper reaches and reduced in lower reaches ➡ Channel incision and confined streams with minimized estuary connectivity	➡ High road density has created a number of channel blockages that limit floodplain interaction, especially in the upper reaches. Floodplain interaction is reduced in lower reaches because of downstream blockages. Downstream blockages modulate instream flow promoting sedimentation and changes in plant community composition in riparian habitat. Connectivity to estuary habitat has also been significantly impacted by instream blockages; thereby, limiting fish usage during estuary residence. ➡ Increased timber harvest has also increased peak flow discharge by increasing overland flow, decreasing floodplain interaction and decreasing channel complexity (e.g., LWD). Increased discharges have resulted in downstream channel incision and decreased off-channel habitat access.	➡ Correct barrier culverts. See Section 4 for guidelines. ➡ Enhance estuary connectivity ➡ Reconnect, enhance, and or restore potential off-channel, floodplain, and wetland habitat

South Bay Tributaries Tier 3 Concerns

South Bay Tributaries Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Increased peak flows and decreased water retention ➡ Conversion of pool habitat to run/glide habitat in headwater and mid-reaches; channel incision in downstream reaches ➡ Decreased water retention (via LWD removal) and channel incision has reduced floodplain interaction and access to over-wintering habitat.	➡ Increased vegetative removal in headwater streams, decreased presence of LWD in lower reaches, and decreased off-channel and floodplain connectivity	➡ See LWD actions ➡ See Riparian actions

South Bay Tributaries Tier 3	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Primary water quality concerns are associated with elevated sediment delivery ➡ Increased water temperatures ➡ Presence of carbaryl in estuarine areas	➡ Extensive timber harvest and run-off from roads. Most sediment delivery originates in headwater reaches from increased overland flow (associated with vegetative removal) and road erosion (associated with high densities of parallel-adjacent roads). ➡ Likely due to riparian timber harvest in headwater reaches ➡ Use of carbaryl (Sieven) by the oyster culture industry also may negatively impact salmonid productivity. Impacts of pesticide and nutrient application on fish productivity are unclear.	➡ Implement TMDL recommendations ➡ See Sediment actions

WYNOOCHEE MANAGEMENT UNIT

WYNOOCHEE RIVER

Description:

The Wynoochee River flows 63.5 miles from its headwaters in the Olympic Mountains to its confluence with the Chehalis River. The river has 68 tributaries totaling 173 miles, as well as an unknown number of smaller tributaries.

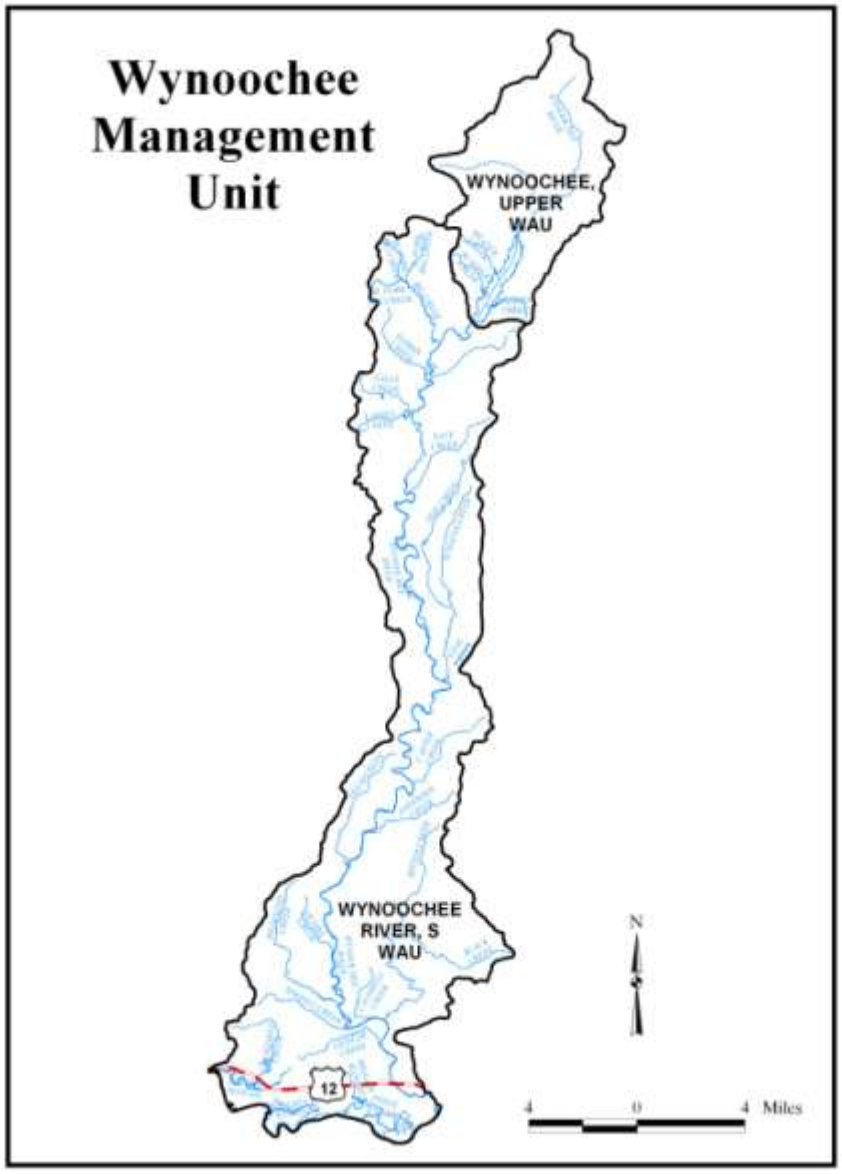
Starting with the lower 20 miles, the Wynoochee flows through a wide, flat farming area with stream widths varying from 25 to 50 yards. This section has good spawning gravel, low gradient, but a less than adequate riparian zone. The next 15 miles alternates between broad floodplains to narrow valleys with small farms. Here the stream gradient is low to moderate, approximately 60 yards wide, and with good spawning gravel. The riparian area has good streambank cover with a mix of timber. The surrounding terrain consists of low, forested hills.

Large timber companies and the USFS own large tracts from the middle to upper reaches of the Wynoochee. This area has extensive side channels with excellent spawning and rearing areas for all salmonids. However, some of these side channels are separated from the mainstem and are not accessible. Farther upstream, the river flows through steep valleys, canyons, and timberlands for six miles. The river in this section has good pool/riffle areas, most of which has spawning gravels. In the areas opposite Neil/Schafer Creek, the river has scoured to its bedrock, most likely due to the lack of gravel transport through the dam. To mitigate the impact of the Wynoochee Dam operated by Tacoma Power, gravel and LWD buildup at the dam is physically transported around this barrier and reintroduced downstream.

Major Tributaries: Schaefer Creek and Black Creek

Land Uses: Forestry, Agriculture, and Rural Residences

Anadromous Fish Stocks: Fall Chinook, coho, chum, cutthroat, winter steelhead, summer steelhead, and bull trout



Wynoochee River Tier 1 Concerns

Wynoochee River Tier 1	FISH PASSAGE	
Symptom	**Cause**	**General Actions**
➡ The Wynoochee has 225 barrier culverts and 55 of unknown passability ➡ Upstream and downstream fish passage impeded at Wynoochee Dam	➡ High road densities. Since the late 1990s, extensive timber harvest has been going on and the access roads have increased. Old roads have been reopened not using the new Forest and Fish rules, leaving barrier culverts. ➡ The Wynoochee Dam is at RM 47.8, which marks the uppermost extent of natural fish migration. From here, fish are trucked above Wynoochee Lake to spawn in the tributaries flowing into the lake ➡ Residualization in lake and mortality during downstream migration through dam facilities	➡ Correct barrier culverts. See Section 4. ➡ Habitat enhancement projects downstream from dam to mitigate losses ➡ Improve fish passage at fishways and add a fishway to those structures that do not have them

Wynoochee River Tier 1	RIPARIAN	
Symptom	**Cause**	**General Actions**
➡ Between RM 31 and 22, the forests have been intensely managed and riparian conditions are "fair" with narrow buffers of conifer remaining ➡ Below RM 22 all timberlands located within the floodplain are harvested and converted to agricultural land with the riparian being primarily narrow bands of alder mixed with Douglas fir and the rating is "poor."	➡ Timber harvest and agricultural practices. Logging and agricultural practices have reduced late seral vegetation cover over large areas of the watershed. ➡ Agricultural practices. Agricultural lands below RM 22 remain with narrow bands of mixed conifer/deciduous tree stands, so the lower reaches will remain with a "poor" for the foreseeable future. ➡ In the lower agricultural areas livestock access has been one of the problems in maintaining or improving adequate riparian buffers.	➡ Control invasive species. See Section 5. ➡ Identify specific degree at riparian areas for restoration ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ Protect by fee simple or easement key properties of riparian habitat ➡ Revegetate open riparian areas with native plants

Wynoochee River Tier 1	FLOODPLAIN	
Symptom	**Cause**	**General Actions**
➡ The floodplain connectivity from RM 22 to the mouth is "poor" because of shoreline armoring. ➡ Upstream from RM 22, the riverbed has incised and scoured to bedrock disconnecting the river from the floodplain ➡ Some off-channel spawning and rearing areas have been cut off from the main channel.	➡ Shoreline armoring and diking used to protect farmlands and residential development in the mid to lower mainstem river. ➡ The mainstem has accelerated gravel transport incising the river and causing severe bank erosion in many locations in the upper portion of the agricultural area. ➡ Dam operations may increase gravel transport and the lack of flooding from the dam operations has likely diminished off-channel habitat from historic levels. ➡ Timber harvest. Recent high peak flows are likely caused by accelerated timber harvesting in the watershed and lack of sufficient late seral vegetative cover to retain water. ➡ Floodplain mining. Past floodplain mining is likely a partial cause of the riverbed scouring. ➡ Severe flooding in 1996-97. ➡ Gravel scouring from high peak flows due to land use (farming and logging)	➡ Assess floodplain conditions and identify impacts ➡ Conduct a study similar to upper Wishkah study to determine sediment loading and reduction ➡ Gravel enhancement; when removing gravel build up from the fish trap and dam and depositing it downstream, additional gravel should be added to decrease scouring and incision areas downstream ➡ Reconnect, enhance, and/or restore potential off-channel, floodplain, and wetland habitat ➡ Reduce the amount of allowable clearcuts at one time to allow for regeneration to catch up to logging ➡ Reduce the percentage of area harvested to allow regeneration to maintain a higher percentage of late seral timber at any given time to allow the watershed to retain more water ➡ Remove hard armoring (rip rap) or implement bioengineering techniques in place of hard armoring ➡ Upgrade logging roads to comply with Forest and Fish Agreement (1999)

Wynoochee River Tier 2 Concerns

Wynoochee River Tier 2	WATER QUALITY	
Symptom	**Cause**	**General Actions**
➡ Regular temperature exceedances above 16 degrees C. resulted in a 303(d) List, 1996 & 1998. Because of the warm temperatures the Wynoochee is rated "poor" water quality. ➡ The Wynoochee River is the second largest contributor of sediment to the Chehalis system. Water quality during major rain events is likely extremely poor.	➡ Increased temperatures, dam operations, livestock access, and timber harvest. This is probably caused by warmer weather combined with dam operations, logging vast quantities of the watershed, reducing vegetative cover and shading ➡ Sediment transporting to the river from roads, and sediment deposits blocking stream flow through clean gravels that can have a cooling effect.	➡ Abandon roads on steep geologically sensitive areas ➡ Conduct a detailed study to determine the causes of temperature increases ➡ Conduct a study similar to the Upper Wishkah study to determine sediment loading and reduction ➡ Erosion control treatments along forest roads to reduce mass wasting, i.e., revegetation, bioengineering, willow cuttings ➡ Install riparian fencing to exclude or reduce livestock access ➡ Reduce sediment loading by reducing road densities (abandon/decommission) ➡ Reduce the percentage of area harvest to allow regeneration to maintain a higher percentage of late seral timber at any given time to allow the watershed to retain more water ➡ Revegetate riverbanks for added protection from erosion ➡ Temperatures, DOs, pH, and turbidity should be monitored regularly ➡ Upgrade logging roads to comply with Forest and Fish Agreement (1999) ➡ Wider riparian areas on agricultural lands with conifers dominating the tree species

Wynoochee River Tier 2	SEDIMENT	
Symptom	**Cause**	**General Actions**
➡ The Wynoochee contributes 30.6% to the sediment loading and the Chehalis River. ➡ In the lower 45 miles, including tributaries, the rating is poor because I'll high quantities of fine sentiment ➡ Juvenile salmonids experience excessive predation ➡ Subbasin is naturally prone to landslides ➡ Mass wasting and debris torrents at road crossings ➡ Sediment has embedded in spawning gravels and dominates the river channel in the slower flowing areas in the lower basin	➡ 1960's sediment loading study data: • 42% -- timber management / roads • 31% -- agriculture • 27% -- natural causes ➡ Agricultural practices and livestock access. The main causes of sediment delivering to the streams are sidecast roads failing and blocked or undersize culverts creating saturated fill slopes. ➡ High road densities. Road densities throughout the watershed are considered poor, (less than 3 miles per square mile), except for the upper Wynoochee which is rated fair. ➡ Mass wasting from land use practices ➡ Sport fishermen. Jet sleds traveling up and down the river at high speeds have caused sediment disturbances along the shorelines where juvenile salmon travel, causing them to move to deeper waters where they are vulnerable to predation by larger fish. ➡ The subbasin is a geologically sensitive area prone to mass wasting because of steep slopes and shallow soils ➡ Timber harvest, high road densities and agricultural practices. Farming and earlier logging practices in the middle reaches of the river have eliminated riparian areas, causing reduced LWD recruitment, accelerated flows, reduced gravel retention, stream incision, and eroded unstable banks.	➡ Abandon roads on steep geologically sensitive areas ➡ Conduct a study similar to Upper Wishkah study to determine sediment loading and reduction ➡ Correct cross drains that may trigger mass wasting on geologically sensitive slopes ➡ Determine if sedimentation is a problem ➡ Erosion control treatments along forest roads to reduce mass wasting, i.e., revegetation, bioengineering, willow cuttings ➡ Identify sources that are contributing to sediment loading ➡ Install riparian fencing to exclude or reduce livestock access ➡ Institute a rouge and control treatments along forest roads to reduce mass wasting; i.e., re-vegetation, bioengineering, and willow cuttings ➡ Reduce sediment loading by reducing road densities (abandon/decommission) ➡ Reduce the horse power and speed of powerboats to reduce disturbance of bank and displacement of juveniles ➡ Reduce the percentage of area harvested to allow regeneration to maintain a higher percentage of late seral timber at any given time to allow the watershed to retain more water ➡ Revegetate riverbanks for added protection from erosion ➡ Upgrade logging roads to comply with Forest and Fish Agreement (1999)

Wynoochee River Tier 3 Concerns

Wynoochee River Tier 3	LARGE WOODY DEBRIS (LWD)	
Symptom	**Cause**	**General Actions**
➡ LWD within the mainstem river is poor, adding to accelerated substrate transport, channel incision, lack of channel complexity, and gravel retention. ➡ The agricultural areas below RM 22 have a poor ratio of conifer to hardwood, the riparian is narrow or non-existent, LWD recruitment potential in the lower basin is "poor".	➡ The areas below the dam have been intensely managed for forestlands and the buffers are narrow reducing LWD recruitment potential. ➡ Timber harvest. The reach below the dam is heavily managed for harvest. ➡ Agricultural practices. Reaches below RM 22 have been converted to agriculture and the riparian and LWD recruitment is limited because of the predominance of hardwoods.	➡ Dam operations. ➡ Develop LWD supplementation plan that will install logjams in key places to improve instream channel structure and habitat diversity ➡ Install riparian fencing to exclude or reduce livestock access ➡ Interplant conifers in deciduous dominant areas where appropriate ➡ LWD, primarily conifer and only those pieces that float into the dam area is removed from the dam and placed on a gravel bar below the fish trapping facilities. ➡ Revegetate open riparian areas with native plants ➡ The LWD removed from the dam does not constitute the amount of LWD transporting downstream if the dam were not there, so there is a net loss of LWD recruitment from this area. Even though LWD is removed from the dam area and placed below the dam, the natural recruitment has been diminished because much of the LWD above the dam does not float into an area where it can be recovered

Wynoochee River Tier 3	WATER QUANTITY	
Symptom	**Cause**	**General Actions**
➡ Local residents report that river levels are higher and have more fluctuation. The flow graph for the winter months of December, January, February and March from 1994 to 1999 supports this belief. ➡ Low flows during the spring months can impact the juvenile salmon out-migration. ➡ Overall water quantity conditions are rated "poor" for the Wynoochee subbasin.	➡ Dam operations. Before dam construction in 1972, the river ranged from 3 CFS in August of 1967 to 24,599 CFS in the winter of 1968. This radical difference is now controlled with the dam to maintain flows of 140 CFS from April to June and 190 CFS for the remainder of the year. It is noteworthy that the dam has aided summer low flows, but other activities might be impacting low flow conditions. ➡ Timber management practices have reduced forested land cover, increasing the rate of water run-off into streams, and lowering the water table in summer. Extensive timber harvest below the Forest Service lands after a "poor" rating was determined. The condition of the watershed has continued to decline with extensive harvest practices. ➡ The low quantity conditions are due to altered land cover in the upper Wynoochee coupled with flows that dip below established base flows in summer months. ➡ The lack of late seral forest stages range from 58% above the dam to 45% in the lower Wynoochee, resulting in poor water retention.	➡ Adjust dam flows to better accommodate fish ➡ Conduct a study to collect additional data on the watershed canopy cover, dam operations and flow regimes (Smith/Wenger report). ➡ Reduce the percentage of area harvested to allow regeneration to maintain a higher percentage of late seral timber at any given time to allow the watershed to retain more water

Section 4:
Guidelines for Barrier Projects

The Habitat Work Group has adopted a series of guidelines to assist potential project sponsors as they develop barrier projects within the Lead Entity, regardless of the anticipated funding source. These same guidelines will also help evaluate projects brought before the Habitat Work Group for their consideration.

It is important to note that no single project guideline is more important than another. When designing or comparing projects, the merits of a barrier project should reflect how well it satisfies the guidelines in total.

Culvert Ranking

The Grays Harbor County Lead Entity developed its own process for ranking potential barrier projects within WRIAs 22 and 23. The process relies on criteria consisting of the number of species present, the percent passability of the culvert, and available upstream habitat. Applying the criteria to surveyed culverts resulted in a prioritized list that the Lead Entity maintains on a spreadsheet. Those culverts falling within the upper third rank as "high priority" barrier removal projects.

Focus on Subbasin as a Whole

Barrier projects need to focus on the subbasin as a whole, not just the immediate vicinity of the project. This includes evaluating what is happening upstream and downstream of the proposed corrected barrier. Factors such as land use, road densities, and ownership patterns are critical to understanding how the barrier fits within overall future of the subbasin.

Consider Appropriate Sequencing

The process of rehabilitating a stream by removing a barrier needs to happen in a logical, sequential pattern. Project developers and evaluators need to consider

- The type of culverts upstream of proposed project and their potential for replacement
- The quality of upstream substrate
- The quality of the existing riparian corridor
- Existing and future sediment controls
- The stream gradient of accessible habitat made available by the project

Develop Cost Analysis

Given the limited availability of funding and the number of badly needed barrier projects, the cost of a barrier project is a key consideration regarding its feasibility. Questions to ask are:

- What is the cost of the barrier correction relative to the return of salmonids?
- Does the newly accessible habitat have the potential to be productive?
- How much match is the project sponsor making available?
- What are the social and economic values associated with the project?
- What does Ecosystem Valuation (as becomes available) reveal about the project?

Coordination with Other Projects

Barrier correction projects need to be coordinated with other stream restoration efforts to maximize its benefit. Projects that tie to other efforts, or correct the last barrier on a stream, carry higher favor.

Understand Stream Dynamics

Stream dynamics are an important element to take into account when correcting a barrier. Without functional stream dynamics, newly opened stream miles may provide little long-term habitat for salmonids. Ask questions regarding

- The overall health of the newly available habitat
- The stability of the system itself
- Whether there are naturally occurring systems that contribute to the health of the system (i.e., wood recruitment, aggradation)

Determine Upstream & Downstream Barriers

The status of upstream and downstream barriers to the project is a key consideration, especially if there is strong potential that other parties will correct barriers as well. Refer to FFFTP maps or Road Maintenance and Abandonment Plans. In addition, projects also should note the presence of natural barriers.

Landowner Willingness

Landowner willingness is a requirement of the SRFB and other funding programs. Good projects demonstrate landowner cooperation and contributions.

Fish Use, Priority Stocks, Abundance

Barrier correction projects need to identify those salmonids that potentially will access upstream habitat. Projects that benefit priority stocks receive higher favor. Documentation of fish use is critical. Projects should also be capable of assessing upstream habitat to estimate increased opportunities for improving abundance.

Habitat Quality

Good barrier correction projects are able to demonstrate their capacity to make quality upstream habitat available to salmonids.

Projects should indicate their Fish Passage Priority Index (PI). This measure takes into account the habitat gain, the mobility, and health status of the fish stocks that would benefit from increased access to the habitat. It also considers the projected cost of the project. Projects should also consider other habitat issues, such as

- Water quality and quantity
- The long-term use of land both upstream and downstream of the correction project
- The capacity of local regulatory tools, such as critical area ordinances, to provide long-term protection of habitat
- How salmonids will use the upstream habitat during their life-stages
- The overall benefit to natural resources, including improved stream dynamics

RESOURCES & LINKS	
Grays Harbor County Lead Entity	Basin Wide Culvert Assessments WRIA 22&23 Ranking and Coordinates.xls (available upon request) Chehalis Basin – Fish Passage Barrier Ranking (available upon request) Chehalis Resurvey Culvert Assessment WRIA 23 (Report), Lewis County Conservation District Upper Chehalis Watershed Culvert Assessment WRIA 23 (Report), Lewis County Conservation District Chehalis Resurvey Culvert Assessment (Map)
Washington State Department of Transportation Contact: Tom Burns, WADOT, (360) 902-2558 burnstjb@dfw.wa.gov	Fish Passage
Department of Fish and Wildlife Contact: Curt Holt, WDFW, 360-753-2600 ext. 212, curt.holt@dfw.wa.gov	Fish Passage Technical Assistance, Salmonid Stock Inventory
Department of Natural Resources	Family Forest Fish Passage Program Road Maintenance & Abandonment Plans

Section 5:
Invasive Species Project Guidelines

The Grays Harbor County Lead Entity encourages projects that control invasive plant and animal species. However, it is important for project sponsors to design their projects to be strategic, non-fragmented, and use effective and complementary control and riparian restoration approaches. Furthermore, projects should include acceptable methods and techniques, avoidance of short-term band-aid fixes in favor of strategic control combined with riparian restoration and maintenance elements. [1]

To ensure implementation of this strategic approach, the Strategy requires projects to reflect existing plans as well as Strategy Management Actions that address invasive species.

Integrated Aquatic Plant Plan for the Chehalis River Basin

The overall guiding document for invasive plant species is the "*Integrated Aquatic Plant Plan for the Chehalis River Basin*." 2 This document lays out a strategy for invasive plant species by identifying high priority areas for control and instituting measures that prevent economic and ecological impacts.

Plan Management Goals

The management goals of the plan are:

- Preserve and restore remnant riparian communities, wetlands, estuarine and freshwater aquatic systems throughout the full length of the Chehalis River, its tributaries and associated floodplain. This includes: preserving the entire riparian community with a focus on plant species composition; protecting riparian forest areas including the Chehalis River Surge Plain; preserving and restoring natural river and tidal slough hydrology; and alleviating bank instability problems.
- Special attention will also be given to protecting and enhancing habitat essential to rare or endangered species that occur in this

[1] See SRFB 2009 Review Panel Ratings

[2] Integrated Aquatic Plant Management Plan for the Chehalis River Basin, Bridget Simon WSDA, Marty Peoples, WDFW, 15 pgs, December 16, 2006

community. These species include the Olympic mudminnow, native char and salmon stocks indigenous to this watershed.

- Preserve and restore the permanent and seasonal wetlands that support resident and migratory waterfowl, fish, amphibians, and other invertebrates. Restore native plant communities that provide food and shelter for animals within these wetlands.
- Preserve recreational opportunities associated with these waters including fishing, hunting, boating, swimming and wildlife viewing activities.
- Bring together various private and public landowners, private conservation groups and public agencies as a cooperating body in seeking aquatic weed control in the Chehalis River Basin.
- Help develop compatible economic uses of land and serve as a public education resource that provides people opportunities to experience and further understand the region's diverse landscapes and biology.

Plan Action Items

To implement these goals, the plan identifies the following actions for controlling invasive species within the basin:

- Control – Fortunately, several control methods are authorized and are currently in use for all weed species listed. These methods include chemical, mechanical, biological and cultural. Some control methods require lengthy periods for permit application and approval. Part of a long-term control plan includes the containment of widespread weeds to protect native habitat from further degradation.
- Survey and evaluation – Periodic and complete surveys of the Chehalis River system are needed to document the current level of infestation and evaluate control efficacy. This includes the mainstream Chehalis and lower reaches of the major tributaries, including the Hoquiam, Wishkah, Wynoochee, Satsop, Cloquallum, Black, Skookumchuck, Newuakum and South Fork Chehalis Rivers. Some portions of minor tributaries would also be surveyed, including Lincoln, Scatter and Elk Creeks.
- Surveys will be conducted as funding is available. Maps will be updated as surveys are completed. Prioritization – The Chehalis River Working Group recognizes the importance of a process to prioritize weed control projects throughout the watershed. Data compiled

from surveys will be used to help prioritize current and new projects, and it will be used to guide long-term control work.

- Land ownership – There are a wide and diverse range of property owners (and jurisdictions) throughout the Chehalis River System. It is a continuing process to identify and update the landowners. The 2005 Knotweed Control Project by TNC showed the challenges and the successes of a control project in an area with different ownership distributions and infestation levels. County noxious weed programs work to notify landowners about weed infestations on their lands, and project teams contact landowners require control and provide advice in how to or if funding is provided to gain consent to control infestations, or to make other arrangements. All data will be downloaded into the GIS database and shared by the cooperators.
- Education and outreach – Many of the control projects in place (e.g. TNC knotweed project and the Brazilian elodea project) already notify landowners and the public about what they are doing in the Chehalis, and why. Survey crews and work crews are often the first point of contact with the public. The Nature Conservancy field crews use educational material and fliers that attach to doorknobs for property owners or interested citizens.
- Local newspapers, newsletters, and resource groups are used to spread information about current projects. In addition, County Noxious Weed Control Programs have extensive educational outreach programs for the species in this plan. The media often pick up strategic news releases about weed removal projects and articles are then featured in the newspapers and television. An example is the excellent news story about Thurston County's project on the removal of Brazilian elodea that featured a large color photograph and prominent coverage.
- Future plans for education and outreach include the initiation of a project to develop a newsletter for landowners and other interested parties. Public awareness and education will continue with an official development of a weed prevention program, targeting landowners and those that use these waters. Signs will be made and posted at access points to inform users of potential impacts and hazards to the Chehalis River from aquatic weed species. Education and outreach will work to educate people to recognize weed species and discourage those practices that spread aquatic weeds.
- An effective education program can generate a volunteer base for specific weed projects. These projects will be identified for

volunteers when and where practical. They will be given adequate instruction and tools to complete projects. Depending on the how weed is listed in a specific county, landowners may be required to control it on their property. It is hoped that the working group will be able to offer technical assistance to these landowners for weeds listed in the plan.

- Funding – The ability to implement on-the-ground projects in the Chehalis Basin is directly tied to the availability of funding. The Chehalis River IAVMP identifies specific weed threats to the Basin, outlines approved methods for control and includes a record of past and on-going projects in the Chehalis River Basin, as well as provides information on the flora, fauna and habitat. The plan can be used by landowners and land managers as a tool to help apply for funding and by the granting organizations to verify their funding is being used productively and as part of a integrated effort.
- In an area as large as the Chehalis River Basin, the funding for surveys and weed control projects often limit the scale of the project to just a portion of the area. However, the data, maps, and information generated from these control projects will be used to update the overall plan. This continual input of new information will benefit landowners and land managers by making them more competitive and successful in their application for grants for invasive species control projects. It is also hoped that by formalizing this plan it will be utilized and integrated by other local and regional organizations into their grant projects and management activities. As more small and medium-sized projects are funded and implemented we hope to see a cumulative improvement in weed control in the Chehalis Basin.

Strategy Management Actions

An ad hoc invasive species committee for the Lead Entity inventoried the presence of invasive species in subbasin channels and riparian areas. This information follows in the table below.

Flora Species of Concern	Black	Boistfort	Cloquallum	Hoquiam-Wishkah	Humptulips	Lincoln	Newaukum	Satsop	Skookumchuck	South Harbor	Wynoochee	Estuary & Surge Plain	Chehalis Mainstem
Brazilian elodea				X	X								X
Bohemian knotweed				X				X					X
Giant knotweed				X				X					X
Himalayan knotweed				X									X
Japanese knotweed				X									X
Knotweed	X	X	X	X	X	X	X	X	X	X	X	X	X
English Ivy				X									X
Parrot Feather				X	X								X
Phragmites				X									X
Purple Loosestrife	X			X	X								X
Spartina													X
Yellow Flag Iris													X

The committee then examined how invasive species generally altered natural processes in a subbasin and their impacts to salmonids. This allowed the group to identify a series of standardized management actions that control or eliminate invasive plant species.

Chehalis Basin Watershed Invasive Plant Species Basin-Wide Concerns

Known Limiting Factor

- Invasive riparian plant species replace natural vegetation, affecting overall water quality by raising temperatures, lowering dissolved oxygen, and altering natural pH. Invasive species fail to stabilize banks, encouraging erosion that leads to excessive sedimentation.
- Invasive aquatic plant species choke out slow moving sections of streams, wetlands, and sloughs. In-water infestations can trap natural or excessive sediment supply and change flow characteristics that can lead to flooding.
- Major infestations of invasive species can radically alter the ecosystem, rendering it an incompatible habitat for native animal species.

Effects on Salmonids

- Decreased oxygen levels and higher temperatures create significant stress for salmonids that can lead to increased mortality, limiting their abundance and productivity.
- Aquatic infestations affect juveniles by reducing spatial structure in slower sections, sloughs, and wetlands. This results in a loss of refugia[3] and areas for rearing and feeding. Dense aquatic vegetation can lead to decreased fish size that can affect long-term productivity.
- Ecosystem changes favoring other nonnative fish species can lead to significant predation and competition for food resulting in loss of diversity, abundance, and productivity.

Actions

- Control invasive species with chemical, mechanical, biological, and cultural methods. Focus on preventing propagule[4] production areas.
- Reestablish riparian areas in areas impacted by invasive species. Encourage projects like "living flood fences" along riparian areas.
- Establish education and outreach program with partners, such as the Farm Bureau, Cooperative Extension, NRCS, Conservation District, counties, cities, and tribes.
- Place education signs at boat launches and other public areas adjacent to waterways. Include information about potential nonnative invasive infestations.
- Conduct frequent surveys to identify new infestations.
- Emphasize eradication programs on any public lands, including highway right-of-ways near waterways.
- Get landowner buy-in before starting a project.
- Encourage all restoration and acquisition projects to incorporate an invasive plant species component

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[3] An area of relatively unaltered climate that is inhabited by plants and animals during a period of continental climatic change (as a glaciation) and remains as a center of relict forms from which a new dispersion and speciation may take place after climatic readjustment.
[4] A propagule is any plant material used for the purpose of plant propagation. In asexual reproduction, a propagule may be a woody, semi-hardwood, or softwood cutting, leaf section, or any number of other plant parts. In sexual reproduction, a propagule is a seed or spore. In micropropagation, a type of asexual reproduction, any part of the plant may be used, though it is usually a highly meristematic part such as root and stem ends or buds.

- Work with state and county road maintenance crews to eradicate invasive plant species along roadways and drainage ditches

Washington State Aquatic Nuisance Species Management Plan

The Washington Department of Fish and Wildlife prepared the strategy "*Washington State Aquatic Nuisance Species Management Plan*" in 2001 that addresses both nonindigenous plant and animal species in Washington waters. This plan's goal for aquatic nuisance species (ANS) is to:

"…fully implement a coordinated strategy designed to minimize the risk of further ANS introductions into Washington waters through all known pathways; and where practical, stop the spread of ANS already present; and eradicate or control ANS to a minimal level of impact."

The plan intends to implement the goal through a series of objectives, strategic actions, and tasks. While the plan does not identify any species or actions specific to the Chehalis Basin, the plan does provide both guidance and information about ANS, especially those relating to fauna.

Strategy Management Actions

The ad hoc committee, in consultation with WDFW staff, identified those invasive animal species[5] known or suspected to be present in WRIA 22-23.

ANIMAL SPECIES OF CONCERN IN THE CHEHALIS BASIN	
Invasive Aquatic Mammals	Nutria
Nonnative Mollusks	Japanese Oyster, Japanese Oyster Drill, Corbicula, possibly other non-native saltwater clams
Threat of Nonnative Mollusks	New Zealand Mudsnails, Zebra Mussels, Quagga mussels, Asian clam (introduced)
Invasive Crustaceans	European Green Crab
Threat of Invasive Crustaceans	Nonnative freshwater crayfish
Invasive and introduced fish	Atlantic Salmon, Rock Bass, Largemouth & Smallmouth Bass, Sunfish, and Bullhead Catfish
Threat of Invasive Fish	Yellow Perch, White Perch, Black Crappie
Invasiva Chordata	Club Tunicate, Transparent Ciona Tunicate, Invasive Didemnum

[5] Jesse M. Schultz, WDFW; Molly Hallock, WDFW

As with invasive plant species, the committee followed a similar path of evaluating how invasive animal species alter natural processes in a subbasin, charting the subsequent impacts to salmonids, and outlining a series of standardized management actions.

CHEHALIS BASIN WATERSHED INVASIVE ANIMAL SPECIES BASIN-WIDE CONCERNS

Species and Known Limiting Factors[6]

- Fish species such as bass and Atlantic salmon prey on smaller fish, invertebrates.
- Disruption of food chain & nutrient cycling
- Non-native mollusks can dramatically alter plant ecology of ecosystems by consuming native vegetations and outcompeting native macroinvertebrates
- Rapid reproduction and lack of competition or predation from native species allows them to form dense mats on hard structures, instigating large-scale environmental change.
- Filter copious amounts of water while filter-feeding, causing bottom-up food-web affects that can alter plankton blooms, benthic community composition, biodiversity and fish populations
- Burrowing by nutria causes significant erosion damage to streambanks which can increase sedimentation and alter habitat & hydrology.

Effects on Salmonids[7]

- Non-native species that compete with or prey on native organisms and plant species alter habitat and ecosystem functions that support salmon, reducing spatial structure

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[6] *On the Lookout for Aquatic Invaders*, Identification Guide for the Pacific Northwest, SeaGrant, Oregon, 71 pgs.

[7] Sanderson, BL, KA Barnas, M Rub. 2009. Non-indigenous species of the Pacific Northwest: an overlooked risk to endangered salmon? BioScience 59: 245-256

- Non-native species can consume large numbers of juvenile salmonids, affecting both abundance, diversity, and in the long-term productivity

Actions

- Place education signs at boat launches and other public areas adjacent to waterways. Include information about potential nonnative invasive infestations.
- Eradication or control of non-native animal species.

LINKS & RESOURCES	
USGS	Spread, Impact, and Control of Purple Loosestrife (Lythrum salicaria) in North American Wetlands
USDA	National Invasive Species Information Center
Grays Harbor County	Noxious Weed Control Board
King County	Learn about Noxious Weeds
PSP	Aquatic Nuisance Species
SeaGrant	Preventing the Spread of Aquatic Invasive Species and Reducing Impacts
Thurston County	Thurston County Noxious Weeds Website
TNC	Protecting Native Plants and Animals
Washington State	Department of Agriculture Noxious Weed Control Board Recreation and Conservation Office
Department of Fish & Wildlife	Aquatic Nuisance Species
DNR	Noxious Weeds – Invasive Species Program
Department of Ecology	Aquatic Plant Identification Manual for Washington's Freshwater Plants Non-native, Invasive, Freshwater Plants Spartina Green Crab

Section 6:
Guidelines for Small Tributaries

The scale of the Chehalis Basin makes inventorying and analyzing habitat conditions in every tributary difficult, if not impossible given current resources. While there are a large number of tributaries in the basin that invite the potential for excellent restoration or protection projects, many of them are not assessed in the subbasin profiles.

The omission of these tributaries from the Work Plan should not detract from their importance as potential restoration or protection targets. Instead, the Work Plan offers separate general guidelines for evaluating projects within these tributaries and their importance to salmonids.

Guidelines for Evaluating Projects not assessed in Subbasin Profiles

A project associated with a tributary not assessed in a subbasin profile will be considered a Tier 1 restoration or protection action whenever it addresses one or more of the following situations:

1. The project improves or protects habitat used by salmonids.

2. The project will reduce high sedimentation that contributes to excessive downstream aggradation or alters substrate composition in a subbasin beset by Tier 1 sedimentation problems.

3. The project addresses fish passage conditions that rank as a "high priority" under the Fish Passage Barrier Ranking. A fish passage project that has not yet been assessed may rank as a "high priority" project if the following parameters place it within the top one-third of all assessed barriers:
    - The number of species that utilize upstream habitat,
    - The amount of habitat upstream of the barrier, and
    - The severity of the barrier (percent passable)

4. The project restores riparian conditions that contribute to poor downstream conditions ranked as a Tier 1 restoration action in a subbasin profile. Downstream conditions of particular note include poor LWD, water quality, and/or water quantity.

5. The project protects intact riparian habitat under threat of development.

6. The project restores floodplain connectivity beneficial to salmonids or improves water quantity to a subbasin with Tier 1 water quantity issues.

7. The project protects connected floodplains or water quantity beneficial to salmonids in a subbasin with Tier 1 water quantity issues.

8. The project addresses LWD deficiencies by improving existing instream channel complexity beneficial to salmonids.

The project contributes to the restoration or protection of water quality conditions of a subbasin.

Section 7:
Other Lead Entity Management Actions

This Strategy recognizes that salmon habitat projects and activities that address limiting factors are only one-half of the total solution for bringing about successful wild salmon habitat recovery in WRIAs 22 and 23. The other half involves implementing a wide range of other projects and activities that focus on managing the salmon habitat recovery process. In both the short- and long-term, resolving complex social, political, and organizational problems is just as important as "in the field" projects that address limiting factors. In fact, salmon habitat projects and activities may never achieve their full potential if many of these "process problems" remain unresolved. That is why this Strategy ranks the strategies in this section for developing projects and activities as being no less important to WRIAs 22 and 23 than those previously discussed in Section Two.

Some of the strategies for managing the salmon habitat recovery process are broad in concept while others are very specific in scope. Most projects intended to develop from these strategies are outside of the scope of eligibility for SRFB funding. However, this Strategy encourages project planners to consider including elements of these strategies in any projects and activities developed from the strategies in Section Two.

❖ Adopt strategies for the salmon habitat recovery process that can adapt to change

RCW 90.82.100, Habitat Component, states, "Where habitat restoration activities are being developed under chapter 246, Laws of 1988, such activities shall be relied on as the primary non-regulatory habitat component for fish habitat under this chapter.

The Chehalis Basin Salmonid Habitat Restoration and Preservation Strategy represents a long-term commitment to salmon habitat recovery in WRIAs 22 and 23. However, it is important to recognize that the Strategy functions within an extremely fluid environment. It is reasonable *to expect that federal and state environmental policy will shift over time* and that ongoing technical assessments and monitoring will reveal new dimensions that will change our knowledge base regarding salmon recovery. For the Strategy to be successful in this kind of environment, it must be capable of quickly adapting to change. Frequent review and maintenance of the Strategy is a necessity.

In the near future, the Strategy must integrate into the basin-wide watershed management plan as the habitat component. Moving in this

comprehensive direction will force the existing regulatory and future policy framework to align itself more effectively with salmonid habitat restoration and protection efforts. This outcome must be a driving force for watershed planning under Chapter 90.82 RCW.

❖ Introduce a successful public outreach program about salmon recovery and stream processes

Citizens play one of the most important roles in salmon habitat recovery. They are sometimes landowners, taxpayers, project contributors, or a combination of all three. People will stand behind and support the salmon recovery process if they understand the needs of wild salmonids, why these fish are important to everyone, and what we all need to do to save them.

The strategy for winning people over to salmon recovery is by sharing knowledge through active and persistent educational outreach programs. Efforts like *Stream Team* are effective methods for ensuring community support for salmon recovery in general and wild salmon in particular. More resources and effort is needed to expand and maintain such programs throughout the basin.

Public agencies and project sponsors have a long way to go before they earn the trust of private landowners. Outreach programs need to target landowners in a way that make them feel comfortable about public involvement on their lands. Incentives for involvement will help, but more importantly, agencies and sponsors need to connect personally with landowners – familiarity builds trust.

Salmon recovery is not cheap and the job is beyond the current resources of natural resource agencies and local government. Salmon recovery needs the help of active citizens from a broad section of our communities. The Lead Entity wants to create programs that enlist citizens to become physically involved in designing, implementing, and monitoring salmon habitat projects and activities.

❖ Create a simplified and useable project implementation process

It is an unfortunate reality that the present system for designing, funding, implementing, and monitoring salmon habitat projects and activities is

unwieldy and complex. The same is true for some environmental permitting.

In order to get landowners, citizens, and different government agencies working together at the project and permitting table, the overall process needs simplification on all levels of government. Landowners will become more willing to sponsor salmon habitat projects and activities on their properties if there was a system accessible to them that would facilitate project development and funding in a timely and trustworthy fashion.

There is need to create a more responsive permitting system that aids project proponents rather than intimidates them. Some landowners cause damage to critical salmonid habitat through a lack of knowledge when they by-pass what they perceives to be a long and complex permitting process. It would help if there were technical project facilitators more widely available to provide landowners technical assistance on best management practices as early in the project development phase.

❖ Create an interactive data management system

Ecosystem Diagnosis and Treatment (EDT): is a method that uses a "rule-based" system that focuses on habitat as the unit of analysis, and estimates salmon performance by using an analytical model that predicts the numbers of fish supported by the habitat over the salmon's life history. It is an "expert system" that captures the state of existing knowledge including areas of incomplete or missing data.

The complexity of juggling a large knowledge base about salmon habitat recovery in an area as big as the Chehalis Basin is a daunting task. This is why such tools as geographic information systems (GIS), the GeoData Viewer, and Ecosystem Diagnosis and Treatment (EDT) offer significant data management benefits for WRIAs 22 and 23. The availability of such a system would provide greater understanding about which technical data gaps within the WRIAs are most important to fill as well as the planning, implementing, and monitoring of projects and activities.

It is important for an interactive data management system to be something more than just a resource tool for technical experts. It needs to be accessible to all citizens by being user friendly, comprehensive, and available in one easy to find location, such as the World Wide Web and public libraries. In this way, an interactive data management system can be an important public outreach asset as well.

The Lead Entity has identified and prioritized four levels of Systematic Action Steps for Managing the Salmon Habitat Recovery Process. These are critical projects or processes for the Lead Entity that will support and strengthen salmon habitat projects and activities. Many of these

Systematic Action Steps rests on the successful implementation of preceding ones.

❖ Create an organizational entity for natural resources program coordination

The ability of the Strategy to weather change and eventually take on more diverse, phased salmon habitat projects and activities depends on creating a permanent organization capable of securing permanent funding resources. The Lead Entity will create a formal organization capable of planning, coordinating, and implementing federal, state, and local habitat restoration efforts within WRIAs 22 and 23.

This is a direction to push towards locally, along with garnering strong support from the state and federal governments.

❖ Secure dedicated funding for natural resource programs

The long-term success of doing habitat restoration and preservation work depends on the availability of permanent and dedicated funding sources. The Lead Entity will investigate opportunities for taxing or bond initiatives at the county level or tax relief for landowners allowing salmon habitat projects and activities on their property.

❖ Integrate the classic extension model within natural resources stewardship

The historic success of agricultural extension programs within the American farming community is a transferable model to natural resources stewardship. In a natural resources stewardship extension model, agents would provide scientific knowledge and expertise to the public through non-resident educational programs. Such programs could build the trust levels of private landowners, encouraging them to apply established and innovative methods to their lands that benefit the overall management of natural resources.

❖ Lobby for resources and support

The likelihood of instituting salmon habitat projects and activities and changing how we manage the salmon recovery process will depend on local, state, and federal legislative support. The Lead Entity needs to

develop the political savvy and muscle to convince legislators to fund projects and pass the needed legislative reform to ensure the long-term preservation and restoration of salmon habitat projects and activities.

❖ Exchange information about the importance of natural resource management

The Lead Entity needs to adopt a program that gets the word out about natural resource successes and partnerships within WRIAs 22 and 23 to encourage greater local citizen and landowner involvement. Possible methods to accomplish this include regular briefings for elected officials and better utilization of radio, television, and newspaper to reach the public. Establishing a formal community education program for people of all ages is vital for helping people understand how they impact the environment and how they can play a role in restoration and preservation efforts.

❖ Market the importance of WRIAs 22 and 23 to natural resources in Washington

The Chehalis Basin needs to communicate to citizens and legislators statewide that the quality and size of this watershed mandates greater public and private investment for its natural resources management. Compared to many watersheds in this state, the Chehalis Basin remains relatively productive and intact. The importance of this basin to the statewide vision for salmon recovery needs greater emphasis.

❖ Develop a monitoring strategy

Monitoring the success or failure of salmon habitat projects and activities is a requirement of Chapter 77.85 RCW. However, the many monitoring approaches, as well as their varying degrees of cost, has resulted in inconsistent monitoring guidance at the local and state levels that has confused technical experts and citizens alike. The Lead Entity needs to initiate a study that examines the breadth of monitoring methods and selects a unified monitoring model with minimum standards that is most appropriate for our local resources and expertise. This will help local citizens and technical experts, as well as funding agencies, evaluate the short- and long-term efficacy of salmon habitat recovery.

❖ Provide guidance for future Salmon Habitat Field Projects and Activities

Until citizens and project sponsors acquire enough experience in developing and implementing Salmon Habitat Field Projects and Activities, the process will be intimidating to them and a potential recruiting barrier. The Lead Entity needs to facilitate the process by developing a clear process and product, augmented with plenty of one-on-one technical assistance. An easy to read project development handbook, similar in approach to the "Forest Practices Illustrated" published by the Department of Natural Resources, would be extremely helpful. In addition, it would be easier to recruit landowners who express interest in doing projects but not the paperwork if there were resource people readily available to facilitate the project process for them.

❖ Implement hatchery reform

The impact of hatcheries on wild salmonids in the Chehalis Basin could negate any efforts focused on salmon habitat recovery. The Lead Entity intends to track and participate in the Hatchery Reform Project currently underway in the State of Washington. Congress created the Hatchery Reform Project to review hatcheries, ensure their activities do not present a risk to ESA listed species, and provide benefits to recovering wild salmonids.

❖ Make sure environmental laws are consistent

It is critical for salmon habitat recovery that federal, state, and local enforcement officials be capable of doing their jobs consistently. This entails ensuring that agencies handle all violations without political interference. Elected officials need to give in-field managers the support and resources they need to enforce the law.

It is also important that local, state, and federal environmental laws be consistent and simple to manage. Differences in application, procedures, and even definitions often result in inadequate protection of salmonid habitat. The Lead Entity will make recommendations to regulatory agencies as to how they can coordinate these permitting systems more effectively in a way that benefits salmon habitat recovery.

Section 8:
Community Interests and Concerns

Integrating community interests and concerns with habitat recovery efforts for wild salmon is a high priority for the Grays Harbor County Lead Entity. Sharing information and listening to citizens is important for building and maintaining for projects and activities.

To this end, the Lead Entity relies on a variety of approaches for reaching out to the public to ensure projects fit within the social and economic framework of the WRIAs 22 and 23.

Community Outreach Efforts

Community outreach by the Lead Entity consists of information sharing and offering active participation opportunities through programs and events.

One community outreach tool for sharing information with the public has been the quarterly newspaper, Drops of Water. An important goal of this four-page newspaper insert published by the Lead Entity is to increase citizen awareness about watershed planning, including habitat restoration efforts for salmon within WRIAs 22 and 23. The newspaper also provides information about volunteer efforts and related community events.

Local Stream Team chapters provide another method for collecting information about citizen interests and concerns. Stream Teams organize events and projects that bring citizens together through habitat restoration projects. As Stream Team paid and volunteer staff work with citizens, they learn about issues and concerns and share them back with the Lead Entity.

The annual Chehalis Watershed Festival offers the most direct opportunity for citizens to share with the Lead Entity their opinions about habitat restoration and protection efforts. Using an open house format, the public participates by reviewing storyboards summarizing the Strategy and then completing a survey. The Lead Entity provides the results with its citizen and technical committees through its annual update of the Strategy.

Community Issues and Concerns

The combination of these outreach efforts reveal citizen interests and concerns relating to Lead Entity directions in salmon recovery. Their perceptions over the years are summarized below:

What are the greatest problems facing wild salmon in the Chehalis Basin?

- Water pollution is most often mentioned as the greatest threat
- Habitat degradation and loss caused by fish barriers, development, and logging
- Overfishing
- Reduced water quantity
- Loss of access to rivers, especially due to restoration efforts
- Lack of knowledge about how to restore habitat
- Predator problems (seals, birds, other fish species)
- Inability of restoration groups to work together

What are current attitudes about the amount of salmon recovery work going on in the Chehalis Basin?

- The majority of people (61%) felt that there were not enough habitat restoration and protection projects happening
- The second largest number of people (29%) did not know what habitat restoration and protection projects were happening
- The last group (10%) felt there were enough projects happening

Which salmon restoration and protection projects does the public think are most important?

- Removing barriers to fish was mentioned as the most important type of project
- Reducing sediment caused by road and other activities came in second
- Improving upland habitat problems that affect water quality and quantity came in third
- Restoring or improving habitat in rivers, the estuary, and wetlands came in fourth

Integrating Community Interests and Concerns into Project Selection

The Lead Entity relies on membership from watershed planning and other environmental groups to serve as citizen representatives on the local review team.

During the annual Habitat Project List development process, the local technical review team reviews, ranks, and recommends projects in accordance with the highest biological priority. Upon receiving these recommendations, the review team acts as the "eyes and ears" of the community by reviewing these projects for their appropriateness in addressing community interests and concerns. The review team not only relies on the discussion of community interests and concerns identified through the Strategy, but the constituents whom they represent.

This combined review process ensures that projects submitted to the Salmon Recovery Funding Board or other funding agencies balances science-based habitat projects with community values.

Section 9:
Implementing the Strategy through the Salmon Recovery Grant Program

The Salmon Recovery Funding Board's Salmon Recovery Grant Program has been instrumental in funding over 60 completed habitat protection and restoration projects within the Grays Harbor County Lead Entity (Lead Entity). Habitat projects using these funds have addressed a multitude of limiting factors and protected a number of key habitat areas in many subbasins of WRIA 22-23.

Because applying for project grant funding through the Salmon Recovery Grant can be both competitive and somewhat complicated for many new project sponsors, the intent of this section is to provide guidance in navigating the application process and preparing a successful application. This section will also be useful for prospective project sponsors by making them familiar with the technicalities and procedures of the program before fully developing a project.

The information below is a summary of the major points contained in Salmon Recovery Funding Board Manual 18, the official guidance on the Salmon Recovery Grants program. It also outlines the established operational procedures used by the Lead Entity in submitting project lists to the Salmon Recovery Funding Board. First-time and repeat project sponsors are encouraged to review Manual 18 before submitting an application. The Recreation and Conservation Office updates Manual 18 annually and is available at:

http://www.rco.wa.gov/documents/manuals&forms/Manual_18.pdf.

The Salmon Recovery Funding Board Overview

The Washington State Legislature created the Salmon Recovery Funding Board in 1999 to provide grants for salmon habitat restoration and protection projects and other salmon recovery activities. The Board resides within the Washington State Recreation and Conservation Office and has staff to support its function.

The mission of the Salmon Recovery Funding Board is to "provide funding for elements necessary to achieve overall salmon recovery, including habitat projects and other activities that result in sustainable and measurable benefits for salmon and other fish species."[8] The Salmon Recovery Funding Board does this through implementation of the Salmon Recovery Grant Program.

Salmon Recovery Grant Profile

The Salmon Recovery Grant Program funds projects supported by lead entity strategies that:

- Protect existing, high quality habitats for salmon,
- Restore degraded habitat to increase overall habitat health and biological productivity, and
- Assess the feasibility of future projects and other salmon related activities

There are five basic categories of eligible projects:

1. Acquisition, which includes the purchase of land, access or other property rights
2. Restoration projects that assist in the recovery of degraded, damaged, or destroyed habitat conditions
3. Non-capital projects consisting of assessments, project designs, inventories, and studies that do not directly result in on-the-ground restoration or acquisition projects
4. Design-only projects that lead to preliminary design (30 percent) or final design

[8] http://www.rco.wa.gov/documents/strategy/srfb-strategic-plan.pdf

5. Combination acquisition projects that include different restoration elements or assessments and studies

Projects may include the actual habitat used by salmon and the land and water that support ecosystem functions and processes important to salmon.[9] The SFRB will closely review if a project clearly links with the goals and subbasin priorities of this strategy.

Entities eligible for Salmon Recovery Funding Board funding include:

- Local agencies (defined as any "city, county, town, federally recognized Native American tribe, special purpose district, port district, or other political subdivision of the state providing services to less than the entire state if legally authorized to acquire and develop public open space, habitat, farmlands, riparian habitat, or recreation facilities"[10])
- State agencies
- Tribes
- Private landowners
- Nonprofits
- Conservation districts
- Regional Fisheries Enhancement Groups

While grants must be greater than $5,000, there is no grant cap except for design-only projects, which have a $200,000 ceiling. In all practicality, however, the Salmon Recovery Funding Board allocates a set dollar amount for grants available to each of the eight salmon recovery regional organizations in the state. The Grays Harbor County Lead Entity is one of four lead entities that are members of the Washington Coastal Sustainable Salmon Partnership (WCSSP), the regional organization responsible for four WRIAs along the coast. Working through WCSSP, the four lead entities use a formula to distribute the WCSSP allocation amongst them.

[9] http://www.rco.wa.gov/grants/salmon.shtml

[10] http://www.rco.wa.gov/grants/sal_rec_grants.shtml

Generally, there is a 15 percent match requirement for all grants with the exception of design-only projects, which are exempt. Projects satisfying a Road Maintenance and Abandonment Plan (RMAP) have a required 35 percent match for fish passage projects and a 50 percent match for sediment reduction projects. Match may consist of cash or appropriations, bonds, donations, grants, and an applicant's labor, equipment, and materials.

Understanding Roles in the Salmon Recovery Grant Application Process

The Salmon Recovery Grant Program application process is unique in the distinct roles played by the Washington State Recreation and Conservation Office, the Grays Harbor County Lead Entity, the Washington Coast Sustainable Salmon Partnership, and the individual project sponsors. The diversity of the players in this process reflects how the Salmon Recovery Grant Program is a bottoms-up driven process. Understanding these roles and responsibilities is critical to understanding how the process works.

The Project Sponsor

At the core of the Salmon Recovery Grant application process are the entities eligible to apply – the Project Sponsors. The Project Sponsor develops an eligible project, prepares the application, and if successfully funded by the Salmon Recovery Funding Board, implements the project. Project Sponsors must submit their applications for funding under the Salmon Recovery Grant Program through the Grays Harbor County Lead Entity.

The Grays Harbor County Lead Entity

The Grays Harbor County Lead Entity is the local organization responsible for developing and implementing a salmon habitat recovery and protection strategy within Water Resource Inventory Areas (WRIAs) 22 and 23. It is also responsible for evaluating and ranking grant applications submitted by project sponsors before submitting them for funding under the Salmon Recovery Grant Program. The grant

applications submitted by the Lead Entities during an annual grant cycle is a project list.

Since Grays Harbor County is the administrative entity responsible for the Lead Entity, the Board of County Commissioners acts as the formal decision making body for the organization. A county staff person serves as the Lead Entity Coordinator, who is responsible for the day-to-day administrative duties. The Lead Entity Coordinator coordinates the Salmon Recovery Grant at the Lead Entity level.

The Habitat Work Group is a committee within the Lead Entity consisting of local technical experts and citizens. This group acts as the steering body for Lead Entity; it develops and administers the strategy, helps recruit prospective project sponsors, and provides technical assistance to project sponsors as they develop their projects.

A subcommittee of the Habitat Work Group, the Local Review Team, prepares a recommendation for the Board of County Commissioners that evaluates and ranks projects for submission to the Salmon Recovery Grant Program. The Local Review Team consists of both technical experts and citizens; this blend of participates allows the Lead Entity to evaluate projects from an integrated approach that includes scientific, social, economic, and cultural factors.

Washington State Recreation and Conservation Office

The Salmon Recovery Funding Board consists of ten members; five gubernatorial appointees and five representatives from five state agencies. This board is responsible for setting program policy and awarding grants for project lists submitted to the Salmon Recovery Grant Program by the Grays Harbor County Lead Entity.

Assisting the Salmon Recovery Funding Board in evaluating the technical merits of project lists is the Technical Review Panel. This body consists of a variety of technical experts in the field of salmon recovery.

Coordinating the administrative duties of the program as well as providing technical assistance is the role of staff grant managers.

The Washington Coast Sustainable Salmon Partnership

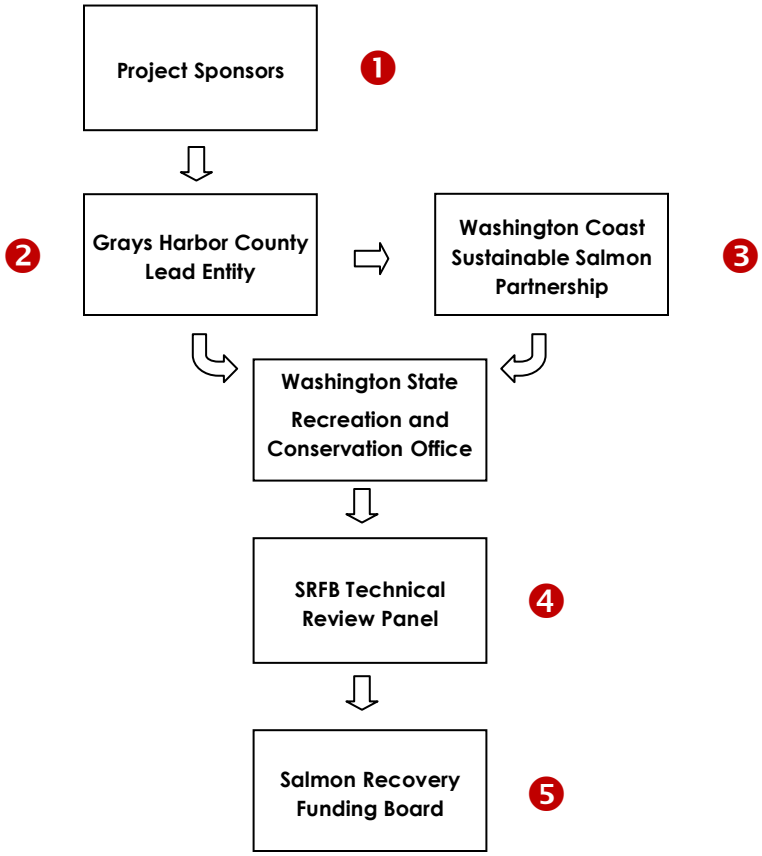
To coordinate salmon recovery efforts within watersheds bordering the Pacific coastline, the Governor's Salmon Recovery Office encouraged the formation of the Washington Coast Sustainable Salmon Partnership (WCSSP). WCSSP is one of eight regional organizations in the state dedicated to preparing and implementing salmonid recovery plans. The WCSSP regional organization roughly corresponds to the Evolutionarily Significant Units (ESU) for coastal salmonids. In addition to the Grays Harbor County Lead Entity, other WCSSP members include the North Pacific Coast Lead Entity, the Quinault Indian Nation Lead Entity, and the Pacific County Lead Entity.

Under the Salmon Recovery Grant Program, the Salmon Recovery Funding Board provides a set funding allocation for each regional organization; currently, 9 percent of its funding goes to WCSSP. The lead entity members of WCSSP in turn distribute funding amongst themselves based on an internally agreed formula.

The Salmon Recovery Funding Board requires WCSSP to provide a regional assessment of the project lists submitted by its member lead entities. The assessment examines how the projects tie into regional plan strategies.

The Salmon Recovery Grant Application Review Process

The review process for Salmon Recovery Grant applications submitted by Project Sponsors begins at the Grays Harbor County Lead Entity Level and ends with the Salmon Recovery Board. The diagram below is an illustrated overview of the process. The numbers correspond to the description of the steps that follow.



Step 1

Most prospective Project Sponsors have completed extensive groundwork for a project by January of each year. Project sponsors have selected ideas based on having a high benefit to salmon, high certainty of success, and a close fit to goals and general actions of the Grays Harbor County Lead Entity strategy. (Appendix H in Manual 18)

Restoration and acquisition projects will need commitment forms signed by the time the Lead Entity accepts applications. Many of these tasks can take up to a year or more to obtain.

Step 2

The Salmon Recovery Grant process officially begins in January of each year when the Grays Harbor County Lead Entity sets the process and announces the review schedule for receiving applications under the program. The Grays Harbor County Lead Entity Coordinator is a central figure in managing this process.

Other tasks that the Lead Entity is doing in January include:

- Informing prospective grant applicants about the program and revisions, if any, to Manual 18
- Announcing the submission date in April for the Early Application Form
- Recruiting members for the Local Review Team, who will review and recommend ranking of the projects later in July. Members of the Habitat Work Group, invited members of the Chehalis Basin Partnership, RCO staff, WDFW staff, local citizens, and other salmonid experts typically comprise the Local Review Team.

Between the beginning of February and early April, potential project sponsors are preparing their Early Application Form, including entering materials into PRISM (PRoject Information SysteM)[11], which later allows the Salmon Recovery Funding Board Technical Review Panel to comment on the application.

The Early Application Form, which the potential Project Sponsor turns into the Lead Entity during the first working day in April, is a "working draft" that must contain:

- A project location/vicinity map, a detailed site or parcel map
- Site or aerial photos, if available
- Design plans or sketches that convey the intent of the project
- A detailed project description
- Estimated budget
- Evidence that the project is a high priority within the Lead Entity Strategy

[11] http://www.rco.wa.gov/prism_app/about_prism.shtml

- Comment on whether the Salmon Recovery Funding Board has reviewed any part of this project previously, including discussion on how it is different[12]

The Early Application Form is available on the Grays Harbor County Lead Entity website.

Soon after receiving the Early Applications, the Lead Entity's Habitat Work Group discusses and provides feedback on the proposals to the project sponsors at their April meeting. The remainder of April is devoted to organizing site visits and/or presentations that happen in May.

Site visits usually occur around mid-May. The Lead Entity Coordinator, the grant manager from the Washington State Recreation and Conservation Office, and members of the Local Review Team attend these visits and/or presentations. Two weeks later the Salmon Recovery Funding Board Technical Review Panel forwards their initial evaluation of each project to the sponsor and the Lead Entity coordinator.

Project sponsors use this feedback opportunity to improve their applications. If Salmon Recovery Funding Board Technical Review Panel has concerns about any project, they will "flag" it and encourage the project sponsor and the lead entity to go through additional review to improve the project. The Technical Review Panel will meet in person or by conference call to assist individual Project Sponsors with comments.

Project Sponsors also must attend a scheduled Salmon Recovery Funding Board application workshop before submitting a final draft application, known as a Project Proposal, to the Lead Entity. There are three types of Project Proposals:

- Restoration, Acquisition, or Combination Restoration and Acquisition Projects
- Planning (Assessment, Design, and Study) or Combination Planning and Acquisition Projects
- Barrier Inventory Projects

[12] Section 3, "*How to Apply*," Manual 18.

Section 4 in Manual 18 provides a description of what material goes into a Project Proposal.

The third Friday in June marks the deadline for final Draft Project Proposals and the beginning of the Lead Entity review process. Members of the Local Review Team each receive complete copies of the applications before coming together on the second Friday in July for an evaluation and ranking session.

The Local Review Team relies on Appendix H of Manual 18 as the basis for its evaluation of each application. This Appendix sets criteria for evaluating projects on a high, medium, and low scale in terms of benefit to salmon and certainty of project success. In addition, the Local Review Team examines each project in its fit with the strategy and the partnerships/ outreach efforts it incorporates.

After the Local Review Team completes scoring each Project Proposal, the highest scored project takes on the highest rank, with the other projects following suit. Depending on the amount of money allocated to the Lead Entity, there will be a cut-off point as to which projects move forward within a recommended project list that the Local Review Team forwards to the Grays Harbor County Board of County Commissioners (BoCC). The BoCC will then review the recommended project list during and take appropriate action at one of their latter July meeting dates.

From July until the approximately the second week of August, project sponsors will polish their applications and update PRISM accordingly before the Lead Entity Coordinator formally submits its project list and accompanying application materials to the Recreation and Conservation Office during the last week of August. This submittal point marks the start of the formal Salmon Recovery Funding Board review process. After checking each project application for completeness, RCO staff forwards the Lead Entity's project list to the Salmon Recovery Funding Board Review Panel for its consideration.

Step 3

The Washington Coast Salmon Sustainable Partnership, in its capacity as the Regional Organization, also prepares and submits to the Recreation and Conservation Office in mid-September its regional assessment of the Lead Entity's project list.

Step 4

During the latter part of September, the Technical Review Panel convenes a regional project meeting, which WCSSP and each of the Lead Entity Coordinators presents the regional project list. This meeting is an opportunity to discuss any problem areas and to exchange information. After the conclusion of this meeting, the Technical Review Panel prepares evaluation forms to forward to the full Salmon Recovery Funding Board.

While the Technical Review Panel does not rate, score, rank, or advocate for projects, it does assess them for technical merit. The Technical Review Panel examines each project to determine if there is a low benefit to salmon, a low likelihood of success, and if the costs outweigh the anticipated benefits. Projects that show any of these problems receive a "project of concern" designation.

During the month of October, the grant manager with the Recreation and Conservation Office provides Project Sponsors and the Lead Entity the opportunity to comment on the Technical Review Panel evaluation forms. By mid-November, the grant manager puts together a draft Salmon Recovery Funding Board Grant Report that it releases for public review and comment.

Step 5

At their December board meeting, the full SFRB convenes to review the project lists. They consider the Lead Entity strategy summary, comments from WCSSP, reports from the Technical Review Panel and RCO staff, and public comments before making a final decision on grant awards.

Section 10:
Conceptual Projects – Habitat Work Schedule

CONCEPTUAL PROJECT LISTS

The Grays Harbor County Lead Entity is assembling an inventory of conceptual projects as a proactive step towards strategically directing habitat restoration and protection within the Chehalis Basin.

Conceptual projects are the first phase in project development. A conceptual project may range in scope from a broad idea to one that is ready to implement. Projects are "conceptual" because they may not be fully ready for implementation. The reasons may vary, but typically, it is because a project lacks a sponsor, community buy-in or support, or enough information to move forward.

There are three advantages to having the Lead Entity compile this inventory of conceptual projects. The first one is that using the expertise of Lead Entity members, a project can increase in quality as the group fine-tunes it. Waiting until a SRF Board grant cycle to have this happen can be a poor use of both a project sponsor's *and* the Lead Entity's time. The time a project spends maturing on a conceptual inventory list will give Lead Entity members the opportunity to properly vet it, which will in the end increase its chances of becoming a stronger, fundable project – whether by a SRF Board grant or another funding opportunity.

A second advantage to the conceptual project inventory is that it will encourage the development of the "tough" projects – those large, complex ones that often take more expertise and resources than an individual sponsor can muster. These types of projects demand more of a team approach needing broad expertise in habitat, community development, and project management.

The final benefit to the conceptual project inventory is that the Lead Entity can use it to recruit sponsors for potential projects. For example, the Lead Entity currently compiles a list of fish barriers throughout the Chehalis Basin as part of its *Restoration and Preservation Work Plan for WRIA 22-23*. Using a conceptual project inventory accessible to public inspection may connect a potential, interested sponsor with a specific project. In addition, if that sponsor lacks expertise in developing a project, it could receive assistance from the Lead Entity.

The perfect tool available for complimenting the conceptual project inventory is the Habitat Work Schedule (HWS). The HWS was born out a partnership formed between the Washington Department of Fish and Wildlife and Washington's 27 Lead Entity organizations. Both partners needed a public website that provided current information about restoration and acquisition projects. The intent was to have an interactive web tool that could share information about conceptual, proposed, active, and completed projects with policy makers, funders, the public, and other stakeholders.[13] The outcome of the effort now allows each Lead Entity to communicate visually its habitat goals, strategies, and project efforts.

The Grays Harbor County Lead Entity appointed a subcommittee to find a way to combine the usefulness of the HWS with its conceptual project inventory. Lee Napier, Bob Amrine, Bob Burkle, Janel Spaulding, Lonnie Crumley, Mike Kuttel Jr., and Miranda Plumb served on this subcommittee.

DEVELOPING THE CONCEPTUAL PROJECT INVENTORY

The subcommittee initiated the development of the conceptual project inventory by simultaneously exploring how to organize the HWS and sending out calls to populate the inventory itself.

Creating a Hierarchy for Entering Projects on the HWS

The subcommittee first looked at how the Upper Columbia and North Coast Lead Entities currently were using the hierarchal features of the HWS and then discussed the pros and cons of each approach. Based on the two examples, the subcommittee decided that the Grays Harbor County Lead Entity would enter projects using a geographical hierarchy:

Level 1:	Geographic Sub-Basin / Management Unit
Level 2:	Stream Name
Level 3:	Actions /Projects

[13] Under the Habitat Work Schedule, there are three other project status categories. A "proposed" project is one that is ready for implementation, but the sponsor has yet to secure funding. An "active" project is one that the sponsor has some or all of its funding needed to complete the project. A "completed" project is one that the sponsor has fully implemented.

Outreach

The Lead Entity's goal was to continue developing strong projects aimed at benefitting large populations of salmonids classified as priority stocks under *The Chehalis Basin Salmon Habitat Restoration and Preservation Work Plan for WRIA 22-23 (Strategy)*. To this end, the Lead Entity reached out to the public in early 2011 to identify potential projects in their communities. The outreach activities included sending personal emails to stakeholders, making telephone calls, and submitting two newspaper articles to the Drops of Water.[14]

The Grays Harbor County Lead Entity website contains documents and materials to make the project solicitation process easier. The web page assists by:

- Introducing the HWS database
- Explaining the Conceptual Projects Inventory approach
- Describing the information required for a conceptual project
- Providing documents to assist with project identification within subbasins

Access the Lead Entity Habitat Work Schedule web page at:
http://www.co.grays-harbor.wa.us/info/pub_svcs/Lead_Entity/hws/hws.htm

The website further provides links to Management Unit documents. These documents include summarized sections of the Strategy. Each summary provides a description of the watershed, its major tributaries, land uses, and anadromous fish stocks. It also outlines limiting factors, symptoms / causes, and general actions for each major river or stream.

Several sponsors and agencies responded to the request for projects. These projects include:

- Basin-wide education outreach efforts
- Black River Conservation Initiative – Water Rights

[14] Additional outreach information is provided in the attachment.

- Chehalis Mainstream Shoreline Restoration
- China Creek Headwater Retention
- China Creek Interpretive Park
- Dunnagan Creek Fish Passage at Gate Road
- Eaton Creek Fish Passage Barrier Correction
- Fin the Fiberglass Fish
- Fish Passage (i.e., Culvert Replacements)
- Frase Creek Barrier Removal
- Johns River Estuary Restoration
- Land acquisitions
- Lucas Creek Barrier Removal Project MP 4.2
- McDonald Creek Restoration Project
- Sam's Canal Enhancement
- Sampson Wetland Enhancement Project Phase 1
- Wetland Restoration
- Wildcat Creek Drainage

Information regarding each one of these conceptual projects is now available on the Grays Harbor County Lead Entity HWS database. The diagram on the next page shows how to access conceptual projects on HWS website.

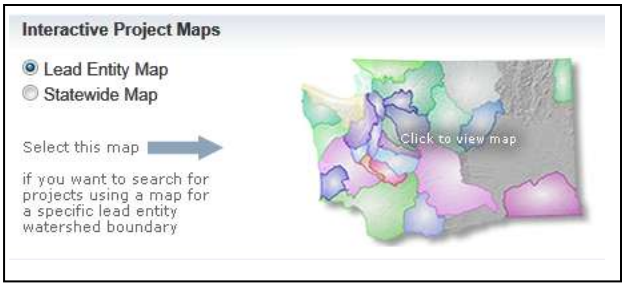
Habitat Work Schedule
Tracking salmon recovery throughout Washington State

Accessing Conceptual Projects on

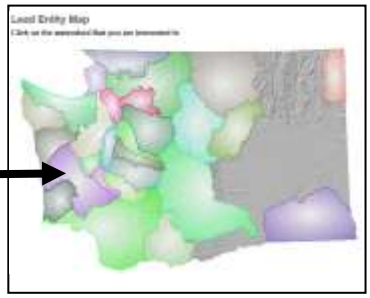
Go to HWS Home Page:

http://hws.ekosystem.us/

On the Home Page, click 'Click to View Map'



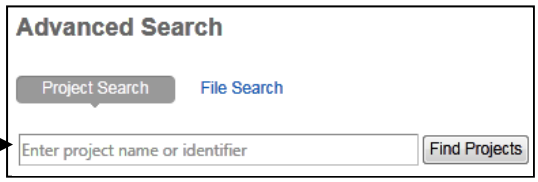
Click the map of WRIA 22-23



Click 'View Project List'

Click 'Advanced Search'

Type in 'Conceptual'



MANAGING & PRIORITIZING CONCEPTUAL PROJECTS

The HWS subcommittee recommended that before any project sponsor submits a project for SRF Board funding, it should first go on the conceptual project list to allow a field review and subsequent vetting by them. The subcommittee intends to review conceptual projects on a monthly basis from September through February. The focus of the group's efforts will be to mentor prioritized projects in order to get them "project ready" for funding under SRFB or other grant programs.

Prioritization of Conceptual Projects

To determine which projects the HWS subcommittee intends to mentor, the group developed a series of eight "thinking points" to help them in their selection process. These points are:

- Salmonids
  Does the project benefit the greatest number of salmonids?
  Does the project location benefit salmonids in all or most subbasins?

- Limiting Factors
  Is the project a Tier 1, 2, or 3 action within the WRIA 22-23 strategy?
  Does the project address the greatest number of limiting factors?

- Protection
  What percentage of the acquisition is intact?
  What is the type of protection? (Purchase by a public/non-profit, permanent easement, temporary easement, open space-type, etc.)

- Habitat Complexity
  What percent of the stream is fragmented (simplification)?
  What is the quality of the structural materials in stream?
  What water quality issues exist? (see limiting factors)

- Education and Outreach
  Is it an on-going E&O program?
  Is it a temporary E&O program?

- Cost
  What is the project's cost in relation to similar ones recently completed?

  What is the project cost relational to benefit to salmonids? (high, medium, low)

- Climate Change
  Does the project incorporate resiliency in its design?

  Does the project engage citizens to respond to or address climate change?

- Location / Tenure
  Is it likely that future land uses or activities could reduce a project's benefit?

The subcommittee used the form below as a loose guide to evaluate and rank each of the projects submitted:

CONCEPTUAL PROJECTS EVALUATION FORM									
Project	Salmonids	Limiting Factors	Protection	Habitat Complexity	Education & Outreach	Cost	Climate Change	Location/ Tenure	Selected
Conceptual Project									
Conceptual Project									
Conceptual Project									

The subcommittee has initially selected four conceptual projects to mentor towards a proposed status:

- McDonald Creek, sponsored by Jarred and Chehalis Basin FTF
- FIN the Fiberglass Fish, sponsored by the City of Centralia
- Johns River Estuary Restoration, sponsored by WDFW
- Chehalis Mainstem Shoreline Restoration with the suggestion that county conservation districts be contacted to see if they would be interested in forming an alliance as sponsors

In September, the subcommittee will begin site visits for projects and then assisting the sponsor in preparing the project for a future SRF Board grant process.

Appendix A:
A Policy Framework for Salmonid Habitat Restoration in the Chehalis Basin

To understand the purpose and scope of the Chehalis Basin Salmonid Habitat Restoration and Preservation Strategy, a brief overview of the federal, state, and local salmonid habitat recovery process is helpful.

For an overview of the ESA and ESA Recovery, see these WWW sites:

NMFS 1

NMFS 2

NMFS 3

FWS

The Endangered Species Act

After decades of declining wild salmonid and steelhead populations in the Pacific Northwest, the National Marine Fisheries Service (NMFS) began a comprehensive review process in 1991 to assess the possible listing of salmonids under the Endangered Species Act (ESA). The destruction and alteration of habitat, as well as the impacts of hatcheries, hydropower, and harvesting, have placed salmonids into a precarious position within many watersheds in Washington State. The eventual outcome of the review was the listing of several salmonids within several geographic areas as a "threatened" species under the ESA in March 1999. The US Fish and Wildlife Service added bull trout for all regions of the state the following November 1999. Both agencies will be developing recovery plans in the near future to recover salmonid populations in the Pacific Northwest so they no longer need legal protection to prevent their extinction.

Bull trout are the only "threatened" specie in WRIAs 22 & 23. The draft 2002 SaSI lists the following stocks as "depressed":

- Satsop summer Chinook
- Wynoochee fall Chinook
- Hoquiam winter steelhead
- Humptulips fall Chinook

A "depressed" stock is a fish whose production level is below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely.

Salmon Recovery, Chapter 77.85 RCW

Because an ESA listing could have such a significant economic impact on the state, the Washington Legislature responded to the ESA review process by passing ESHB 2496 in 1998 and 2E2SSB 5595 in 1999. Together, these two laws became Chapter 77.85, Salmon Recovery, under of the Revised Code of Washington (RCW). The intent of this chapter was "…to retain primary responsibility for managing the natural resources of the state rather than abdicate those responsibilities to the federal government." The state would accomplish this by "…integrating

For the complete text of Chapter 77.85 RCW, follow this link: RCW

local and regional recovery activities into a statewide plan that can make the most effective use of provisions of federal laws allowing for a state lead in salmon recovery." Furthermore, Chapter 77.85 RCW expands upon the ESA purpose of preventing salmonid extinction by instructing the "…office of the governor to coordinate state strategy to allow for salmon recovery to healthy and sustainable population levels with productive commercial and recreational fisheries." It is important to note that this state law is not a replacement for the ESA process. Instead, the law seeks to make the state a proactive partner in the ESA recovery planning effort.

The term "salmon" in Chapter 77.85 RCW "includes all species of the family Salmonidae which are capable of self-sustaining, natural production.

RCW 77.85.010(7)

One of the central themes of Chapter 77.85 RCW focuses on habitat as a vital component of the salmon recovery effort. To do this, the Chapter states that salmon recovery be accomplished "…in a coordinated manner and to develop a structure that allows for the coordinated delivery of federal, state, and local assistance communities for habitat projects that will assist in the recovery and enhancement of salmon stocks." It is also important to note, however, that the law specifically entrusted voluntary "lead entities" consisting of counties, cities, and tribal governments to develop the projects necessary for restoring and protecting fish habitat within the state's 62 Water Resource Inventory Areas (WRIAs).

Habitat is the physical, chemical, and biological features of an area that supplies food, water, shelter and space necessary for a particular species existence.

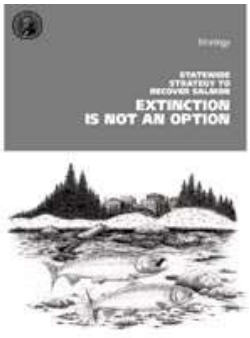
To institute salmon recovery, Chapter 77.85 RCW set up an organizational framework to guide and implement salmon recovery through salmonid habitat restoration and protection. This framework involves three main participants:

See:

RCW 77.85.030

RCW 77.85.150

- The Salmon Recovery Office
- The Salmon Recovery Funding Board
- Local Lead Entities



Follow this link to view the report

The Salmon Recovery Office

Chapter 77.85 RCW established the Salmon Recovery Office within the Office of the Governor for the purpose of establishing and coordinating a statewide strategy for salmon recovery. The Salmon Recovery Office, working with the Governor's Joint Natural Resources Cabinet, accomplished this initial task in September 1999 when it issued its statewide salmon recovery strategy, Extinction is Not an Option. The focal point of the plan is its vision to:

"Restore salmon, steelhead, and trout populations to healthy and harvestable levels and improve habitat on which fish rely."

See RCW 77.85.020

2002 State of the Salmon Report

Implementing this vision rests on four main areas of emphasis – Habitat, Harvest, Hatcheries, and Hydropower. These four areas, under human control, influence the health of salmonids within Washington's 62 Watershed Resource Inventory Areas (WRIA). The statewide salmon recovery strategy includes analysis about how each of the four areas of **emphasis impact salmonids and proposes goals, objectives, and** solutions to address them.

In addition, Chapter 77.85 RCW also requires the Governor to submit biennially to the Legislature a "State of the Salmon Report." The most recent one is a three-volume report for 2002.

The Salmon Recovery Funding Board

See:

RCW 77.85.110

RCW 77.85.120

RCW 77.85.130

RCW 77.85.140

The Salmon Recovery Funding Board (SRFB) plays a leading role under Chapter 77.85 RCW with its responsibilities for making grants and loans to local lead entities for salmon habitat projects and activities. The SRFB has 10 members appointed by the Governor and the Interagency Commission for Outdoor Recreation provides staff support and administrative assistance to the board.

Chapter 77.85 RCW clearly outlines the procedures and criteria for the SRFB to evaluate, rank, and fund salmon habitat projects and activities. The SRFB must give preference to projects that:

- Rely on a prepared limiting factors analysis;
- Provide greater benefit to salmon recovery based upon the stock status information from the Salmon Stock Inventory (SaSI) and the Salmon and Steelhead Habitat Inventory and Assessment project (SSHIAP), and any comparable science-based assessment when available;
- Benefit a listed species;
- Preserve high quality salmonid habitat;
- Are cost-effective;
- Have the greatest matched or in-kind funding; and,
- Will be implemented by a sponsor with a successful record.

In its own strategy, Mission, Roles, Responsibilities, and Funding Strategy, the SRFB states that it will accomplish this in a manner "…consistent with the state salmon strategy Extinction is Not an Option." The SRFB report goes on to add to the Chapter 77.85 RCW criteria by requiring each Lead Entity to have:

See the SRFB

Mission, Roles, Responsibilities, and Funding Strategy

(In pdf file format)

- An assessment of current and potential conditions (limiting factors analysis);
- Goals and strategies for salmon habitat recovery in the affect WRIA;
- A project list consistent with the strategy;
- A monitoring program for determining if a project is or is not effective; and,
- Adequate funding to implement the project.

Furthermore, the SRFB requires lead entities to use the best science available to guide all decisions and actions in the development of habitat project lists.

Local Lead Entities

Chapter 77.85 RCW authorizes counties, cities, and tribal governments to voluntarily join and designate a Lead Entity responsible for submitting habitat project lists to the SRFB for their funding consideration.

The law requires the Lead Entity to establish a committee of people representing counties, cities, conservation districts, tribes, environmental groups, business interests, landowners, citizens, volunteer groups, regional fish enhancement groups, and other habitat interests. The purpose of this Lead Entity committee is "...to provide a citizen-based evaluation of the projects proposed to promote salmon habitat." The committee is supposed to "…compile a list of habitat projects, establish priorities for individual projects, define the sequence for project implementation, and submit these activities as the habitat project list. The committee shall also identify potential federal, state, local, and private funding sources."

See

RCW 77.85.050
RCW 77.85.060
RCW 77.85.070

The Lead Entity Committee must develop a habitat project list and habitat work schedule that, according to Chapter 77.85 RCW "…ensures salmon habitat projects will be prioritized and implemented in

a logical sequential manner that produces habitat capable of sustaining healthy populations of salmon." Using the critical pathways methodology, the Lead Entity:

- Prepares a limiting factors analysis for salmonids;
- Identifies habitat projects that sponsors are willing to undertake;
- Identifies how to monitor and evaluate projects;
- Reviews monitoring data, evaluates project performance; and,
- Outlines the adaptive management strategy used in its WRIAs.

Assisting the Lead Entity Committee in its work is the Technical Advisory Group (TAG), a collection of private, tribal, federal, state, and local government personnel with appropriate scientific expertise. The Conservation Commission invites these TAG members, in consultation with local governments and tribes, to help bring the best available science to the overall local decision-making process. At a minimum, Chapter 77.85 RCW gives the TAG two main jobs in assisting the Lead Entity Committee:

- Developing the limiting factors analysis for WRIAs 22 and 23; and,
- Reviewing monitoring data, evaluating project performance, and making recommendations.

See Chehalis Basin Partnership

The Chehalis Basin Partnership

The Chehalis Basin Partnership designated Grays Harbor County to act as the Lead Entity for WRIAs 22 and 23. The Chehalis Basin Partnership in turn serves as the Lead Entity Committee. In addition, the Chehalis Basin Partnership has a Technical Advisory Group (TAG) who aided in the preparation of the limiting factors analysis and who continues to provide assistance in technical planning, review, and monitoring tasks.

Salmon and Steelhead Habitat Limiting Factors, Water Resource Inventory Areas 22 & 23

The Conservation Commission published in June 2001 Salmon and Steelhead Habitat Limiting Factors, Water Resource Inventory Areas 22 and 23, by Carol Smith PhD. and Mark Wenger. This comprehensive document compiles data and provides technical analysis on limiting factors for wild salmonid habitat in the Chehalis Basin.

The Chehalis Basin Partnership published its first Plan for Habitat Restoration in April 2001. That planning effort focused on interpreting

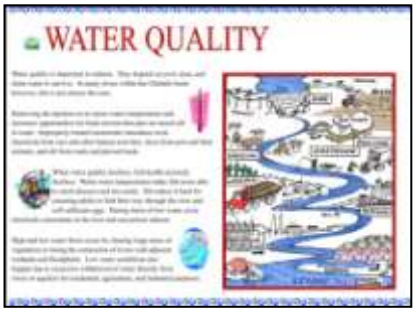
data from the limiting factors analysis to prioritize subbasins in the two WRIAs and provide guidance to future project sponsors as to what type of projects each subbasin needs to overcome limiting factors and achieve the plan's goals.

Since that time, the Partnership has facilitated two project habitat lists for SRFB consideration. This first effort has proven successful; the SRFB has funded 29 salmon habitat projects and activities totaling $4.8 million within the two WRIAs. However, the complexity of the process, coupled by experience, has prompted the Lead Entity Committee of the Partnership to revisit and refine the first Plan for Habitat Restoration. The result is this document, the Chehalis Basin Salmon Habitat Restoration and Preservation Strategy.

Appendix B:
Results of Citizen Survey Chehalis River Festival September 10, 2009

The Grays Harbor County Lead Entity participated in the third Annual Chehalis River Watershed Festival at Morrison Riverfront Park in Aberdeen at the Rotary Log Pavilion on September 10, 2000. The festival hosted "Fin," the 28-foot fiberglass salmon, and a wide array of free educational activities and entertainment. This was a celebration of the Basin's wealth of natural resources and the people who stewarded them over time.

The Lead Entity exhibited 17 poster storyboards (see examples below) with information about the strategy, including discussions about limiting factors in each of the 13 subbasins. After participants had the opportunity to review the storyboards, Partnership representatives asked them to complete a written survey. The results follow below.



Sub-Basin	Wild Salmon Greatest Problem	Attitude re Current Salmon Habitat Recovery	Top 3 Salmon Recovery Projects "1"	Top 3 Salmon Recovery Projects "2"	Top 3 Salmon Recovery Projects "3"
Grays Harbor	Loss of habitat	Not enough	Restoring habitat	Reducing sediment	Acquisition / easements
Satsop	Overfishing	Don't know	Removing barriers	Restoring habitat	Improving upland habitat
Satsop	Overfishing in Alaska and the ocean	Not enough	Planting natural vegetation	Acquisition or easements	
Chehalis Mainstem	Netting	Doing enough	Reducing sediment		
Chehalis Mainstem	Netting	Don't know	Reducing sediment	Acquisition or easements	Improving upland habitat
Hoquiam	There is not a lot of little streams that are safe and easy to pass through for the fish to survive. Need to make more streams safe for the fish like getting the garbage out.	Not enough	Removing barriers	Planting natural vegetation	Improving upland habitat
Don't know		Not enough	Removing barriers	Restoring habitat	Acquisition or easements
Chehalis Mainstem		Don't know	Removing barriers	Restoring habitat	Conserving water use
Grays Harbor	Over fishing / poaching	Not enough	Planting natural vegetation	Reducing sediment	Improving upland habitat
Grays Harbor	Pollution, industry and mainly peoples disrespect of other living beings.	Not enough	Restoring habitat	Reducing sediment	Improving upland habitat
Chehalis Mainstem	Water quality	Don't know	Planting natural vegetation	Restoring habitat	Improving upland habitat
Grays Harbor	Nets, over fishing	Don't know	Removing barriers	Reducing sediment	Improving upland habitat
Grays Harbor	Pollution and over fishing in areas	Doing enough	Removing barriers	Reducing sediment	Improving upland habitat
	Pollution, over fishing	Don't know	Removing barriers		Gathering data
Grays Harbor	Pollution	Don't know			
Grays Harbor	Pollution – farm runoff and storm runoff city streets, silt, habitat destruction	Doing enough	Removing barriers	Restoring habitat	Reducing sediment
Chehalis Mainstem	High turbidity, high algae blooms	Doing enough	Planting natural vegetation	Reducing sediment	Gathering data
South Harbor	Logging forests, sediment build-up, impassable culverts, fishing regulations not being enforced	Not enough	Removing barriers	Restoring habitat	Reducing sediment
Grays Harbor	Interruption of waterways	Don't know			
Wishkah	The garbage in the rivers	Not enough	Restoring habitat	Reducing sediment	Improving upland habitat
Grays Harbor	No access to rivers from roads	Don't know	Removing barriers	Restoring habitat	Improving upland habitat
Wynoochee	Water quality, passage, habitat loss	Not enough	Removing barriers	Planting riverbanks	Improving upland habitat

Sub-Basin	Wild Salmon Greatest Problem	Attitude re Current Salmon Habitat Recovery	Top 3 Salmon Recovery Projects "1"	Top 3 Salmon Recovery Projects "2"	Top 3 Salmon Recovery Projects "3"
NA	Harvest, habitat, noxious weeds	Not enough	Removing barriers	Reducing sediment	Acquisition or easements
Black River	Ocean fishing, habitat, pollution and development	Not enough	Removing barriers	Restoring habitat	Conserving water use
South Harbor	Natural flow of streams interrupted	Not enough	Removing barriers	Planting natural vegetation	Acquisition or easements
Satsop	Nets across the rivers. Too much gravel accumulation that causes shallow flows and erosion. Too much wash from high-speed boats.	Doing enough	Reducing sediment		
Grays Harbor	Lack of knowledge about the best way to improve the habitat and still allow access and use of the basin.	Not enough	Removing barriers	Restoring habitat	Gathering data
Chehalis Mainstem	Sediment in streams and rivers	Not enough	Restoring habitat	Reducing sediment	Improving upland habitat
Satsop	Fish netting, logging, pollution	Not enough	Restoring habitat	Reducing sediment	Improving upland habitat
Newaukum	Pollution, barriers – dams, culverts	Not enough	Reducing sediment	Conserving water	Improving upland habitat
Black River	Probably fertilizers from farms because there is so much agriculture	Not enough	Planting natural vegetation	Restoring habitat	Improving upland habitat
Black River	The pollution from the fertilizers that are used on farms	Not enough	Removing barriers	Planting natural vegetation	Restoring habitat
Wishkah	Pollution	Not enough	Conserving water	Acquisition or easements	Improving upland habitat
NA	Development, habitat degradation, point and non-point source pollution, hatcheries, exempt wells	Not enough	Restoring habitat	Acquisition or easements	Improving upland habitat
Chehalis Mainstem		Not enough	Restoring habitat	Improving upland habitat	
Lincoln	Overgrowth of canary grass, blackberries choking streams, city giving permits to business complexes to allow holding basins to be built in flood-plains where waters polluted with oil and other things will be washed into creeks	Not enough	Removing barriers	Restoring habitat	Acquisition or easements
Chehalis Mainstem	Pollution, over fishing and the dams stopping them	Not enough	Removing barriers	Planting riverbanks	Reducing sediment
Chehalis Mainstem	Pollution in the water	Doing enough	Conserving water use		
Grays Harbor	Protection of salmon	Not enough	Removing barrier	Restoring habitat	Acquisition or easements

Sub-Basin	Wild Salmon Greatest Problem	Attitude re Current Salmon Habitat Recovery	Top 3 Salmon Recovery Projects "1"	Top 3 Salmon Recovery Projects "2"	Top 3 Salmon Recovery Projects "3"
Grays Harbor	Chemicals in water	Not enough	Restoring habitat	Acquisition or easements	Improving upland habitat
Grays Harbor	Proper spawning conditions	Not enough	Removing barriers	Reducing sediment	Improving upland habitat
Black River	Temperature, dissolved oxygen	Not enough	Acquisition or easements		
Hoquiam	Habitat loss and degradation	Not enough	Removing barriers	Planting natural vegetation	Restoring habitat
Mox Chehalis	Loss of riparian vegetation (shade and erosion control); excessive sedimentation and mass failure due to logging on steep slopes, in streams and wetlands; toxic runoff from farms, lawns, roads and industrial sites	Not enough	Removing barriers	Planting natural vegetation	Acquisition or easements *all are important
Satsop	Pollution, man, over fishing	Not enough	Restoring habitat		
Grays Harbor	Adequate food supply and spawning sites; boundaries on the rivers	Don't know	Removing barriers	Acquisition or easements	Improving upland habitat
Grays Harbor	Don't know	Don't know	Planting natural vegetation	Conserving water	Gathering data
Salzer	Keeping and cleaning up the river. Stop filling the wetlands for floodplain.	Not enough	Removing barriers	Reducing sediment	Acquisition or easements
Chehalis Mainstem		Not enough	Removing barriers	Planting natural vegetation	Gathering data
Grays Harbor	Pollution	Don't know	Restoring habitat	Reducing sediment	Gathering data
Satsop	Unsure	Don't know	Removing barriers	Reducing sediment	

Additional Thoughts

Grays Harbor County needs a critical area ordinance that meets the standards of best available science.

More info to the public. While I grew up on the Satsop River and wood area, spending many days fishing with my dad; he teaching me right & wrong in these areas; today I'm not seeing many parents doing the same. Also, until my daughter came home from school I did not know anything about this project.

Commercial fishing needs to be more limited so more fish are allowed to enter their native habitat when the return to spawn.

They should get out all natural debris such as rivers that are crowded with dead trees.

I am in new in the area. I don't know a lot about salmon but I see you all are working very hard to keep the native resources (and salmon). Thank you.

Doing a great job!

Keep up the good work!

Additional Thoughts

What is impact of floods on the watershed?

We need to do more to prevent the pollution.

We need to be concerned about all the fish species and the other wildlife in the basin. We need to improve informing the public about what we're doing.

Remove gravel in a salmon-safe manner and involving all stakeholders. Example process is found on the Fraser River in British Columbia.

Don't forget trout.

Keep up the good work!

Without changes in city and county building laws, or city/ county participation in watershed improvement, we will only be able to accomplish a limited amount. If we can get cities to pass statutes protecting these habitats, we have a much stronger chance of reaching our goals.

We are going to do a project and plant trees to help stop erosion.

We need to clean the water.

Continue public information and education projects involving all public for the benefit of the salmon.

Keep working on it!

Public education about laws to protect streams, wetlands and river (some school children already get this info). Farmers, forest owners and developers need to be focused on.

That we are trying to keep our salmon and other fish and natural resources around for a long time to have for our future generations.

This is a very important project to keep up.

Keep filling of the floodplain stopped. No building or septic tanks close to the river.

Being sure more native salmon are allowed; not letting them mix with hatchery salmon; just native is the best.

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