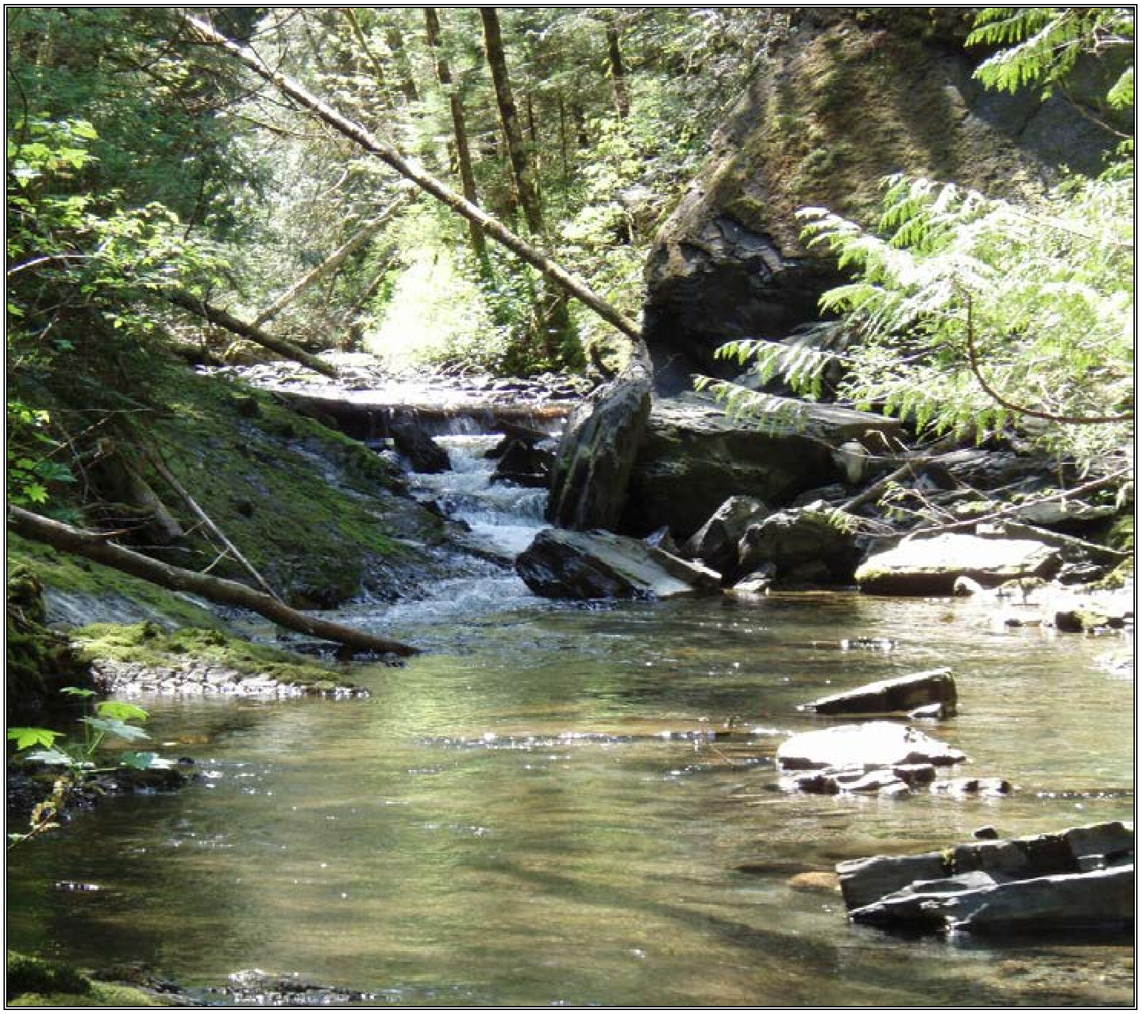
Water Resource Inventory Area 19 (Lyre-Hoko) Salmonid Restoration Plan



June 28, 2015

Prepared by:

North Olympic Peninsula Lead Entity for Salmon

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Disclaimer

The information contained herein was obtained from multiple plans and assessments of various origins, and generated from GIS data maintained by different sources and agencies. Results are based on best available data, but are not necessarily accurate to all applicable standards. Because of this, Mike Haggerty and the North Olympic Peninsula Lead Entity for Salmon do not retain any liability for the information contained herein.

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Acknowledgements

The WRIA 19 Salmonid Restoration Plan represents many years of intense effort by many individuals from multiple disciplines, far too many to acknowledge and thank individually; however, special recognition is deserved by consultant Mike Haggerty, who served as the primary author of the plan.

Finally, the authors would like to recognize all those who have worked over the years to conserve WRIA 19 salmonids. This proposed restoration plan builds on their dedication and their effort to preserve freshwater resources throughout their range in WRIA 19.

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Clallam County Commissioners
Lower Elwha Klallam Tribal Council
Makah Tribal Council
Jamestown S'Klallam Tribal Council
Puget Sound Salmon Recovery Council
And the many interested individuals and organizations working on salmon recovery on the North Olympic Peninsula:

RE: Approval of the Salmonid Restoration Plan for Water Resource Inventory Area 19

The North Olympic Lead Entity for Salmon is pleased to announce their approval of the WRIA 19 Salmonid Restoration Plan. The plan has been prepared as a road map for restoration and recovery in the 27 salmonid-bearing streams that enter the Strait of Juan de Fuca between Cape Flattery and the Elwha River, along with their associated upland and nearshore areas. This plan has been many years in the making, and we also wish to thank the local citizens, tribes, and agencies who have offered their expertise and involvement throughout the process.

The western Strait of Juan de Fuca region remains largely undeveloped and predominantly forested, thus offering tremendous potential for salmonid recovery. The nearshore areas of WRIA 19 also represent an essential migratory pathway for all the salmonid populations that leave and return to Puget Sound. The plan emphasizes actions directed toward long term ecosystem processes that will ensure improved habitat function in the uplands, streams and estuaries.

The WRIA 19 Plan has evolved over a period of several years, and already serves as our blueprint for action. Originally written in 2008, the draft plan was updated in 2010 and underwent extensive public review in 2011. For the past few years, our community has been focused on "getting stuff done" in terms of restoration projects, data collection, and monitoring the effectiveness of habitat restoration. In 2015, the North Olympic Lead Entity for Salmon determined that it was essential to finish the plan approval process. In the future, our intent is to prepare periodic updates that focus on results and adaptive management.

The identity of the Olympic Peninsula has been intertwined with forests and fish for over a century, and it is the community's desire to ensure that these natural resources survive and thrive together. Many local people depend directly on this ecosystem for their food, livelihood, and cultural well-being, and they have demonstrated their pride in living here by working hard on salmon restoration efforts. We also have a long history of working together with other communities across Puget Sound and the state of Washington. The WRIA 19 Plan is a continuation of these collaborative efforts to protect and restore salmon for everyone.

Thank you for your continued commitment to progress in regional salmon recovery, and your contributions to the WRIA 19 Salmonid Restoration Plan.

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LIST OF ACRONYMS/ABBREVIATIONS USED

BFW	bankfull width
BIBI	benthic index of biological integrity
BRT	West Coast Biological Review Team
BY	brood year
CCNWCB	Clallam County Noxious Weed Control Board
cfs	cubic feet per second
CMZ	channel migration zone
CWT	coded wire tag
dbh	diameter at breast height
DO	dissolved oxygen
DOE	Washington State Department of Ecology
EIS	environmental impact statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FEMAT	Forest Ecosystem Management Team
FPHCP	Forest Practices Habitat Conservation Plan
GLO	Government Land Office
HCP	Habitat Conservation Plan
HORs	hatchery-origin recruits
IMW	intensively monitored watershed(s)
IMWSOC	Intensively Monitored Watershed Scientific Oversight Committee
ITP	Incidental Take Permit
LEG	Lead Entity Group
LFA	Limiting Factors Analysis
LWD	large woody debris
M&R	Merrill and Ring
MDN	marine-derived nutrients
MFM	Makah Fisheries Management
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOLT	North Olympic Land Trust
NOPLE	North Olympic Peninsula Lead Entity for Salmon
NOR	Natural Origin Recruit
NPS	National Park Service
NWIFC	Northwest Indian Fisheries Commission
ONF	Olympic National Forest
ONP	Olympic National Park
PFMC	Pacific Fishery Management Council
PNPTC	Point No Point Treaty Council
PUD	Public Utility District
RCU	riparian channel unit
RFRS	Riparian Forest Restoration Strategy

RM	river mile
RMAP	Road Maintenance and Abandonment Plan
RY	return year
SASSI	Salmon and Steelhead Stock Inventory (Now also SaSi)
SEPA	State Environmental Policy Act
SJF	Strait of Juan de Fuca (also referred to as “Strait”)
SRFB	Salmon Recovery Funding Board
SSHIAP	Salmon Steelhead Habitat Inventory and Assessment Project
STE	survival to emergence
TFW	Timber, Fish, and Wildlife
TRG	Technical Review Group
USDA FS	United States Department of Agriculture Forest Service
USDI BLM	United States Department of Interior Bureau of Land Management
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VSP	Viable Salmonid Population
WAU	Watershed Administrative Unit
WDF	Washington Department of Fisheries (now WDFW)
WDFW	Washington State Department of Fish and Wildlife
WDNR	Washington State Department of Natural Resources
WDOT	Washington State Department of Transportation
WRIA	Water Resource Inventory Area
WSI	Western Strait Independent subbasins
WSJF	Western Strait of Juan de Fuca

Glossaries of salmon recovery terms may be found at:

http://www.nwfsc.noaa.gov/trt/glossary.cfm#A
or
http://www.stateofthesalmon.org/resources/glossary.asp?let=a

WRIA 19 Salmonid Restoration Plan: Executive Summary

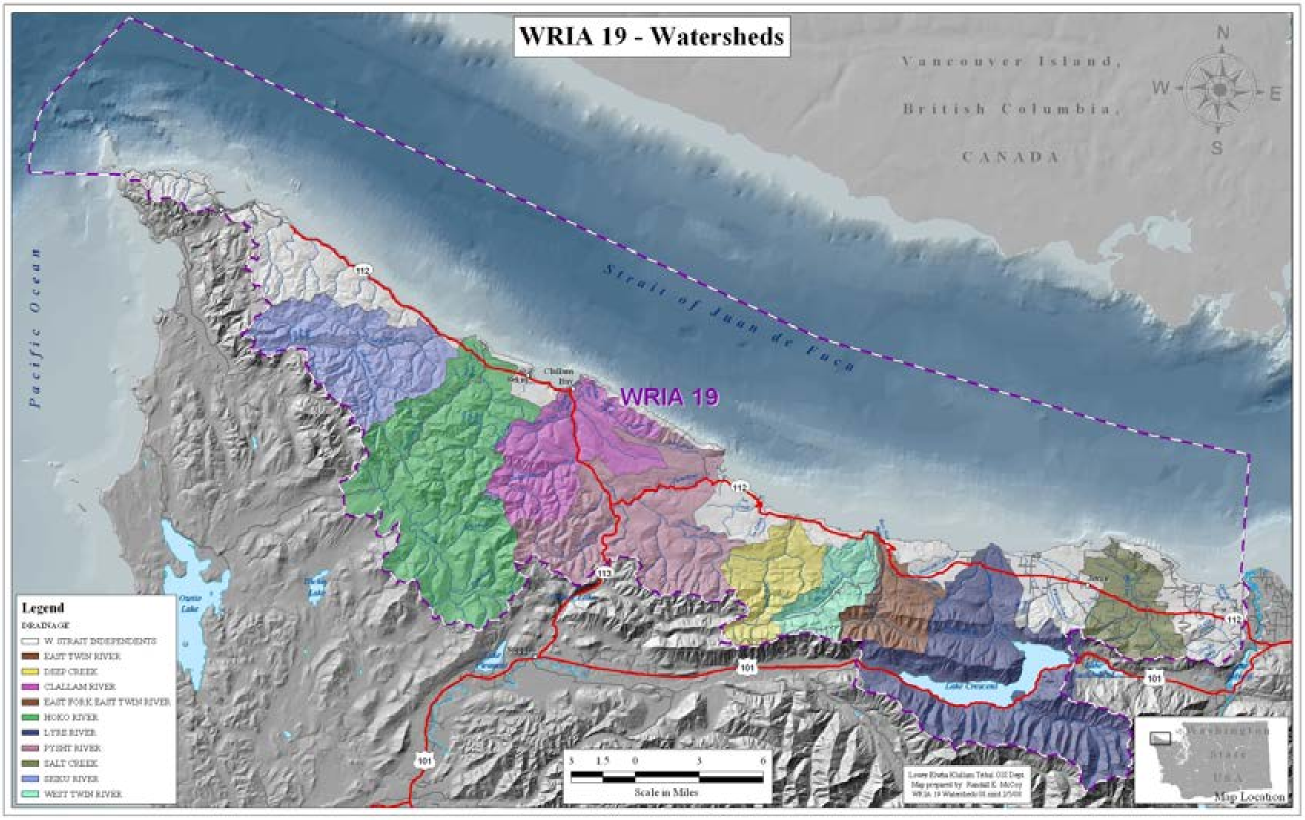
WRIA 19 provides a unique opportunity for protection and restoration of biological and landscape processes that will support long term salmonid survival and recovery.

INTRODUCTION

Encompassing the northwest tip of the Olympic Peninsula, Water Resource Inventory Area (WRIA) 19 contains the rivers and streams that drain the area from west of the Elwha watershed to the tip of Cape Flattery. A total of 27 separate salmonid-bearing watersheds in the area flow directly to the Strait of Juan de Fuca, and variously support Chinook, chum, and coho salmon, and steelhead and rainbow trout. The rivers and creeks of WRIA 19 meander through public and private forest land, with complex side channels, wetlands, and small estuaries.

The nearshore areas of WRIA 19 serve as an important migratory corridor for many other salmonid populations leaving or entering the Strait of Juan de Fuca, and are an important habitat for forage fish.

Several WRIA 19 salmonid populations are considered critical or depressed from historic levels. However, WRIA 19 remains largely undeveloped and predominantly forested, thus offering substantial potential for recovery.



The WRIA 19 Salmonid Restoration Plan (Plan) has been prepared as a road map for salmonid restoration and recovery. Salmonid recovery planning in the WRIA 19 area is coordinated by the North Olympic Lead Entity for Salmon and is part of the larger effort to protect and restore salmonids throughout Puget Sound, Washington State, and the Pacific Northwest.

The Plan for WRIA 19 recommends a series of restoration goals, strategies, and actions that can be implemented to restore the salmonids that spawn and rear in WRIA 19 freshwater habitats. The Plan is also intended to help organize, coordinate, and set priorities for the myriad of possible restoration actions, and ensure that the actions are scientifically sound and ecologically effective.

The Plan is divided into eight main chapters:

1. Introduction
2. Watershed Overview and Land Use
3. Salmonid Resources
4. Recovery Goals and Objectives
5. Habitat Conditions and Limiting Factors
6. Recent and Ongoing Conservation Efforts
7. Recovery Strategy and Actions
8. Restoration Actions (as well as research, monitoring, and evaluation)

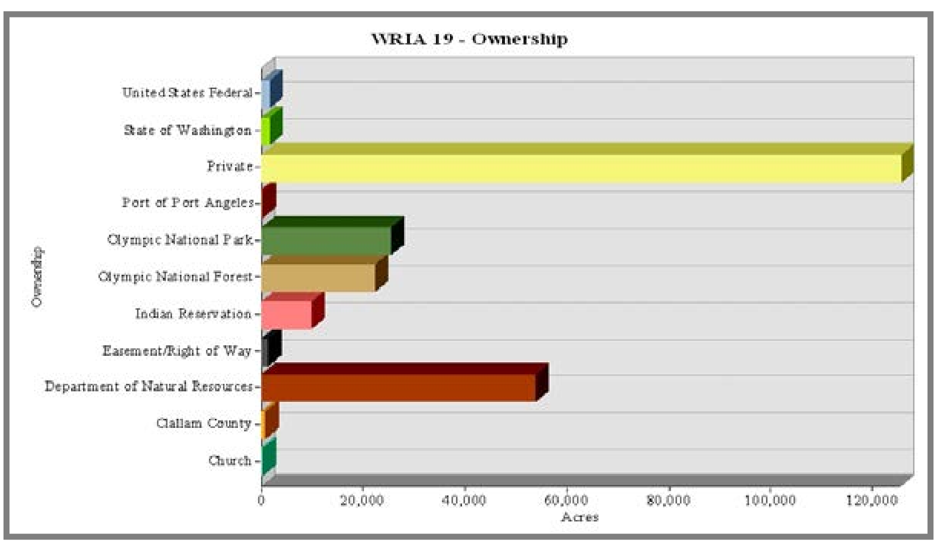
WATERSHED OVERVIEW and LAND USE

Most of the watersheds in WRIA 19 drain low elevation forested hills and mountains ranging from 2,000 to 3,000 feet. The exception is the Lyre River, which originates at 5,500 feet and contains alpine meadows and seasonal snow fields. Annual precipitation in WRIA 19 increases dramatically from east to west—over an inch per mile—as the sheltering effect of the Olympic Mountains diminishes. The Salt Creek basin receives precipitation of 35-55 inches per year while the Sekiu River basin receives 95-120 inches annually.

Prior to the treaties with the Makah and S'Klallam Tribes in 1855, seasonal and year-round tribal villages were located at the mouths of several of the major streams and beaches. As European settlement expanded in the 19th and 20th centuries, some of these locations became coastal logging communities and later transitioned to small residential and recreational communities.

Since the late 19th century, the watersheds adjoining the western Strait of Juan de Fuca have been timber territory, with extensive networks of logging roads and railroads. Almost 76 percent of the WRIA 19 area is classified as commercial forest land. Olympic National Park makes up 11.6 percent and the remaining 12.4 percent is classified as a mix of rural, urban, industrial, tribal reservation, and miscellaneous. The extensive timberlands of the area are managed according to Habitat Conservation Plans for private and state lands; federal forest land is managed under the Northwest Forest Plan.

Over 51 percent of the WRIA 19 area is owned privately. Public land is owned/managed primarily by the WA Department of Natural Resources, the US Forest Service, and Olympic National Park. Ownership patterns vary significantly from watershed to watershed; for example, nearly 77 percent of the Pysht River subbasin is privately owned while less than 7 percent of the East Twin basin is privately owned. These patterns necessitate different strategies and partnerships in salmonid restoration planning across WRIA 19.



SALMONID RESOURCES

Historically, chum and coho salmon, and steelhead and coastal cutthroat trout, were present in almost every watershed in WRIA 19. Chinook were historically present in the Hoko, Sekiu, and Pysht Rivers, but predominantly spawn in the Hoko. Chinook also stray into other north Olympic Peninsula rivers including the Lyre and Clallam. The Hoko and Pysht River systems support the largest coho populations in WRIA 19; while the Lyre, Hoko and Pysht are the major systems for steelhead trout. The Lyre and Pysht Rivers are also the major producers of chum in the western Strait of Juan de Fuca region.

Within the WRIA 19 watersheds, no species of salmon have been listed under the Endangered Species Act (ESA), but listed populations utilize the nearshore area as a migratory and rearing corridor. Many of the individual stock complexes in WRIA 19 are considered depressed, critical or have been eliminated from some streams.

The salmonids of the 27 separate basins in WRIA 19 are part of five distinct population segments as classified by federal agencies, and have 19 separate stock complexes classified by WDFW, as well as the endemic Lake Crescent Beardslee and Crescenti trout (rainbow and cutthroat subspecies, respectively). Summarizing the status of the salmonids in WRIA 19 is thus rather complicated. A review of historical information and trends was conducted by the Lead Entity Technical Review Group in 2004.

Summary of the 2004 N. Olympic Lead Entity status review for WRIA 19 Salmonids

Chinook			
Stream System	**Historical Presence**	**Population Status**	**Population Trend**
Sekiu River	Present	Critical	Stable
Hoko River	Present	Depressed	Increasing
Clallam River	Strays	na	na
Pysht River	Present	Critical	Stable
Deep Creek	Absent	na	na
West Twin River	Absent	na	na
East Twin River	Absent	na	na
Lyre River	Strays	na	na
Salt Creek	Absent	na	na
Western Strait Independents	Absent	na	na
Chum			
Sekiu River	Present	Critical	Stable
Hoko River	Present	Critical	Unknown
Clallam River	Present	Depressed	Stable
Pysht River	Present	Depressed	Declining
Deep Creek	Present	Critical	Declining
West Twin River	Present	Critical	Declining
East Twin River	Present	Critical	Declining
Lyre River	Present	Depressed	Declining
Salt Creek	Absent	Unknown	NA
Western Strait Independents	Absent	Critical	Declining

Summary of the 2004 N. Olympic Lead Entity status review for WRIA 19 Salmonids			
Coho			
Stream System	**Historical Presence**	**Population Status**	**Population Trend**
Sekiu River	Present	Depressed	Stable
Hoko River	Present	Depressed	Increasing
Clallam River	Present	Depressed	Increasing
Pysht River	Present	Depressed	Increasing
Deep Creek	Present	Depressed	Increasing
West Twin River	Present	Depressed	Declining
East Twin River	Present	Depressed	Declining
Lyre River	Present	Critical	Declining
Salt Creek	Present	Healthy	Stable
Western Strait Independents	Present	Critical	Declining
Steelhead			
Sekiu River	Present	Depressed	Stable
Hoko River	Present	Healthy	Stable
Clallam River	Present	Depressed	Unknown
Pysht River	Present	Healthy	Stable
Deep Creek	Present	NA	Stable
West Twin River	Present	Depressed	Declining
East Twin River	Present	Depressed	Declining
Lyre River	Present	Unknown	Unknown
Salt Creek	Present	Healthy	Stable
Western Strait Independents	Present	Depressed	Unknown

Salmonid refers to any of the various species of the family *Salmonidae*, including salmon, trout, char, and whitefish.

Chinook Salmon

Chinook spawning in WRIA 19 occurs primarily in the Hoko River. In recent years, Chinook salmon have also been observed spawning in the Sekiu, Clallam, and Pysht Rivers. Adult Chinook begin entering the lower Hoko River and estuary as early as late August and peak spawning typically occurs in late October. Hoko River Chinook have a complex age structure, with spawners returning as 2 through 7-year-old fish.

Natural production of Hoko River Chinook has fluctuated significantly over the past 27 years, ranging from a maximum of 736 natural-origin recruits[1] (NORs) in 1989 to a low of 72 NORs in 2005. Natural-origin Chinook spawning in the Hoko River increased from 1988 through 1999, and declined again from 2000 to 2005.

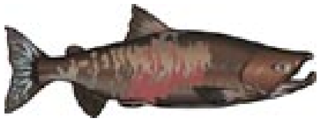
Chinook Hatchery Programs: Prior to 1981, many of the larger streams in WRIA 19 were supplemented sporadically with non-native stocks of Chinook from Puget Sound and Canada. A hatchery was built on the Hoko by the Makah Tribe in 1982, and uses adult Chinook returning to the Hoko to produce juvenile salmon. Approximately 200,000 juvenile Chinook are released annually into the Hoko and Little Hoko Rivers.

[1] The term "Natural Origin Recruit" is often used synonymously with "wild fish" and refers to a fish who spent its entire life cycle in the wild and whose parents spawned in the wild. Essentially, a Natural Origin Recruit is a fish that did not originate from a hatchery.

Hoko Chinook:
A US-Canada Indicator Stock
Since 1992, the Hoko Chinook has been an indicator stock for research programs conducted under the joint management of the US and Canada. This program provides information on ocean survival and the relative contribution of various Chinook stocks to the fisheries operated in different locations. All Hoko Chinook are tagged and clipped prior to release. Hoko Chinook tags have been collected in fisheries from Oregon to Alaska.

Chinook Harvest: Chinook were historically harvested from the Hoko and other larger streams in WRIA 19 by the Makah and Klallam tribes. There has not been a directed Chinook salmon tribal fishery in the Hoko River since 1982. From the late 1950's to 1988, the Hoko River was open to a salmon sport fishery, with size and retention restrictions, but has been closed by WDFW since 1989. Ocean fisheries that impact Hoko River Chinook occur primarily in Alaska and Canadian fisheries; less than 4% of the harvest occurs in Washington State waters. Recent measures have been taken to reduce overall exploitation rates in Pacific Ocean and Strait of Juan de Fuca fisheries.

Habitat conditions are described in the Plan on a river by river basis. Chinook salmon recovery and restoration projects will focus primarily on the Sekiu, Hoko, and Pysht rivers where historical populations were clearly present, and will entail close coordination of harvest and hatchery activities with rebuilding.

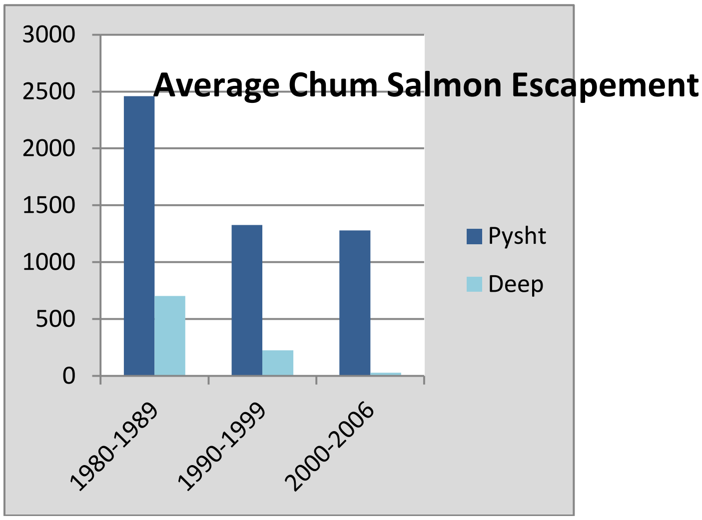


Chum Salmon

A thorough review of the WDFW spawning ground survey database revealed that from 1952 through 2003 a combined total of 122,406 adult salmon and steelhead were counted in WRIA 19 streams. Of these, 57,699 (47%) were chum salmon.

Historically, chum salmon spawning occurred in most of the WRIA 19 subbasins, with the largest populations likely in the Pysht and Lyre Rivers, followed by the Clallam, Hoko and Sekiu Rivers. Fall-run chum enter the rivers from late October through early November, and hold briefly before spawning. Juvenile chum salmon typically migrate to salt water within days or weeks after emerging from gravel, and spend an extended holding time in estuaries. Estuaries along the Strait of Juan de Fuca are small, and chum rearing in these areas has not been well documented.

Chum Hatchery Programs: Hatchery releases of chum using non-native stocks have occurred in only two WRIA 19 basins (Lyre River and Salt Creek) in three specific years during the 1970s. A streamside incubator was operated at Whiskey Creek in approximately 1991-92.



Chum Harvest: Total exploitation rates of western Strait of Juan de Fuca chum stocks are thought to be minimal, and generally occur as incidental harvest during fisheries for other salmonid species. Moreover, the fall-winter timing of chum returning to WRIA 19 occurs after most seasons are closed.

Lyre River Chum
The Lyre River has been described as being one of the premier chum populations on the north Olympic Peninsula, supporting annual runs of about 10,000 fish. Unlike other WRIA 19 streams, the Lyre supports both a fall run of chum, and a uniquely timed winter run that spawns from mid-November to late January.

Coho Salmon

Coho salmon spawn in nearly all of the accessible, low and moderate gradient streams draining into the Strait of Juan de Fuca. Within WRIA 19, the largest coho populations are found in the Hoko and Pysht Rivers. Small spawning populations are found in small subbasins including Village and Rasmussen Creeks.

Adult coho begin entering WRIA 19 streams as early as September if flows permit. Peak spawning typically occurs from late November through mid December. Stock status and trends for coho vary between subbasins. For example, Salt Creek coho spawning escapement declined from 1984 to 2000, followed by an increasing trend from 2001 to 2006. The Hoko River exhibits the opposite trend—positive increases from 1986 through 2002 followed by a severely negative trend.

Coho Hatchery Supplementation: Planting and release records indicate that WRIA 19 streams were planted with a cumulative total of 13.7 million juvenile coho from 1952 through 1988 from 11 different broodstock sources from outside of WRIA 19. The majority came from the Dungeness and Elwha Rivers, but small portions came from sources including the Skagit River, Hood Canal, and Pacific coastal streams. Coho outplants from the Elwha and other sources ended in approximately 1988, and there have been no other hatchery supplementation activities.

Coho Harvest: Coho returning to western Strait of Juan de Fuca streams are subject to intercepting fisheries that occur in the Pacific Ocean and Strait in the US and Canada, as well as small amounts of harvest in WRIA 19 streams. Most coho harvest in US waters occurs as incidental catch during fishing that is targeted on Frasier-bound sockeye, or during sport fisheries that occur in the Strait of Juan de Fuca. In 2010, the Pacific Fisheries Management Council reviewed the fisheries and escapement data for western SJF coho; they concluded that overfishing had not occurred and attributed low returns to poor ocean survival. The technical team recommended a review of escapement goals as well as continued work on habitat restoration programs.

"For its size, Salt Creek is one of the most productive coho systems around."
With only 19.1 square miles, the Salt Creek drainage is small, but coho productivity remains high. This is attributed, in part, to unique geological features, including a robust input of groundwater to the Salt Creek system.

Trout (Steelhead/Rainbow and Coastal Cutthroat)

Steelhead trout are among the most widely distributed and abundant salmonids in WRIA 19. Like other salmonids, steelhead trout are **anadromous**, meaning they return from saltwater to their natal freshwater to spawn. However, unlike Pacific salmon species, which die after spawning, steelhead are **iteroparous** and may transit from saltwater to freshwater and back repeatedly to spawn.

All WRIA 19 steelhead populations and spawning aggregations are classified as winter-run with the exception of the Lyre River, which includes both summer-run and winter-run steelhead. Historically the largest steelhead trout populations in WRIA 19 were found in the Lyre, Pysht, and Hoko Rivers, but significant populations were found in the Clallam and Sekiu Rivers, as well as Deep Creek. Small streams including Bullman and Rasmussen Creeks have spawning populations.

The 2004 status review of WRIA 19 steelhead by the Technical Review Group found that healthy populations exist in the Pysht/Deep and Hoko River stocks, and in the Salt Creek aggregation. All other stocks in WRIA 19 were considered depressed, with the exception of the Lyre River stock, which had an unknown status. Combined escapement estimates from all WRIA 19 subbasins range from a high of 1,988 steelhead in 1999 to a low of 918 in 2005. An index of these subbasins shows a slight negative trend

Steelhead Hatchery Programs: Until 2009, steelhead trout were planted by WDFW in the Lyre, Pysht, and Clallam rivers to provide harvest opportunity. Both winter-run and summer-run steelhead have been planted in WRIA 19 streams. The majority of the winter-run steelhead hatchery outplants came from the Bogachiel and Hoko River stocks. The Lyre River is the only stream that consistently received summer-run plants. Currently, approximately 20,000 yearlings are released from the Hoko hatchery annually, and off-station releases occur in the Sekiu and Sail Rivers along with some Neah Bay creeks.

Steelhead Harvest: Most WRIA 19 streams have had multiple rule changes to the recreational fisheries in the last 15 years that were designed to reduce impacts to wild steelhead. Closures occurred in the Twin river systems during periods of potential impact to the winter run. Sport fishers were required to release wild steelhead in most WRIA 19 streams while the outplant program was operational, and all but catch-and-release fisheries are now closed. Some wild harvest was permitted in the Pysht and Hoko Rivers from 1995-2005. Total harvest of wild and hatchery fish during that period in the Pysht and Hoko Rivers averaged 154 and 355 steelhead per year, respectively.

Coastal cutthroat

Coastal cutthroat trout within the WRIA 19 watersheds are not considered to be at risk of extinction. Coastal cutthroat trout are present in most WRIA 19 streams but there is little historical data. There is no hatchery supplementation, and harvest has been limited similar to steelhead.

RECOVERY GOALS AND OBJECTIVES

Recovery is a process that leads to salmonid populations that are not only viable, but that also provide a harvestable surplus for treaty tribes and other citizens of the region. Quantitative goals for salmonid populations originating in WRIA 19 were developed by the Technical Review Group from historical information and/or by extrapolating from other WRIA 19 watersheds. Federal ESA mandates for setting goals are not currently applicable for upland areas of WRIA 19, but interim goals were based on viable salmonid population parameters used in ESA recovery planning, and have been reviewed by state and tribal co-managers for WRIA 19. The development of goals for spatial structure and diversity will require additional research and adaptive management.

The goals may be amended to incorporate new data, future changes in population status, or major changes in harvest and hatchery management in the region. Recovery actions will need to address instream processes as well as upland watershed health, and be applied in concert with complementary management of harvest and hatcheries.

Quantitative goals for steelhead have not been agreed for all basins, and insufficient data exists for the development of recovery goals for cutthroat trout.

Viable Salmonid Population Parameters:
Recovery goals are generally based on long-term population viability as defined by four VSP parameters:

Abundance: How many fish are returning from the salmonid population?
Productivity: How well does the salmonid population replace itself? Do they spawn successfully? Until a depressed or critical population of salmonids recovers, the growth rate should exceed 1to1.
Spatial structure: Are the salmonids distributed in multiple streams and stream segments, to avoid the risk of a catastrophic event?
Diversity: Do they show a variety of genetic and behavioral traits such as run-timing, spawning-timing, and age at maturity?

Summary of Western Strait of Juan de Fuca Interim Chinook Salmon Recovery Goals	
Watershed	**Adult Spawning Escapement Goal**
Pysht River	360 adult spawners (interim goal)
Hoko River	850 natural spawners + 200 broodstock
Sekiu River	260 adult spawners (interim goal)
Total	**1,470 adult spawners + 200 broodstock**

Summary of the WRIA 19 Interim Chum Salmon Abundance Recovery Goals				
Subbasin	**Watershed Area (sq mi)**	**Chum/Sq Mi.**	**Abundance Ratio**	**Interim Recovery Goal**
WSI (Coville, Whiskey, Bullman, and Sail only)	25.9	28.95	1	750
Salt Creek	19.1	40.9	1	780
Lyre River	67.9	53.1	0.83	2,990
East Twin River	13.6	28.95	1	390
West Twin River	12.6	28.95	1	360
Deep Creek	17.2	40.9	1	700
Pysht River	46.3	53.1	1	2,460
Clallam River	31	53.1	0.74	1,220
Hoko River	71	53.1	0.32	1,210
Sekiu River	33.2	17	1	560
Total				**11,420**

Summary of WRIA 19 Coho Salmon Escapement Goals by Stock Group (source: FAB#83-30 *in* PFMC 1997)	
Stock Group	**Coho Escapement Goal**
Western Strait Miscellaneous	2,200
Lyre River	250
Twin Rivers	1,050
Pysht River	1,650
Clallam River	1,150
Hoko River	2,200
Sekiu River	900
Total	**9,400**

HABITAT CONDITIONS AND LIMITING FACTORS

The factors for decline of WRIA 19 salmonid populations are numerous and include loss of adequate quality and quantity of spawning and rearing habitat; over-harvest; poor ocean conditions; and the interaction of these factors. It is likely that the decreased numbers of naturally-spawning salmonids also reduced the amount of marine-derived nutrients in the streams, further lowering productivity. Past hatchery practices may have contributed to the decline of some species, but there is no direct evidence of this factor.

A distinction must be made between factors for decline and factors that currently limit salmonid abundance and productivity (limiting factors), as they are not necessarily the same. Actions that may have contributed to the decline of some species may no longer operate to limit abundance or productivity.

Limiting Factors in Freshwater Areas
Habitat conditions and limiting factors within each of the WRIA 19 subbasins is described in Sections 5.1 through 5.10 of the WRIA 19 Salmonid Recovery Plan, and include the following.

- Floodplain development and alterations
- Loss of large woody debris
- Estuary and nearshore alterations at stream mouths
- Degraded water quality and high stream temperatures
- Barriers that block access to spawning and rearing habitat
- Conversion of riparian forests to non-forest uses
- Excess sedimentation, including fine sediment in spawning gravels
- Degraded riparian conditions (e.g., conversion from conifer to hardwood dominated riparian forests)
- Stream channelization and bank armoring
- Stream cleaning
- Channel destabilization and channel incision
- Loss of adequate quality and quantity of spawning gravel
- Increased peak flows
- Unauthorized water withdrawals and low flows

The 1990 landslide in Deep Creek created a chain reaction of habitat degradation:
"The ensuing debris flow traveled approximately 2 stream miles, burying the USFS 30 road crossing and temporarily damming water flow in the upper main channel of Deep Creek. . . . The dam-burst flood scoured the main channel to as much as 10 feet vertical depth, tossing old growth logs outside of the active channel margins." (Shaw, in McHenry et al. 1995)

Deep Creek was a prime steelhead stream until the late 1980s, when mass landslides and debris dam-bursts filled spawning and rearing areas with sediment, or scoured and incised the channel. Restoration activities have been designed to accelerate natural habitat formation processes. Between 1997 and 2002 LWD and rock was placed in a 3 mile reach of Deep Creek to restore pool-riffle structure. Over 1,500 individual pieces of LWD were used to form log revetments, log jams, deflectors, log weirs, and rock/log structures. In the long term, protection of habitat-forming processes in Deep Creek will depend on programmatic activities and monitoring under newer forest practices regulations.

Nearshore Habitat
Nearshore habitat overlaps with and is influenced by upland riparian and stream processes, tidal mixing and sunlight limitation in the marine environment, and coastal geology. Nearshore areas of WRIA 19 are relatively undeveloped as compared to much of Puget Sound.

The nearshore within WRIA 19 offers greater than 130 linear kilometers of shoreline and is a critical component of the marine ecosystem. The WRIA 19 nearshore is an important migratory corridor and rearing environment for several population segments of salmonids listed under the Endangered Species Act including Puget Sound Chinook, Strait of Juan de Fuca/Hood Canal Summer Chum, Puget Sound Steelhead, and Columbia River Chinook. Sea run cutthroat trout, bull trout (ESA listed), and pink, sockeye, chum, and coho salmon, as well as forage fish, are also known to utilize the nearshore and estuarine habitat within WRIA 19.

Development of Restoration Strategies and Actions in WRIA 19:

A workgroup was formed by the Technical Review Group composed of local fish biologists, watershed scientists, and other interested individuals.

For each subbasin in WRIA 19, habitat conditions and watershed processes were evaluated in terms of:

- Estuary and nearshore processes and habitat conditions
- Habitat connectivity
- Biological processes
- Hydrologic processes
- Sediment processes
- Riparian and floodplain processes and conditions
- Habitat and LWD conditions
- Water quality conditions

The workgroup rated the level of impairment in each subbasin, and developed recovery goal narratives and strategies for each watershed process/ habitat condition.

Recovery goals and strategies were linked to restoration actions from previous reports and plans, as well as newly developed actions.

RECOVERY STRATEGIES AND ACTIONS

WRIA 19 provides a unique opportunity for protection and restoration of biological and landscape processes that will support long-term salmonid survival and recovery. The predominant land use is long-term forest management and there are relatively few individual landowners. Human population density is low throughout most of the region, with pockets of development around towns and the lower river mainstems.

The recovery strategy has been tailored for conditions specific to each of the WRIA 19 subbasins, which may or may not be shared across all subbasins. Additionally, different species and life histories within a species may have different limiting factors, creating multiple layers of complexity for restoration and recovery. .

Protection and restoration actions fall into three categories: programmatic actions (PA); habitat restoration actions (HRA); or research, monitoring and evaluation (RME).

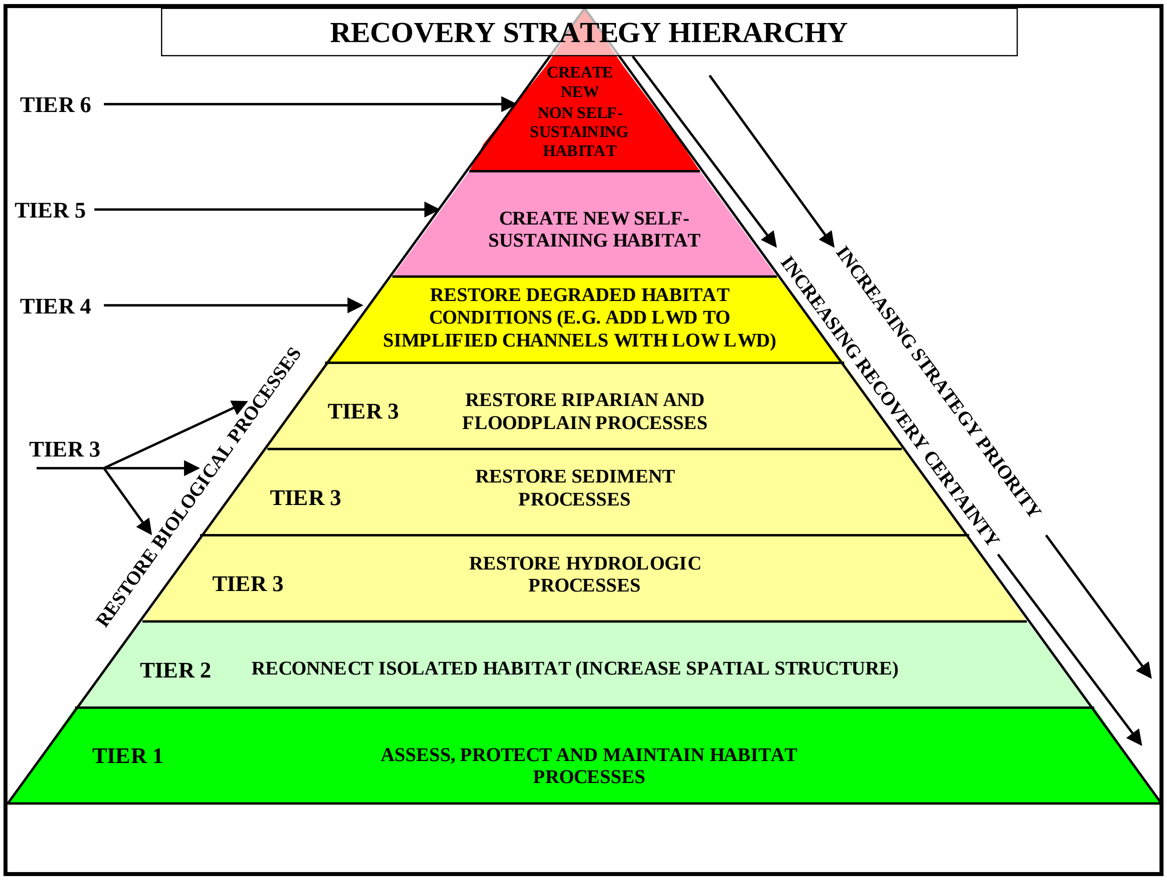
Programmatic actions are part of a policy, program or process, as opposed to being specific projects or related to specific sites. They are generally part of a regulatory or planning process. Important programmatic actions affecting WRIA 19 salmonids include updates to the Clallam County Shoreline Master Program and Critical Areas Ordinance, and implementation and adaptive management of the State Forest Practices Act and Habitat Conservation Plans for state and private forest landowners. Changes to US and Canadian fishing treaties and annual regimes will also affect salmonid survival and abundance.

Habitat restoration actions include a broad suite of action types including: LWD placement, riparian planting and fencing, culvert barrier removal, nearshore fill removal, conservation easements, etc. The most important aspect of long-term habitat restoration involves the restoration and protection of habitat forming processes. Often habitat restoration projects are focused primarily on restoring or enhancing site-specific habitat conditions. However, failure to protect and restore habitat-forming processes throughout WRIA 19 is unlikely to result in long-term improvement to watershed or nearshore habitats.

Research, Monitoring and Evaluation actions include a variety of watershed, project, and species monitoring actions such as salmonid abundance trend monitoring, channel migration zone mapping and delineation, and effectiveness monitoring.

The Plan assumes that Clallam County, the Tribes, WDFW, WDNR, WDOE, WDOT, private forest land managers, local residents, citizen groups, numerous other agencies, and individuals will develop and implement the recovery actions described within the Plan. It is important to note that the restoration actions identified within the Plan are voluntary. These actions are proposed for future consideration, and are not required or mandated as a result of being in the Plan.

Activities for habitat protection and restoration have been placed into tiers that can be used to sequence and aid in prioritization of strategies and actions needed to restore processes, inputs, and conditions affecting salmonids within each of WRIA 19 subbasins and the nearshore. Scientists and resource managers have recognized that restoration planning that carefully integrates watershed and ecosystem processes is more likely to be successful at restoring depleted salmonid populations.



WRIA 19 recovery strategy and action hierarchy

Implementation

The long-term implementation plan/schedule for the WRIA 19 Salmonid Recovery Plan is summarized in two tables: recovery goals and strategies, and recovery actions (Plan Appendices E and F). The recovery actions listed in Appendix F have been added to the North Olympic Lead Entity 3-year work plan for coordination of implementation.

Please refer to the NOPLE 3-year work plan for further details.

1 INTRODUCTION

The Water Resource Inventory Area 19 (Lyre-Hoko) Salmonid Recovery Plan (Plan) recommends a series of restoration goals, strategies, and actions that can be implemented to help restore salmonids (genus *Oncorhynchus),* which spawn and rear in freshwater habitat within WRIA 19. WRIA 19 includes all waters emptying into the Strait of Juan de Fuca west of the Elwha River, to the tip of Cape Flattery, on the northwestern tip of the Olympic Peninsula, as well as the nearshore habitat adjacent to the Strait of Juan de Fuca. The salmonid species included in this plan are Chinook salmon (*Oncorhynchus tshawytscha*), chum salmon (*Oncorhynchus keta*), coho salmon (*Oncorhynchus kisutch*), coastal cutthroat trout (*Oncorhynchus clarki & Oncorhynchus clarki crescenti)*, and steelhead/rainbow trout (*Oncorhynchus mykiss & Oncorhynchus mykiss irideus*). The Plan includes all watersheds within the WRIA and therefore may consider and recommend actions on a wide array of different land ownerships including: private lands, lands administered by the Washington Department of Natural Resources, Olympic National Forest, Olympic National Park, and Indian reservation lands.

The Plan works within the authorities of Clallam County, the Forest Practices Habitat Conservation Plan (FPHCP), the WDNR Habitat Conservation Plan (HCP), the Northwest Forest Plan, the National Park Service Organic Act of 1916, and tribal trust and treaty rights, and does not supplement or supersede these or other authorities.

Statewide salmon recovery planning in Washington began in earnest in 1998, with the enactment of Engrossed Substitute House Bill 2496 (ESHB 2496), codified as Chapter 77.85 RCW. The legislation followed actions taken by the National Marine Fisheries Service (NMFS) between 1992 and 1999 to list thirteen salmon and steelhead evolutionarily significant units (ESUs) in Washington by under the Endangered Species Act. State salmon recovery planning was divided geographically by NMFS into Salmon Recovery Domains and by the State of Washington into Recovery Regions. Salmon recovery planning in WRIA 19 falls outside of any Salmon Recovery Domain, but listed populations of salmon utilize the nearshore, and WRIA 19 is included within Washington State's Puget Sound Recovery Region. The North Olympic Peninsula Lead Entity for Salmon (NOPLE) coordinates salmon recovery planning within this portion of the Puget Sound Recovery Region. NOPLE works closely with the Puget Sound Partnership.

1.1 PURPOSE OF PLAN

The purpose of this Plan is to serve as a road map for salmonid recovery and restoration in WRIA 19. The Plan is needed to help organize, coordinate, and prioritize the myriad of possible recovery goals, strategies, and actions. The Plan will help ensure that restoration and recovery actions within WRIA 19 are scientifically sound, as well as effective and efficient. The Plan is based upon locally led collaborative efforts to develop recovery plans, involving local communities, state, tribal, and federal entities, and other stakeholders, primarily through the North Olympic Peninsula Lead Entity for Salmon, coordinated by Clallam County Department of Community Development.

1.2 PLAN ORGANIZATION

The Plan is divided into eight main chapters:

- Introduction (Chapter 1)
- Background (Chapter 2)
- Salmonid Resources (Chapter 3)
- Recovery Goals and Objectives (Chapter 4)
- Habitat Conditions and Limiting Factors (Chapter 5)
- Recent and Ongoing Conservation Efforts (Chapter 6)
- Recovery Strategies and Actions (Chapter 7)
- Implementation, Research, Monitoring, and Evaluation (Chapter 8)

Chapter 2 includes a general overview (Section 2.1) of the WRIA 19 watershed including a summary of the physical setting and a description of subbasins, geology, and climate. Past and current land use within the watershed is described in Section 2.2. Chapter 3 includes a detailed summary of each salmonid species' population status within WRIA 19. In addition, this chapter summarizes by subbasin, each species' population trend and status, fisheries and harvest impacts, and current and historical hatchery practices. Chapter 4 includes the recovery goals and objectives for each salmonid species present within WRIA 19.

Chapter 5 includes a summary of habitat conditions and limiting factors for each of the ten subbasins within WRIA 19. Chapter 5 also summarizes existing information related to estuary and nearshore conditions, habitat connectivity, spawning and rearing habitat conditions, riparian and floodplain conditions, and water quality and hydrologic conditions. A summary of funded and implemented habitat restoration projects for each subbasin is also included in Chapter 5. A brief summary of recent and ongoing conservation efforts is included in Chapter 6. Chapter 7 presents the WRIA 19 salmonid recovery strategy and includes a list of detailed restoration actions. These actions focus on hatchery, harvest, and habitat efforts that will help restore salmonid populations and their habitat throughout WRIA 19. Chapter 8 includes a discussion on Plan implementation, as well as a discussion on research, monitoring, and evaluation (RM&E).

2 BACKGROUND

Chapter 2 includes a general overview of the WRIA 19 watershed including a summary of the physical setting and description of subbasins, geology, and climate. Land use is summarized in Section 2.2 and includes a summary of past and current land use within the watershed.

2.1 WATERSHED OVERVIEW

WRIA 19 drains the northwest tip of the Olympic Peninsula, encompassing waters emptying to the Strait of Juan de Fuca west of the Elwha River to the tip of Cape Flattery (see Figure 1). WRIA 19 contains 27 salmonid-bearing watersheds that drain directly into the Strait of Juan de Fuca. The largest subbasin within the watershed is the Hoko River, followed by the Lyre, Pysht, Sekiu, and Clallam Rivers. The NOPLE salmon habitat recovery strategy combined the WRIA 19 subbasins into 9 geographic units as depicted in Table 1. Within this plan we have followed the general subbasin delineation established by NOPLE but we've separated the East and West Twin Rivers into two discrete subbasins.

Table 1. WRIA 19 NOPLE geographic units and drainage basin areas.

Watershed	**NOPLE Geographic Unit**	**Basin Area (sq. mi.)**	**Basin Area (sq. km.)**
Colville, Whiskey, Field, Murdock, Joe, Jim, Butler, Falls, Olsen, Trettevick, Jansen, Rasmussen, Bullman, and Snow Creeks, Sail River, and Agency, Halfway, and Village Creeks	Western Strait Independents	73.3	189.8
Salt Creek	Salt	19.1	49.5
Lyre River	Crescent-Lyre	67.9	175.9
East Twin River	East & West Twin	13.6	35.2
West Twin River	East & West Twin	12.6	32.6
Deep Creek	Deep	17.2	44.5
Pysht River	Pysht	46.3	119.9
Clallam River	Clallam	31.0	80.3
Hoko River	Hoko	71.0	183.9
Sekiu River	Sekiu	33.2	86.0
Entire WRIA 19 area	**Total Area of WRIA 19**	**385.2**	997.7

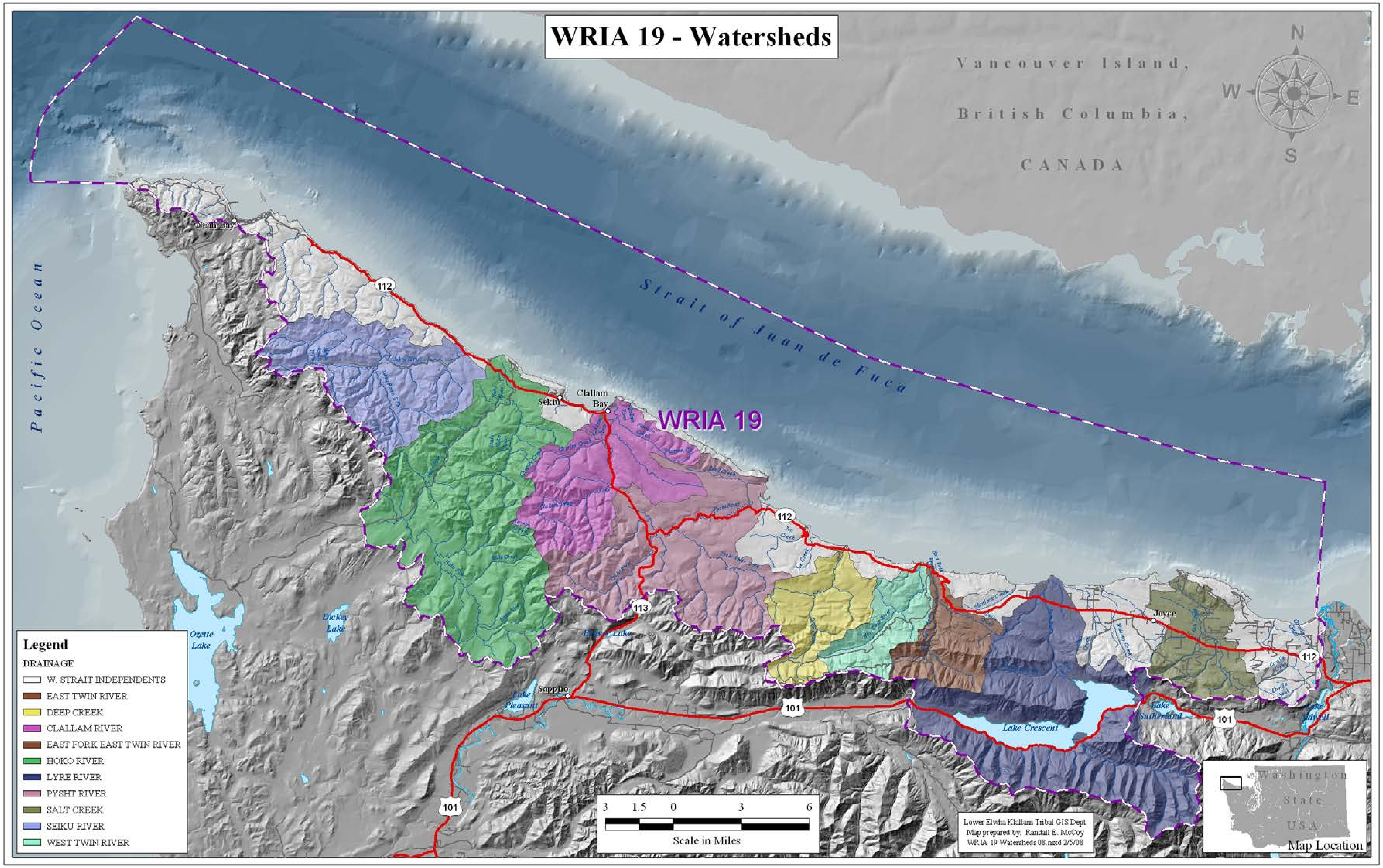


Figure 1. Water Resource Inventory Area 19 watershed overview map.

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As can be seen in Table 1 the Western Strait Independents (WSI) subbasin is composed of 18 small independent tributaries to the Strait of Juan de Fuca. Collectively, this subbasin drains 75.6 square miles. Most of the stream systems within the WSI subbasin are small, draining only a few square miles. The largest stream systems within the WSI subbasin are Whiskey, Colville, and Bullman creeks, and the Sail River. In addition, there are several very small streams included within this subbasin that are unnamed and do not have runs of anadromous salmonids.

The majority of WRIA 19 drains low elevation hills and mountains with maximum elevations ranging from 2,000 to 3,500 feet. The exception is the Lyre River subbasin where maximum elevations approach 5,500 feet and significant portion of the watershed is above an elevation of 2,500 feet. The Lyre River subbasin is the only subbasin within WRIA 19 that contains alpine meadows and seasonal snow fields.

The climate varies widely throughout WRIA 19, with higher annual precipitation to the west and at higher elevations. The climate as a whole can be characterized as temperate coastal-marine, with mild winters and cool summers. The majority of precipitation falls as rainfall from October through April. The eastern half of the watershed is much drier than the western half. For example, the Salt Creek subbasin receives 35-55 inches of precipitation annually (McHenry et al. 2004), whereas the Sekiu River subbasin receives 95-120 inches of precipitation annually (Lautz 2001). Subbasins such as the East and West Twin River and Deep Creek have intermediate precipitation levels averaging 75 inches per year (Stoddard 2002).

The WRIA 19 watershed is predominantly forested. Lake Crescent is the largest unforested area within the watershed. Other unforested areas occur where bogs and open water wetlands naturally exist, as well as in alpine meadows. The WRIA 19 forest can be characterized as a coastal temperate rainforest ecosystem. In the western portion of the watershed, western hemlock (*Tsuga heterophylla*) and Sitka spruce (*Picea sitchensis*), are the dominant conifer species, followed by western red cedar (*Thuja picata*), Pacific silver fir (*Abies amabilis*), Douglas fir (*Psuedotsuga mensiezii*), and western yew (*Taxus brevifolia*). Forests in the eastern half of the watershed are similar but with Douglas fir being a more dominant component and Sitka spruce being a much less prevalent species. Red alder (*Alnus rubra*) is the most prevalent deciduous tree, and is common along streams and disturbed sites. Vine maple (*Acer circinatum*) and bigleaf maple (*Acer macrophylla*) are also common in riparian areas, wetlands, and meadows.

Figure 2 depicts the geology of the WRIA 19 area, which is an interesting mix of sedimentary and basaltic volcanic rock types interspersed with glacial deposits. Bedrock units are generally orientated parallel to the Strait of Juan de Fuca, striking northwesterly in the western portion of the WRIA and west-northwesterly in the eastern half. The rock units are generally youngest nearest the Strait of Juan de Fuca and oldest in the headwaters. Bedrock units are overlain by glacial deposits in many places throughout the watershed but the most extensive glacial deposits occur closest to the Strait and/or east of the East Twin River. For example, glacial deposits occur across 18% of the watershed area but in the Salt Creek subbasin glacial deposits cover more than 35% of the basin.

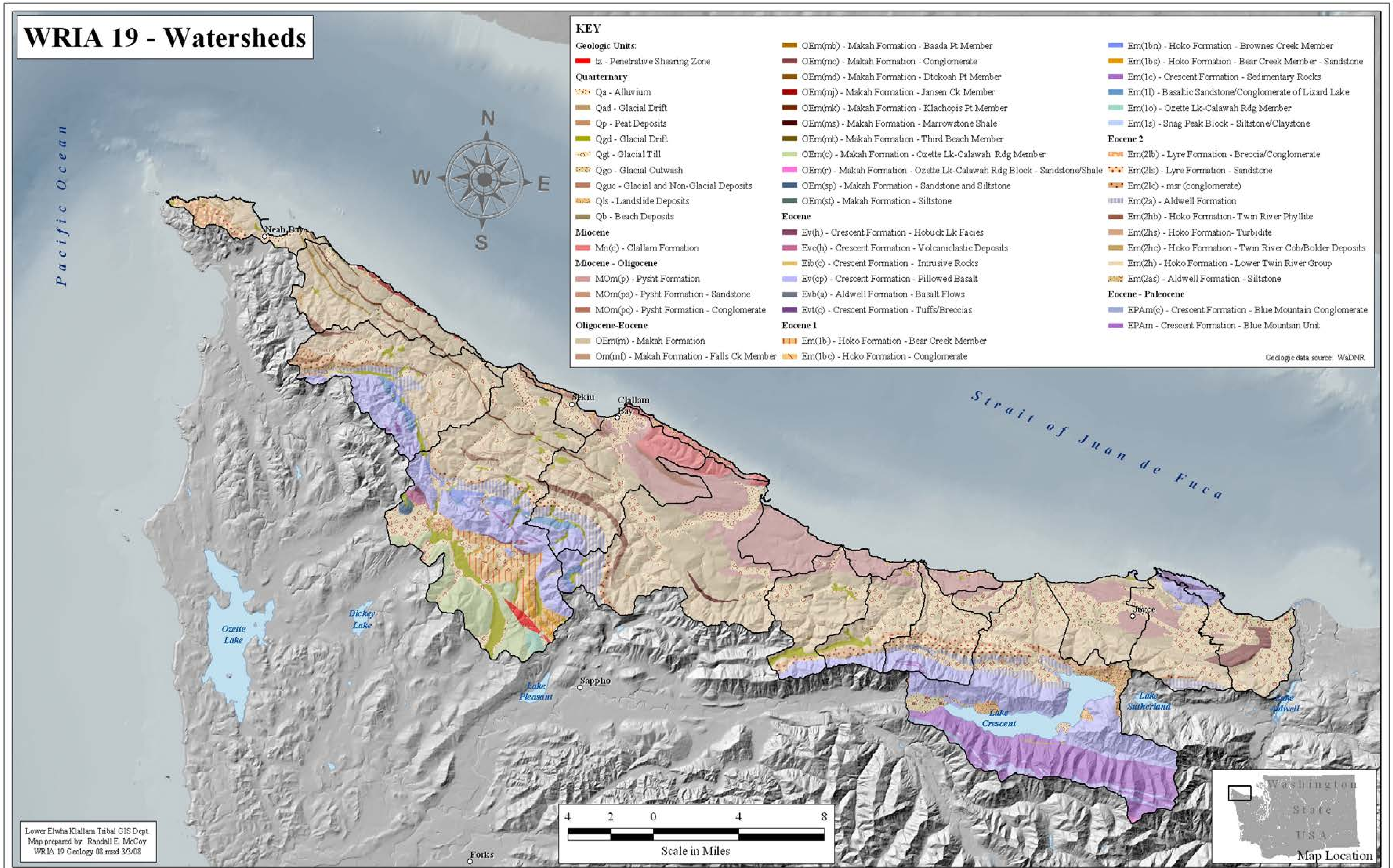

Figure 2. Geologic map of the WRIA 19 watershed (source: WDNR geologic data from Schasse 2003).

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2.2 LAND USE

For thousands of years prior to European settlement, the western Olympic Peninsula was occupied by Native Americans. There is no evidence to indicate significant or extensive anthropogenic effects on watersheds of WRIA 19 before European settlement. Throughout most of the watershed forest fires were infrequent, and mature conifers such as Douglas fir, spruce and cedar trees achieved ages of 400 years and older. In modern times, anthropogenic effects in WRIA 19 are primarily caused by timber harvest, road construction and maintenance, residential and agricultural development, tourism development, wetland filling, and stream clearing/rerouting. In the vicinity of Joyce, Clallam Bay/Sekiu, and Neah Bay, urban land use and/or infrastructure also affects salmonid habitat.

2.2.1 Historical Settlement

The area comprising WRIA 19 was ceded to the United States by the Makah Indian Tribe in the Treaty of Neah Bay in 1855 and by the Klallam Tribe in the Treaty of Point No Point in 1855. Year-round and seasonal tribal villages existed at the mouths of several of the major streams (Salt and Deep Creeks, Pysht River, Hoko River), as well as along the Strait of Juan de Fuca at strategic beaches (Clallam Bay, Neah Bay) and points.

European settlement within the watershed began in the late-nineteenth century. By the late-1800s tannin extraction, logging, coal mining, and farming appear to have been the main economies of the Clallam Bay/Sekiu area. The introduction and extension of logging railroads arrived on the western Olympic Peninsula around 1900 (Wright date unknown). Railroads and the advent of high lead logging opened new territory up to logging and aided in the formation of coastal communities like Port Crescent, Gettysburg, Twin, and Pysht. Many of the early logging communities were booming until the stands severed by the railroads were logged out. By the early 1950s most logging operations were accessed by roads, and logs were trucked to mills or log dumps.

2.2.2 Modern Landownership and Land Use

Ten landownership types exist within the watershed and they include the following: private, U.S. Forest Service (USFS), Washington State Department of Natural Resources (WDNR), Olympic National Park (ONP), Indian reservation, church, Port of Port Angeles, Clallam County, other federal lands, other state lands, and easements/right of way (see Figure 3). Zoning and land use classifications consist of a complex set of zoning types. The Clallam County land parcel database includes 19 different zoning classifications within the watershed. These zoning classifications can be simplified by grouping similar zoning types together to provide a basic summary of the land use types within the watershed: commercial forest, rural, Olympic National Park, urban/industrial, Indian reservation, other public land, easements/right of way, and other.

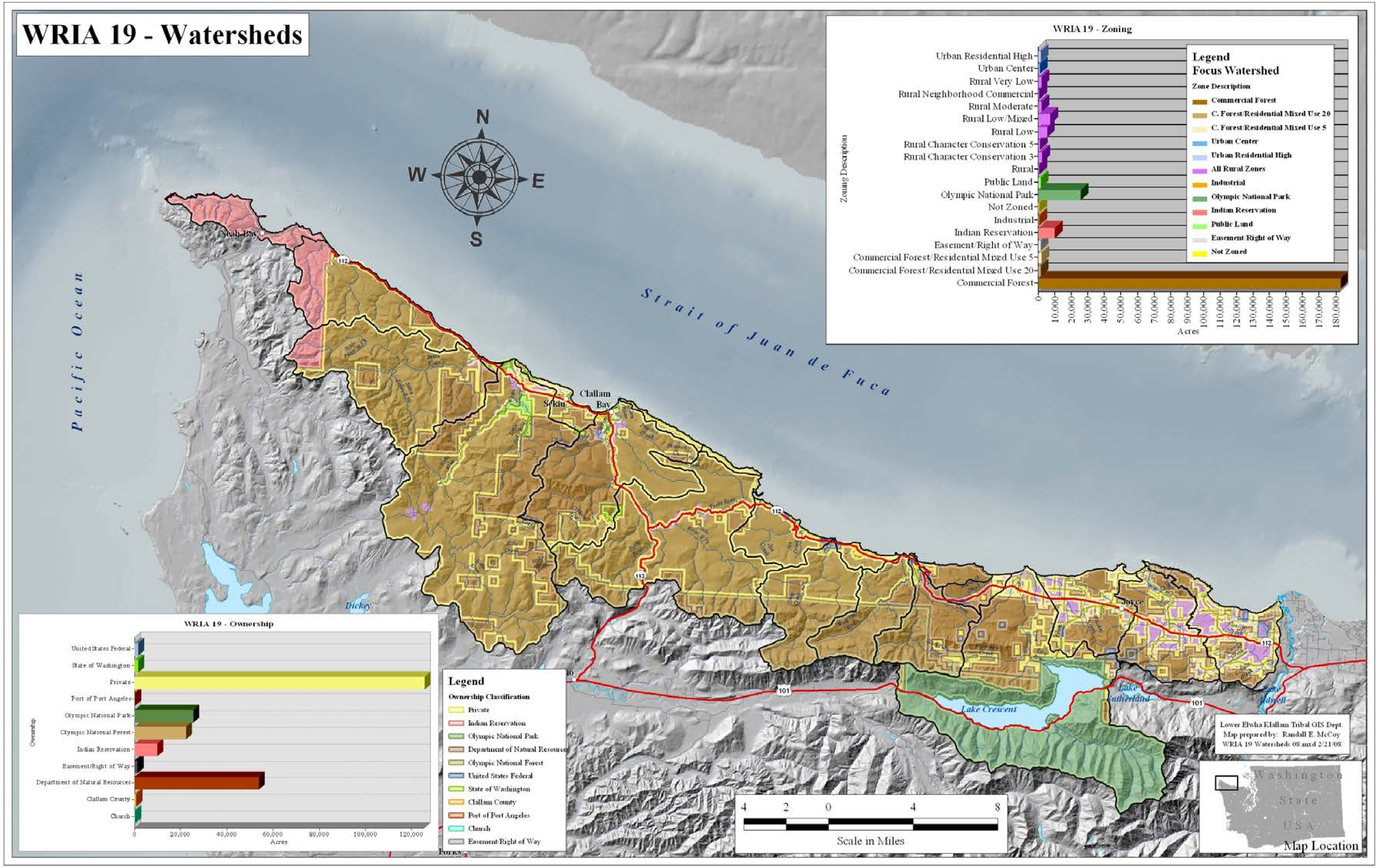

Figure 3. WRIA 19 land ownership types and Clallam County zoning.

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Over 51 percent of the watershed is owned privately (51.4%). Public ownership including WDNR (22.3%), ONP (11.6%), and the USFS (9%) comprise nearly 43% of the remaining land area. Less than 7 percent of the watershed is within the following ownership categories: Indian reservation, county, other state land, other federal land, easements/right of way, and miscellaneous (see Table 2). Landownership type varies significantly by watershed; for example, nearly 77 percent of the Pysht River subbasin is privately owned while less than 7 percent of the East Twin River subbasin is privately owned. Private land includes large industrial forest landowners and small forest, residential, and agricultural landowners. Appendix A includes detailed subbasin maps depicting classified landownership and land use types.

Table 2. Landownership types summarized as a percentage of watershed area by subbasin.

	Percentage of subbasin area within specified landownership types										
Subbasin	**Private**	**WDNR**	**ONP**	**USFS**	**Indian Res.**	**County**	**Other State Land**	**Other Federal Land**	**Ease. / ROW**	**Other**	**Total**
Salt	50.16%	44.31%	0.00%	0.00%	0.00%	1.07%	0.00%	3.13%	1.34%	0.00%	100%
Lyre	10.42%	17.47%	65.54%	5.66%	0.00%	0.00%	0.00%	0.61%	0.30%	0.00%	100%
East Twin	6.82%	46.05%	0.01%	46.21%	0.00%	0.13%	0.00%	0.54%	0.25%	0.00%	100%
West Twin	29.03%	9.88%	0.00%	60.93%	0.00%	0.00%	0.01%	0.00%	0.16%	0.00%	100%
Deep	43.20%	4.91%	0.00%	50.37%	0.00%	0.64%	0.00%	0.83%	0.05%	0.00%	100%
Pysht	76.73%	5.91%	0.00%	16.63%	0.00%	0.03%	0.24%	0.00%	0.45%	0.00%	100%
Clallam	49.56%	47.57%	0.00%	0.07%	0.00%	0.13%	2.07%	0.02%	0.58%	0.01%	100%
Hoko	72.47%	24.55%	0.00%	0.92%	0.00%	0.23%	1.73%	0.00%	0.08%	0.02%	100%
Sekiu	75.65%	17.26%	0.00%	0.00%	7.07%	0.00%	0.01%	0.00%	0.01%	0.00%	100%
WSI	57.06%	22.98%	0.00%	0.00%	16.78%	0.59%	0.38%	1.16%	0.98%	0.06%	100%
Total WRIA 19	**51.42%**	**22.25%**	**11.55%**	**9.05%**	**3.90%**	**0.25%**	**0.59%**	**0.53%**	**0.44%**	**0.02%**	**100%**

Almost 76 percent of the watershed is classified as commercial forest land. The next highest land use type within the watershed is ONP (11.6%). The remaining 12.4 percent of the watershed area's land use is classified as one of the following land use types: rural, urban and industrial, Indian reservation, other public lands, easements and right of ways, and other miscellaneous. Table 3 depicts the percentage of subbasin area with each of the 8 land use types.

As described above, nearly 76 percent of the watershed area is zoned as commercial forest land. Ownership of this commercial forest land is mixed with 56 percent owned by private timber companies, 28 percent owned and managed by WDNR, 12 percent is national forest service land, and the remaining is owned by small landowners, Clallam County, and miscellaneous other owners. This is an important point since land use and timber harvest practices vary by ownership. Section 2.2.2.1 explains the different regulatory systems used for the management of commercial forest land in WRIA 19.

Table 3. Land use types summarized as a percentage of watershed area by subbasin.

	Percentage of subbasin area within land use type							
Subbasin	**Commercial Forestry**	**Rural**	**ONP**	**Urban / Industrial**	**Indian Res.**	**Other Public Land**	**Easements**	**Other**
Salt	55.5%	42.3%	0.0%	0.0%	0.0%	0.7%	1.3%	0.2%
Lyre	31.0%	2.7%	65.8%	0.0%	0.0%	0.0%	0.3%	<0.1%
East Twin	99.9%	0.0%	<0.1%	0.0%	0.0%	0.0%	0.1%	0.00%
West Twin	99.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.00%
Deep	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	<0.1%	0.00%
Pysht	98.1%	1.4%	0.0%	0.0%	0.0%	0.0%	0.4%	0.00%
Clallam	94.3%	2.4%	0.0%	2.6%	0.0%	0.2%	0.6%	<0.1%
Hoko	95.5%	3.0%	0.0%	0.3%	0.0%	1.1%	<0.1%	0.00%
Sekiu	92.0%	0.9%	0.0%	0.0%	7.1%	0.0%	<0.1%%	0.00%
WSI	60.7%	19.6%	0.0%	1.6%	16.8%	0.2%	0.9%	0.2%
Total WRIA 19	**76.0%**	**7.2%**	**11.6%**	**0.6%**	**3.9%**	**0.3%**	**0.4%**	**<0.1%**

2.2.2.1 Timber Harvest and Forest Practices

Since commercial timberlands make up approximately 76 percent of the WRIA 19 land area, their management will play a significant role in salmonid conservation and recovery. As described above in Section 2.2.2, over 96 percent of the commercial forest land within the watershed is owned by WDNR, USFS, and private landowners. Each of these landowners have unique habitat conservation plans (HCPs) that regulate forest management. Private forest landowners operate under the Washington State Forest Practices Habitat Conservation Plan (FPHCP), WDNR state lands harvests timber under the WDNR Habitat Conservation Plan, and the USFS manages their forest land under the Northwest Forest Management Plan.

2.2.2.1.1 Forest Practices Habitat Conservation Plan (FPHCP)

In 1999, the Washington State Legislature passed the Salmon Recovery Funding Act (Engrossed Senate House Bill 5595) which identified forest practices as a critical component for salmon recovery. Through the Act, the Legislature recognized a report known as the Forests and Fish Report (FFR) as being responsive to its policy directive for a collaborative, incentive-based approach to support salmon recovery. The FFR was developed to create forest practices regulations that would protect riparian and aquatic habitat for the conservation of listed salmon species and other unlisted fish and stream associated amphibian species.

In 1999 the Washington State Legislature also passed the Forest Practices Salmon Recovery Act (Engrossed Senate House Bill 2091), which directed the Washington Forest Practices Board to adopt new forest practices rules, encouraging the Forest

Practices Board to follow the recommendations of the FFR. In its rulemaking procedures, the Forest Practices Board conducted an evaluation of the FFR, as well as alternatives to the FFR. This evaluation included an Environmental Impact Statement (EIS) under the Washington State Environmental Policy Act (SEPA). The Final State Environmental Impact Statement, entitled Alternatives for Forest Practices Rules for Aquatic and Riparian Resources, was published in April 2001. The Forest Practices Board adopted new permanent forest practices rules in 2001 based on the FFR.

Beginning in 2001, the State began working closely with U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) to develop what has become the FPHCP, under section 10(a)(1)(B) of the ESA, based on the forest practices rules adopted in 2001. The State submitted a formal application to the Services for Incidental Take Permits (ITPs) from each agency on February 9, 2005. In June, 2006, NMFS and the USFWS issued ITPs to the State of Washington that incorporated the terms of the FPHCP. In 2006, NMFS approved a federal HCP and ITP under ESA section 10, which covers all private forest lands in the State of Washington. The HCP, issued to the WDNR, represents a set of agreements between USFWS, NMFS, the State of Washington, and private timber landowners on conservation measures necessary to protect the survival and provide for the recovery of fish and aquatic species (NMFS 2006).

2.2.2.1.2 Washington State Department of Natural Resources

The Washington State Department of Natural Resources manages over 5.5 million acres of state owned lands. Nearly 3 million acres of the state's trust lands are managed to earn revenue to help fund construction of public schools and universities, while maintaining diverse habitats and providing public recreation opportunities.

In 1999, NMFS issued an Incidental Take Permit under ESA section 10 to the WDNR based on the HCP approved in 1997. The WDNR HCP covers all forested state trust lands in western Washington. The Riparian Forest Restoration Strategy (RFRS), developed with the Services and approved in 2005, defines the management goal for riparian areas as the restoration of high quality habitat to aid in salmon recovery efforts and to contribute to the conservation of other aquatic and riparian dependent species. Riparian management includes various types of thinning and also the natural development of some unmanaged areas to facilitate restoration of structurally complex older riparian forests.

The WDNR HCP covers approximately 1.6 million acres of forest land in eastern and western Washington within the range of the northern spotted owl (WDNR 1997). The HCP divides forest management into 9 planning units within 3 planning areas. The 3 planning areas are east side, west side, and Olympic Experimental State Forest (OESF). Within WRIA 19 the OESF planning area includes Deep Creek, Pysht, Clallam, Hoko, and Sekiu River subbasins, as well as small tributaries west of Deep Creek within the WSI subbasin. The Straits planning unit contains the remaining WSI subbasin tributaries and the West Twin, East Twin, and Lyre River subbasins and the Salt Creek subbasin.

The OESF strategy differs in both concept and detail from other west side planning units by combining conservation, timber production, and research and monitoring. One of the primary goals of the OESF is to manage the forest so that habitat conservation and timber production are melded across the landscape, rather than separated into designated areas (WDNR 1997).

2.2.2.1.3 Northwest Forest Management Plan

In 1993, after nearly two decades of debate and a dozen lawsuits regarding the protection of northern spotted owls and old-growth forests on federal forests of the Pacific Northwest a team was convened at the direction of President Clinton to develop a balanced, comprehensive and long-term policy for the management of over 24 million acres of public land (USDA FS and USDI BLM 1994). The team produced a detailed plan and analysis that included ten forest management scenarios. Attached to and made part of the Record of Decision (ROD) for the Northwest Forest Plan are standards and guidelines, taken from the Forest Ecosystem Management Team (FEMAT) report (USDA FS and USDI BLM 1993) and consistent with the Final Supplemental Environmental Impact Statement (USDA FS and USDI BLM 1994).

Collectively this work resulted in the development of a plan that uses land allocations, managed primarily to protect and enhance habitat for late-successional and old-growth forest related species, and standards and guidelines for the management of the land allocations. One of the guiding principles of this plan includes the Aquatic Conservation Strategy, developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands. The ROD includes seven land allocation categories. Within the WRIA 19 watershed only three of these land allocation types are present including, congressionally removed lands, adaptive management areas, and late-successional reserves. Congressionally removed lands only occur within the Lyre River subbasin, while adaptive management areas and late-successional reserves are distributed throughout the federal forest lands within the subbasins that contain federal forest land.

2.2.2.2 Private Residential, Urban, and Industrial Land Use

Less than 8 percent of the WRIA 19 watershed area is zoned as rural (several different rural zoning classifications), urban, and industrial. Nearly 78 percent of the area zoned as rural, urban, and industrial is contained within the Salt Creek and WSI subbasins (see Table 3). In 2000, Clallam County developed a draft "Salmon Habitat and Ecosystem Conservation Plan." The plan was prepared as Clallam County's ecosystem recovery strategy for ESA-listed salmonids. The purpose of the plan is to ensure that Clallam County's land use regulations are ESA compliant. The plan addresses the twelve critical land use-habitat issues identified by NMFS in the 4(d) rule (65 FR 42481, July 10, 2000) for development and/or redevelopment. The plan illustrates over 30 ongoing conservation measures being taken by the county, as well as numerous future conservation measures that can be taken, to ensure compliance with the ESA and promote salmon recovery. Although there are no ESA-listed salmonids inhabiting WRIA 19, the county's approach has been to develop and implement salmon recovery strategies across the entire county independent of ESA listing status.

2.2.2.3 Makah Tribe- Makah Indian Reservation

Just less than 4 percent of the WRIA 19 watershed area is within the boundaries of the Makah Indian Reservation. The majority of land within the reservation is forested and managed similarly to land in Clallam County zoned as commercial forest land. Rural, urban, and industrial land use types are also present within the boundaries of the reservation. Tribal rules and ordinances regulate all land use activities within the rural, urban, and industrial areas of the reservation (excluding fee lands).

In 1999, the Makah Tribe developed the "Forest Management Plan for the Makah Indian Reservation" (Makah Indian Tribe 1999). This document establishes the foundation for tribal forestry management on the 30,142 acre reservation. The Makah Forest Management Plan used an interdisciplinary approach to managing forest resources with four primary goals: 1) Provide for long-term sustainable level of harvest; 2) Sustain or enhance the long-term productivity of forest resources; 3) Preserve, protect, and enhance environmental, social, and cultural values to insure the availability of resources for current and future generations; and 4) Manage for a wide array of forest stand structures that will provide for diversity and stability. The plan divides the reservation into six forest management zones: timber, riparian, wildlife, cultural, mature forest, and wilderness. The plan protects approximately 38 percent of the forest from clear-cut logging in riparian, cultural, mature forest, and wilderness management zones.

2.2.2.4 Olympic National Park

Almost 12 percent of the WRIA 19 watershed is within the boundaries of ONP. The Park protects 922,651 acres of land on the Olympic Peninsula. All of the Park land within the WRIA 19 watershed is located within the Lyre River subbasin. Olympic National Park is subject to specific laws and mandates that relate directly to the management of national parks.

The NPS Organic Act (16 USC § 1) provides the fundamental management direction for all units of the national park system:

> [P]romote and regulate the use of the Federal areas known as national parks, monuments, and reservations…by such means and measures conform to the fundamental purpose of said parks, monuments and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.

The National Park System General Authorities Act (16 USC § 1a-1 et seq.) affirms that while all national park system units remain "distinct in character," they are "united through their interrelated purposes and resources into one national park system as cumulative expressions of a single national heritage." The act makes it clear that the NPS Organic Act and other protective mandates apply equally to all units of the system. Further, amendments state that NPS management of park units should not "derogat[e]…the purposes and values for which these various areas have been established."

The mission of the National Park Service at Olympic National Park is rooted in and grows from the park's legislated mandate found in the Act of Congress establishing the park on June 29, 1938 (which abolished the Mount Olympus National Monument established on March 3, 1909 and provided authority to proclaim certain enlargements) and in subsequent Congressional legislation.

The act establishing Olympic National Park, approved on June 29, 1938 (H.R. 10024) and the accompanying House Report (Report No. 2247) more specifically defined the purposes of the park, stating:

> The purpose of the proposed national park is to preserve for the benefit, use and enjoyment of the people, the finest sample of primeval forests of Sitka spruce, western hemlock, Douglas fir, and western red cedar in the entire United States; to provide suitable winter range and permanent protection for the herds of native Roosevelt elk and other wildlife indigenous to the area; to conserve and render available to the people, for recreational use, this outstanding mountainous country, containing numerous glaciers and perpetual snow fields, and a portion of the surrounding verdant forests together with a narrow strip along the beautiful Washington coast.

2.3 INTENSIVELY MONITORED WATERSHEDS

Recently, substantial investments in salmon and salmon habitat recovery have been made across the Pacific Northwest. However, there has been little research and monitoring to determine the effectiveness of salmon habitat restoration projects (Monitoring Oversight Committee [MOC] 2002). The MOC (2002) defines effectiveness monitoring as the measure of environmental parameters to determine whether the actions implemented were effective in creating the desired outcome. Little if any restoration validation monitoring has been conducted to date. Validation monitoring is the only type of monitoring that can establish cause and effect relationships between fish, habitat, water quality, and management actions.

Substitute Senate Bill (SSB) 5637, an act relating to monitoring of watershed health and salmon recovery, was signed into law by Governor Locke in 2001 (MOC 2002). The legislature found that, "…*a comprehensive program of monitoring is fundamental to* *making sound public policy and programmatic decisions regarding salmon recovery and watershed health. Monitoring provides accountability for results of management actions and provides the data upon which an adaptive management framework can lead to improvement of strategies and programs*." The act established the MOC and directed the committee to develop, for the consideration of the governor and legislature, a comprehensive and coordinated monitoring strategy and action plan on watershed health, with a focus on salmon recovery.

In 2002, the MOC drafted their first version of "The Washington Comprehensive Monitoring Strategy and Action Plan for Watershed Health and Salmon Recovery." The plan recommended among other things the creation of one or more Intensively Monitored Watersheds (IMW). In 2003, a proposal was submitted to the Salmon Recovery Funding Board (SRFB) to develop a long-term, state wide validation monitoring program using the IMW model as part of the state's salmon recovery strategy (Salmon Index Watershed Monitoring Redesign Group [SIWMRG] 2003).

Currently the IMW Program consists of three elements:

- Studies at three complexes of three or four watersheds each focusing on coho salmon and steelhead trout,
- Evaluation of the effects of estuary restoration on juvenile Chinook salmon growth and survival on the Skagit River Estuary,
- A Pacific Northwest-wide landscape classification intended to guide the application of IMW results to other watersheds. The classification is based on similarity of physical and biological characteristics to the watersheds included in the IMW project. Watersheds which have biophysical characteristics and patterns of human activities comparable to IMW sites will be locations where IMW results can be extended with the greatest degree of certainty (IMWSOC 2007).

There are three IMW complexes that focus on coho salmon and steelhead trout: Strait of Juan de Fuca (SJF), Hood Canal, and Lower Columbia, these complexes include a total of ten watersheds (IMWSOC 2007). The SJF IMW complex consists of 3 WRIA 19 subbasins: East Twin River, West Twin River, and Deep Creek. The goals of the IMW Program in the coho/steelhead complexes are to determine:

- Whether freshwater habitat restoration can effect a change in production of out-migrant coho salmon and steelhead trout;
- What features or processes influenced by habitat improvements caused the increased production or lack thereof; and
- Whether the beneficial effects of habitat improvement are maintained over time.

In order to develop answers to the three questions above, seven hypotheses will be tested in the SJF complex. These hypotheses are listed below:

1. The increase in out-migrant production following habitat treatments is greater in treatment watersheds than in reference watersheds.

2. The increase in mean parr population, growth, and density is greater in treated watersheds than in control watersheds.
3. The increase in mean egg to parr survival is greater in treated watersheds than in control watersheds.
4. The increase in mean parr to smolt survival is greater in treated watersheds than in control watersheds.
5. Restoration results in a measurable increase in habitat, basin wide.
6. The relative proportion of fall out migrants in East Twin River and Deep Creek does not change over time relative to West Twin River.
7. Marine survival rates of fall and spring migrants from East Twin River, Deep Creek and West Twin Rivers are equal

Within the SJF complex, smolt production, as well as the rate of change (in production) over time in treatment versus control basins after restoration, will be used to evaluate cause and effect relationships between restoration treatments and salmonid population responses (IMWSOC 2007). The study design consists of two treated watersheds and one untreated watershed. Deep Creek and East Twin River are the treated watersheds and West Twin River will not receive any restoration treatments and will serve as a no-treatment reference basin. Select reaches within the treatment basins may also receive no treatments and serve as controls for reach level experimentation. The IMW approach requires sufficient influence over management decisions to ensure that reference sites, at all spatial scales, remain untreated through the duration of the study (IMWSOC 2007).

Based on the importance and complexity of the IMW Program the WRIA 19 Plan defers all restoration planning and projects in these three subbasins to the Intensively Monitored Watershed Scientific Oversight Committee.

3 SALMONID RESOURCES

WRIA 19 salmonids have been subject to status reviews and classification systems that vary between federal and state agencies, tribes, and local salmon recovery organizations. This complicates the process of summarizing the status of salmonids in the Plan because these systems combine and omit spawning populations to different degrees.

WRIA 19 contains portions of 5 distinct evolutionarily significant units as defined by the National Marine Fisheries Service (NMFS):

Washington Coast Chinook Salmon
Olympic Peninsula Coho Salmon
Pacific Coast Chum Salmon
Olympic Peninsula Steelhead Trout
Olympic Peninsula Coastal Cutthroat Trout

An evolutionarily significant unit (ESU) is a salmonid population, or group of populations, that is substantially reproductively isolated from other populations and that represents an important component of the evolutionary legacy of the species. NOAA has established an ESU policy for Pacific salmon (56 FR 58612) that defines the criteria for identifying a Pacific salmon population as a distinct population segment that can be listed under the Endangered Species Act. Within the WRIA 19 upland watershed areas, there are currently no ESA-listed salmonid populations; however, the WRIA 19 nearshore area is an important migratory corridor for listed and unlisted salmonid populations. Federal status reviews of salmonids in the Pacific Northwest were conducted by Biological Review Teams (BRTs) appointed by NMFS to evaluate each species.

Comprehensive reviews of stock status by Washington State agencies and tribal co-managers were first summarized in the Salmon and Steelhead Stock Inventory (SaSSI) published in 1993. The classification system used by WDFW lists 19 different stock complexes in WRIA 19, as well as the endemic Lake Crescent Beardslee and Crescenti trout (rainbow and cutthroat subspecies, respectively).

The Technical Review Group of the North Olympic Peninsula Lead Entity completed a stream-by-stream review of WRIA 19 salmonids in 2004. The review was conducted as part of the development of the NOPLE recovery strategy, and incorporated state, federal, tribal, local and historical sources of information about each species.

The following sections of this plan describe the general life history of each salmonid species, the current population status and trends, as well as past and present harvest and hatchery management within the watershed.

3.1 CHINOOK SALMON (*O. tshawytscha*)

In WRIA 19, Chinook salmon spawning primarily occurs in the Hoko River. In recent years, Chinook salmon have also been observed spawning in the Sekiu, Clallam, and Pysht Rivers (Figure 4). There is some uncertainty regarding the historical distribution of Chinook salmon in WRIA 19 streams. For example, the 1992 Salmon and Steelhead Stock Inventory (SaSSI) states that spawning primarily occurs in the Hoko River and in only small numbers in the Pysht, Clallam, Sekiu, and Lyre (WDF et al. 1993). The NOPLE strategy (NOPLE 2004) concluded that Chinook salmon were historically only present in the Sekiu, Hoko, and Pysht Rivers. Kramer (1952a) describes a small run of Chinook salmon utilizing Salt Creek. McHenry et al. (2004) concluded that Chinook salmon do not appear to be a native species to Salt Creek; however, McHenry et al. (2004) also state that it may be possible that Chinook salmon went extinct prior to the 1950s. Kramer (1952b) describes small to moderate runs of coho, Chinook, and chum salmon in the Clallam River. WDFW et al. (2004) also describe a historical spawning population of Chinook salmon in the Clallam River. For the purposes of restoration planning, Chinook salmon recovery and restoration projects should focus primarily on the Sekiu, Hoko, and Pysht rivers where historical populations were clearly present.

Within the Hoko River system, Chinook begin entering the estuary and lower river as early as late August and will continue entering the system through late October to early November. Upon entering the system, Chinook will typically hold until the first significant rainfall event in October and then quickly migrate upstream to suitable spawning habitat. In most years, spawning occurs from late September through late November. Peak spawning in the Hoko River typically occurs in late October. Significant numbers of spawning Chinook have been observed into late November. Fry emerge in late winter or early spring and rear in the mainstem and large tributary habitat through May. Peak juvenile emigration in the Hoko River occurs from late May to late June. The Hoko River Chinook population has a complex age structure with spawners returning as two-through-seven-year-old fish (Haggerty et al. 2001). The majority of spawners (84%) during return years 1988 through 1999 returned as four and five-year-old fish. During the same period of time, the average age at return was as follows: Age 2 years 1 percent, age 3 years 9 percent, age 4 years 38 percent, age 5 years 46 percent, age 6 years 6 percent, and age 7 years less than 1 percent.

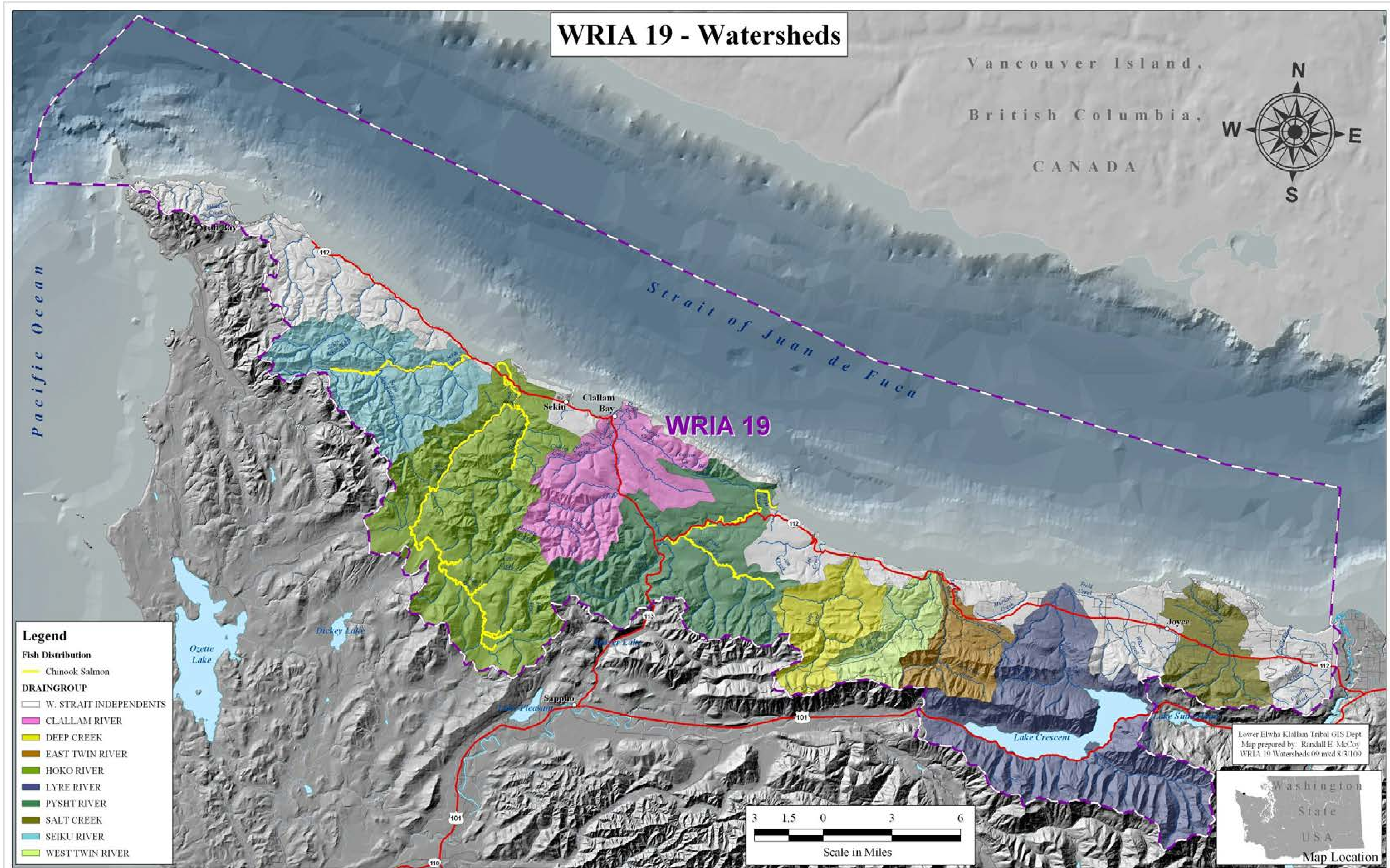

Figure 4. WRIA 19 Chinook salmon distribution map (source: salmonid distribution modified from Salmonscape 2005).

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3.1.1 Chinook Salmon Population Status and Abundance Trends

3.1.1.1 Chinook Salmon ESA Status Review

The Washington Coast Chinook ESU includes fall, summer, and spring runs of Chinook spawning north of the Columbia River and west of the Elwha River. Allozyme data indicate geographical differences between this ESU and Puget Sound, Columbia River, and Oregon coast ESUs. Populations within this ESU are ocean-type Chinook and generally mature at ages 3, 4, and 5 (older than in the Puget Sound ESU). Ocean distribution for these fish is more northerly than that for the Puget Sound and Lower Columbia River ESUs. The boundaries of this ESU are within the Coastal Ecoregion, which is strongly influenced by the marine environment, exhibiting high precipitation, moderate temperatures, and easy migration access.

Long-term trends for most populations in the Washington Coast Chinook Salmon ESU have been upward; however, several smaller populations are experiencing sharp downward trends. Fall-run populations are predominant and tend to be at lower risk than spring or summer runs. Hatchery production is significant in the southern portion of this ESU, whereas the majority of the populations in the northern portion of the ESU have minimal hatchery influence. The West Coast Biological Review Team unanimously concluded that Chinook salmon in this ESU are ***not*** in danger of extinction nor are they likely to become so in the foreseeable future.

3.1.1.2 Chinook Salmon WDFW Status Review

SaSSI identifies a single WRIA 19 Chinook stock: Hoko Fall Chinook, a native stock with composite production. The status of Hoko Fall Chinook was identified as depressed in 1992, and again in 2002. An alternate name for this stock is Western Strait of Juan de Fuca Fall Chinook. Current WDFW management goals do not manage for escapement in any western SJF stream except the Hoko. The 2002 SaSSI omits the Pysht, Clallam, Sekiu, and Lyre components of this stock/stock complex. The current Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component (WDFW et al. 2004) describes recent observations of Chinook spawning in the Sekiu River but assumes they are strays from the Hoko River system.

3.1.1.3 Chinook Salmon NOPLE Status Review

Version 3.5 of the NOPLE Salmon Habitat Recovery Project Strategy includes an updated stock status review for Chinook salmon in WRIA 19 streams. The status review was conducted by the NOPLE's Technical Review Group (TRG). Table 4 includes a summary of the 2004 NOPLE status review of the historical presence, population status, and population trends for Chinook salmon in WRIA 19 streams.

Table 4. Summary of the 2004 NOPLE status review for Chinook salmon in WRIA 19 streams (source: NOPLE 2004).

Stream System	Historical Presence	Population Status	Population Trend
Sekiu River	Present	Critical	Stable
Hoko River	Present	Depressed	Increasing
Clallam River	Strays	na	na
Pysht River	Present	Critical	Stable
Deep Creek	Absent	na	na
West Twin River	Absent	na	na
East Twin River	Absent	na	na
Lyre River	Strays	na	na
Salt Creek	Absent	na	na
Western Strait Independents	Absent	na	na

3.1.2 Chinook Salmon Abundance and Trends

3.1.2.1 Hoko River Chinook

Long-term Chinook salmon spawning ground survey data for all WRIA 19 streams are not available. The Hoko River has the most complete dataset. Annual spawning escapement estimates are available from 1979 to 2005. Hoko River Chinook are also part of the Pacific Salmon Treaty's Indicator Stock Program to assess the relative contribution of Hoko River Chinook to fisheries harvest in Alaska, Canada, Washington, and Oregon. Since 1985 Hoko River Chinook hatchery releases have been coded wire tagged (CWT). The CWTs are recovered from fisheries along the West Coast, as well as from salmon carcasses and brood stock collected in the Hoko River. Coded wire tags, fin clip status, and scale samples collected from returning Chinook salmon allow fishery managers to determine the age and origin of Chinook salmon in the Hoko River.

Figure 5 depicts Hoko River adult Chinook salmon total returns, total spawning escapement, and total number of natural origin Chinook by return year for the period 1979 through 2005. Reliable Chinook return disposition estimates are available for return years 1988 through 2005. Natural origin returns in Figure 5, for return years 1979-1987 were estimated based on hatchery releases (timing, number, and proportion relative to natural spawning escapement), average age at return, and average recruitment rates.

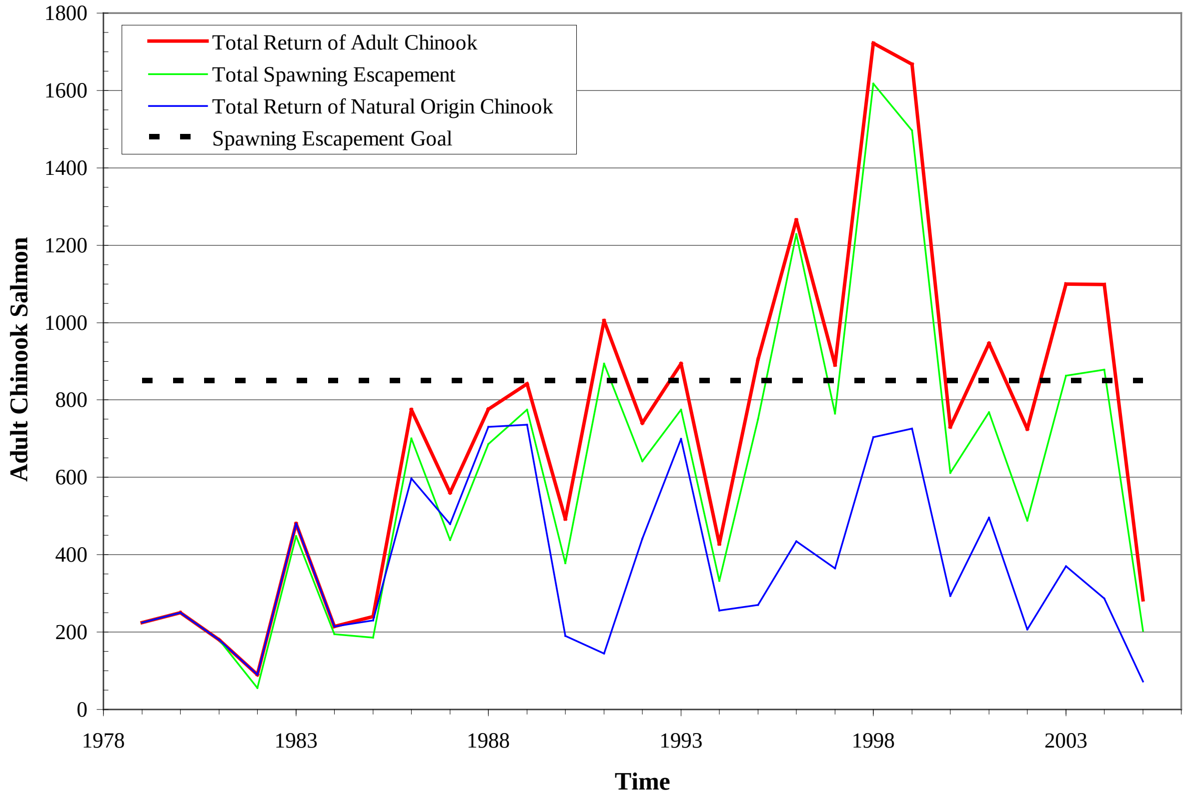

Figure 5. Hoko River adult Chinook salmon total returns, total spawning escapement, and total number of natural origin Chinook by return year (source: PST Indicator Stock Studies for return years 1988 through 2005). Note: the difference between total return and total spawning escapement reflects hatchery broodstock removal.

Natural production of Hoko River Chinook has fluctuated significantly over the past 27 years, ranging from a maximum of 736 natural-origin recruits (NOR's) in 1989 to a low of 72 NOR's in 2005 (Haggerty et al. 2001a; 2001b; 2001c; MFM 2006). The standard error of the mean of NOR's from 1979 to 2005 was 376 ± 40, n = 27. The number of natural-origin spawners averaged 240 fish from 1979 to 1984. Natural-origin Chinook spawning in the Hoko River during the period from 1988 through 1999 increased 97.1 percent over the period from 1979 through 1984, before Chinook began to return from the supplementation program in 1985. The abundance trend shifted negative in return year 2000. Natural-origin Chinook spawning in the Hoko from 2000-2005 averaged only 288 adult Chinook. The long-term trend in natural-origin recruit abundance is slightly positive and the trend was not statistically significant (p=0.63; see Figure 6). The 1979-1984 short-term trend in natural-origin recruit abundance was positive but the trend was not statistically significant (p=0.67). The 2000-2005 short-term trend in natural-origin recruit abundance was strongly negative but the trend was not statistically significant (p=0.22).

The number of NOR's per spawner for brood years 1986 through 1994 remained extremely low; averaging only 1.32 ± 0.42 NOR/spawner, with a range of 0.37 to 4.5.

Even more alarming is the fact that the natural-origin spawner to parent spawner replacement rate has only averaged 0.80 ± 0.29, ranging from 0.31 to 3.07 (Haggerty et al. 2001c)

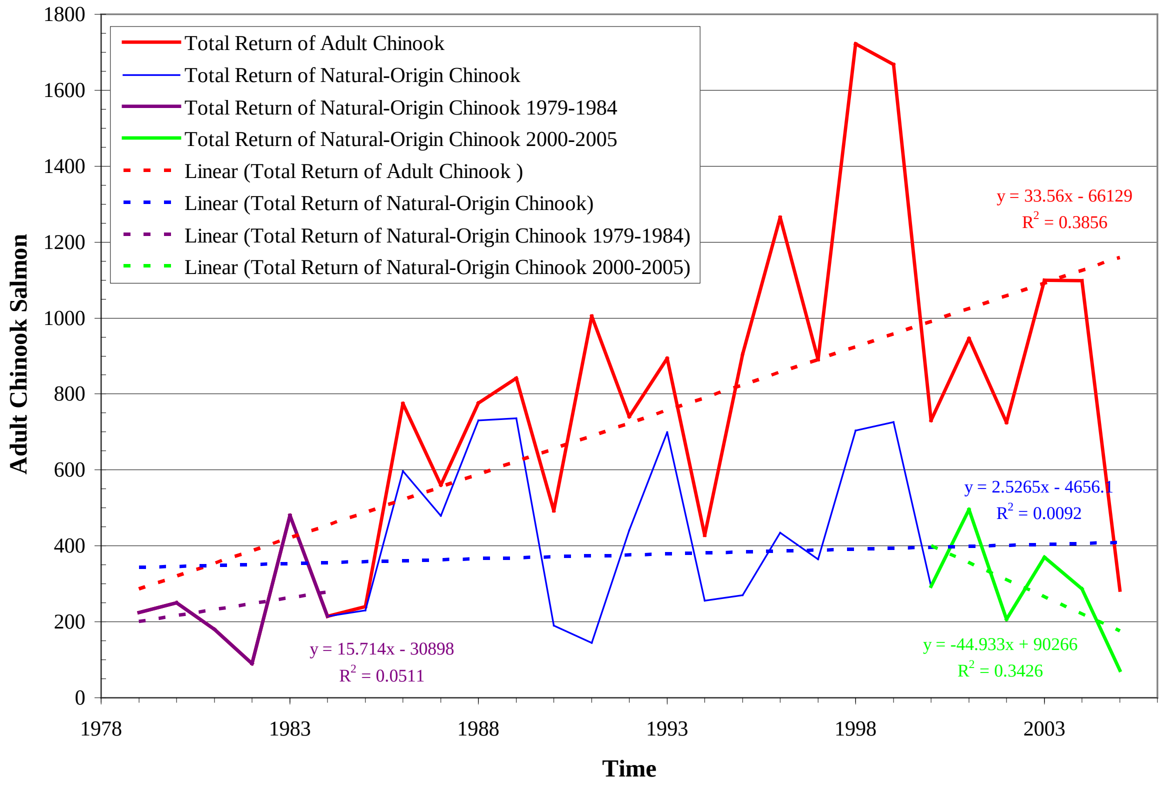

Figure 6. Hoko River adult Chinook salmon total returns and total returns of natural-origin Chinook by return year. Trends are included for total returns (RY 1979-2005), total natural-origin returns (RY 1979-2005), and total natural-origin returns (RY 1979-1984) and total natural-origin returns (RY 2000-2005) (source: PST Indicator Stock Studies for return years 1988 through 2005).

3.1.2.2 Sekiu River Chinook

Long-term spawning ground survey data for Chinook salmon in the Sekiu River system are not available. Spawning ground surveys conducted in the 1970s and early 1980s detected Chinook spawning during most years when surveys were conducted. However, during many of the years surveys were limited to the lower 1.5 miles of the Sekiu River, which is downstream of the areas where most Chinook spawning has been documented during the last 10 years. The Makah Tribe began detailed weekly surveys for spawning Chinook in 1997. Estimates of Chinook salmon spawning escapement are available for the period 1997 through 2005 (see Figure 7). The spawning escapement trend is slightly up but the trend is not statistically significant ($p>0.05$).

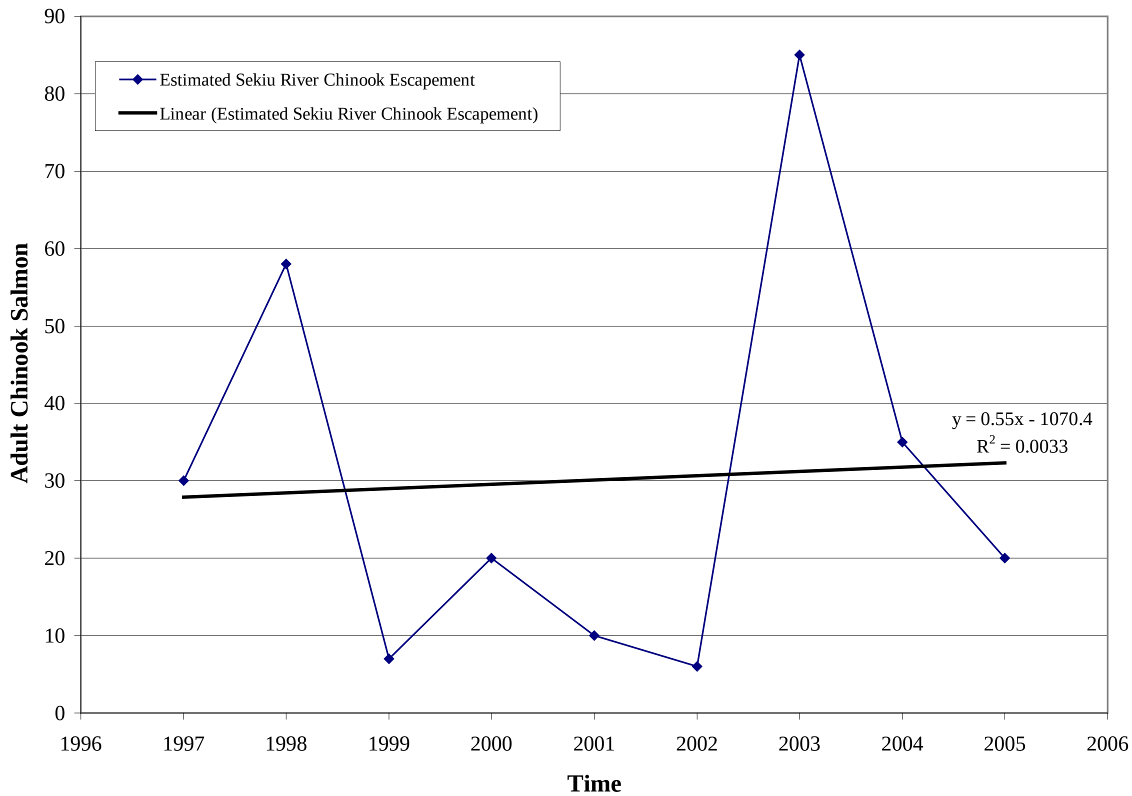

Figure 7. Sekiu River estimated Chinook spawning escapement for return years 1997 through 2005 (source: Annual Hoko River Chinook Indicator Stock Studies).

3.1.2.3 Pysht River Chinook

Chinook spawning ground surveys were conducted occasionally from 1952 through 1969. Starting in 1970, at least two Chinook spawning ground surveys were conducted every year until 1987, with the exception of 1973 and 1982. Spawning ground surveys were typically conducted in four index reaches: RM 3.5 to 5.6, RM 5.6 to 7.4, RM 7.4 to 8.2, and RM 8.2 to 10.0. The index reach from RM 7.4 to 8.2 was the most frequently surveyed reach. Since 1987 no systematic surveys for Chinook salmon have been conducted. The data from the 1970-1987 Chinook spawning ground surveys were recorded as the total number of live and dead Chinook. These data are summarized below in Figure 8. Note that Chinook salmon were regularly observed in spawning ground surveys in the Pysht River until the 1980s when the species was no longer encountered. It appears that the index surveys for Chinook salmon were discontinued after 1987. This may have been due to the lack of Chinook observed during the 1980s when a total of less than 30 live and dead Chinook were observed despite frequent surveys. McHenry et al. (1996) describe the historical spawning distribution as being concentrated between the confluence with S.F. Pysht River, upstream to SR 113, as well as including the S.F. Pysht River and Green and Needham creeks.

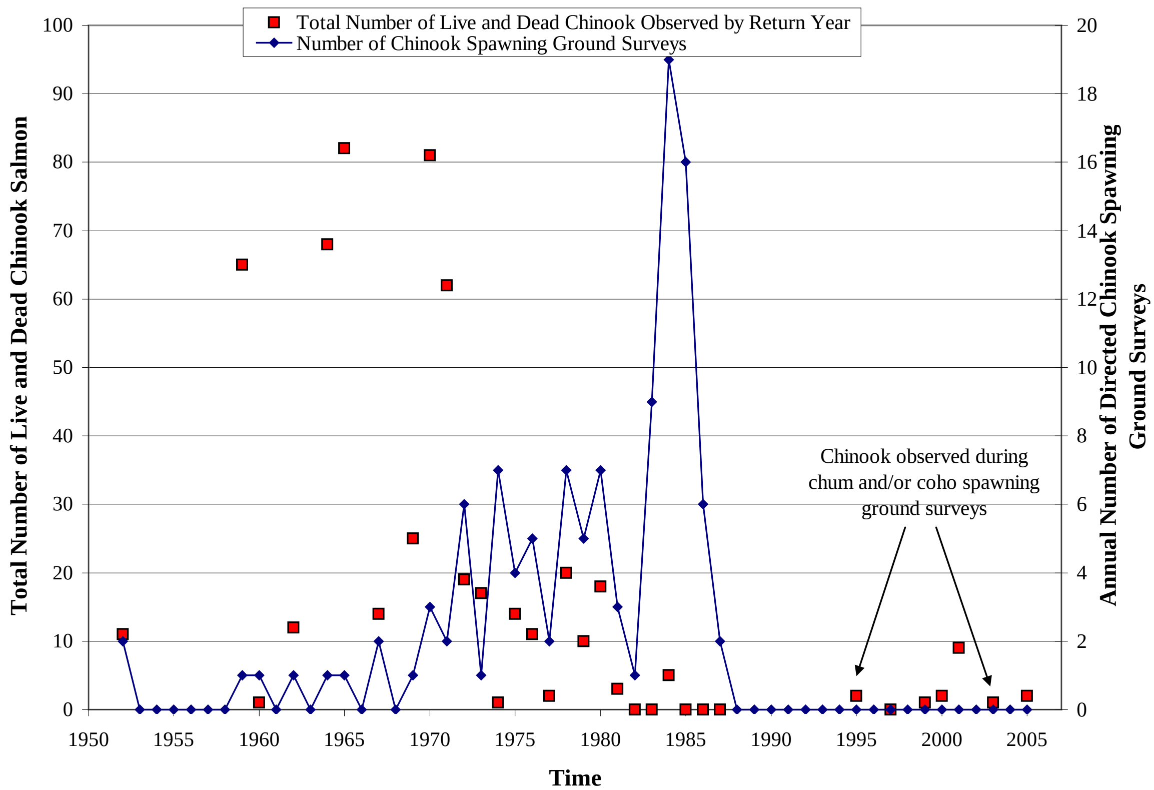

Figure 8. Summary of Pysht River Chinook salmon spawning ground data summarized as total number of live and dead Chinook observed (by return year) and the annual number of directed Chinook salmon spawning ground surveys (source: unpublished WDFW spawning ground survey data).

3.1.3 Chinook Salmon Fisheries and Harvest

3.1.3.1 Historical Fisheries and Harvest

Hoko River Chinook salmon have been harvested by the Klallam and Makah tribes for centuries (McHenry et al. 1996). From 1952 through 1977 tribal in-river set net harvest ranged from 72 to 723, averaging 271 Chinook salmon per year (Figure 9). From 1978 to 1982 tribal Chinook salmon harvest ranged from 0 to 22 (Currence, N., Pers. Comm. *In* Martin 1995). There has not been a directed Chinook salmon tribal fishery in the Hoko River since 1982. The directed sport salmon fishery in the Hoko River was closed in 1989 (WDF 1989). From the late 1950s through 1988 the Hoko River was open to salmon fishing but only Chinook salmon less than 24 inches could be retained. Fishing regulations prior to the late 1950s allowed the retention of two Chinook salmon greater than 24 inches in length per day (WDF 1958).

McHenry et al. (1996) attribute the collapse of Pysht River Chinook to two primary factors: habitat degradation and over-harvest. They speculate that the migration patterns of Pysht River Chinook are likely subjected to high ocean harvest rates in sport and commercial fisheries. In addition, they describe the initiation of a treaty in-river net fishery in the mid-1970s; this fishery may have contributed to the over-harvesting of Chinook salmon. A review of historical Pysht River directed sport salmon fishing regulations indicates that the regulations in the Pysht were the same as those described above for the Hoko River.

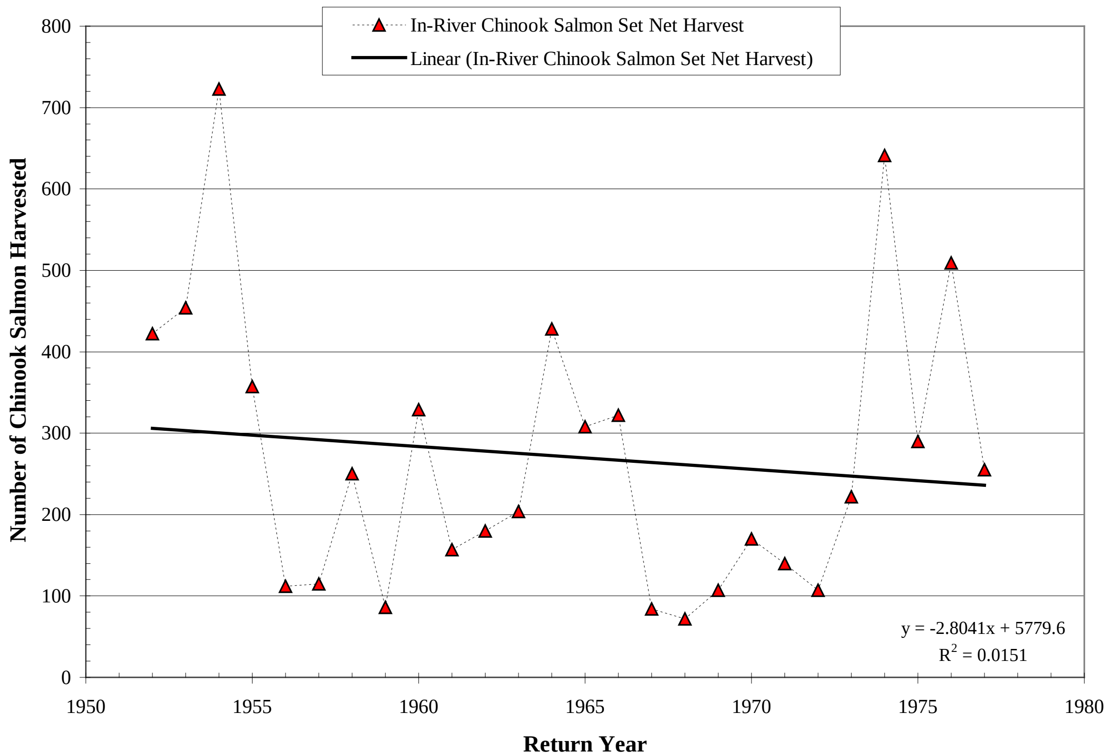

Figure 9. Hoko River tribal in-river set net Chinook salmon harvest from 1952 through 1977 (source: McHenry et al. 1996).

3.1.3.2 Recent Fisheries and Harvest

Hoko River Chinook are caught in salmon fisheries from the coast of Oregon north to Southeast Alaska. Coded wire tag (CWT) recoveries from 1996 through 2001 indicate that about 99 percent of the harvested Hoko River Chinook were caught in Alaska (75%) and B.C (24%). Only about 1 percent of Hoko River Chinook harvested were caught in Washington salmon fisheries (WDFW et al. 2004). A query of the Regional Mark Information System (RMIS) database (www.rmpc.org) of CWT recoveries from 2002-2006 indicates that more recently (2002-2006), Alaska catch accounted for about 53 percent of the harvest, while B.C. accounted for 43 percent, and Washington fisheries for roughly 4 percent of the harvest. Total adult-equivalent exploitation rates for Hoko River Chinook were thought to have declined significantly over the last 30 years. WDFW et al. (2004) state that total adult exploitation rates based on post-season Fishery Regulation Assessment Model (FRAM) estimates for 1983-87 averaged 76 percent and that these same estimates for 1998-2000 averaged 38 percent yielding a 51 percent decrease in estimated overall exploitation rates. However, no data are available for Hoko River Chinook for return years 1983-1987. During the five year period from 2001-2005 the exploitation rate ranged from 10 percent (2001) to 31 percent (2005), averaging 23 percent (Figure 10).

Several measures have also been taken during the last 10 to 15 years to help reduce the fisheries impacts on Hoko River Chinook salmon. Freshwater fisheries have remained closed to salmon fishing for both treaty and non-treaty fishers. In addition, the Hoko River trout fishery is open for fly fishing only from September 1 through October 31. This rule is designed to help reduce fishing impacts on Chinook salmon, as well as to reduce snagging and poaching in the river. In order to limit fisheries impacts from the Marine Area 4B/5 fishery on Sekiu and Hoko River Chinook, a special closure area was established. The Kydaka Point Closure includes waters south of a line from Kydaka Point, westerly approximately four miles to Shipwreck Point (this area is closed to salmon fishing from July 1 through September 30).

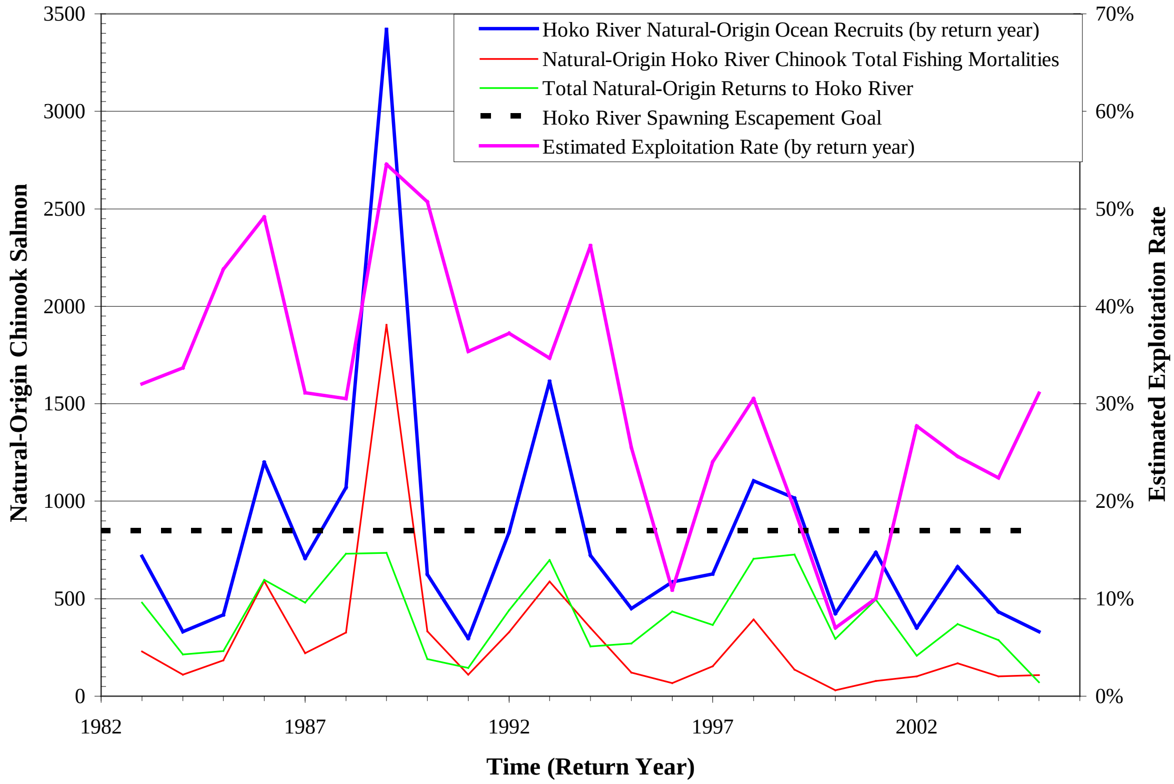

Figure 10. Estimates of Hoko River natural-origin Chinook salmon ocean recruits, total fishing mortalities, total returns to Hoko River and estimated exploitation rates. Return year 1989-2005 estimates are based on run-reconstruction from CWTs (source: Hap Leon, personal communication, 2008). Return year 1983 through 1988 are based on a regression of Elwha and Hoko River exploitation rates from CWTs for RYs 1989-2005 scaled to ocean recruits and fishing mortalities from run-reconstruction.

3.1.3.3 Chinook Salmon Hatchery Practices

In general, watersheds in the WRIA 19 portion of this ESU have not been extensively outplanted with hatchery Chinook salmon since 1981. Prior to this date sporadic outplanting with non-native stocks (Puget Sound/Hood Canal) occurred in the larger watersheds. For example, the Hoko River was annually supplemented with non-native stocks from 1950 through the mid-1970s. A hatchery was built in 1982 on the Hoko River by the Makah Tribe. This facility has produced juveniles obtained from adults returning to the Hoko River. Chinook fry from the facility are marked as part of the US Canada Indicator Stock program and released into the Hoko and Little Hoko rivers. Although the annual production target is 500,000, annual releases usually number approximately 200,000 (see Appendix B).

Table 5, adapted and corrected from Appendix D of the Chinook Salmon Status Review, summarizes Chinook salmon releases in WRIA 19 (Busby et al. 1997). An updated and corrected summary of hatchery Chinook releases in WRIA 19 can be found in Appendix B. This Appendix includes detailed release information not contained within the status review. In addition, errors were identified in the status review data as follows: (1) total Elwha River releases into the Pysht River include 17,155 Chinook that are not listed in the RMIS database; (2) two releases in the Clallam were omitted from the status review, a release of 937,990 Chinook in Charley Creek in 1965, and a release of 35,700 Hood Canal x White River Chinook in 1974; (3) the status review total for Hoko River incorrectly identifies 13,464 Hoko River Chinook reared in the Sooes Hatchery as Sooes River stock, includes an additional 190,588 Chinook that are not listed in the RMIS database (it appears that 190,588 was added twice), and omits 41,650 Hood Canal x White River plants in 1974 (see Appendix B).

Table 5. Hatchery releases of Chinook salmon summarized by release location and hatchery of origin, adapted and corrected from Status Review. Shaded cells contain values that differ from those reported in Busby et al. (1997).

Hatchery Source		Release Location							
		Salt	**Lyre**	**Deep**	**Pysht**	**Clallam**	**Hoko**	**Sekiu**	**Sail**
Deschutes R. (WA)	yr no	1975 100,800	1959 70,425	1975 100,800	1959 156,432	1961,75 193,185	1959,75 336,400	1975 184,800	
Elwha R.	yr no	1959 42,120			1953-56 109,760		1953,55 84,456		
Green R. H.	yr no		1958 101,012		1958-65 444,831	1965,66 1,442,930	1958,60 226,416		
Hoko R.	yr no						1983-2011 5,460,648		
Hood Canal H. (Finch)	yr no	1971,73 443,890	1963 112,348		1963,73 408,950	1962-73 2,096,097	1963-73 1,850,582	1971,73 758,450	
Hood Canal H./ Elwha R	yr no	1972 234,817			1972 234,366	1972 98,987	1972 234,877		
Hood Can H./ Sol Duc H.	yr no	1974,75 104,830		1975 25,774	1974,75 138,900		1974,75 172,348		
Hood Can H. X White R	yr no	1974 35,700				1974 35,700	1974 41,650		
Issaquah Cr. X White R.	yr no	1972 153,016			1972 152,535		1972 153,027		
Minter Cr. H.	yr no					1964 302,000		1971 524,221	
Portage Bay	yr no								1980 2,000
Sol Duc H.	yr no					1974,75 226,234			
Total Released		1,115,173	283,785	126,574	1,645,774	4,395,133	8,560,404	1,467,471	2,000

3.2 CHUM SALMON (*O.keta*)

Historically chum salmon spawning occurred in most WRIA 19 subbasins. The largest populations were likely in the Pysht and Lyre Rivers, followed by the Clallam, Hoko, and Sekiu Rivers. The Lyre River population has been described as being one of the premier chum salmon populations on the north Olympic Peninsula, supporting annual runs of about 10,000 fish (Goin 1990). Figure 11 depicts chum salmon distribution in WRIA 19 streams. Below is a simplified description of the life-history of WRIA 19 chum salmon.

Chum salmon exhibit two life history types: fall-run and winter-run. Fall-run chum salmon begin entering fresh water in late-October through early-November. Fall-run chum salmon will continue entering spawning streams through early-December. Upon entering freshwater most chum salmon will hold briefly before spawning. Most spawning occurs from mid-November through December (WDF et al. 1993). The winter-run chum salmon, which are unique to the Lyre River have protracted entry and spawn timings. Lyre River chum salmon spawn from mid-November through late -January.

Typically chum salmon migrate to the ocean shortly (days to weeks) after emergence from the gravel. Emergence timing is dependent upon spawn timing and incubation temperatures. Smolt trap data collected on various WRIA 19 streams has documented emigrating chum salmon as early as the first week of April (Deep Creek) and as late as the last week of June (Deep Creek; Unpublished Elwha Tribal smolt data). In the nearby Elwha River juvenile chum salmon have been captured as early as February. Smolt trapping in WRIA 19 streams doesn't target age 0 fish. However, peak counts of incidentally captured chum fry suggests peak emigration during the coho smolt trapping period occurs from mid-April through mid-May. Chum salmon fry typically have a longer residence time in estuaries than other Pacific salmon, where they spend an average of 10 weeks (Wydoski and Whitney 2003). Most WRIA 19 streams contain only small estuaries and chum rearing in these habitats is poorly documented. Most chum salmon in Washington State spend 3-5 years in saltwater before maturing and migrating into coastal streams to spawn (Wydoski and Whitney 2003).

3.2.1 Chum Salmon Population Status and Abundance Trends

3.2.1.1 Chum Salmon ESA Status Review

The Pacific Coast Chum ESU includes all natural chum salmon populations from the Pacific coasts of Washington, Oregon, and California, and the Strait of Juan de Fuca west of the Elwha River. The ESU definition is primarily based on life history and genetics. Allozyme data indicate that coastal populations form a coherent group that shows consistent differences between other fall-run populations in Washington and British Columbia.

Geographically, populations in the Pacific Coast Chum ESU are also isolated from most populations in the Puget Sound/Strait of Georgia and Columbia River ESUs, although Dungeness and Elwha stocks appear intermediate (Johnson et al. 1997). All chum salmon populations in the Pacific Coast Chum ESU are considered to include fall-run fish. The geographic extent of the Pacific Coast Chum ESU overlaps with multiple steelhead, Chinook and coho ESUs. Additional data may indicate that multiple chum ESUs also occur in this area. Many BRT members concluded that multiple ESUs of chum salmon may exist within the Pacific Coast ESU, but a lack of a variety of data prevented a more detailed evaluation (Johnson et al. 1997).

The boundary between the Pacific Coast and Puget Sound/Strait of Georgia Chum ESU is not clearly constrained. Both genetic and run timing data for the Elwha and Dungeness populations are inconclusive. WDFW considers the Dungeness and Elwha River populations to be affiliated with WRIA 19 populations, primarily because of their geographic separation from inner Puget Sound fall-run populations. However, the transition to the wetter, coastal climate occurs west of the Elwha and Dungeness Rivers on the Olympic Peninsula. The BRT concluded, based on available information, that Elwha and Dungeness fall chum should be considered part of the Puget Sound/Strait of Georgia ESU.

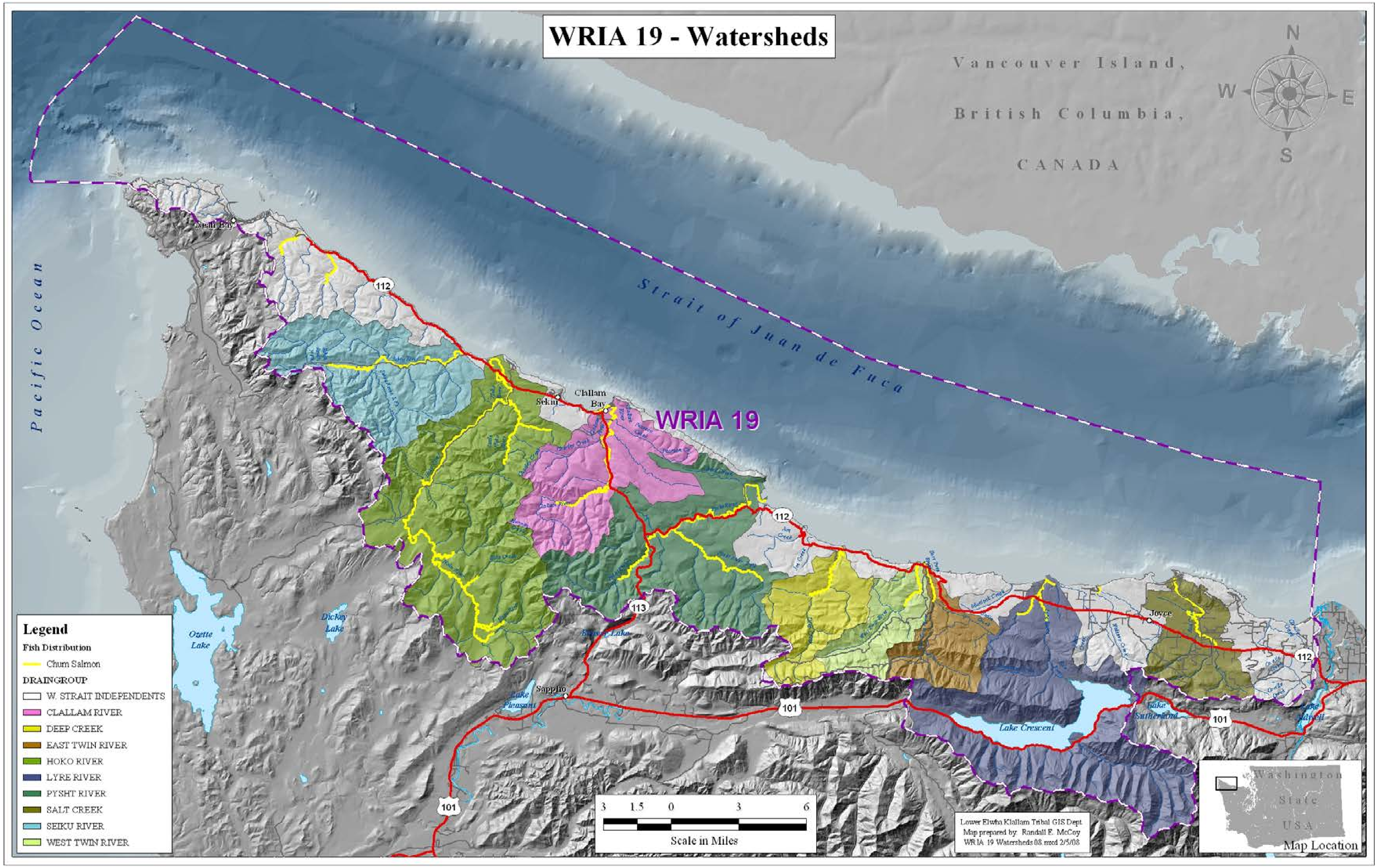

Figure 11. WRIA 19 chum salmon distribution map (source: salmonid distribution modified from Salmonscape 2005).

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The BRT concluded that the Pacific Coast Chum Salmon ESU is not presently at risk of extinction or endangerment. A key factor in this conclusion was the abundance of natural populations in Grays Harbor and Willapa Bay, where returns number in the tens of thousands. The BRT also noted that elsewhere on the Olympic Peninsula the population was depressed from historical levels but relatively stable.

3.2.1.2 Chum Salmon WDFW Status Review

The WDF and tribal status review in 1992 (WDF et al. 1993) and the WDFW 2002 status review both identify four chum stocks in WRIA 19: Lyre River, East Twin/West Twin/Deep Creek, Pysht River, and Clallam/Hoko/Sekiu River. All stocks are considered native with wild production. The 1992 status review determined that the Pysht River and the East Twin/West Twin/Deep Creek stocks were healthy and that the status of the Lyre River and Clallam/Hoko/SekiuRiver stocks were unknown. The 2002 WDFW stock status review determined that the East Twin/West Twin/Deep Creek stock had become depressed due to chronically low escapement. No other changes in stock status were identified.

3.2.1.3 Chum Salmon NOPLE Status Review

Version 3.5 of the NOPLE Salmon Habitat Recovery Project Strategy includes an updated stock status review for chum salmon in WRIA 19 streams. The status review was conducted by the NOPLE's Technical Review Group (TRG). Table 6 includes a summary of the 2004 NOPLE status review of the historical presence, population status, and population trends for chum salmon in WRIA 19 streams.

Table 6. Summary of the 2004 NOPLE status review for chum salmon in WRIA 19 streams (source: NOPLE 2004).

Stream System	Historical Presence	Population Status	Population Trend
Sekiu River	Present	Critical	Stable
Hoko River	Present	Critical	Unknown
Clallam River	Present	Depressed	Stable
Pysht River	Present	Depressed	Declining
Deep Creek	Present	Critical	Declining
West Twin River	Present	Critical	Declining
East Twin River	Present	Critical	Declining
Lyre River	Present	Depressed	Declining
Salt Creek	Absent[1]	Unknown	NA
Western Strait Independents	Absent[1]	Critical	Declining

[1]Note: chum salmon are currently present in both WSI and Salt Creek, their reported historical presence is assumed to be an error.

3.2.2 Chum Salmon Abundance and Trends

Long-term chum salmon population abundance data are lacking for most WRIA 19 streams. The only subbasins with long-term data are the Pysht River and Deep Creek; however the validity of some of these older data is questionable. For example, WDF et al. (1993) report that Pysht River chum salmon escapement from 1968 to 1991 ranged from 50 to 5,700, but a review of the spawning ground survey data indicates that fewer than 4 miles of total survey effort occurred on average between 1968 and 1979. For the purposes of this analysis we have concluded that the only potentially reliable spawning escapement estimates for Pysht River chum salmon are from 1980 to 2006. Therefore, there are 26 years of escapement estimates available for trend analysis. During the ten year period from 1980-1989 escapement averaged 2,459 (median 2,230), from 1990-1999 escapement averaged 1,328 (median 1,076), and from 2000-2006 escapement averaged 1,279 ([median 896]; WDFW 1997; Unpublished WDFW data). These data indicate that the average escapement declined by approximately 48 percent between the first period (1980-1989) and the last period (2000-2006).

The 1992 SaSSI reports that escapement in Deep Creek from 1968 to 1991 ranged from 40 to 1,800. A review of the Deep Creek spawning ground survey data showed a similar lack of survey effort prior to the 1980s. For the purposes of this analysis we have concluded that the only potentially reliable spawning escapement estimates for Deep Creek chum salmon are from 1980 to 2006. Therefore, there are 26 years of escapement estimates available for trend analysis. During the ten year period from 1980-1989 escapement averaged 703 (median 516), from 1990-1999 escapement averaged 225 (median 75), and from 2000-2006 escapement averaged 29 (median 25); (WDFW 1997; Unpublished WDFW data). These data indicate that the average escapement declined by approximately 96 percent between the first period (1980-1989) and the last period (2000-2006).

Figure 12 depicts the estimated annual chum salmon spawning escapement in the Pysht River and Deep Creek for return years 1980 through 2006. The trends for both spawning groups are negative and they are nearly parallel to each other. The long-term trend for Deep Creek chum salmon was statistically significant ($p=0.004$), but the trend for the Pysht River was not statistically significant ($p=0.089$). The data for the Pysht River for return years 1980 through 2000 show a decreasing trend in the peak escapement during the 3 to 5 year dominant brood year cycle, as well as lower lows. Return years 2000 through 2006 show a moderate increasing trend in the Pysht River (not significant $p=0.47$) but not in Deep Creek.

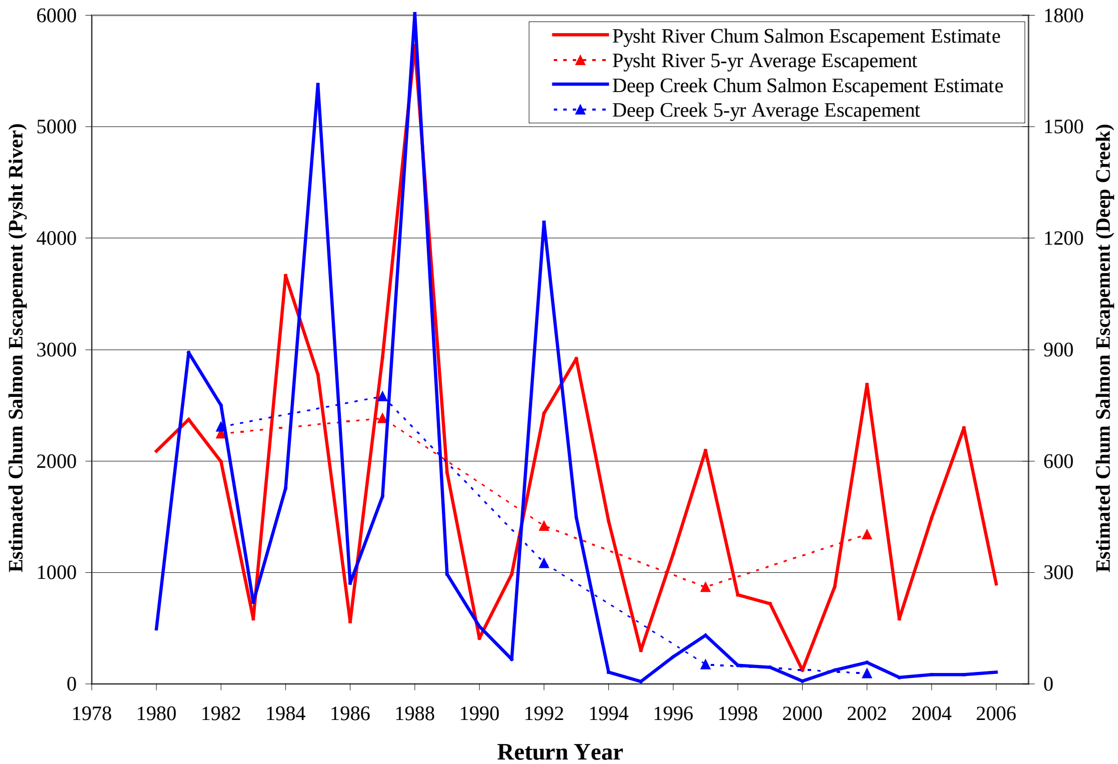

Figure 12. Pysht River and Deep Creek chum salmon spawning escapement estimates for return years 1980 through 2006 (source: WDFW 1997, 2002). Note escapement estimates for 2004-2006 were preliminary estimates based on average ratio of annual peak count to estimated escapement (source: WDFW unpublished spawning ground data).

A thorough review of the WDFW spawning ground survey database revealed that from 1952 through 2003 a total of 122,406 salmon and steelhead were counted in WRIA 19 streams; of these 57,699 (47%) were chum salmon. Figure 13 depicts the total number of all salmon and steelhead observed by return year contrasted with the total number of chum salmon observed and chum salmon observed per mile surveyed. Since 1952, chum have been documented spawning in each of the major nine WRIA 19 streams as well as within 28 tributaries to the major nine subbasins. Chum have only been documented in four of the WRIA 19 miscellaneous independents: Colville, Whiskey, Jim, and Falls creeks. Of the 57,699 chum salmon observed between 1952 and 2003 a total of 40,539 (70%), 8,375 (15%), 4,842 (8%), and 2,353 (4%) were observed in the Pysht River, Deep Creek, Lyre River, and Hoko River respectively. The remaining 1,590 (3%) were observed in the Clallam River (918), West Twin River (273), Sekiu River (68), East Twin River (62), Salt Creek (24), and miscellaneous Western Strait Independents.

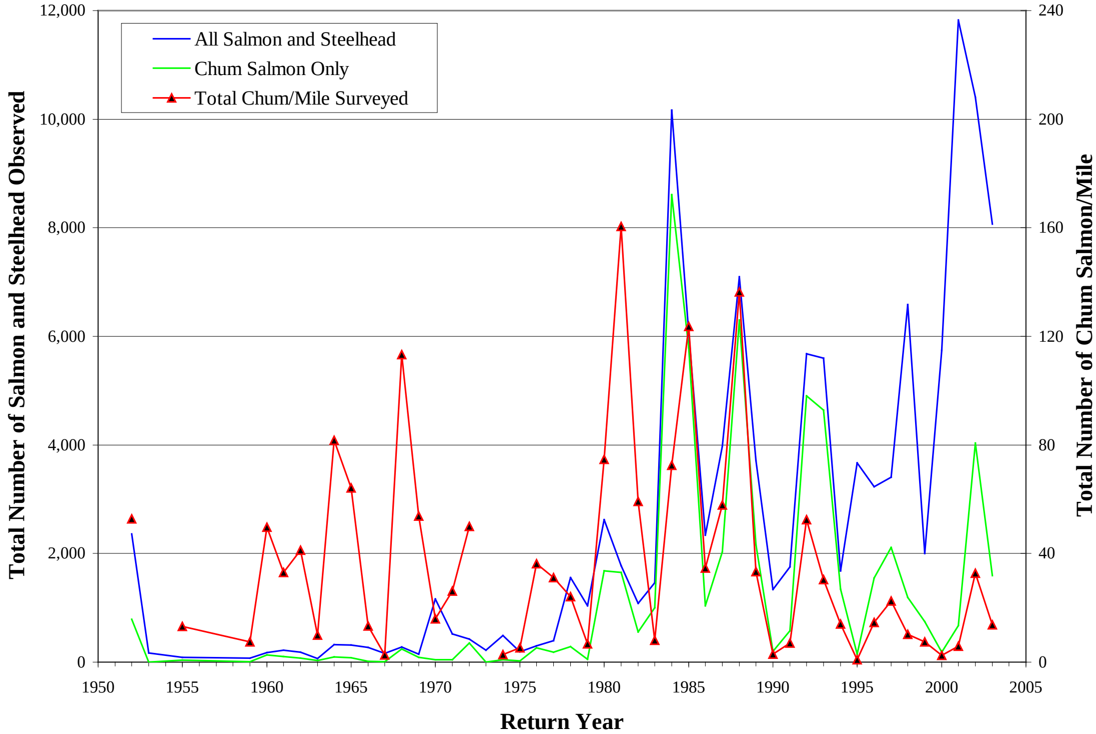

Figure 13. Total number of salmon and steelhead observed in all WRIA 19 streams from return year 1952 through 2003 contrasted with chum salmon only and total chum salmon observed per mile surveyed (source: WDFW spawning ground survey database).

3.2.3 Chum Salmon Fisheries and Harvest

Total exploitation rates for Strait of Juan de Fuca chum stocks are thought to be minimal. Directed chum fisheries do occur within the marine waters of the Strait, but the majority of chum taken in saltwater are taken incidentally during other net fisheries, specifically Fraser sockeye fishery openings. Moreover, these fisheries typically occur during the late summer months (July through September) and likely do not impact chum stocks returning to Strait of Juan de Fuca stream systems, as Strait chum return during the October to December timeframe.

Similarly, freshwater fisheries (tribal net fisheries and non-tribal sport fisheries) target steelhead, but chum may be harvested incidentally. One example is the Lyre River where the late-fall chum are often intercepted during steelhead fisheries. Tribal net fishing effort has been low within WRIA 19 streams for the past ten years. All WRIA 19 streams are closed to sport fishing for salmon; however there are opportunities for trout fishing. WDFW sport fishing regulations require the immediate release of all salmon caught in WRIA 19 streams. An estimated 10-15 percent of the fish that are caught and released die after being released.

3.2.4 Chum Salmon Hatchery Practices

In WRIA 19, hatchery out planting has been at much lower levels than on the Washington Coast and Hood Canal (Johnson et al. 1997). In WRIA 19, chum have only been released into two stream systems, during a total of three years. Hatchery release data indicate that approximately 188,000 Finch Creek fry were released in 1970 in the Lyre River, and 170,000 fry of unknown origin were released in 1978 and 1979 in the Sail River (Johnson et al. 1997). A streamside incubator for chum was operated on Whiskey Creek in approximately 1991-1992 utilizing Elwha chum (L. Ward, pers. comm. 2009).

3.3 COHO SALMON (*O. kisutch*)

Coho salmon are the most widely distributed and abundant anadromous salmonids in WRIA 19. They spawn in nearly all the accessible low (0.1-3%) and moderate (3-8%) gradient streams draining into the Strait of Juan de Fuca. Within WRIA 19, the largest coho populations are found in the Hoko and Pysht Rivers. The smallest spawning populations are typically found in the smallest subbasins (e.g., Village and Rasmussen Creeks). Figure 14 depicts coho salmon distribution in WRIA 19 streams. A simplified description of the life-history of WRIA 19 coho salmon is included below.

Adult coho salmon begin entering WRIA 19 streams as early as September if flows permit. Generally, October and November are the peak months for migration into WRIA 19 streams. Coho salmon spawn from late-October through January (WDFW unpublished spawning ground survey database, 2007). Peak spawning typically occurs from late-November through mid-December. Coho salmon are generally found spawning in smaller streams than Chinook, and often at higher gradients (Quinn 2005). Most coho spawning occurs throughout the numerous tributaries to the larger mainstem rivers, in the mainstem of the smaller rivers and larger streams, as well as in the upper mainstems of the larger rivers (e.g., Hoko River upstream of RM 20).

Fry emergence occurs from February through April with peak emergence during the month of March (based on spawn timing and water temperature it was assumed that egg-to-fry emergence required 100-130 days of incubation depending upon temperature). After emergence fry will continue to hide in gravel interstices and under cobbles during daylight hours, but within a few days they progress to swimming near stream banks and take advantage of available cover, often congregating in quiet backwaters, side channels, and small streams (Sandercock 1991). Early stream rearing often occurs in small habitats and very small tributaries not accessible to adult coho. In the Hoko and Pysht River subbasins, emergent coho fry have been observed in stream channels only a few inches wide.

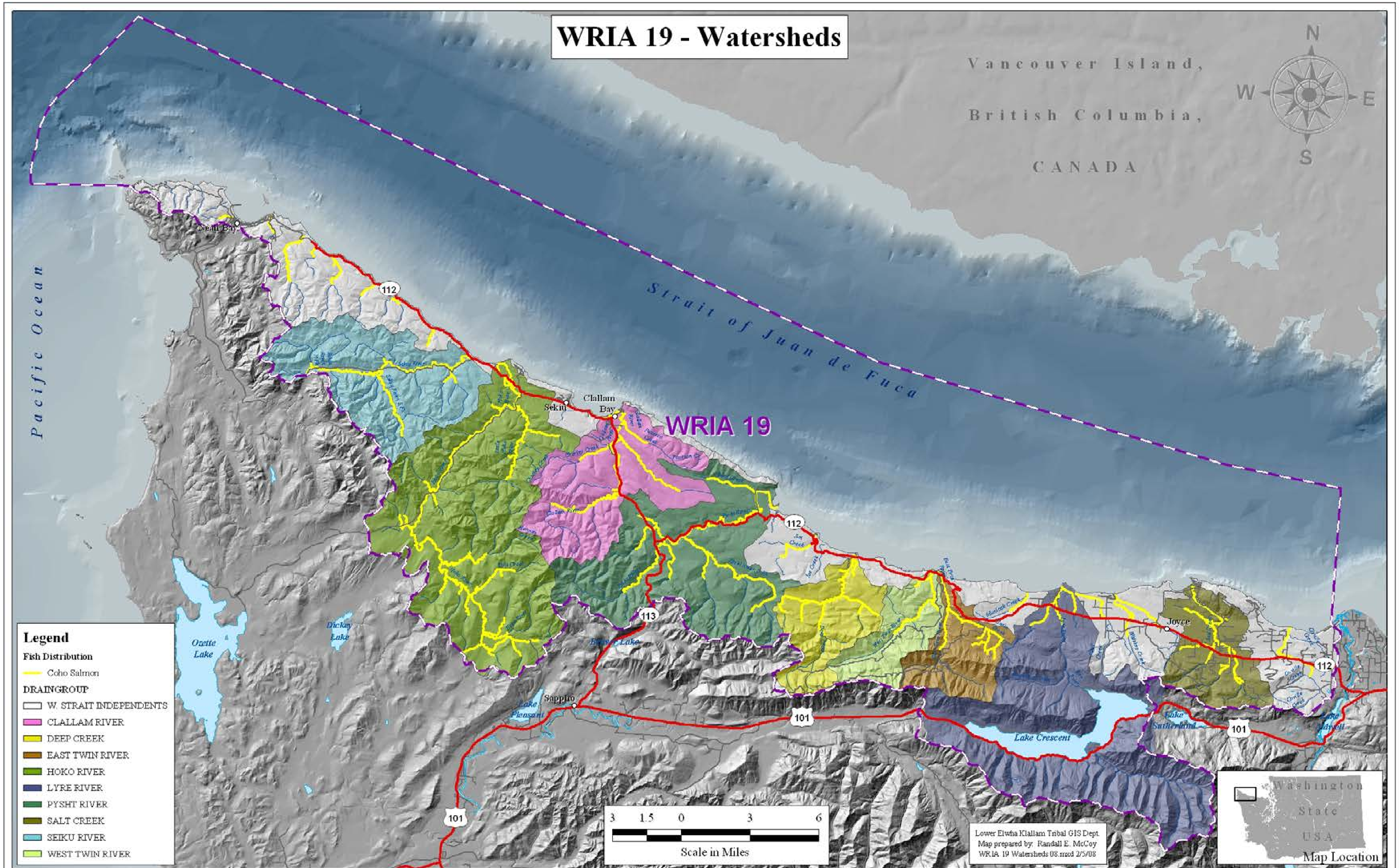

Figure 14. WRIA 19 coho salmon distribution map (source: salmonid distribution modified from Salmonscape 2005).

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As spring progresses and coho fry increase in size they will begin occupying larger habitats, including mainstem river habitats. Juvenile coho spawned in tributaries may develop rearing territories locally where they were hatched or they may migrate downstream, upstream, or into mainstem habitats to rear. Juvenile coho may occupy all accessible habitats during the summer and earlier fall months with a preference for pools with abundant woody cover. Once the fall rains set in and flows increase, juvenile coho will often seek lower energy habitats with abundant cover. Where available, juvenile coho will move into floodplain habitats such as wetlands, forested wetlands, and small, low energy streams. Examples of these habitats in the Pysht River system are described in detail in Haggerty et al. 2006. Juvenile coho will continue to utilize low-energy off-channel habitats until spring when they begin their emigration to the SJF. The primary smolt emigration period is from April through June, peaking from mid-May to early-June (Figure 15). Most coho salmon spend approximately 16-months feeding in the ocean prior to returning as adults to spawn. Some return as jacks after only 4 or 5 months at sea.

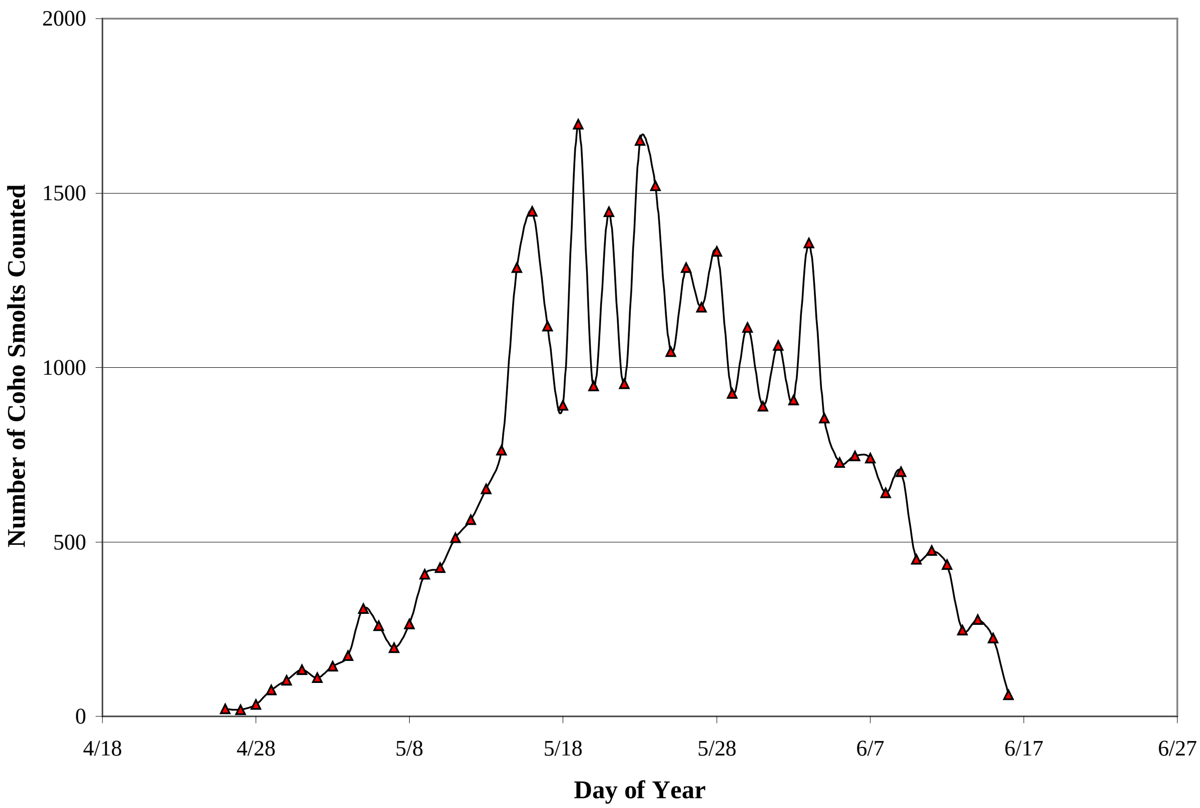

Figure 15. Combined annual (2001-2005) daily average coho smolt counts for Salt Creek, East Twin River, West Twin River, and Deep Creek for the period April 26 to June 16 (source: Lower Elwha Tribe, unpublished smolt data).

3.3.1 Coho Salmon Population Status and Abundance Trends

3.3.1.1 ESA Status Review (Weitkamp et al. 1997)

The Olympic Peninsula Coho ESU includes coastal drainages from Point Grenville (just south of Taholah) to Colville Creek. Coho salmon from the Olympic Peninsula ESU have a more northerly ocean distribution than populations from the Columbia River or coastal regions in Oregon, and they are more commonly captured in Canadian waters than are coho salmon from the Puget Sound region. Genetic data show that coho salmon from this region are distinct from populations to the south and somewhat differentiated from populations in Puget Sound.

Coho salmon abundance in the Olympic Peninsula ESU is moderate, but stable. Coho have declined from historical levels due to large-scale habitat degradation in the lower river basins, but there is a significant portion of coho salmon habitat in several rivers protected within Olympic National Park. This refuge, along with modest hatchery production using mostly native stocks, may have protected this ESU from declines experienced in neighboring ESUs. Habitat destruction and hatchery practices within this ESU were identified as a source of concern, but the BRT concluded that there is sufficient native, natural, self-sustaining coho salmon production, and the Olympic Peninsula coho ESU is not in danger of extinction, nor is it likely to become endangered in the foreseeable future unless conditions change substantially.

3.3.1.2 Coho Salmon WDFW Status Review

SaSSI identifies 6 discrete coho stocks in WRIA 19 in both the 1992 and 2002 status reviews. The six stocks identified include: Salt Creek (includes independents: Colville, Whiskey, and Field Creeks), Lyre River, Pysht/Twin/Deep (includes: Pysht River, East Twin, West Twin, and Deep Creek, as well as several miscellaneous independents (e.g., Murdock, Jim, and Joe Creeks), Clallam River, Hoko River, and Sekiu/Sail (includes Sekiu and Sail Rivers, as well as miscellaneous tributaries (e.g., Olsen, Jansen, Bullman Creeks). All stocks were considered mixed with wild production. The 1992 and 2002 SaSSI status reviews are summarized in Table 7.

The 1992 status review determined that the Pysht/Twin/Deep and Sekiu/Sail stocks were depressed due to a short-term severe decline. The 1992 status review determined that Salt Creek and Hoko River stocks were healthy but did not provide a rationale. The 2002 stock status review determined that five of the six stocks were healthy. The status of the Lyre River stock remained unknown. Four of the stocks were determined to be healthy based on either robust numbers or increased numbers and increasing trend in abundance. Salt Creek was the only stock rated as healthy that had a decreasing trend in abundance. All stocks listed in Table 7 are classified as mixed (mixture of native stocks and introduced non-native stocks) with wild (natural) production (WDFW 2002).

Table 7. Summary of the 1992 and 2002 SaSSI status review for coho salmon in WRIA 19 (source: WDF et al. 1993; WDFW 2002). Note production type is no longer mixed.

Stream System	1992 SaSSI Status	2002 SaSSI Status	Production Type
Salt Creek	Healthy	Healthy	Mixed/Wild
Lyre River	Unknown	Unknown	Mixed/Wild
Pysht/Twin/Deep	Depressed	Healthy	Mixed/Wild
Clallam River	Unknown	Healthy	Mixed/Wild
Hoko River	Healthy	Healthy	Mixed/Wild
Sekiu/Sail	Depressed	Healthy	Mixed/Wild

3.3.1.3 Coho Salmon NOPLE Status Review

Version 3.5 of the NOPLE Salmon Habitat Recovery Project Strategy includes an updated stock status review for coho salmon in WRIA 19 streams. The status review was conducted by the NOPLE's TRG. Table 6 includes a summary of the 2004 NOPLE status review of the historical presence, population status, and population trends for coho salmon in WRIA 19 streams.

Table 8. Summary of the 2004 NOPLE status review for coho salmon in WRIA 19 streams (source: NOPLE 2004).

Stream System	Historical Presence	Population Status	Population Trend
Sekiu River	Present	Depressed	Stable
Hoko River	Present	Depressed	Increasing
Clallam River	Present	Depressed	Increasing
Pysht River	Present	Depressed	Increasing
Deep Creek	Present	Depressed	Increasing
West Twin River	Present	Depressed	Declining
East Twin River	Present	Depressed	Declining
Lyre River	Present	Critical	Declining
Salt Creek	Present	Healthy	Stable
Western Strait Independents	Present	Critical	Declining

3.3.2 Coho Salmon Abundance and Trends

3.3.2.1 Salt Creek

Limited coho salmon spawning ground data are available for the Salt Creek watershed from 1952 to 1976 consisting of live and dead counts. More complete annual survey data are available in the WDFW spawning ground survey database for return years 1977 through 2003. Coho salmon redd count data are available for 1984 through 2006. Coho salmon are the most abundant species of anadromous salmonids in the Salt Creek watershed and likely always were (McHenry et al. 2004). Goin (1990) estimates returns in the 1950s of 3,000 to 5,000 adults. Figure 16 depicts the annual total number of live and dead coho observed during spawning ground surveys compared to total number of coho observed/mile surveyed and total number of miles surveyed for return years 1952 through 2003.

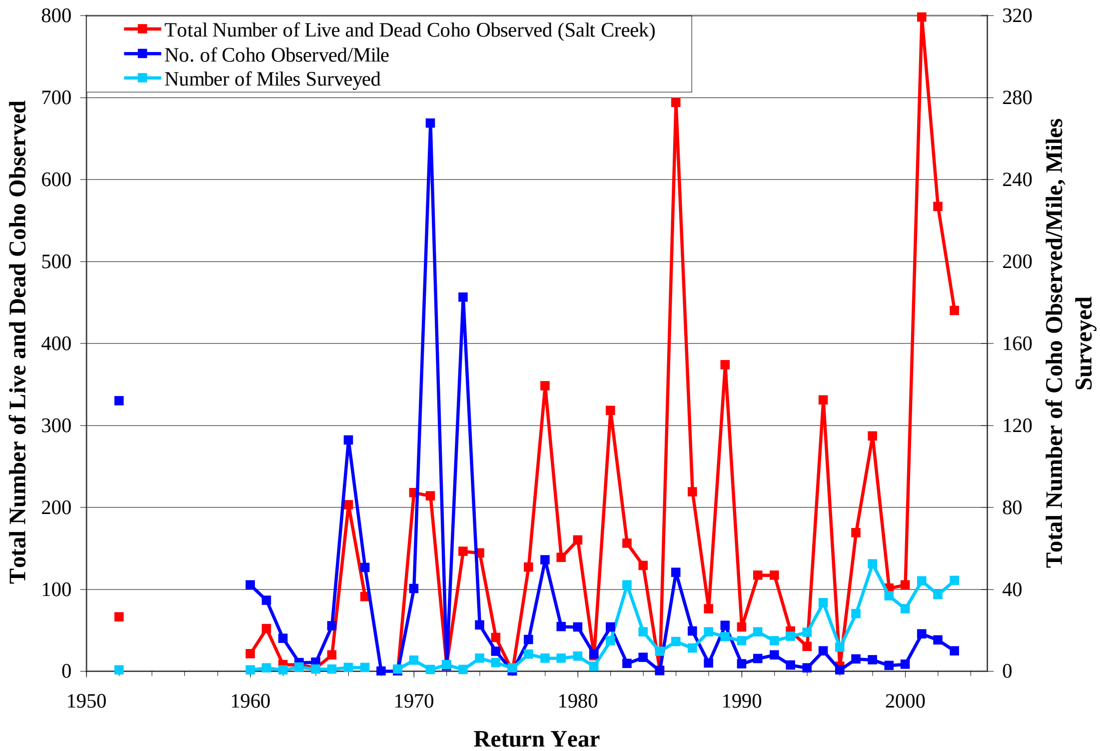

Figure 16. Total number of live and dead coho salmon observed in the Salt Creek watershed by return year contrasted with total number of coho observed per mile and total number of miles surveyed (source: WDFW spawning ground survey database).

McHenry et al. (2004) state that between 1961 and 1973 the peak coho density (fish/mile) was significantly higher than observed in the 1980s and that recent coho counts per mile have been similar to those observed in the 1980s, suggesting that the initial decline in the population started in the 1980s. Coho salmon spawning escapement data collected by WDFW in their index survey reaches from 1984 through 2006 are included in Figure 17. These data show a downward trend from 1984 through 2000, followed by an increasing trend from 2001 to present. None of these trends are statistically significant. Salt Creek coho also display a dominant cohort year class during this period (RY ’86, ’89, ’92,’ 95, ’98). This year class experienced a significant (p=.0016) decline from 1986 through 1998 and has since been increasing (see 2001 and 2004). Total estimated escapement for the Salt Creek watershed for return years 1998 through 2005 are included in Figure 18.

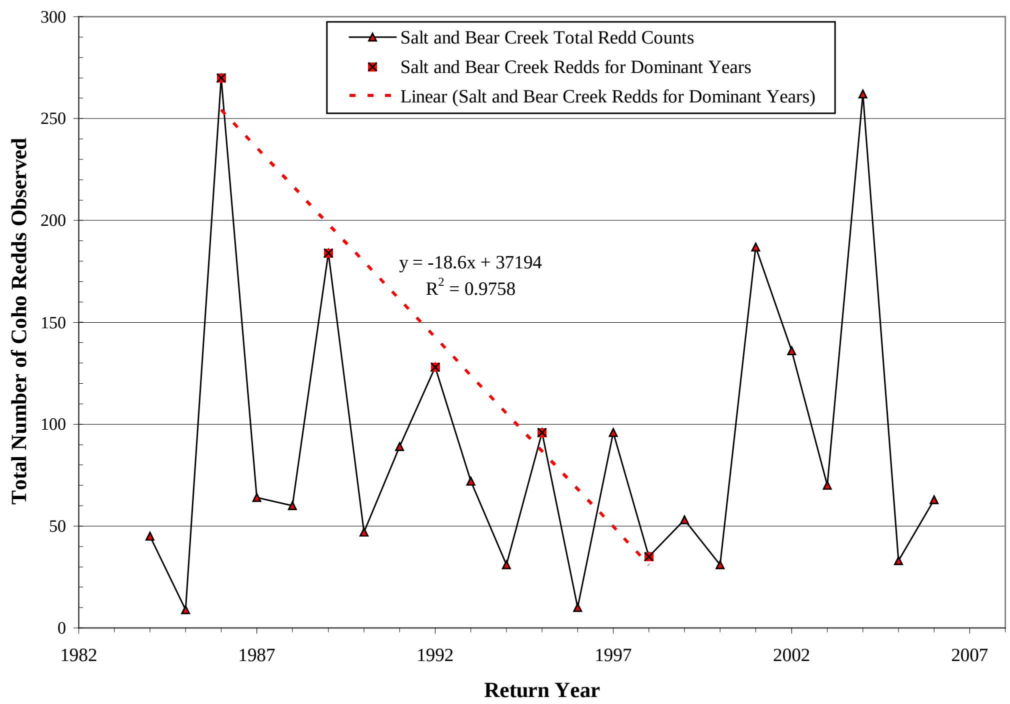

Figure 17. Combined coho redd counts for Salt Creek (RM 5.6 -6.4) and Bear Creek (RM 0.0 – 0.8) by return year and trend of dominant cohort through 1998 (source: WDFW unpublished spawning ground data).

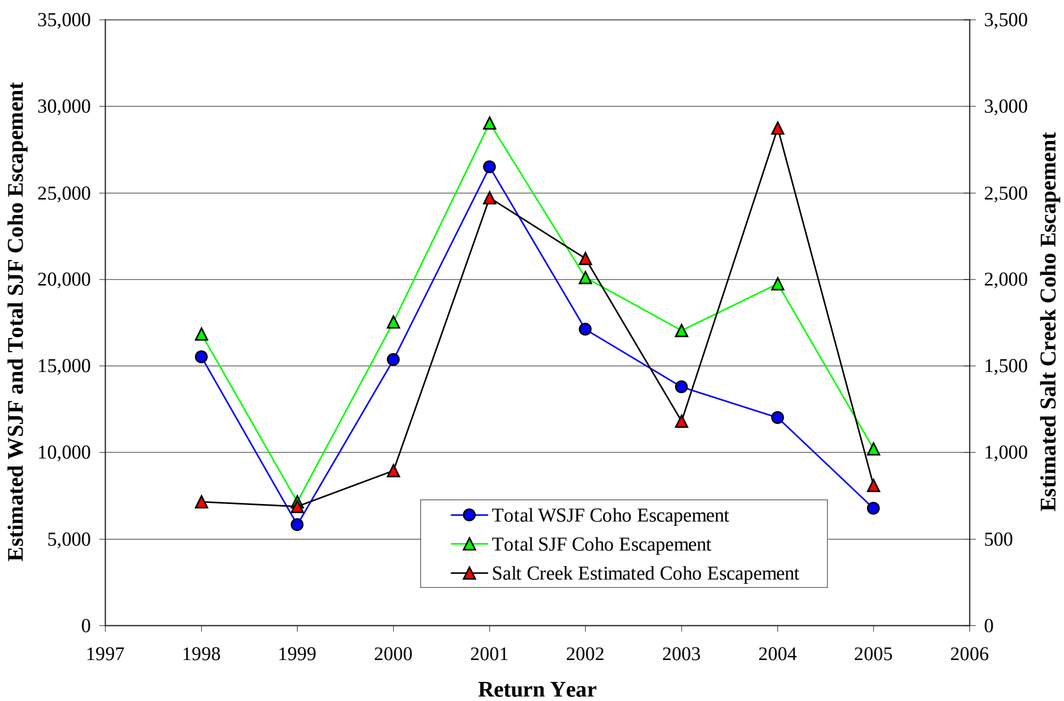

Figure 18. Estimated coho spawning escapement for SJF, WSJF, and Salt Creek for return years 1998-2005 (source: WDFW and Lower Elwha Tribe, unpublished data).

(Note that SJF refers to the coho management unit that includes all Strait tributaries except Elwha and Dungeness. Chimacum Creek is also included in the SJF unit. WSJF as used here refers to the Western Strait of Juan de Fuca coho management unit, which includes all WRIA 19 streams.)

In addition to adult abundance data there are also coho smolt data for Salt Creek. These data are available for 1998 to present. Figure 19 includes Salt Creek coho salmon production estimates for 1998 through 2006 and the estimated survival of coho smolt-to-adult spawners. There is an upward trend in the number of smolt produced within the Salt Creek watershed but the trend is not statistically significant ($p>0.05$). Survival of smolt-to-adult spawners has a slightly positive trend but the trend is not statistically significant ($p>0.05$). With the exception of return year 2004, coho smolt production has not tracked the short-term increases in adult escapement seen in 2001-2003. Figure 20 depicts the estimated coho spawning escapement for Salt Creek and the subsequent number of smolt produced. One of the lowest escapements (RY 1998) corresponds to the highest smolt production estimate (emigration year 2000). Other results are mixed, as the highest spawning escapement measured (return year 2004) corresponds to the second highest smolt production estimate (emigration year 2006). The third highest escapement (return year 2002) corresponds to the second lowest smolt production (emigration year 2006). Several regressions using 14-day, 30-day, and 60-day low flow ratios (at age 0+) and smolt production were conducted and no significant relationship was found. A strong relationship between smolts produced per spawner and parent year spawning escapement was found (Figure 21 and Figure 22). Additional data are needed to fully determine the significance of this relationship.

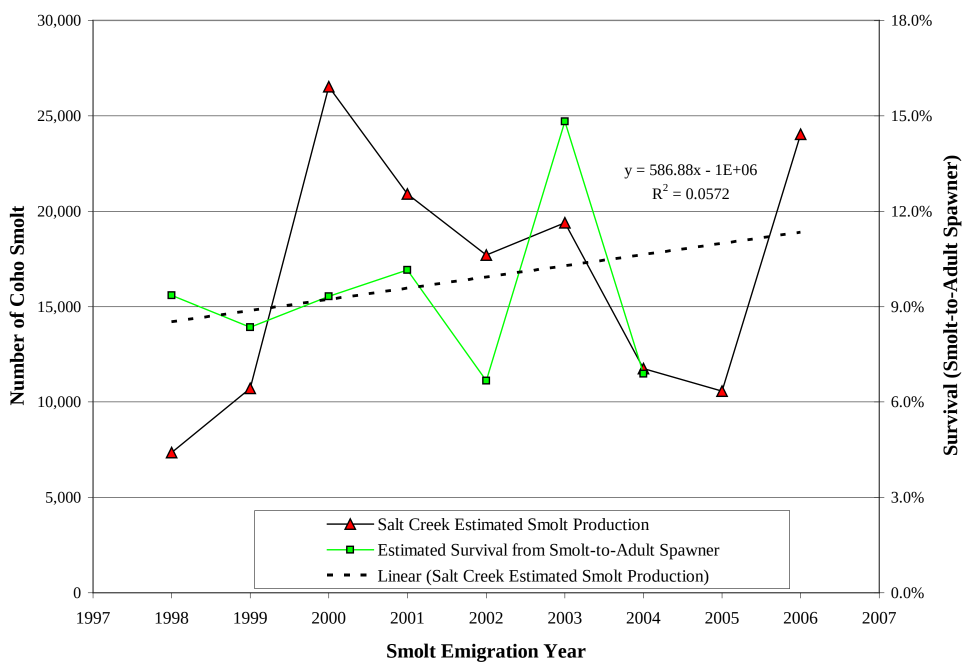

Figure 19. Salt Creek coho salmon smolt production estimates for 1998 through 2006 and estimated survival of smolt-to-adult spawner (source: Lower Elwha Tribe unpublished smolt production estimates).

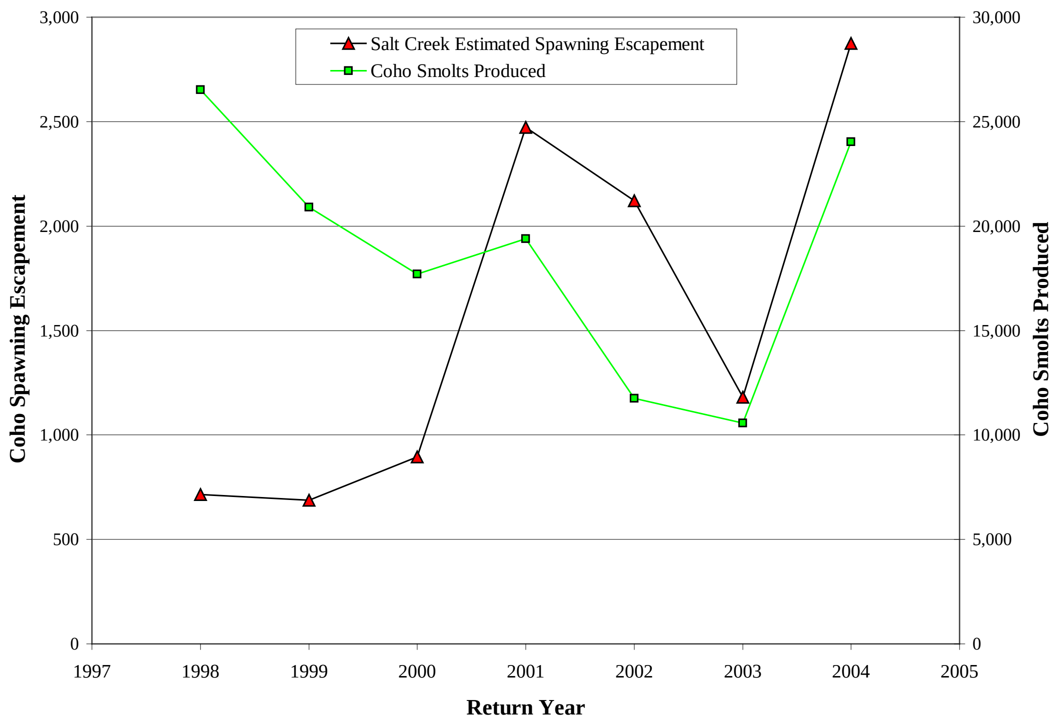

Figure 20. Salt Creek coho spawning escapement and subsequent number of smolts produced (source: Lower Elwha Tribe, unpublished data).

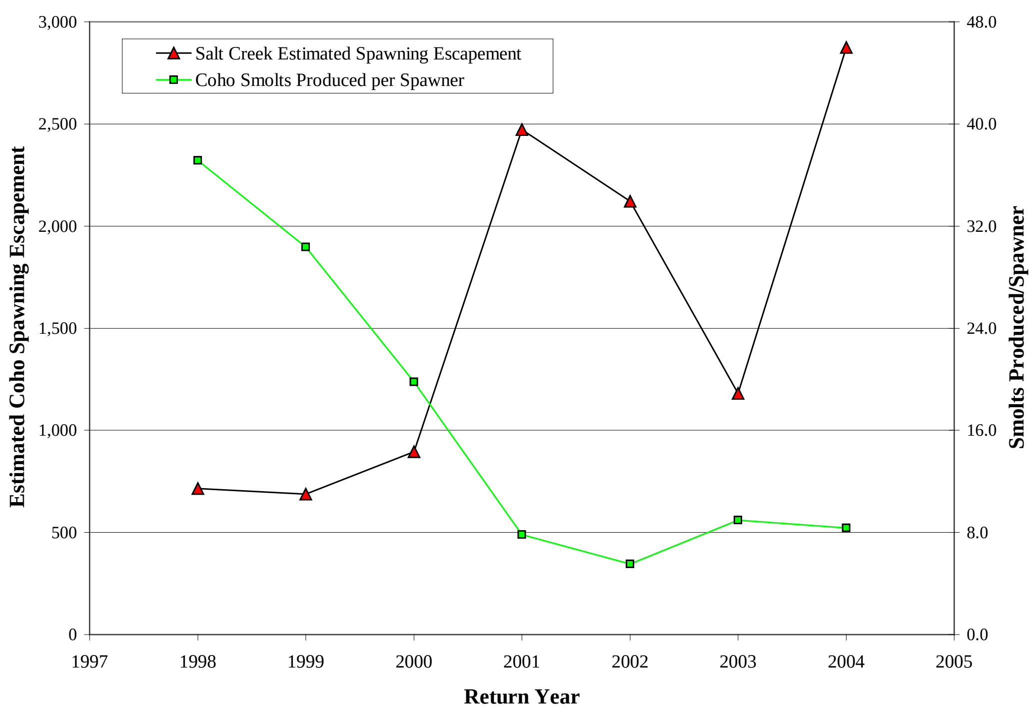

Figure 21. Estimated coho spawning escapement and subsequent number of smolts produced per spawner (source: Lower Elwha Tribe, unpublished smolt data).

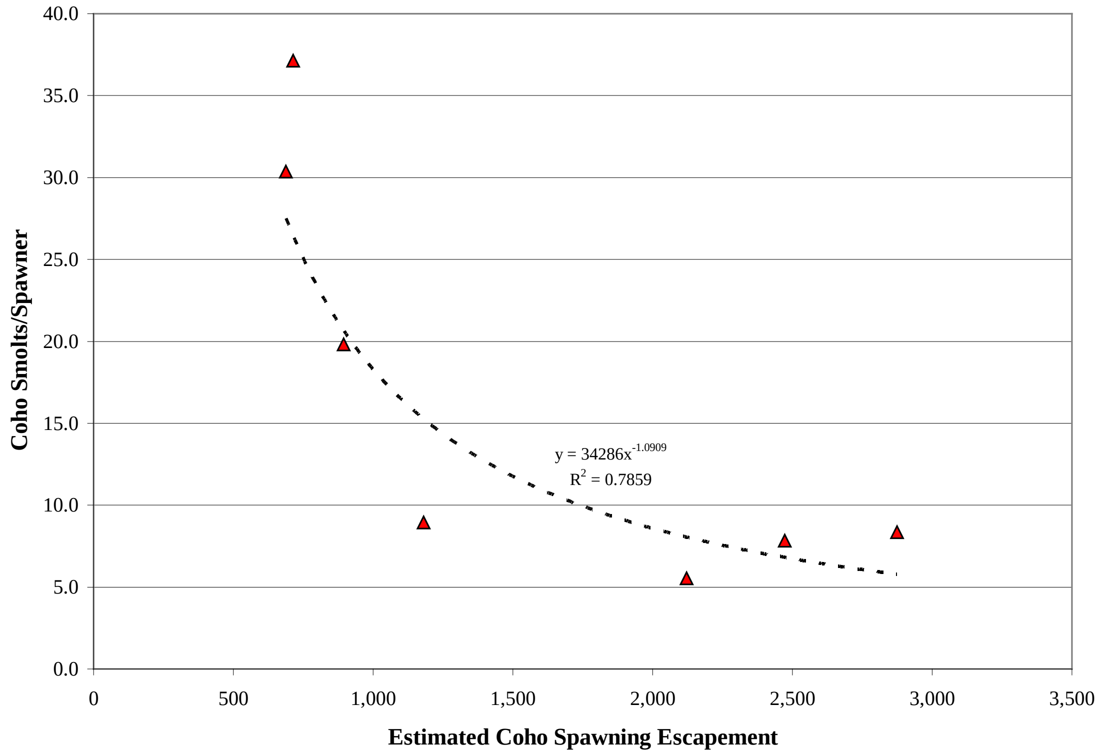

Figure 22. Coho smolts produced per spawner versus coho spawning escapement.

3.3.2.2 Lyre River

McHenry et al. (1996) concluded that available evidence indicated that the Lyre River never hosted a large run of coho salmon despite intensive efforts by WDFW to supplement natural production through hatchery out-planting. The large chum salmon population and limited spawning gravel availability may act to naturally limit the size of the Lyre River coho population. However, tributaries such as Nelson and Susie Creeks likely supported robust spawning aggregations historically. Limited coho salmon spawning ground data are available for the Lyre River watershed from 1952 to 1994. These data consist mostly of live and dead coho counts. Coho salmon redd count data are available for 1995 through 2005. Figure 16 depicts the annual total number of live and dead coho observed during spawning ground surveys compared to total number of coho observed per mile surveyed and total number of miles surveyed for return years 1952 through 2003. Total estimated escapement for the Lyre River watershed for return years 1998 through 2005 are included in Figure 24. Lyre River coho escapement from 1998 through 2005 shows a negative trend, but the trend is not statistically significant ($p=0.36$). Overall coho spawning escapement in the Lyre River tracks closely with the trend in total coho escapement for all streams in the western Strait of Juan de Fuca region. Note that for return year 2001 the total number of live and dead coho observed was 761 and the estimated escapement was only 508. It is assumed that sum of live and dead counts enumerated the same fish more than once.

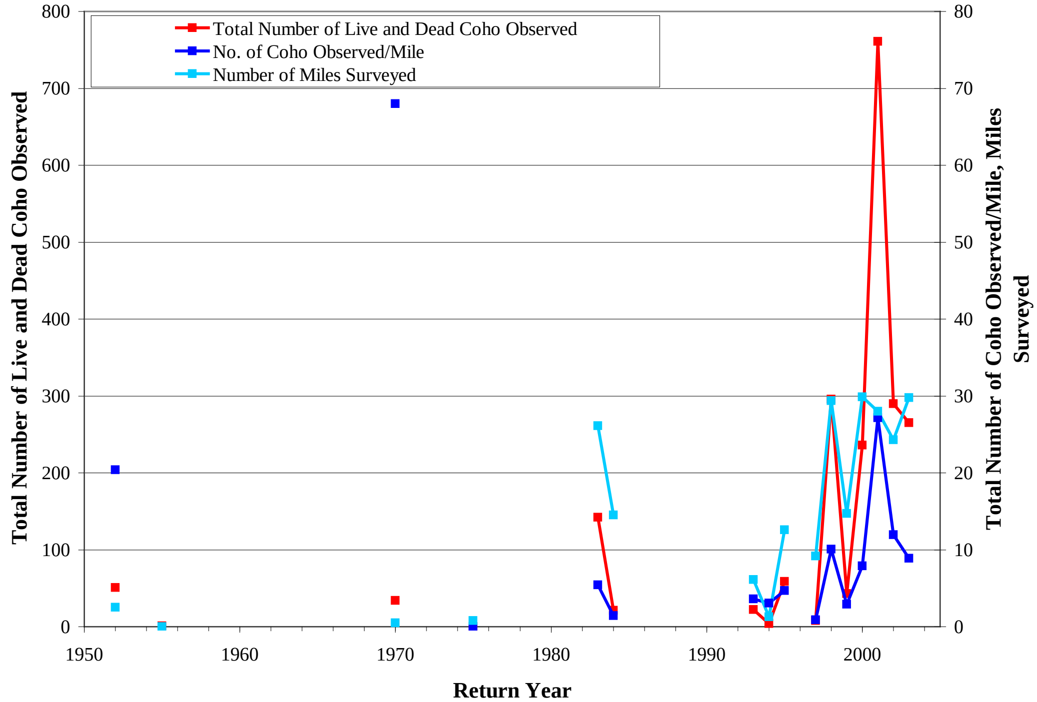

Figure 23. Total number of live and dead coho salmon observed in the Lyre River watershed by return year contrasted with total number of coho observed per mile and total number of miles surveyed (source: WDFW spawning ground survey database).

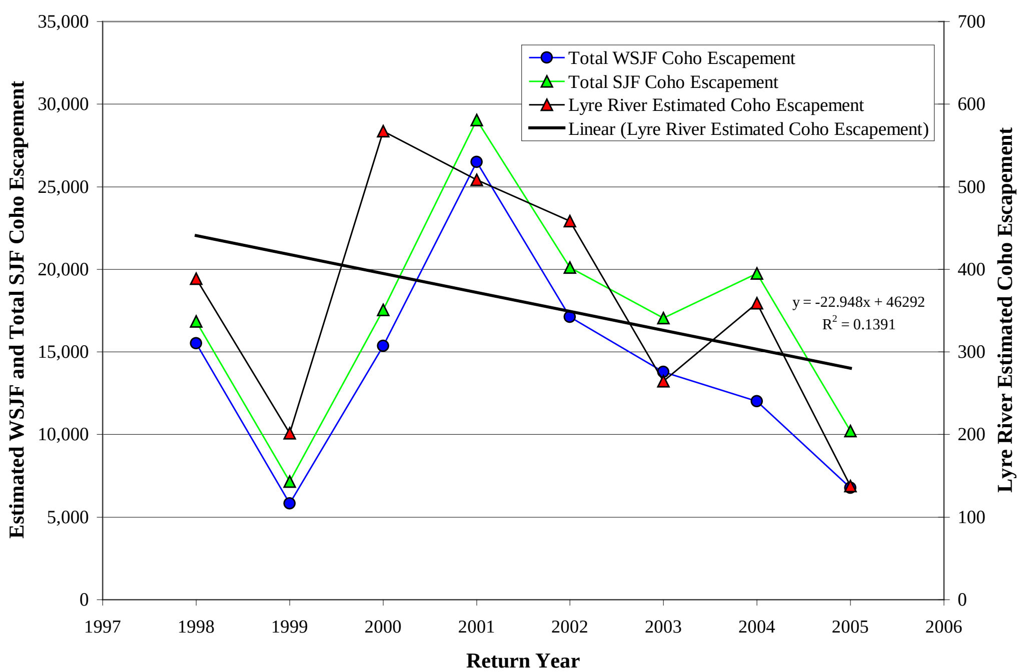

Figure 24. Estimated coho spawning escapement for SJF, WSJF, and Lyre River for return years 1998-2005 (source: WDFW and Lower Elwha Tribe, unpublished data).

3.3.2.3 East Twin River

Limited coho salmon spawning ground data are available for the mainstem East Twin River watershed from 1952 to 1994. These data consist mostly of live and dead coho counts. Coho salmon redd count data are available for 1995 through 2005. Figure 25 depicts the annual total number of live and dead coho observed during spawning ground surveys compared to total number of coho observed/mile surveyed and total number of miles surveyed for return years 1952 through 2003. WDFW has maintained a coho spawning ground index reach in Sadie Creek, the largest tributary to the East Twin River, since return year 1985 (Figure 26). Over this time period the data show a slightly upward trend but the trend is not statistically significant. Note that from 2004 to 2006 an average of only 10 redds per year have been observed and in 2006 only one coho redd was observed in the Sadie Creek index reach. Total estimated escapement for the East Twin River watershed for return years 1998 through 2005 are included in Figure 27. East Twin River coho escapement from 1998 through 2005 shows a negative trend, but the trend is not statistically significant (p=0.59). Note that data from 2004 through 2006 indicate that a short-term severe decline has taken place. Overall coho spawning escapement in the East Twin River tracks closely with the trend in total coho escapement for the streams in the western Strait of Juan de Fuca.

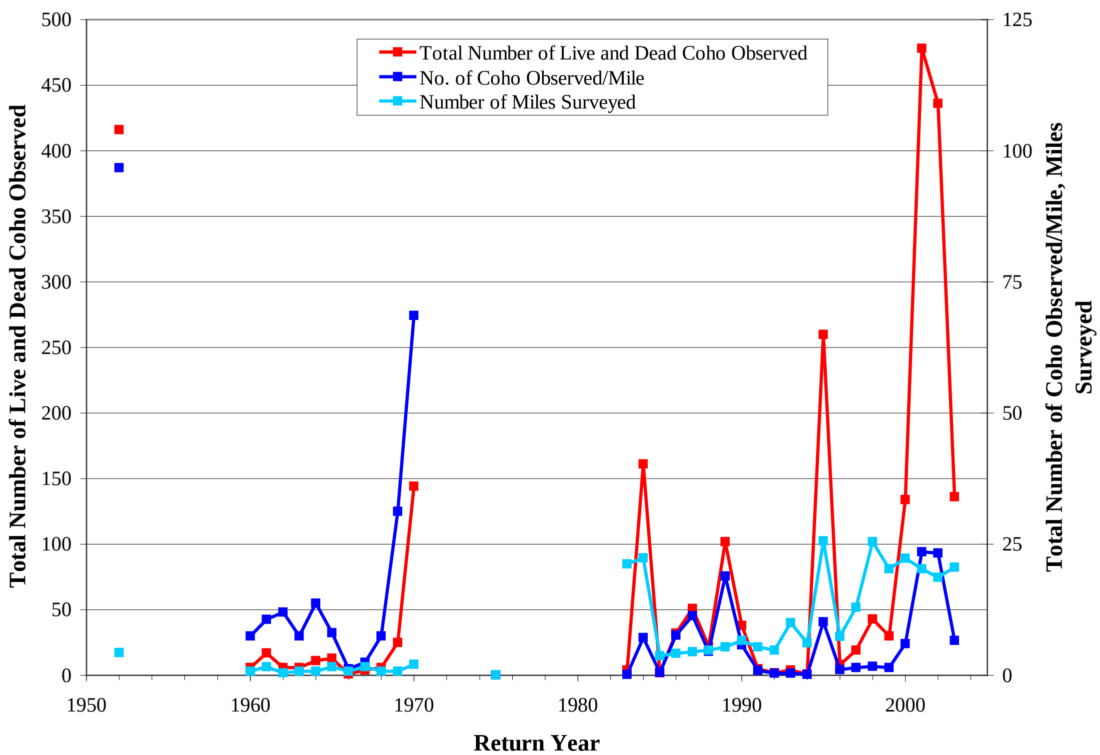

Figure 25. Total number of live and dead coho salmon observed in the East Twin River watershed by return year contrasted with total number of coho observed per mile and total number of miles surveyed (source: WDFW spawning ground survey database).

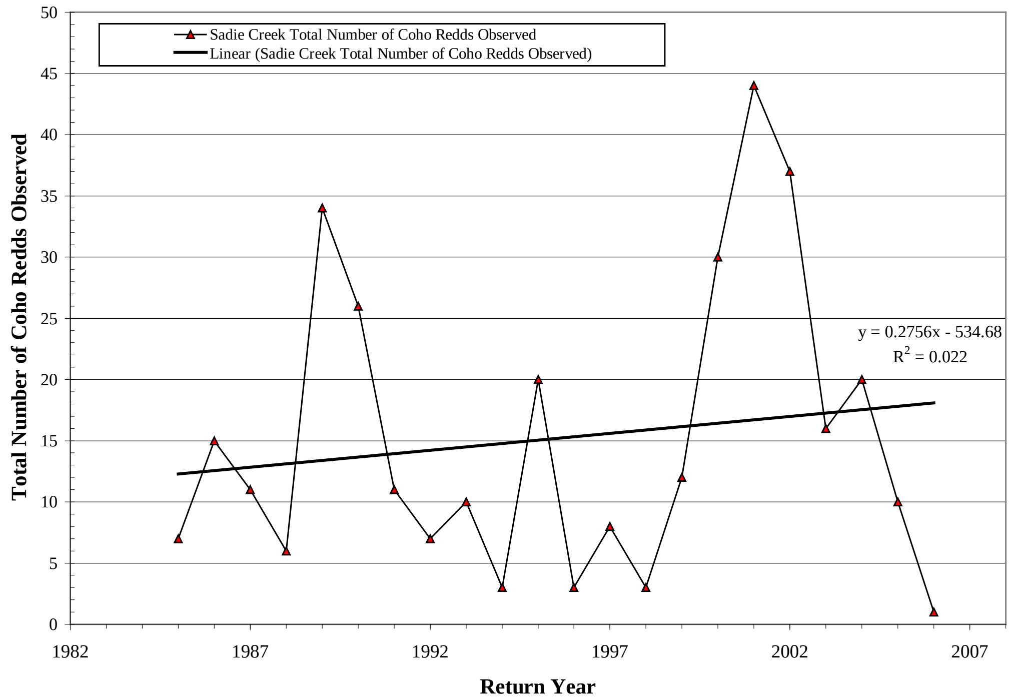

Figure 26. Sadie Creek (RM 1.6 – 2.2) coho redd counts by return year for 1985 through 2006 (source: WDFW unpublished spawning ground data).

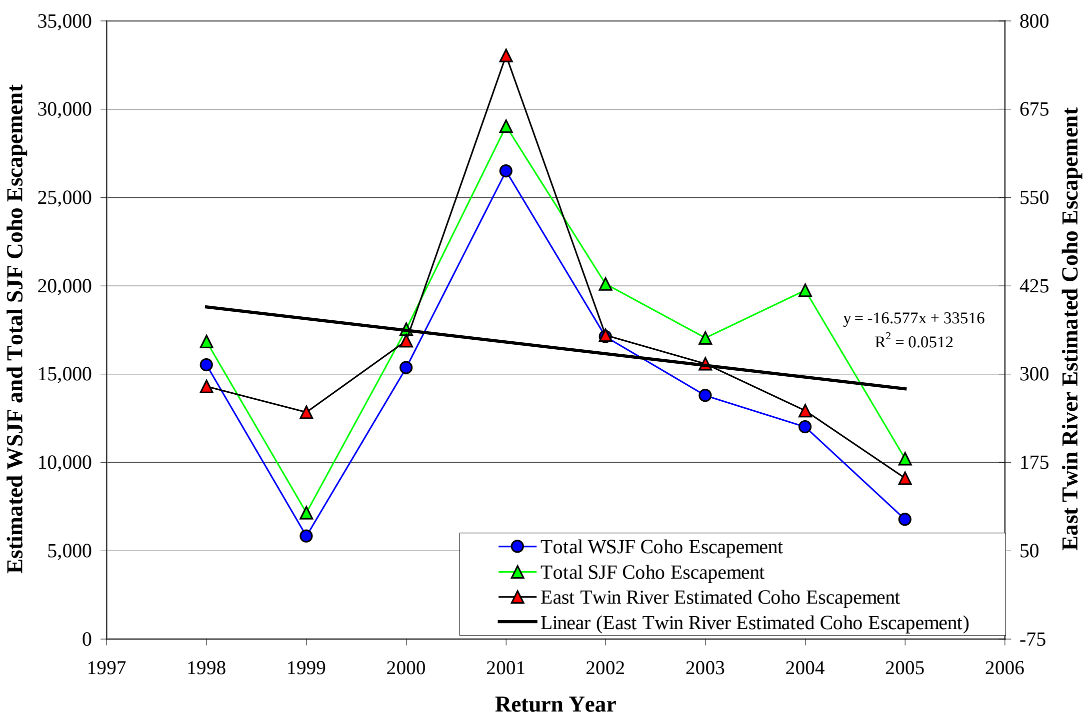

Figure 27. Estimated coho spawning escapement for SJF, WSJF, and East Twin River for return years 1998-2005 (source: WDFW and Lower Elwha Tribe, unpublished data).

In addition to adult abundance data there are also coho smolt data for East Twin River. These coho smolt data are available for 2001 to present. Figure 28 includes East Twin River coho salmon production estimates for 2001 through 2006 and the estimated survival of coho smolt-to-adult spawners. These data indicate that the trend in smolt production has been moderately positive but the trend is not statistically significant (p=0.358). Survival from smolt-to-adult- spawner has declined from 4.0 percent to 1.7 percent from return year 2002 to 2005.

Figure 29 depicts the estimated coho spawning escapement for East Twin River and the subsequent number of smolt produced. No clear relationship between spawning escapement and coho smolt production are evident based on the data collected so far. Several regressions using 14-day, 30-day, and 60-day low flow ratios (at age 0+) and smolt production were calculated and no significant relationship was found. The number of smolt produced per adult spawner shows an inverse relationship where increasing numbers of spawners results in a decreased number of smolts produced per spawner (Figure 30). Additional data are needed to fully determine the significance of this relationship.

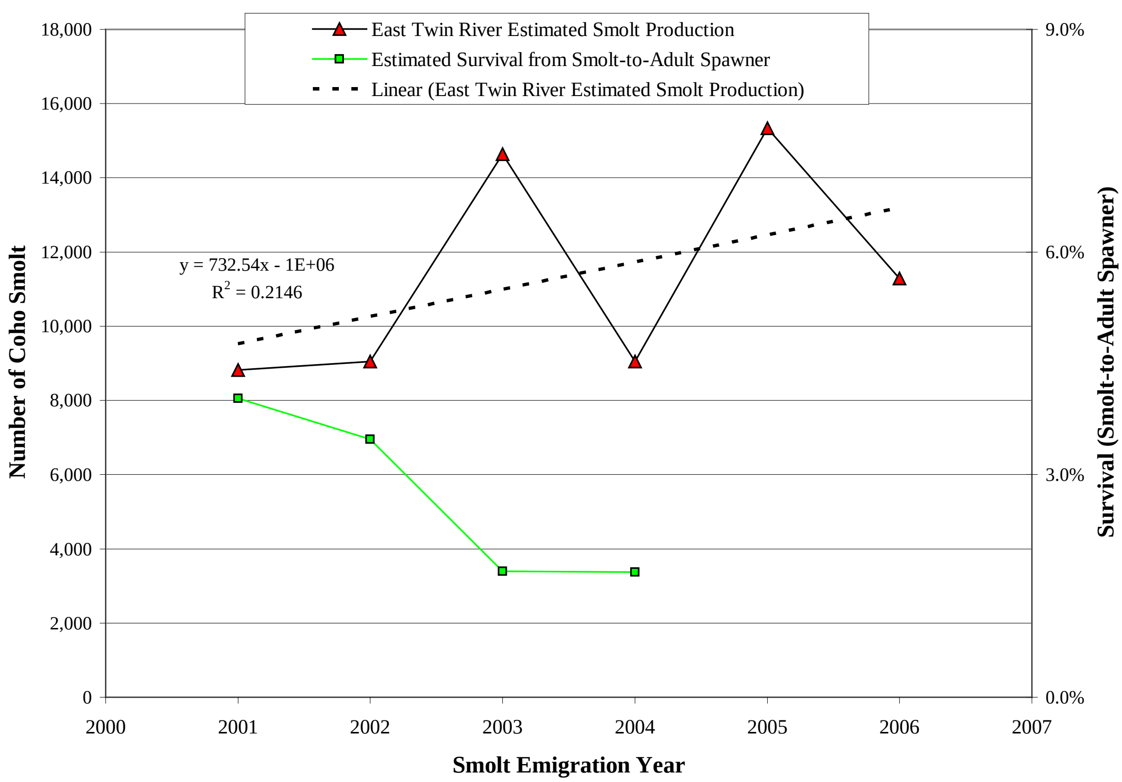

Figure 28. East Twin River coho salmon smolt production estimates for 2001 through 2006 and estimated survival of smolt-to-adult spawner (source: Lower Elwha Tribe unpublished smolt production estimates).

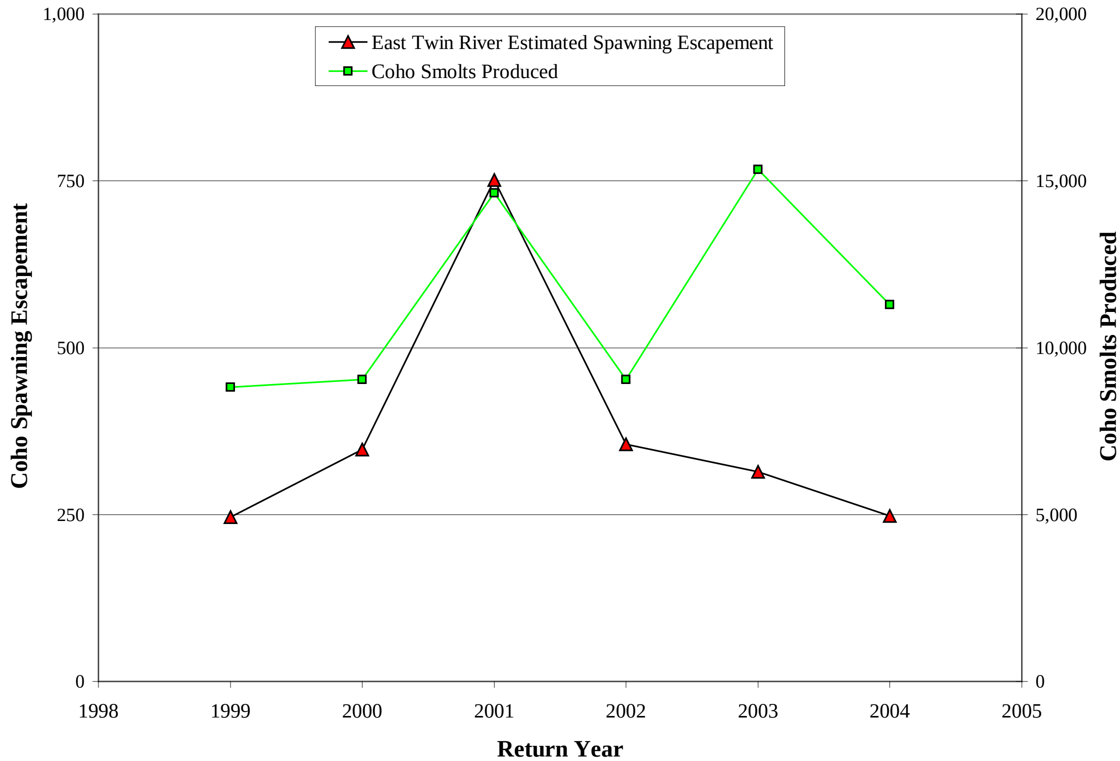

Figure 29. East Twin River coho spawning escapement and subsequent number of smolts produced (source: Lower Elwha Tribe, unpublished data).

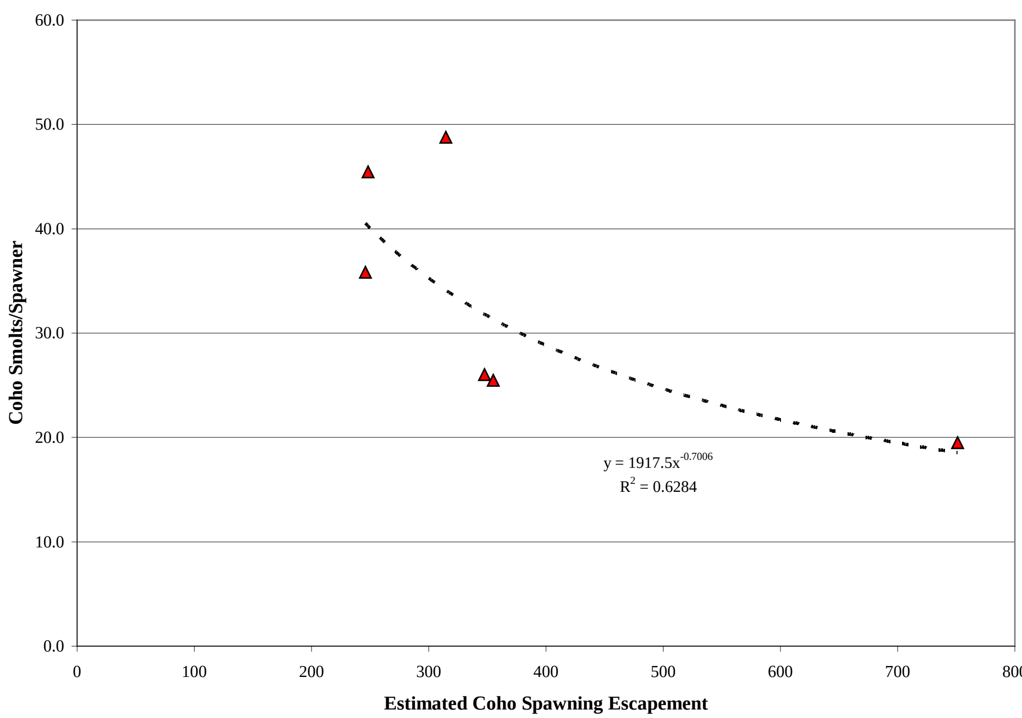

Figure 30. Coho smolts produced per spawner versus coho spawning escapement.

3.3.2.4 West Twin River

Limited coho salmon spawning ground data are available for the West Twin River watershed from 1952 to 1994. These data consist mostly of live and dead coho counts. Coho salmon redd count data are available for 1995 through 2005. Figure 31 depicts the annual total number of live and dead coho observed during spawning ground surveys compared to total number of coho observed/mile surveyed and total number of miles surveyed for return years 1952 through 2003. Total estimated escapement for the West Twin River watershed for return years 1998 through 2005 are included in Figure 32. West Twin River coho escapements from 1998 through 2005 vary significantly from a high of 733 (RY 2001) to a low of 214 (RY 2005). These data depict a general, slightly negative trend, but the trend is not statistically significant (p=0.477). Overall coho spawning escapement in the West Twin River tracks closely with the trend in total coho escapement for western Strait of Juan de Fuca streams.

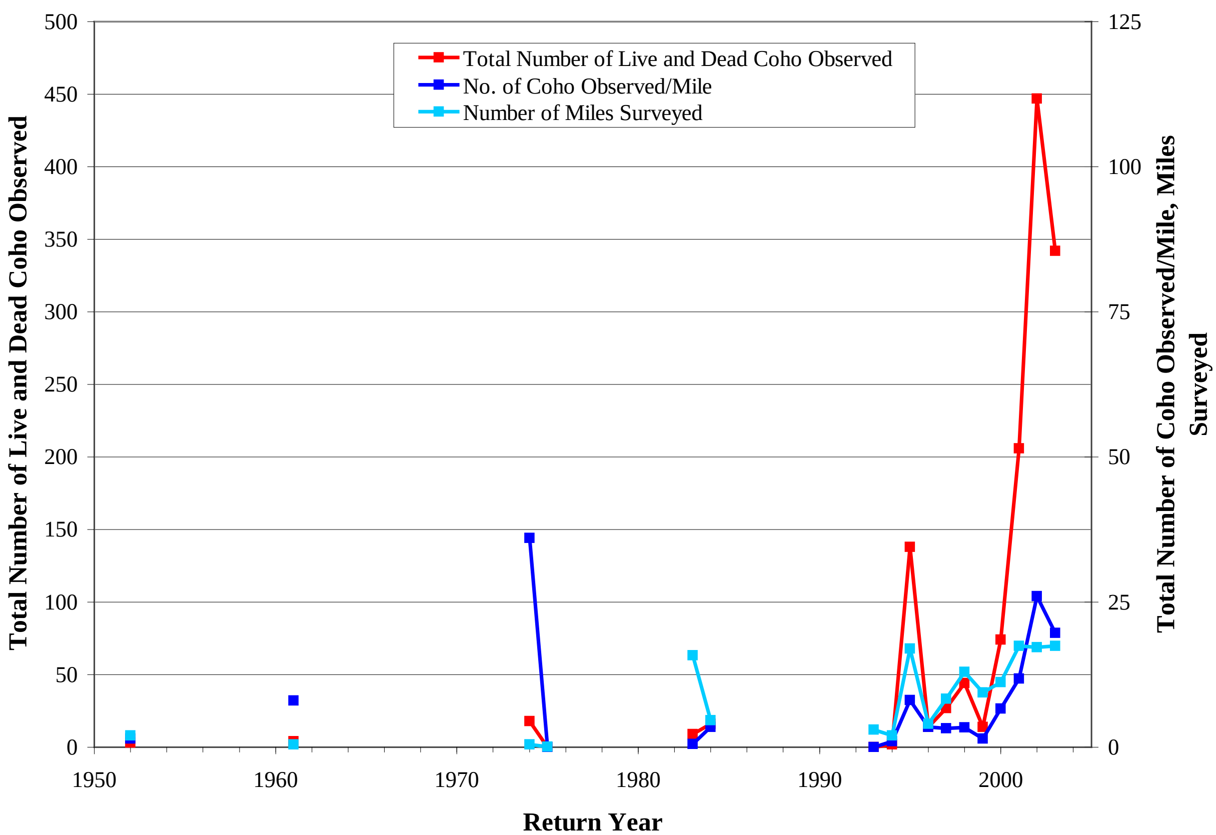

Figure 31. Total number of live and dead coho salmon observed in the West Twin River watershed by return year contrasted with total number of coho observed per mile and total number of miles surveyed (source: WDFW spawning ground survey database).

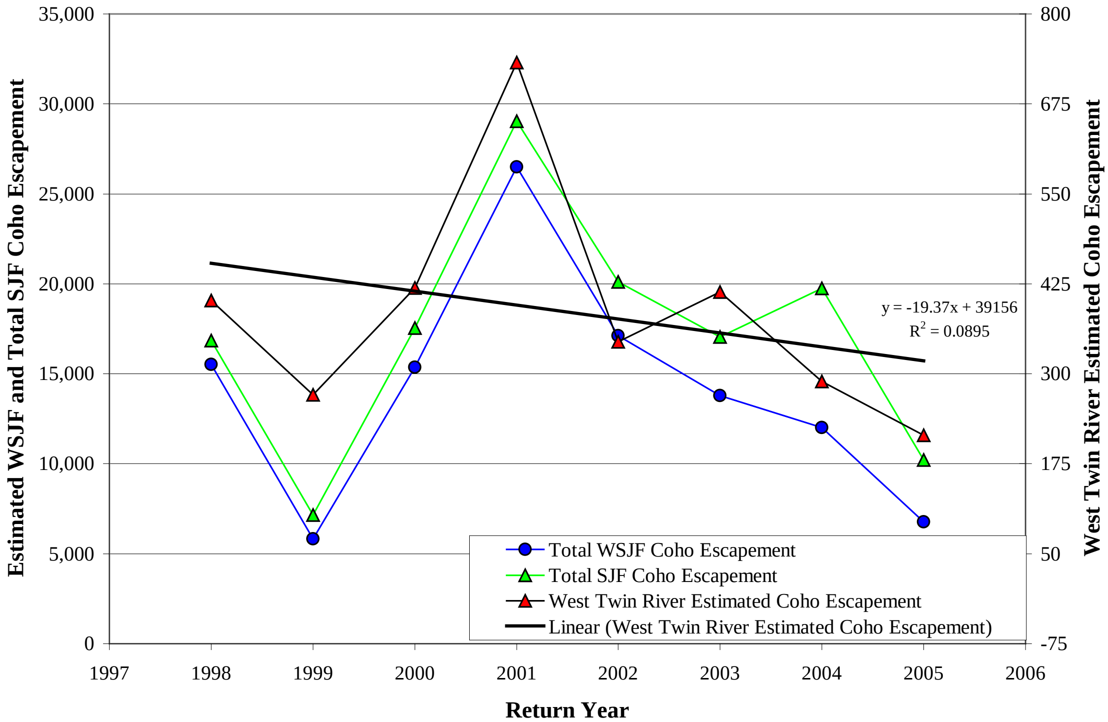

Figure 32. Estimated coho spawning escapement for SJF, WSJF, and West Twin River for return years 1998-2005 (source: WDFW and Lower Elwha Tribe, unpublished data).

In addition to adult abundance data there are also coho salmon smolt data for West Twin River. These coho smolt data are available for 2001 to present. Figure 33 includes West Twin River coho salmon production estimates for 2001 through 2006 and the estimated survival of coho smolts-to-adult spawners. These data indicate that the trend in smolt production has been moderately positive but the trend is not statistically significant ($p=0.513$). Survival from smolt-to-adult- spawner has been highly variable, ranging from a high of 9.1 percent (BY 2000) to a low of 2.3 percent (BY 2001).

Figure 34 depicts the estimated coho spawning escapement for West Twin River and the subsequent number of smolt produced. No clear relationship between spawning escapement and coho smolt production are evident based on the data collected so far. Several regressions using 14-day, 30-day, and 60-day low flow ratios (at age 0+) and smolt production were calculated and no significant relationship was found. The number of smolt produced per adult spawner doesn't show the inverse relationship seen with Salt Creek and East Twin River coho, where increasing numbers of spawners result in a decreased number of smolts produced per spawner (Figure 35).

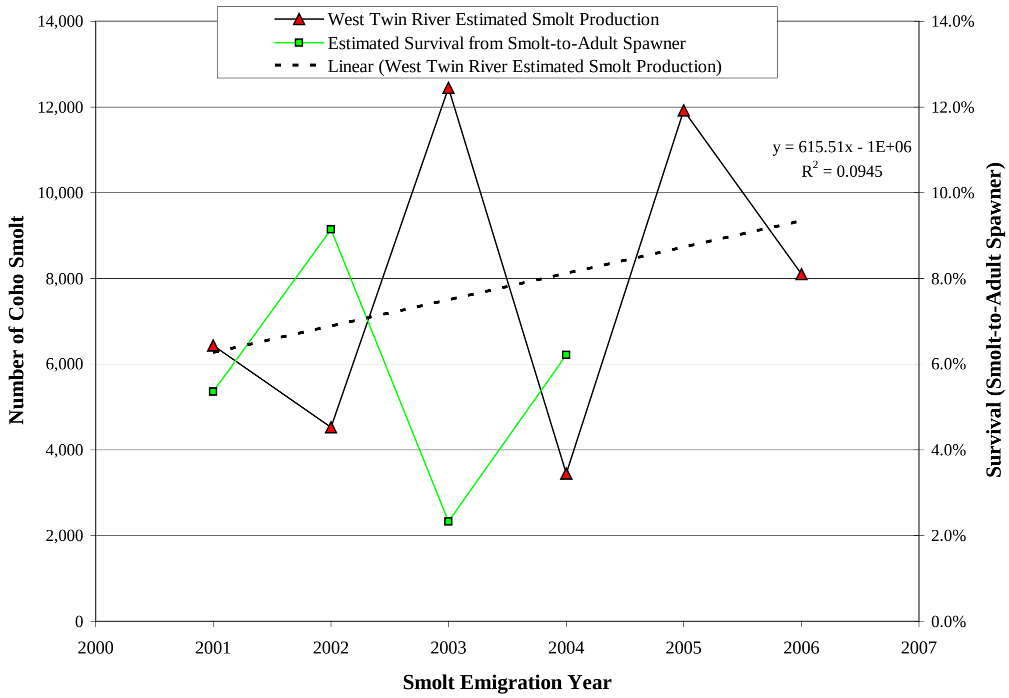

Figure 33. West Twin River coho salmon smolt production estimates for 2001 through 2006 and estimated survival of smolt-to-adult spawner (source: Lower Elwha Tribe unpublished smolt production estimates).

Figure 34. West Twin River coho spawning escapement and subsequent number of smolts produced (source: Lower Elwha Tribe, unpublished data).

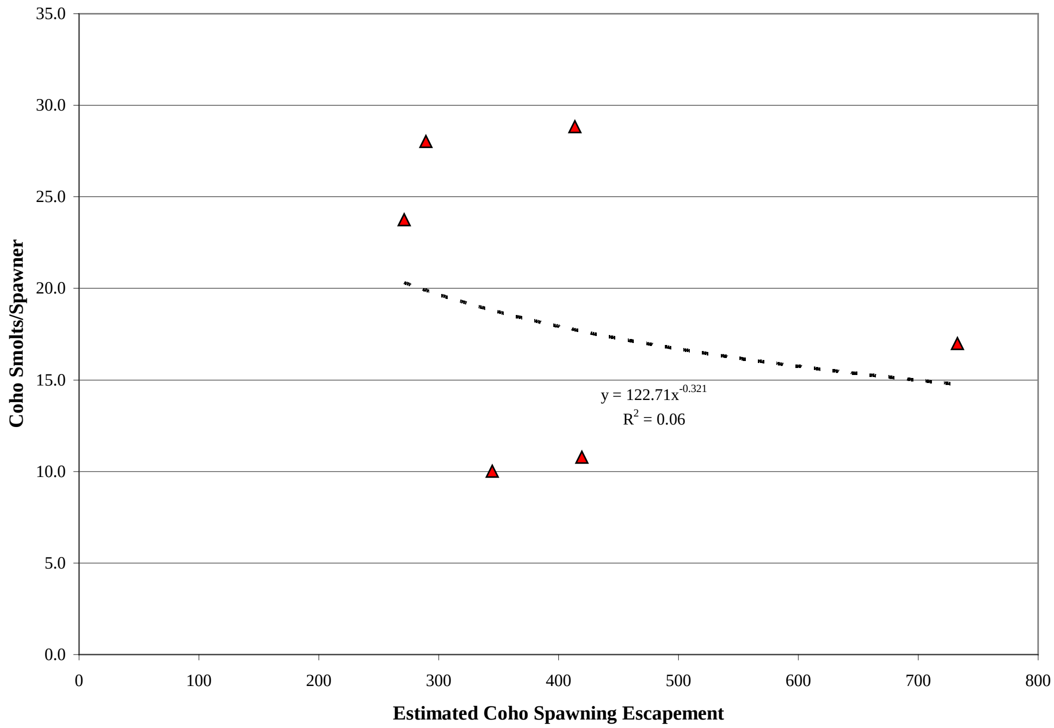

Figure 35. West Twin River coho smolts produced per spawner versus coho spawning escapement.

3.3.2.5 Deep Creek

Limited coho salmon spawning ground data are available for Deep Creek from 1952 to 1998. These data consist mostly of live and dead coho counts. Coho salmon redd count data are available for 1998 through 2005. Figure 36 depicts the annual total number of live and dead coho observed during spawning ground surveys compared to total number of coho observed/mile surveyed and total number of miles surveyed for return years 1952 through 2003. Data collected from 1952 to 1983 are sporadic and it is not possible to distinguish any trends from the data. McHenry et al. (1996) describe the coho population in Deep Creek as "crashing" in the early 1990's as a result of watershed degradation. However, the population appears to be in a rebuilding mode since the late-1990s. Total estimated escapement for the Deep Creek watershed for return years 1998 through 2005 are included in Figure 37. Deep Creek coho escapement from 1998 through 2005 vary significantly from a high of 699 (RY 2001) to a low of 173 (RY 2005), averaging 367. Interestingly the three lowest spawning escapements correspond to the same cohort lineage (Brood Year 1999, 2002, and 2005). These escapement estimates depict a flat trend, with one weak cohort and two stronger cohorts. Overall coho spawning escapement in Deep Creek tracks closely with the trend in total coho escapement for the western Strait. Since the mid-1990s the coho population has shown resilience and recovered from the population crash in the late-1980s and early-1990s.

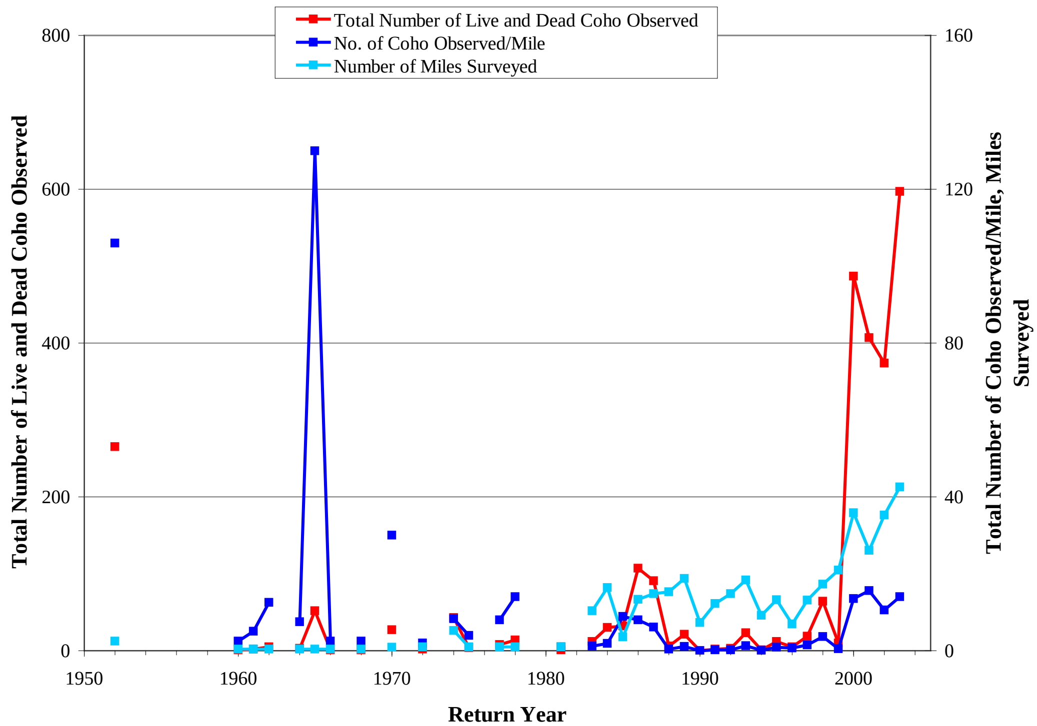

Figure 36. Total number of live and dead coho salmon observed in the Deep Creek watershed by return year contrasted with total number of coho observed per mile and total number of miles surveyed (source: WDFW spawning ground survey database).

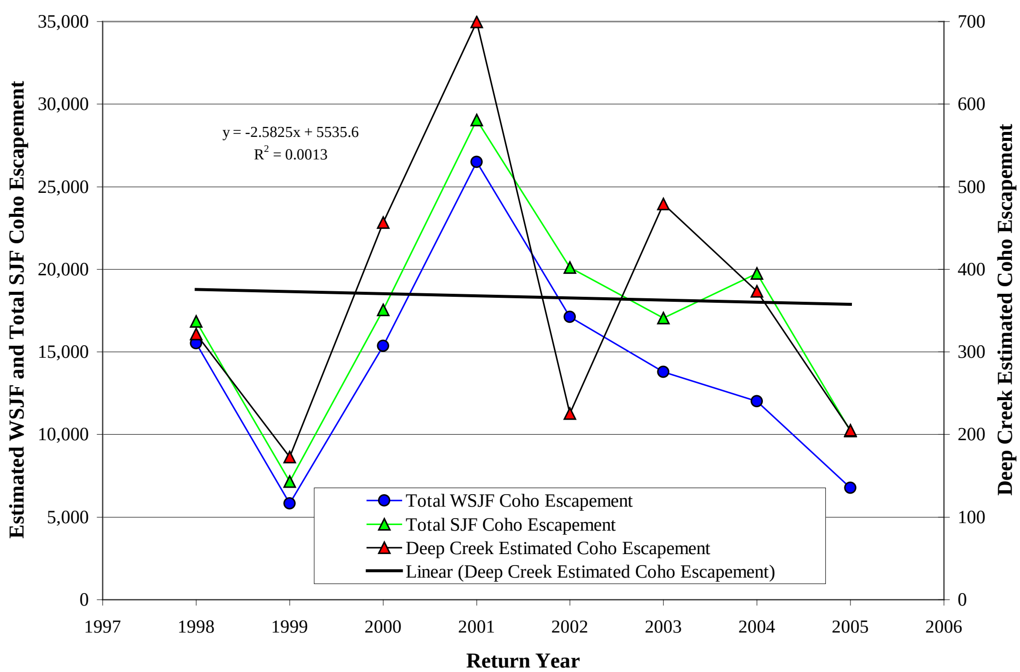

Figure 37. Estimated coho spawning escapement for SJF, WSJF, and Deep Creek for return years 1998-2005 (source: WDFW and Lower Elwha Tribe, unpublished data).

Coho salmon smolt data have been collected in Deep Creek since 1998. Figure 38 includes Deep Creek coho salmon smolt production estimates for 1998 through 2006 and the estimated survival of coho smolts-to-adult spawners. These data indicate that the trend in smolt production has been strongly positive but the trend is not statistically significant (p=0.215). Smolt production has ranged from a low of 4,255 (1998) to a high of 18,796 (2006), averaging 11,933. Survival from smolt-to-adult- spawner has been highly variable, ranging from a high of 8.4 percent (RY 2000) to a low of 1.3 percent (RY 2002).

Figure 39 depicts the estimated coho spawning escapement for Deep Creek and the subsequent number of smolt produced. No clear relationship between spawning escapement and coho smolt production are evident based on the data collected so far. Several regressions using 14-day, 30-day, and 60-day low flow ratios (at age 0+) and smolt production were calculated and no significant relationship was found. The number of smolt produced per adult spawner shows the same inverse relationship seen with Salt Creek and East Twin River coho, where increasing numbers of spawners results in a decreased number of smolts produced per spawner (Figure 40).

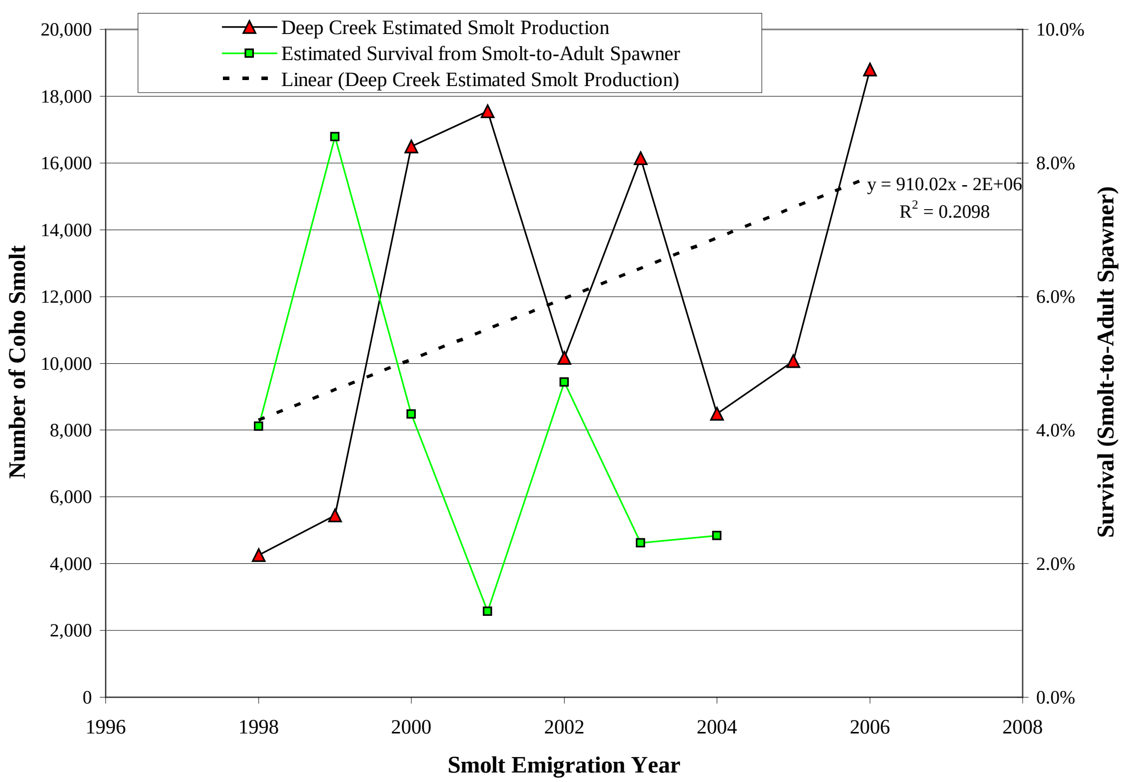

Figure 38. Deep Creek coho salmon smolt production estimates for 1998 through 2006 and estimated survival of smolt-to-adult spawner (source: Lower Elwha Tribe unpublished smolt production estimates).

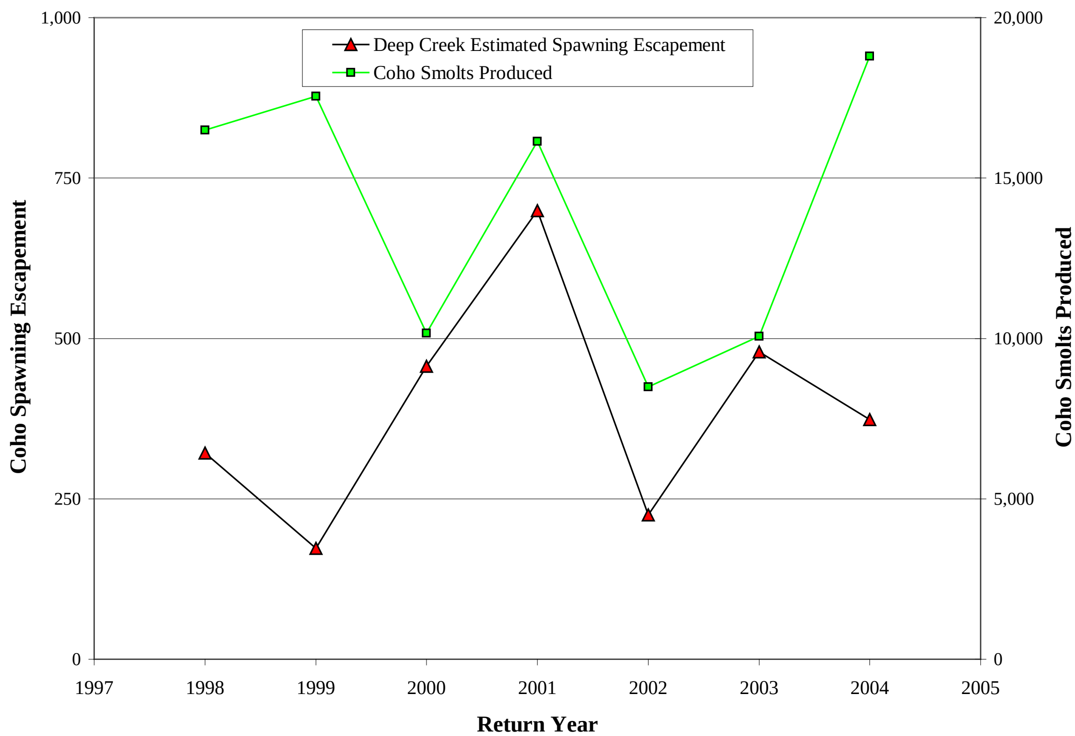

Figure 39. Deep Creek coho spawning escapement and subsequent number of smolt produced (source: Lower Elwha Tribe, unpublished data).

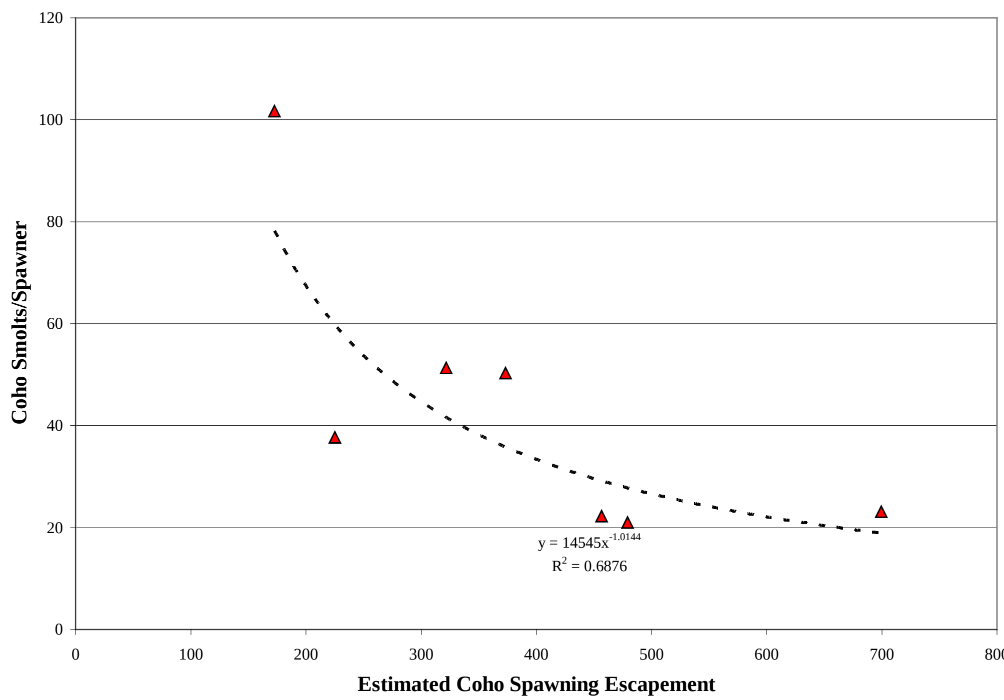

Figure 40. Deep Creek coho smolts produced per spawner versus coho spawning escapement.

3.3.2.6 Pysht River

Limited coho salmon spawning ground data are available for the mainstem and several tributaries from 1952 to 1994. These data consist mostly of live and dead coho counts. Coho salmon redd count data are available for 1995 through 2005. Figure 41 depicts the annual total number of live and dead coho observed during spawning ground surveys compared to the total number of coho observed/mile surveyed and the total number of miles surveyed for return years 1952 through 2003. The number of coho observed per mile surveyed appears to have declined significantly over the time series. Some of this decline might be attributable to the small sample size of the early datasets where a limited number of miles were surveyed each year across some of the best spawning sites. WDFW has maintained three coho spawning ground index reaches within the Pysht River watershed. South Fork Pysht River 1 (RM 5.7 to 6.6) and South Fork Pysht River 2 (RM 6.6 to 7.2) have been surveyed annually since 1984. The Green Creek index reach has been surveyed annually since 1985. Figure 42 depicts the combined total number of coho redds observed in these three index reaches for return years 1985 through 2006. The average number of redds observed during this time period has been 133 redds/year, ranging from a low of 30 (RY 2006) to a high of 440 (RY 2001). These data show a clear, statistically significant (p=0.001), positive trend from 1985 through 2002. The trend from 2002 to 2006 is severely negative and statistically significant (p=0.006). Total coho redds observed in RY 2006 may under represent total redds due to limited survey effort.

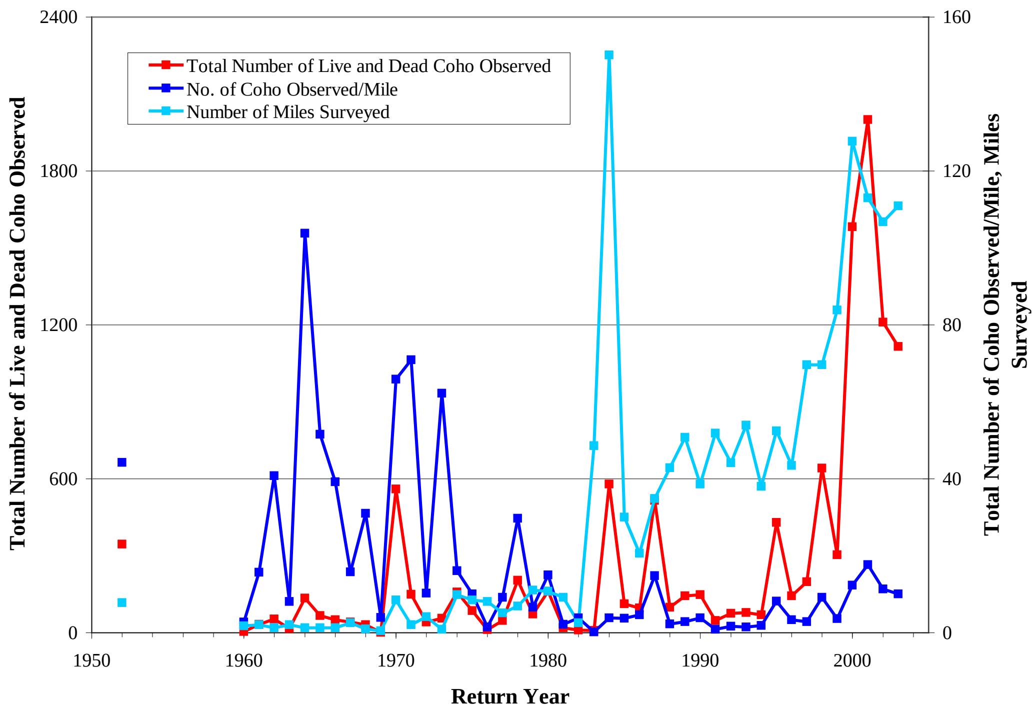

Figure 41. Total number of live and dead coho salmon observed in the Pysht River watershed by return year contrasted with total number of coho observed per mile and total number of miles surveyed (source: WDFW spawning ground survey database).

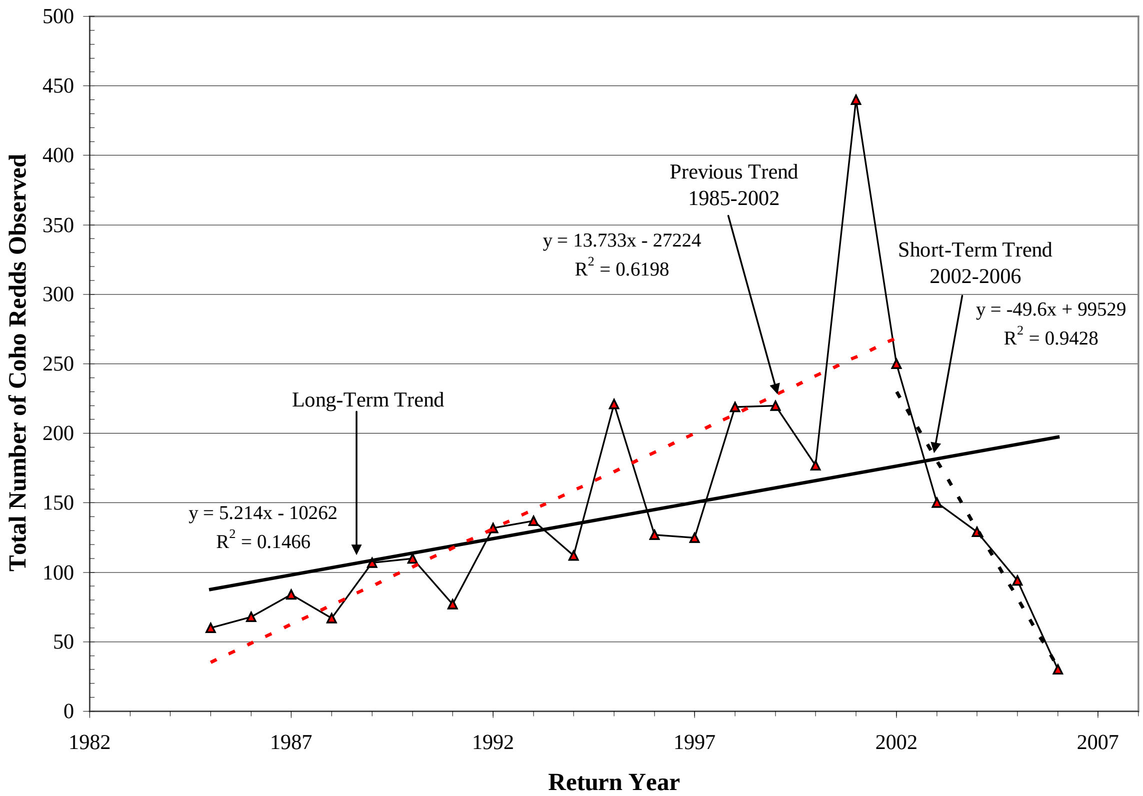

Figure 42. Combined S.F. Pysht River (RM 5.7-7.2) and Green Creek (RM 1.0-2.2) coho redds observed by return year (WDFW: unpublished spawning ground data).

Total estimated escapement for the Pysht River watershed for return years 1998 through 2005 are included in Figure 43. Pysht River coho escapement from 1998 through 2005 has a slightly negative trend, but the trend is not statistically significant (p=0.71). After considering these data along with the longer-term WDFW index reach data, it appears as though the spawning population was increasing from the mid-1980s until 2001 when abundance peaked. The number of spawners returning each year since 2001 have decreased each year, giving the population a short-term downward abundance trend. Overall coho spawning escapement in the Pysht River tracks closely with the trends observed for the entire western Strait coho population. These data suggest that marine survival of individual cohorts may exert a strong influence on observed escapement patterns to the region as a whole.

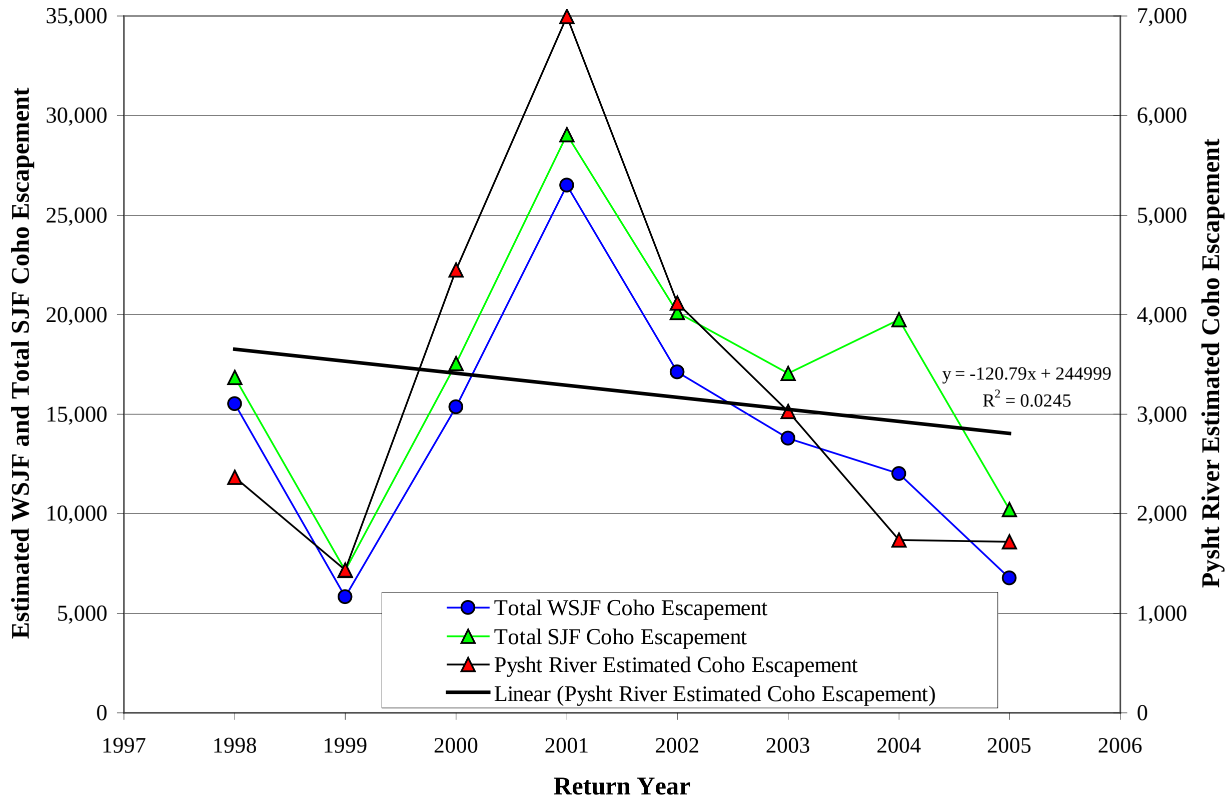

Figure 43. Estimated coho spawning escapement for SJF, WSJF, and Pysht River for return years 1998-2005 (source: WDFW and Lower Elwha Tribe, unpublished data).

3.3.2.7 Clallam River

Limited coho salmon spawning ground data are available for the mainstem and several tributaries from 1960 to 1994. These data consist mostly of live and dead coho counts. Coho salmon redd count data are available for 1995 through 2005. Figure 44 depicts the annual total number of live and dead coho observed during spawning ground surveys compared to total number of coho observed/mile surveyed and total number of miles surveyed for return years 1960 through 2003. The number of coho observed per mile surveyed appears highly variable over the time series. Much of the high variability might be explained by the low survey effort from 1960 through 1982

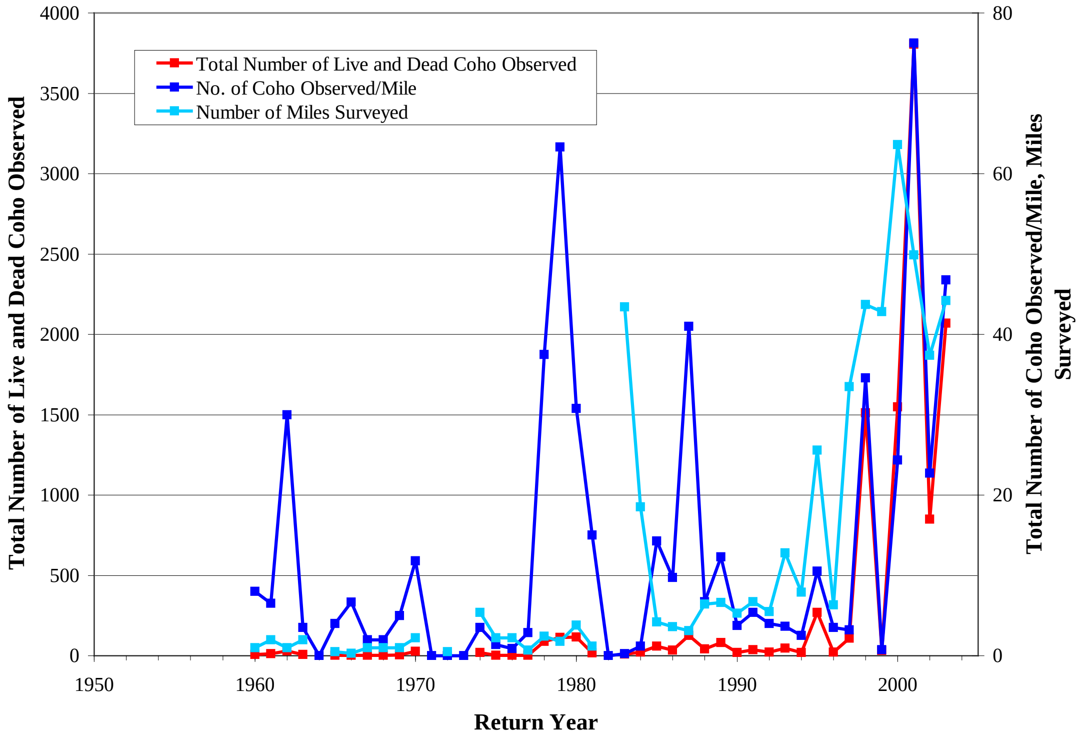

Figure 44. Total number of live and dead coho salmon observed in the Clallam River watershed by return year contrasted with total number of coho observed per mile and total number of miles surveyed (source: WDFW spawning ground survey database).

WDFW has maintained a coho spawning ground index reach in Charley Creek, the largest tributary to the Clallam River. The Charley Creek index reach extends from RM 0.9 to 1.5. This survey reach has been surveyed annually since 1984, and has some of the highest coho spawning densities observed on the Olympic Peninsula. Figure 45 depicts the total number of coho redds observed in the Charley Creek index reach for return years 1984 through 2006. The average number of redds observed during this time period has been 94 redds/year, ranging from a low of 7 (RY 1999) to a high of 389 (RY 2001). These data show a statistically significant (p=0.025), positive trend from 1984 through 2006. The trend from 1984 to 2001 is slightly more positive and statistically significant (p=0.0037), whereas the trend from 2001 through 2006 is strongly negative but is not statistically significant (p=0.056).

Total estimated escapement for the Clallam River watershed for return years 1998 through 2005 are included in Figure 46. Clallam River coho escapement from 1998 through 2005 has a negative trend, but the trend is not statistically significant (p=0.49). Considering these data along with the longer-term WDFW index reach data it appears as though the spawning population was increasing from the mid-1980s until 2001 when abundance peaked. The number of spawners returning each year since 2001 as compared to their parent year have decreased each year, giving the population a short-term downward trend.

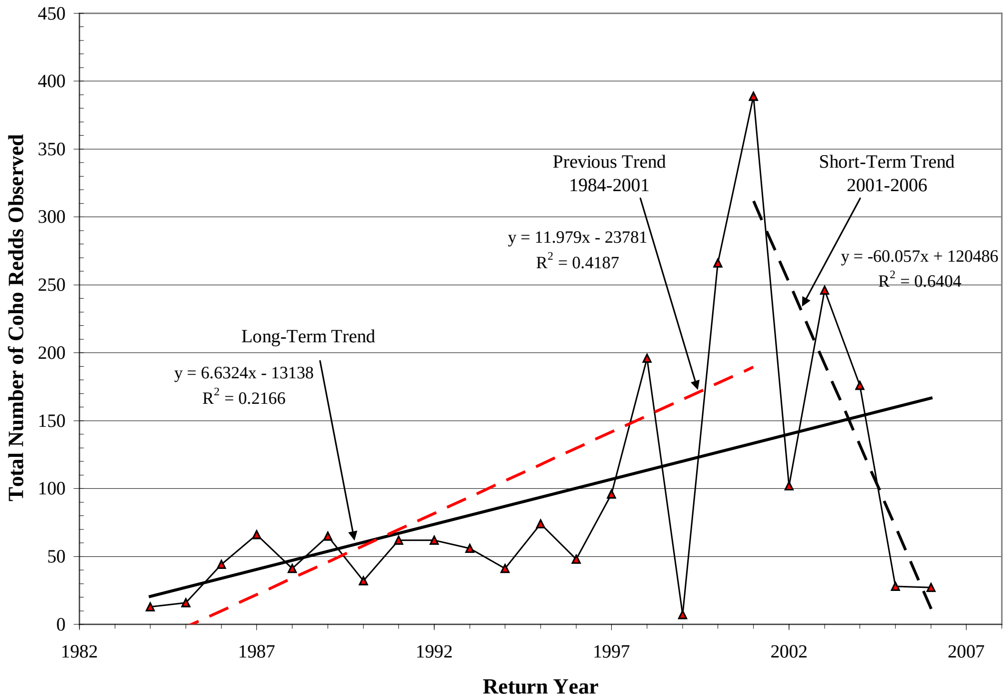

Figure 45. Charley Creek (RM 0.9-1.5) coho redds observed by return year (WDFW: unpublished spawning ground data).

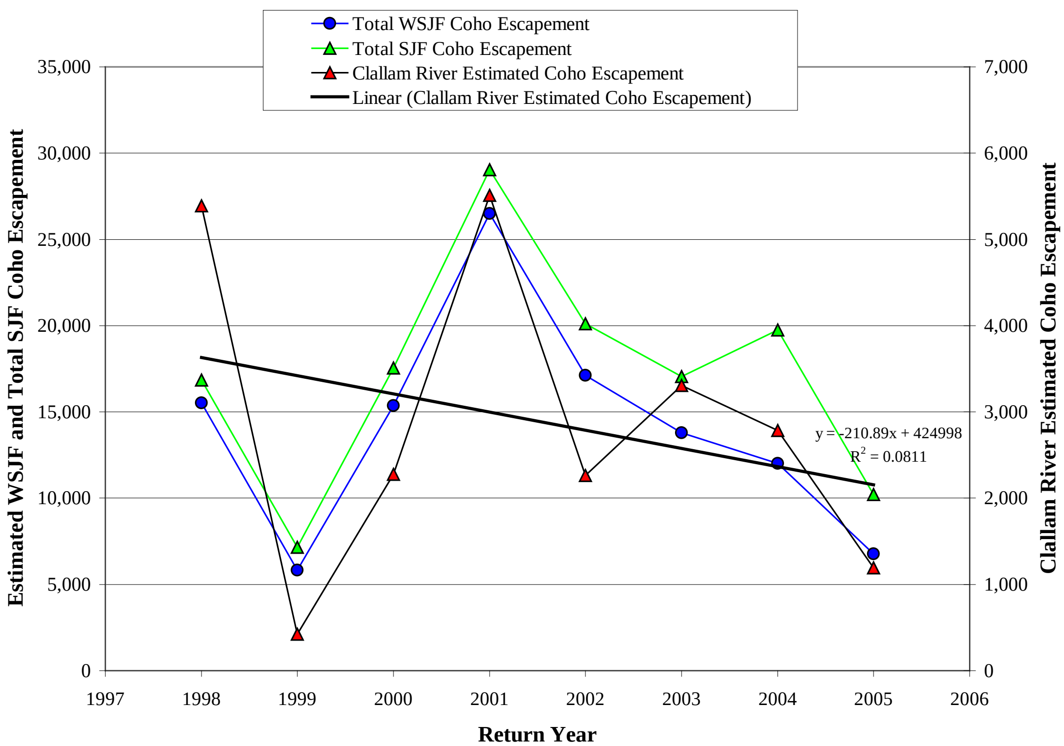

Figure 46. Estimated coho spawning escapement for SJF, WSJF, and Clallam River for return years 1998-2005 (source: WDFW and Lower Elwha Tribe, unpublished data).

The overall coho spawning escapement in the Clallam River tracks closely with the trends observed for the entire western Strait of Juan de Fuca coho population. The very low spawning escapement observed in RY 1999 in both Charley Creek and the entire system appears to be related to the 1998 smolt emigration period when the mouth of Clallam River was sealed off from the Strait during most of the emigration period. From 1986 through 2006 the Charley Creek index has comprised 15 percent of the WDFW western Strait of Juan de Fuca coho escapement index on average. In 1999, the Charley Creek index made up only 1.3 percent of the WDFW WSJF coho escapement index. These data suggest that the mouth closure in 1998 was at least partially responsible for the greater than one order of magnitude reduction in the relative contribution of Charley Creek coho spawners to the WDFW WSJF coho escapement index.

3.3.2.8 Hoko River

Limited coho salmon spawning ground data are available for the mainstem and several tributaries from 1951 to 1994. These data consist mostly of live and dead coho counts. Coho salmon redd count data are available for 1995 through 2005. Figure 47 depicts the annual total number of live and dead coho observed during spawning ground surveys compared to total number of coho observed per mile surveyed and total number of miles surveyed for return years 1951 through 2003. During this time period the number of miles surveyed has ranged from 0 to 235 miles. The number of coho observed per mile surveyed has ranged from 40 (1952; note only 0.2 miles surveyed) to less than one. The highest number of coho observed in the Hoko River watershed within an individual spawning year was in 2001 when a total of 2,167 coho were observed. The WDFW spawning ground survey database does not appear to include recent data (1997-2006) collected by the Makah Tribe and therefore these estimates may not be accurate.

WDFW has maintained four coho spawning ground index reaches within the Hoko River watershed. Hoko River 1 (RM 20.4 to 20.8) and Hoko River 2 (RM 20.8 to 22.5) have been surveyed annually since 1984 (excluding 1985 for Hoko River 1). The Bear Creek (RM 0 to 1.7) and Cub Creek (RM 0.0 to 0.5) index reaches have been surveyed annually since 1985. Figure 48 depicts the combined total number of coho redds observed in these four index reaches for return years 1986 through 2006. The average number of redds observed during this time period has been 221 redds/year, ranging from a low of 54 (RY 2006) to a high of 650 (RY 2001).

These data show a clear, statistically significant ($p=0.0015$), positive trend from 1986 through 2002. The trend from 2002 to 2006 is severely negative and statistically significant ($p=0.017$). Total coho redds observed in RY 2006 may under represent total redds because of limited survey effort caused by high water and poor surveying conditions.

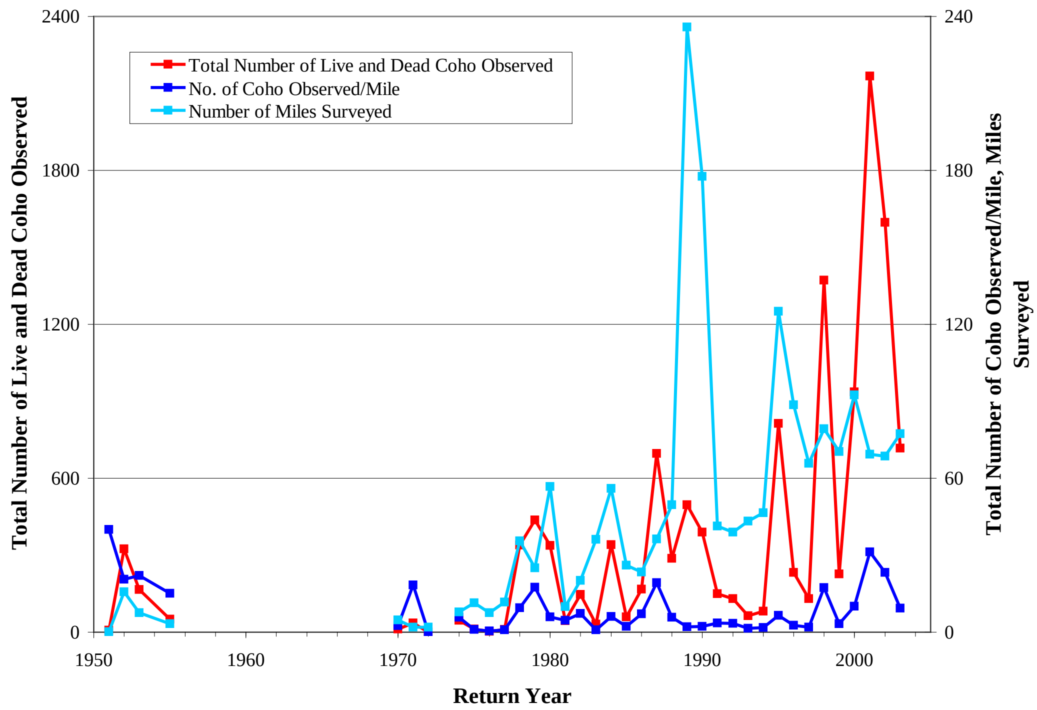

Figure 47. Total number of live and dead coho salmon observed in the Hoko River watershed by return year contrasted with total number of coho observed per mile and total number of miles surveyed (source: WDFW spawning ground survey database).

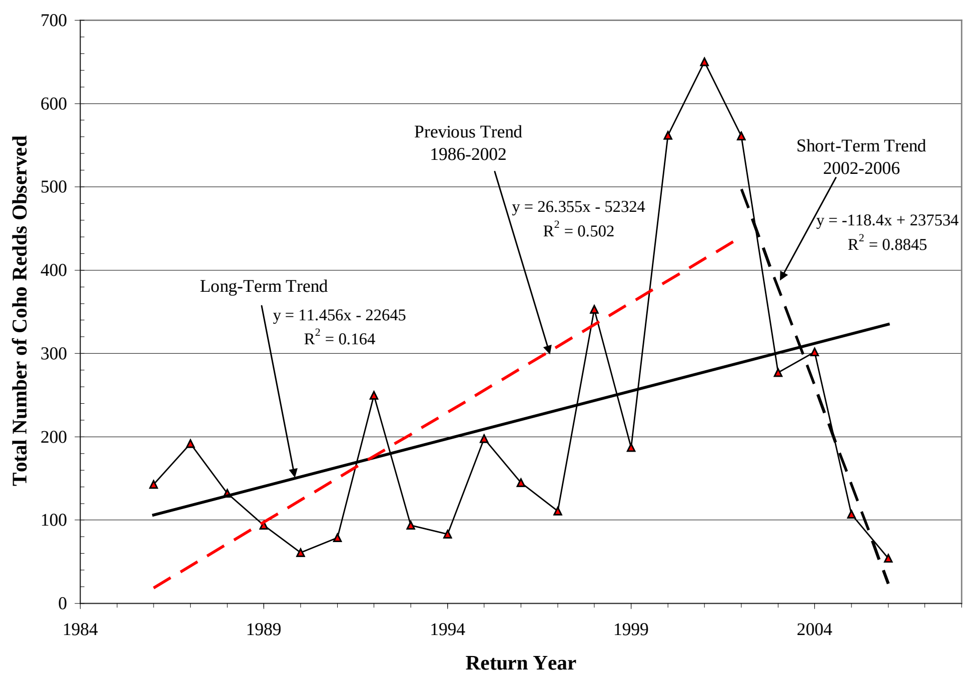

Figure 48. Combined Hoko River (RM 20.4-22.4), Bear Creek (RM 0.0-1.7), and Cub Creek (RM 0.0-0.5) coho redds observed by return year (WDFW: unpublished spawning ground data).

Total estimated escapement for the Hoko River watershed for return years 1998 through 2005 are included in Figure 49. Hoko River coho escapement from 1998 through 2005 has a slightly negative trend, but the trend is not statistically significant (p=0.38). Considering these data along with the longer-term WDFW index reach data, it appears as though the spawning population was increasing from the mid-1980s until 2002 when abundance peaked. The number of spawners returning each year since 2002 has decreased each year, giving the population a short-term downward abundance trend. Overall coho spawning escapement in the Hoko River tracks closely with the trends observed for the entire western Strait of Juan de Fuca coho population.

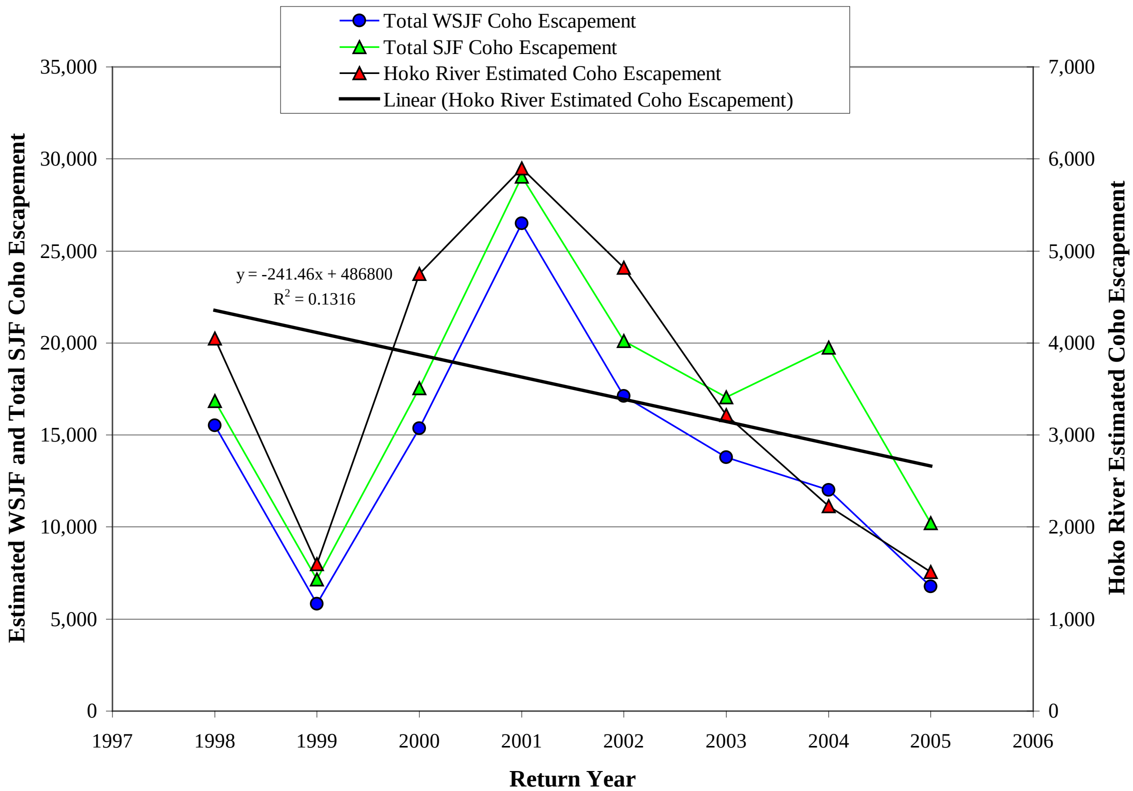

Figure 49. Estimated coho spawning escapement for SJF, WSJF, and Hoko River for return years 1998-2005 (source: MFM, WDFW, and Lower Elwha Tribe, unpublished data).

Coho salmon smolt trap data were collected in the Hoko River at RM 10.2 from 1986 through 1990. Smolt production in the upper Hoko River during this period ranged from 8,400 to 28,100 (Lestelle and Weller 1994). Additional data during this same period were also collected in the lower Little Hoko River, where production ranged from 2,700 to 4,200. Smolt data are also available for the Little Hoko River from 1998 to 2003. Smolt production during this period ranged from 3,797 (1998) to 9,117 (2000), averaging 5,723. Note trap efficiency was quite low in 2000 and this estimate may not accurately reflect the actual number of smolt emigrating during the trapping period.

3.3.2.9 Sekiu River

Limited coho salmon spawning ground data are available for the mainstem and several tributaries from 1951 to 1994. These data consist mostly of live and dead coho counts. Coho salmon redd count data are available for 1995 through 2005. Figure 50 depicts the annual total number of live and dead coho observed during spawning ground surveys compared to total number of coho observed/mile surveyed and total number of miles surveyed for return years 1951 through 2003. During this time period the number of miles surveyed has ranged from 0 to 235 miles. The number of coho observed per mile surveyed has ranged from 11 (ReturnYear 2001) to less than one. The largest number of coho observed in the Sekiu River watershed within an individual spawning year was in 2002 when 753 coho were counted.

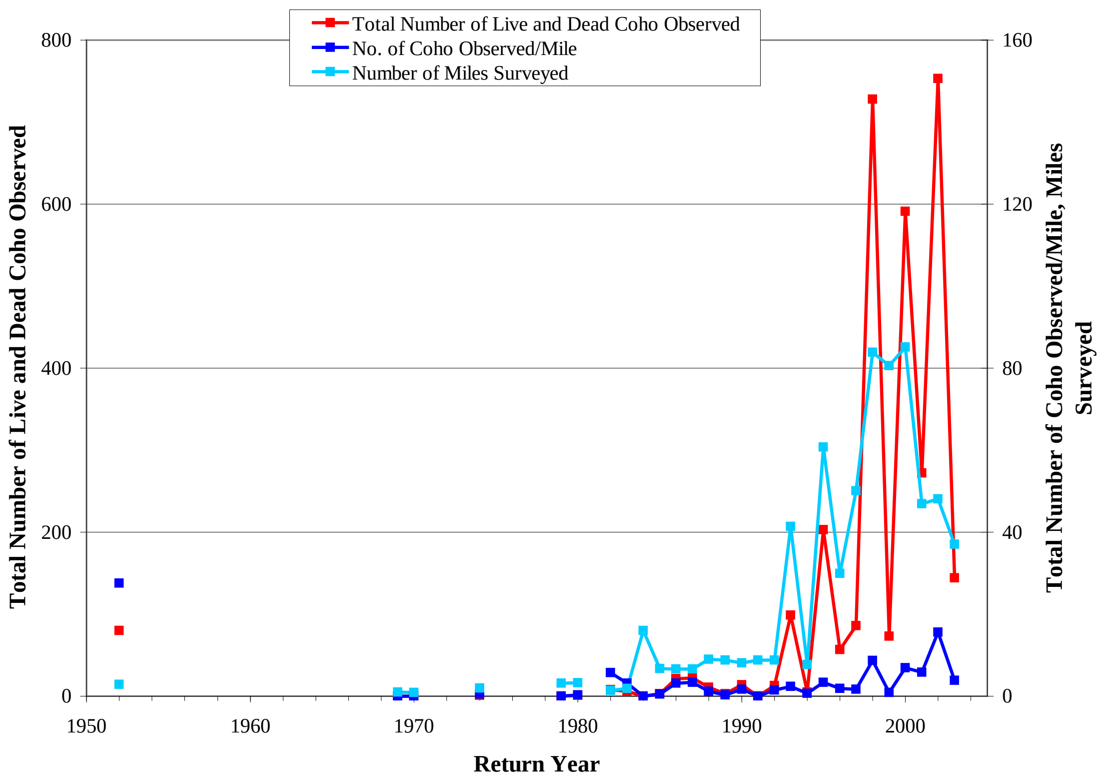

Figure 50. Total number of live and dead coho salmon observed in the Sekiu River watershed by return year contrasted with total number of coho observed per mile and total number of miles surveyed (source: WDFW/MFM spawning ground survey database).

WDFW has maintained two coho spawning ground index reaches within the Sekiu River watershed. Carpenters Creek (RM 0.0 to 0.6) and East Fork Carpenters Creek (RM 0.0 to 0.5) have been surveyed annually since 1985. Figure 51 depicts the combined total number of coho redds observed in these two index reaches for return years 1985 through 2006. The average number of redds observed during this time period has been 34 redds/year, ranging from a low of 8 (RY 1988) to a high of 94 (RY 2001). These data show a clear, statistically significant (p=0.0005), positive trend from 1985 through 2001. The trend from 2001 to 2006 is severely negative and statistically significant (p<0.0001).

Total estimated escapement for the Sekiu River watershed for return years 1998 through 2005 are included in Figure 49. Sekiu River coho escapement from 1998 through 2005 has a slightly negative trend, but the trend is not statistically significant (p=0.70). Considering these data along with the longer-term WDFW index reach data it appears as though the spawning population was increasing from the mid-1980s until 2001 when abundance peaked. The number of spawners returning each year since 2001 has decreased, giving the population a short-term downward abundance trend. However, the number of spawners returning for each year class continued to increase through return year 2003 in Carpenter and E.F. Carpenter Creeks. Current low abundance levels appear to be in the same range as those that occurred from 1985 through 1997.

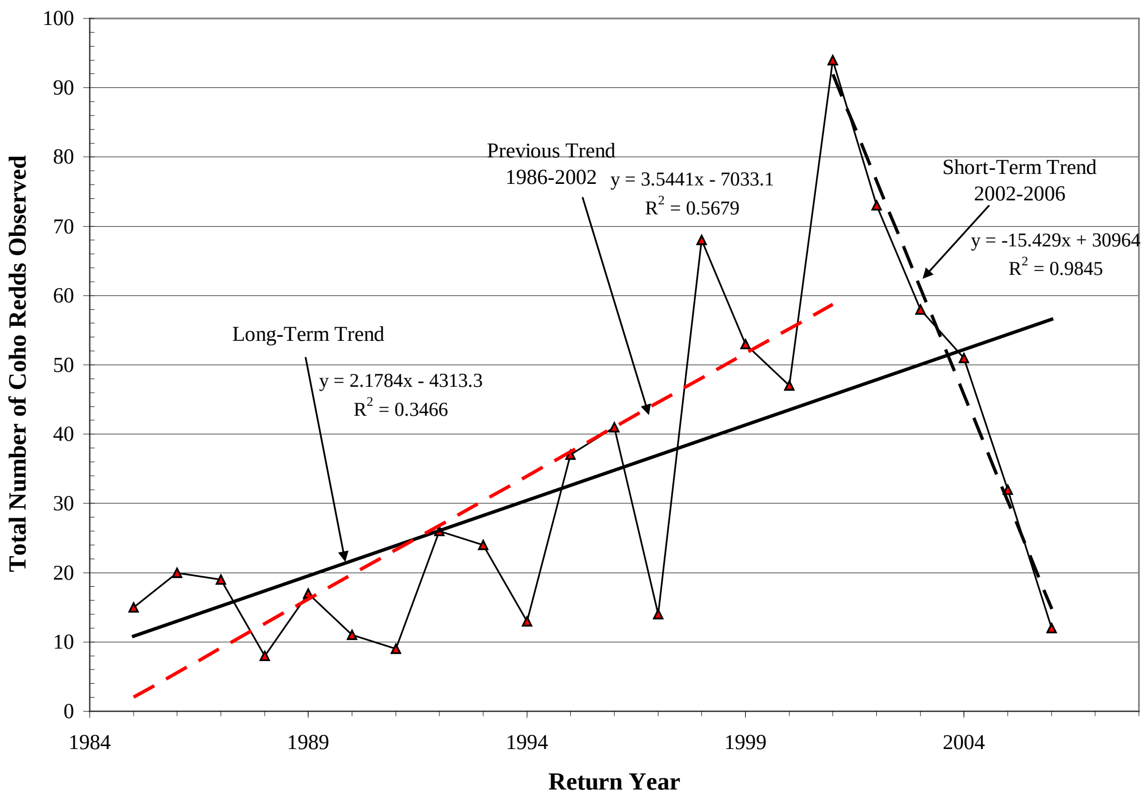

Figure 51. Combined Carpenter Creek (RM 0.0-0.6) and E.F. Carpenter Creek (RM 0.0-0.5) total coho redds observed by return year (WDFW: unpublished spawning ground data).

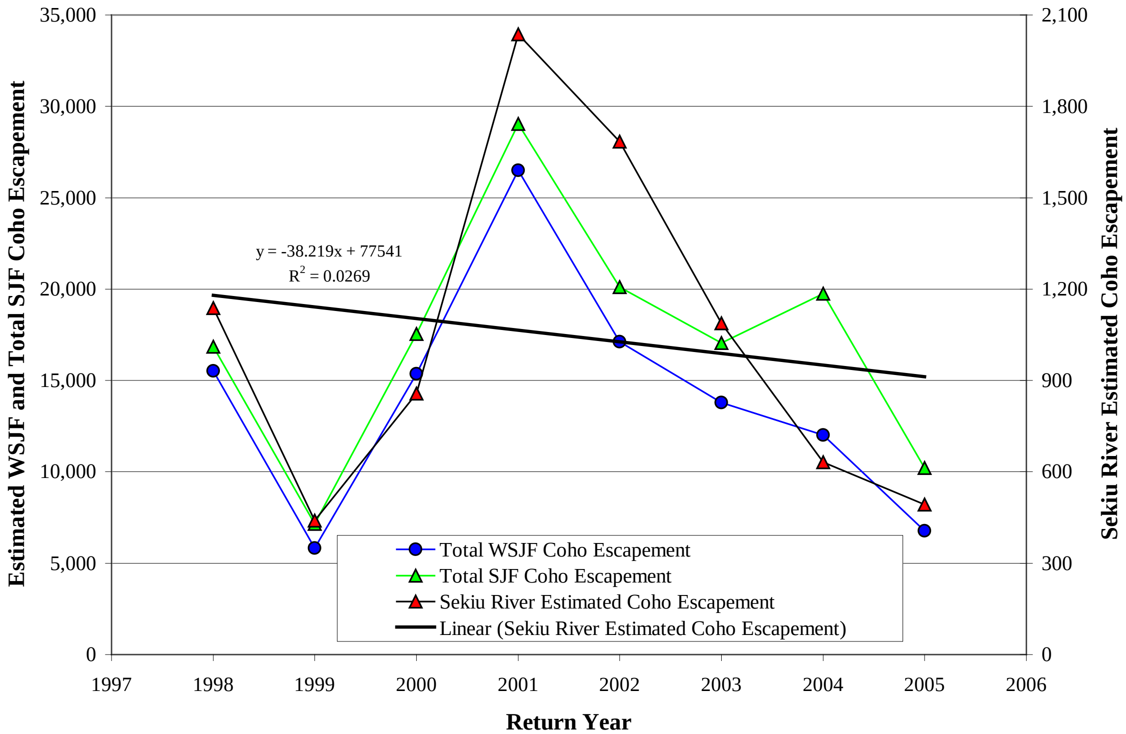

Figure 52. Estimated coho spawning escapement for SJF, WSJF, and Sekiu River for return years 1998-2005 (source: MFM and WDFW, unpublished data).

3.3.2.10 Western Strait Independents

Coho spawning ground survey data are most limited in the Western Strait Independents subbasin. Coho salmon spawning ground data are available for the various independent tributaries from 1968 to present. However, from 1968 to 1982 only 5.8 miles of surveys are reported in the WDFW spawning ground survey database. In 1983 and 1984 survey effort was significantly higher (45 miles of survey effort) but no coho were observed in 1983 and only 1.2 coho/mile surveyed were observed in 1984. Little survey effort is reported in the database from 1985 through 1996, except for 1995 when 27.9 miles of survey were conducted, yielding observations of only 0.5 coho/mile. Consistent, well-distributed spawning ground surveys have occurred each year since 1997. Escapement estimates for the WSI are available from 1998 through 2005. Total estimated spawning escapement for the WSI subbasin for return years 1998 through 2005 are included in Figure 37. WSI subbasin coho escapement from 1998 through 2005 ranged from a high of 908 (RY 2001) to a low of 339 (RY 2005), averaging 518. Overall coho spawning escapement in the WSI subbasin tracks closely with the trend in total coho escapement for western Strait of Juan de Fuca streams.

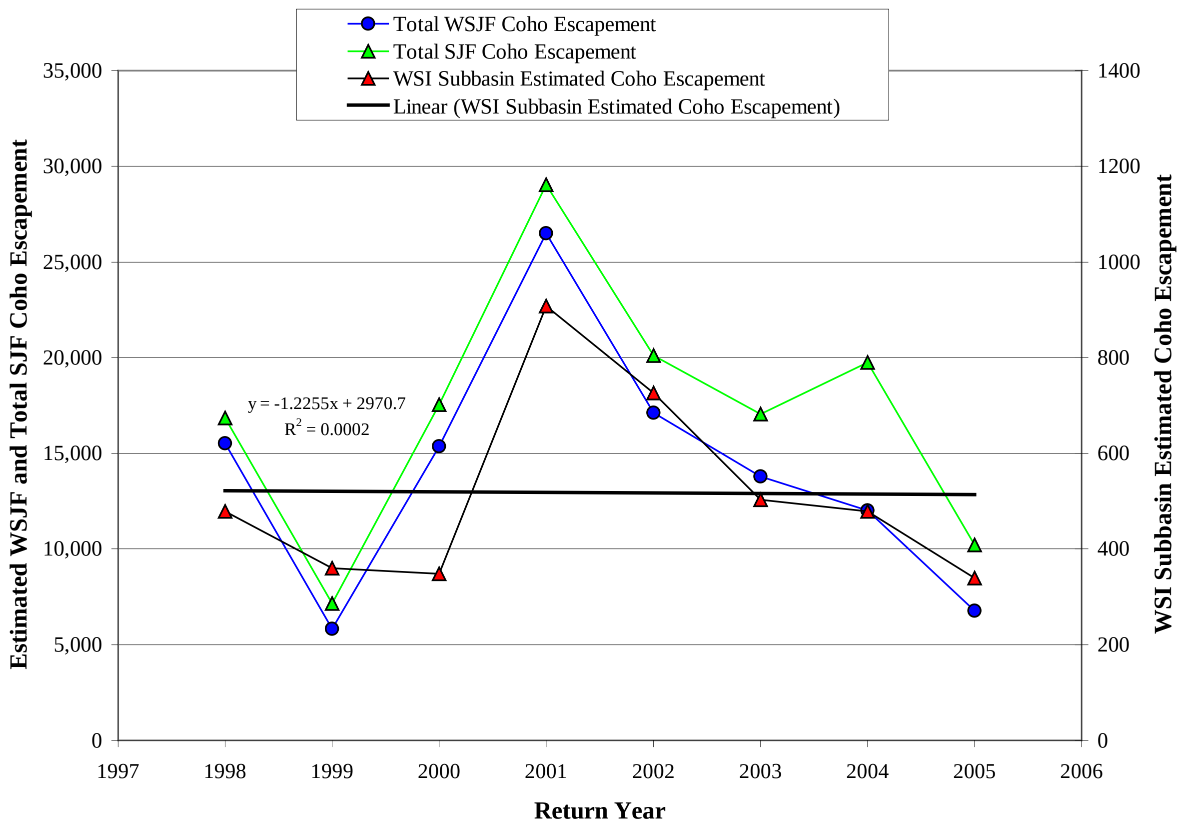

Figure 53. Estimated coho spawning escapement for SJF, WSJF, and Western Strait Independents for return years 1998-2005 (source: MFM, WDFW, and Lower Elwha Tribe, unpublished data).

3.3.3 Coho Salmon Fisheries and Harvest

Coho returning to western Strait of Juan de Fuca streams are subject to intercepting fisheries that occur in the Pacific Ocean and Strait of Juan de Fuca in the United States and Canada, as well as small amounts of harvest in WRIA 19 streams. Prior to 1997, most of the coho harvest occurred in British Columbia fisheries off the West Coast of Vancouver Island (Figure 54). Thereafter, Canada and the US adopted management plans that severely curtailed coho harvest in an effort to protect depleted Fraser River coho, which also benefitted western SJF coho. Most coho harvest in US waters occurs as incidental catch during fishing that targets Fraser-bound sockeye, or during sport fisheries that occur in the Strait of Juan de Fuca. In the last decade, a small number of WRIA 19 coho (less than 20 fish per year) are taken in recreational and treaty fisheries in western SJF streams.

The Pacific Fisheries Management Council investigated the potential of overfishing of coho originating from the western Strait of Juan de Fuca in 2009, following four consecutive years when the goal for naturally spawning coho was not achieved. The PFMC Salmon Technical Team (2010) examined smolt production coming from the western SJF streams, marine survival, and fisheries exploitation patterns, and attributed the shortfall primarily to poor marine survival. Fisheries impacts were well below the exploitation rates allowed under United States and Canadian fisheries management regimes. Had exploitation rates been reduced to zero, the conservation objectives for returning coho would still not have been met. The Salmon Technical Team included several recommendations for improving forecast methods, re-examining escapement goals, and encouraged resource managers to work on habitat improvement in the Strait of Juan de Fuca tributaries.

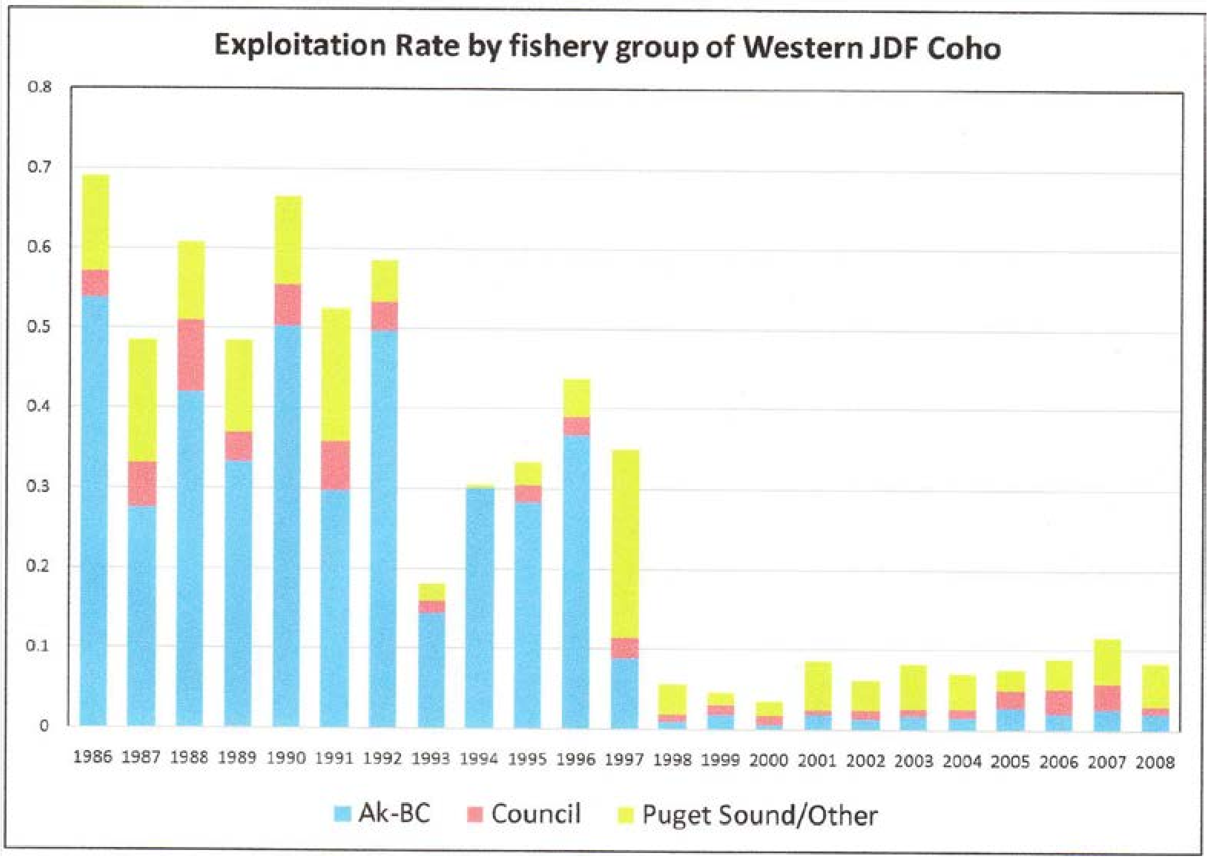

Figure 54: Magnitude and distribution of fishery impacts on Western Strait of Juan de Fuca coho salmon (reproduced from PFMC STT, 2010).

3.3.4 Coho Salmon Hatchery Practices

Hatchery planting records indicate that WRIA 19 streams were planted with hatchery coho from 1952 through 1988. Additional undocumented releases may have occurred prior to and during this time period. Hatchery release records indicate a total of 13.7 million juvenile coho were planted during this time period (Table 9). Broodstock sources included the following 11 stocks: Big Quilcene River, Big Soos Creek, Dungeness River, Elwha River, George Adams, Lake Creek (Sol Duc tributary), Skagit River, Sooes River, Sol Duc River, Washington General, and Washougal River. The majority of hatchery outplants came from the Dungeness River (5.4 million), Elwha River (4.7 million), and

George Adams (0.95 million) stocks. Coho size at release varied widely between releases, 7.6 million, 2.3 million, and 3.8 million coho were less than 1 gram, between 1 and 5 grams, and great than 5 grams respectively. Appendix C includes a detailed summary by brood year of coho salmon hatchery plants for SJF tributaries.

Table 9. WRIA 19 coho salmon hatchery releases by WRIA 19 subbasin (source: RMIS database)

Subbasin Name	First Year Coho Released	Last Year Coho Released	Number of Brood Years Planted	Number of Release Years	Number of Coho Released	Number of Brood Stock Sources Released
Salt Creek	1959	1982	14	14	1,045,024	6
Lyre River	1954	1986	22	23	799,107	5
East Twin	1953	1986	22	23	976,138	5
West Twin	1956	1984	13	13	450,136	6
Deep Creek	1955	1985	17	17	771,499	5
Pysht River	1952	1986	25	26	1,910,287	6
Clallam River	1953	1987	20	22	1,655,074	8
Hoko River	1952	1988	20	22	3,048,133	5
Sekiu River	1958	1986	9	9	1,644,181	4
WSJF Independents	1971	1988	8	9	1,401,600	4
TOTAL	**1952**	**1988**	**n=34**	**n=33**	**13,701,179**	**n=10**

3.4 STEELHEAD/RAINBOW TROUT (*O. mykiss*)

Steelhead trout are among the most widely distributed and abundant anadromous salmonids in WRIA 19. Steelhead trout populations within the Pacific Northwest are classified as either winter-run or summer-run populations. With the exception of the Lyre River, which includes both summer-run and winter-run steelhead, all other steelhead populations and/or spawning aggregations within the WRIA 19 watershed are classified as winter-run steelhead trout. In addition, the Lyre River system also contains a resident form of rainbow trout (Beardslee trout) in Lake Crescent, above the Lyre River falls. Historically, the largest steelhead trout populations were found in the Lyre, Pysht, and Hoko rivers. The Clallam and Sekiu rivers, as well as Deep Creek also supported significant steelhead populations. The smallest spawning populations or spawning aggregations are found in the tributaries to the WSI subbasin (e.g., Bullman and Rasmussen creeks). Figure 55 depicts steelhead trout distribution in WRIA 19 streams. A simplified description of the life-history of WRIA 19 steelhead trout is included below.

Within the WRIA 19 watershed, adult steelhead begin entering stream and river systems in November and continue entering freshwater until May. Peak entry timing into the rivers occurs from December through March. Spawning takes place from December through mid-June with peak spawning occurring from late February through mid-April (WDFW 2002). Steelhead are predominately mainstem spawners but they will also spawn in large tributaries that are accessible and low (0.1-3%) or moderate (3-8%) gradient. Steelhead also spawn in small (less than 10 meters bankfull width) tributaries (WDFW, unpublished spawning ground survey database).

Steelhead egg incubation takes place from December through July. The fry have a protracted emergence period due to the long spawning season and variable incubation temperatures. Juvenile steelhead fry typically rear in freshwater for 2 years before smoltification but may rear in freshwater for 1 to 7 years prior to smolting and emigrating (Wydoski and Whitney 2003). The life history of juvenile steelhead during the freshwater rearing phase in WRIA 19 subbasins has not been studied to a great extent and little documentation is available. Steelhead smolt emigration data are collected from mid-April to late June in several WRIA 19 streams. These data indicate that the primary smolt emigration period is from April through June with peak emigration from mid- to late-May (Figure 56). Most coastal steelhead trout populations rear in the marine environment for 1.5 to 3.5 years prior to returning to spawn.

Unlike salmon, steelhead trout are iteroparous and may make several migrations from salt to freshwater to spawn. Upon spawning some steelhead die but many survive. Those that survive spawning must then migrate back to the ocean. During this life history phase steelhead are called kelts. Kelts are routinely observed transiting downstream during the smolt trapping period. There have been no attempts to quantify the total number of kelts migrating down WRIA 19 streams.

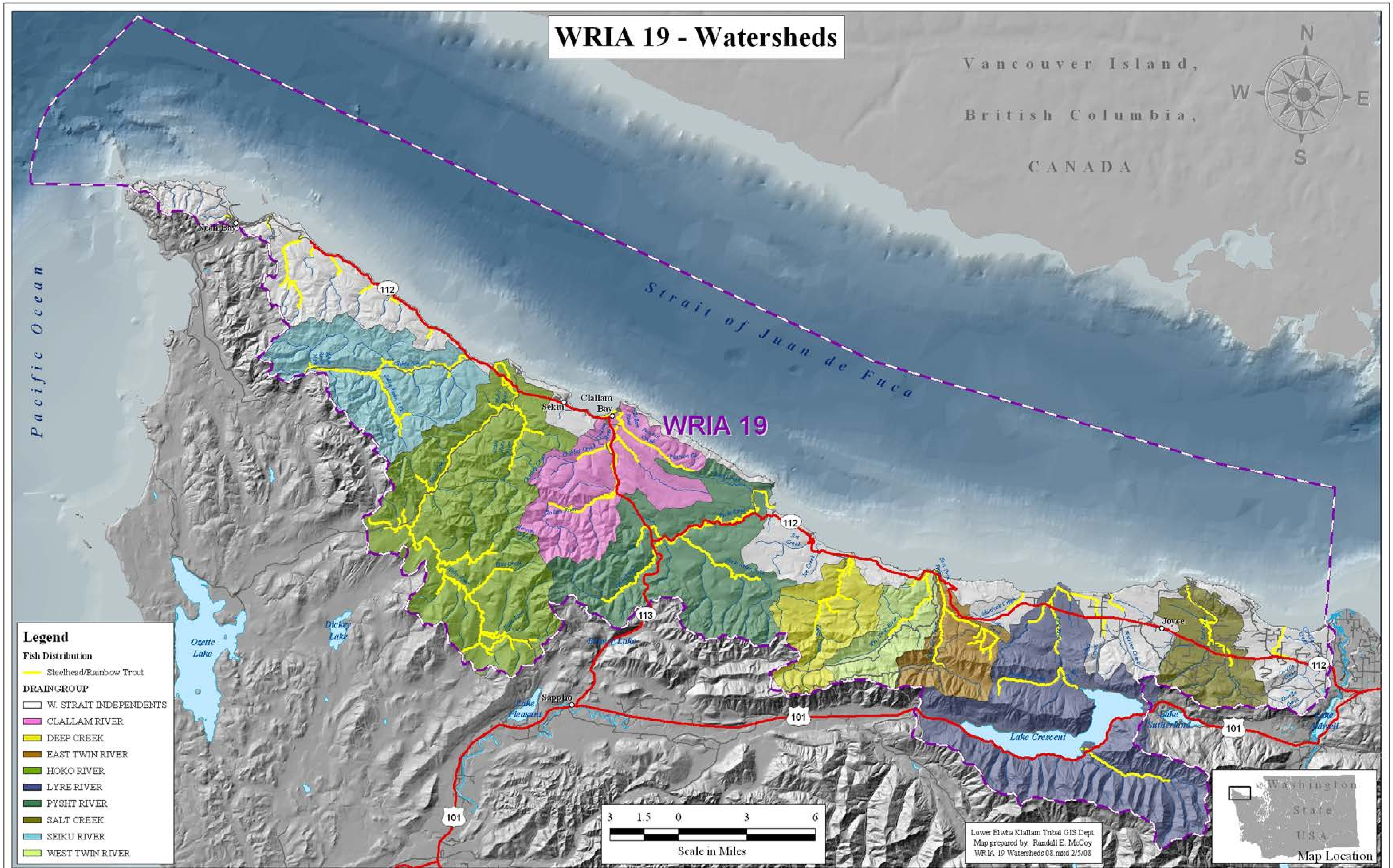

Figure 55. WRIA 19 Steelhead/rainbow trout distribution map (source: salmonid distribution modified from Salmonscape 2005).

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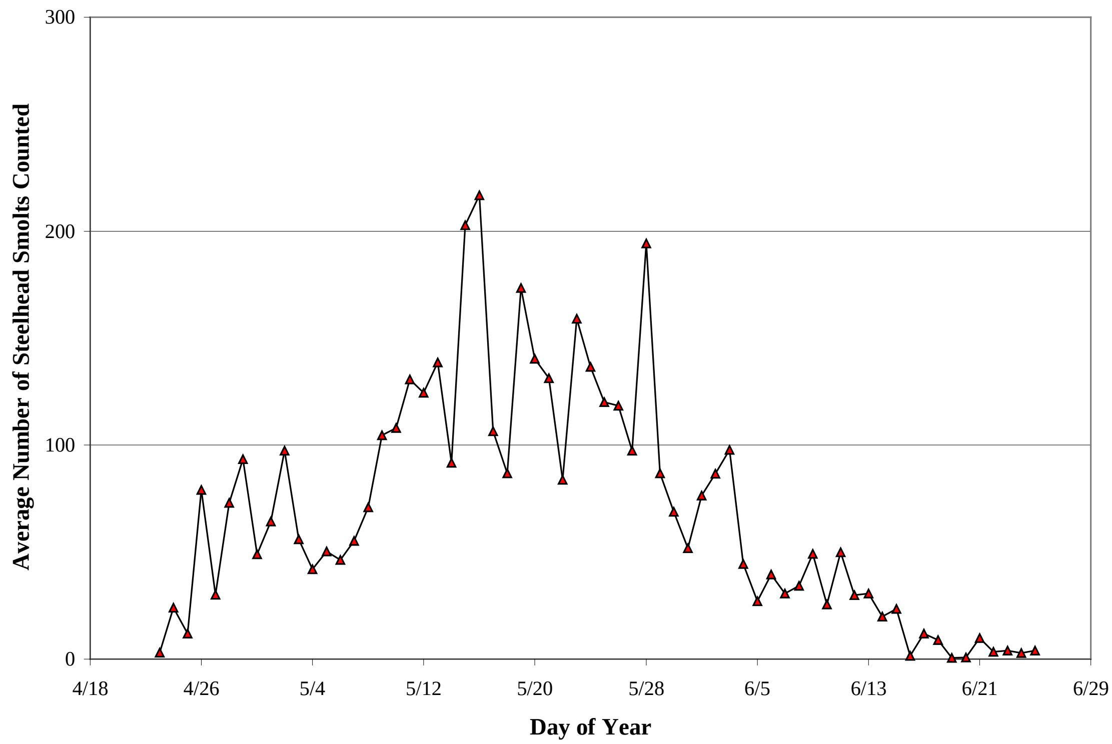

Figure 56. Combined annual (2001-2005) daily average steelhead smolt counts for Salt Creek, East Twin River, West Twin River, and Deep Creek for the period April 23 to June 25 (source: Lower Elwha Tribe, unpublished smolt data).

3.4.1 Steelhead Trout Population Status and Abundance Trends

3.4.1.1 Steelhead Trout ESA Status Review--NMFS (Busby et al. 1996)

The Olympic Peninsula steelhead trout ESU includes river basins of the Olympic Peninsula west of the Elwha River and south to, but not including, rivers flowing into Grays Harbor on the Washington coast. The Olympic Peninsula ESU is primarily composed of winter-run steelhead but summer-run steelhead stocks are present in larger rivers (e.g., Hoh River). Non-anadromous O. mykiss co-occur with the anadromous form in this ESU, although the relationship between the two forms within the ESU is unclear.

Limited life history information is available for Olympic Peninsula steelhead, and the information that does exist is primarily from winter-run fish. There is very little information regarding the abundance and status of summer steelhead. Known life history attributes of Olympic Peninsula steelhead are similar to those of other West Coast steelhead, the notable exception being the difference between U.S. and Canadian populations in age at smoltification (Busby et al. 1996).

Genetic data collected by WDFW support the hypothesis that, as a group, Olympic Peninsula steelhead populations are substantially isolated from other populations in western Washington. The Olympic Peninsula ESU is characterized by habitat, climatic, and zoogeographical differences between it and adjacent ESUs (Busby et al. 1996).

Of the 12 independent stocks for which the status review had sufficient escapement data to compute abundance trends, 7 were declining and 5 increasing during the data series. It was noted that these trends were all for winter steelhead populations, and that no escapement data were available to compute abundance trends for summer steelhead.

The status review noted that there were not strong trends in abundance and that hatchery steelhead contribution to late-run winter stocks is limited. Most winter steelhead stocks in the Olympic Peninsula ESU were determined to be naturally sustaining, but the status review identified concerns about sustainability of some winter steelhead runs in the ESU. This included the Pysht/Independents stock in WRIA 19, which had low abundance and a strongly declining trend over the available data series (Busby et al. 1996).

The Biological Review Team concluded that the Olympic Peninsula steelhead ESU is neither presently in danger of extinction nor likely to become endangered in the foreseeable future. Despite this conclusion, the BRT has several concerns about the overall health of this ESU and about the status of certain stocks within it. The conclusions of the status review have substantial uncertainty. There is little information about the abundance and status of summer steelhead in the ESU, and the degree of interaction between hatchery and natural stocks is not known (Busby et al. 1996).

3.4.1.2 Steelhead Trout WDFW Status Review

SaSSI identifies 7 steelhead stocks in WRIA 19 in both the 1992 and 2002 status reviews: Salt Creek (includes independents: Colville, Whiskey, and Field Creeks), Lyre River, Pysht/Twin/Deep (includes: Pysht River, East Twin, West Twin, and Deep Creek, as well as several miscellaneous independents (e.g., Murdock, Jim, and Joe Creeks), Clallam River, Hoko River, Sekiu River and Sail River.

The 1992 status review determined that the Pysht/Twin/Deep and Hoko River stocks were healthy based on wild spawner escapements. The 1992 status review determined that the status of all other stocks were unknown because of a lack of population monitoring. The 2002 stock status review determined that three of the seven stocks were healthy. The status of the Lyre, Clallam, Sekiu, and Sail River stocks remained unknown. The Salt Creek stock was described as healthy because of the relatively stable escapement estimates and the fact that the escapement goal was met in 5 of 9 years. The Pysht/Twin/Deep stock was rated as healthy because the index reaches in the Pysht River and S.F. Pysht River consistently increased, meeting or exceeding the minimum goal of 200 adult spawners. East Twin River has only exceeded the escapement goal of 86 adults two times since 1995. In the West Twin River the escapement goal of 103 adults has been exceeded 5 times since 1995. Within the Deep Creek watershed the goal of 104 adults has been exceeded every year since 1995. The Hoko River stock was classified as healthy because it met or exceeded the escapement goal of 400 fish every year since 1986 with the exceptions of 1992, 1997, and 2001. It should be noted that the treaty tribes have not agreed to the escapement goals for steelhead established by WDFW.

Table 10. Summary of the 1992 and 2002 SaSSI status review for steelhead trout in WRIA 19 (source: WDF et al. 1993; WDFW 2002).

Stream System	1992 SaSSI Status	2002 SaSSI Status	Production Type
Salt Creek	Unknown	Healthy	Native/Wild
Lyre River	Unknown	Unknown	Unresolved
Pysht/Twin/Deep	Healthy	Healthy	Unresolved
Clallam River	Unknown	Unknown	Unresolved
Hoko River	Healthy	Healthy	Native/Wild
Sekiu River	Unknown	Unknown	Native/Wild
Sail River	Unknown	Unknown	Native/Wild

3.4.1.3 Steelhead Trout NOPLE Status Review

Version 3.5 of the NOPLE Salmon Habitat Recovery Project Strategy includes an updated stock status review for steelhead trout in WRIA 19 streams. The status review was conducted by the NOPLE's Technical Review Group (TRG). Table 11 includes a summary of the 2004 NOPLE status review of the historical presence, population status, and population trends for steelhead trout in WRIA 19 streams. The TRG determined that steelhead were present within all 10 WRIA 19 subbasins. The stock status was rated healthy in only 3 subbasins and depressed in 5 subbasins.

Table 11. Summary of the 2004 NOPLE status review for steelhead trout in WRIA 19 streams (source: NOPLE 2004).

Stream System	Historical Presence	Population Status	Population Trend
Sekiu River	Present	Depressed	Stable
Hoko River	Present	Healthy	Stable
Clallam River	Present	Depressed	Unknown
Pysht River	Present	Healthy	Stable
Deep Creek	Present	NA	Stable
West Twin River	Present	Depressed	Declining
East Twin River	Present	Depressed	Declining
Lyre River	Present	Unknown	Unknown
Salt Creek	Present	Healthy	Stable
Western Strait Independents	Present	Depressed	Unknown

3.4.2 Steelhead Trout Abundance and Trends

Few spawning ground survey records exist prior to the 1980s for most WRIA 19 streams. Steelhead escapement estimates are based on WDFW spawning ground index reaches. These index reaches are present in most of the subbasins (absent in the Lyre, Sekiu and WSI subbasins). The longest time series data are available in the Pysht River. Most subbasins have estimates from 1995 through 2006. In order to compare abundance in each of the individual subbasins, an index of western Strait of Juan de Fuca subbasins was developed by summing the estimated escapement for each year in the following six subbasins: Salt Creek, East Twin River, West Twin River, Deep Creek, Pysht River, and Hoko River. Figure 57 depicts estimated spawning escapement for the WSJF steelhead index. The WSJF index has a negative trend but the trend is not statistically significant (p=0.143). Escapement in the index has ranged from a high of 1,988 (1999), to a low of 918 (2005), averaging 1,417.

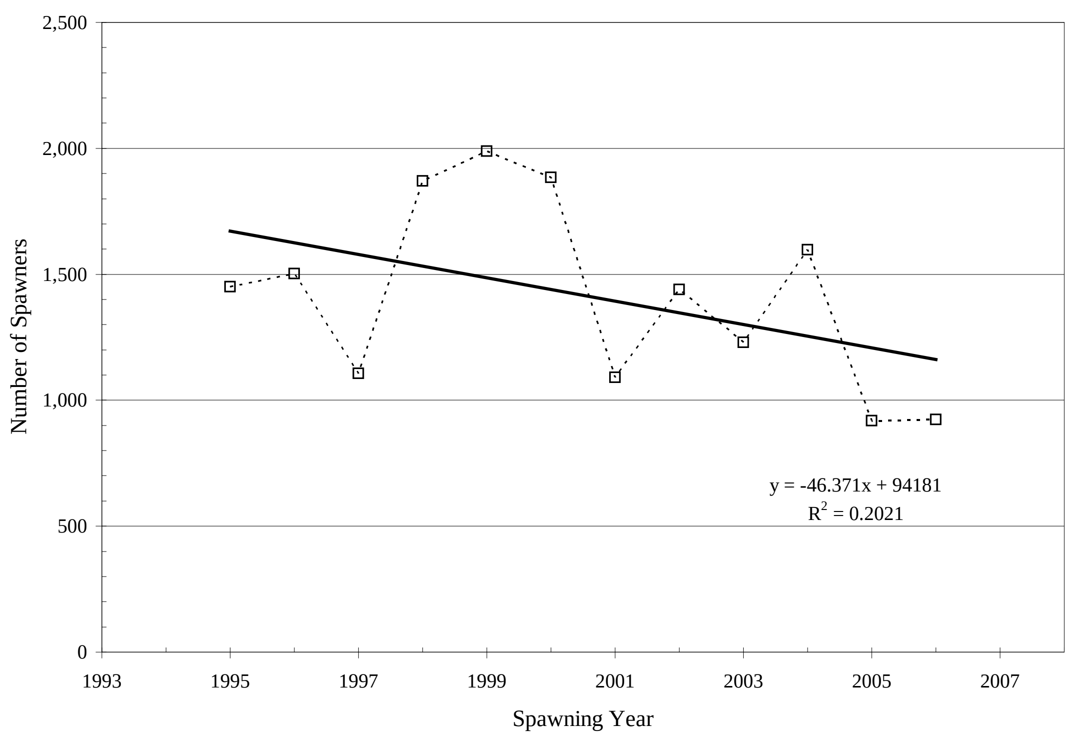

Figure 57. Estimated steelhead spawning escapement for the Western Strait of Juan de Fuca Index (source: WDFW 2002 and WDFW unpublished steelhead escapement estimates).

The following sub-sections of the plan include data on adult steelhead escapement, as well as smolt data where available. No estimates of spawning escapement are available in the Lyre River, Sekiu River, and Western Strait Independent subbasins. Steelhead smolt data are not available for most subbasins.

3.4.2.1 Salt Creek

Spawning ground index escapement data are available for 1995 through 2006 in the Salt Creek subbasin. Figure 58 depicts estimated spawning escapement in the Salt Creek spawning ground index[1] contrasted with the WSJF steelhead index. The Salt Creek index escapement estimates have a negative trend, but the trend is not statistically significant (p=0.153). Escapement in the Salt Creek index has ranged from a high of 237 (1999), to a low of 73 (2003), averaging 146. Abundance has generally tracked the WSJF steelhead index over the period of monitoring. In addition to adult abundance data there are also steelhead smolt data for Salt Creek. These data are available for 1998 to present and are included in Figure 59. Smolt production estimates have a negative trend but the trend is not statistically significant (p=0.641). Smolt production estimates have ranged from a high of 1,930 (2002), to a low of 251 (2005), averaging 1,061.

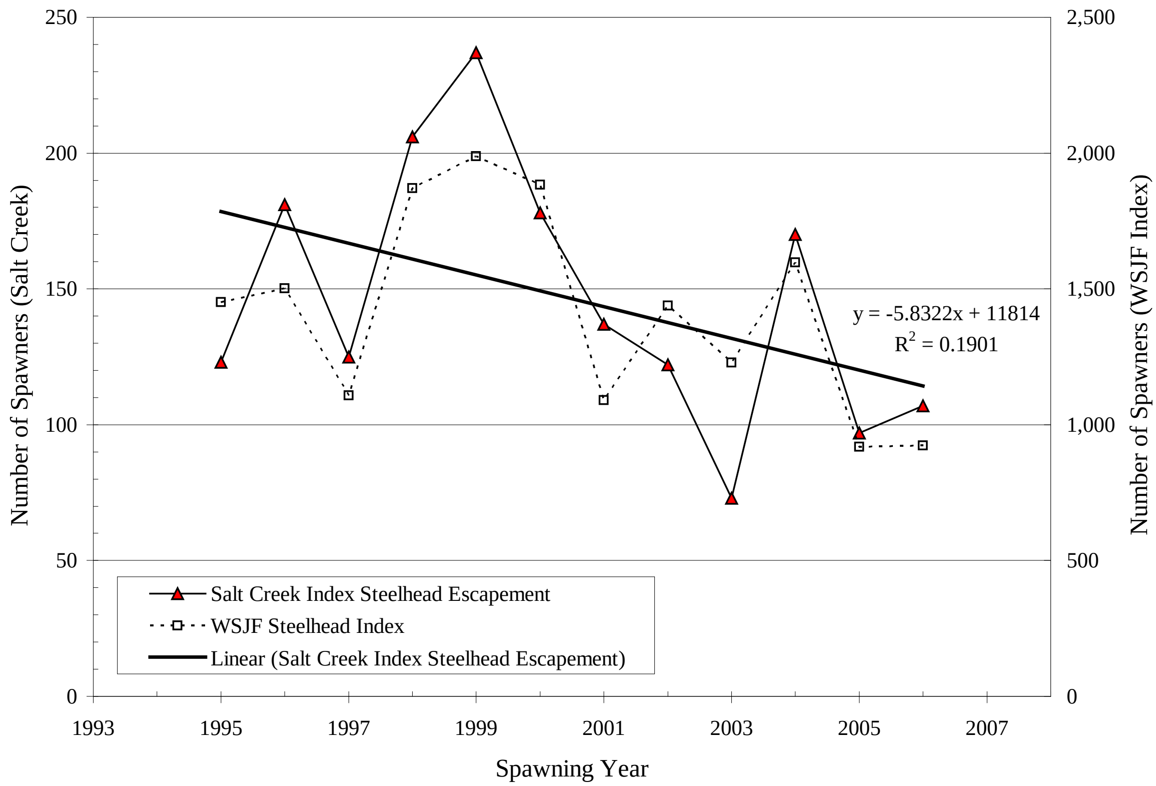

Figure 58. Estimated spawning escapement in the Salt Creek spawning ground index (source: WDFW 2002; WDFW unpublished spawning ground survey data).

[1] Salt Creek index includes RM 0.0-6.6; RM 0-0.6 tributary 19.0011, and RM 0.0-0.5 tributary 19.0014. Goal=137. Goal not agreed to by tribes.

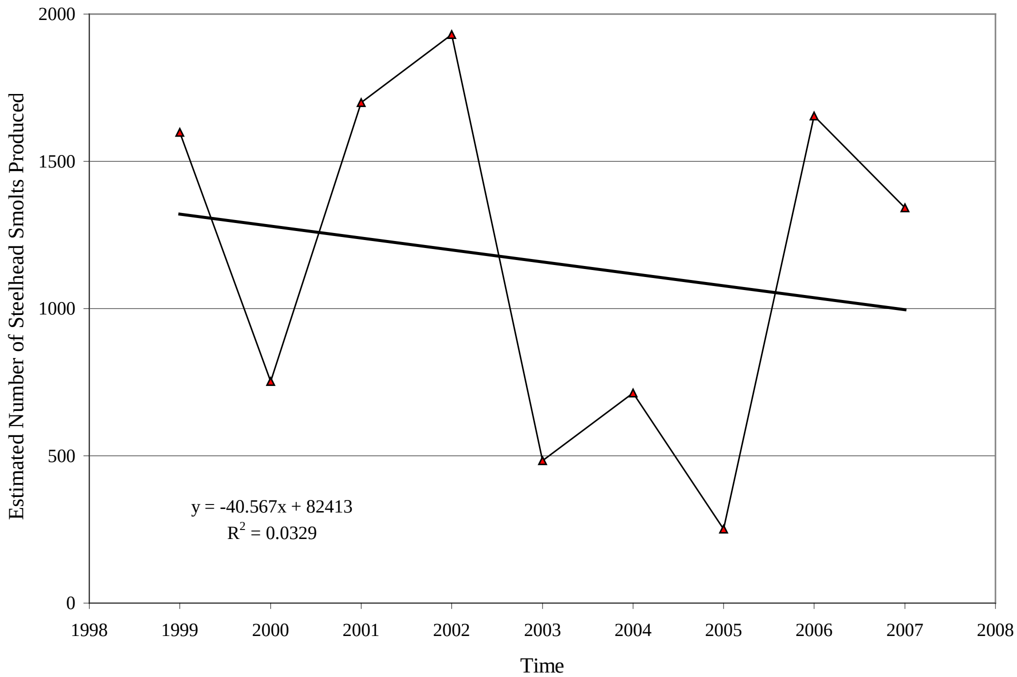

Figure 59. Salt Creek steelhead smolt emigration estimates for 1998 through 2007 (source: Lower Elwha Tribe, unpublished smolt data).

3.4.2.2 East Twin River

Spawning ground index escapement data are available for 1995 through 2006 in the East Twin River subbasin. Figure 60 depicts estimated spawning escapement in the East Twin River spawning ground index[2] contrasted with the WSJF steelhead index. The East Twin River index escapement estimates have a slightly negative trend. The trend is not statistically significant (p=0.400). Escapement in the East Twin River index has ranged from a high of 186 (1998), to a low of 34 (2005), averaging 78. Abundance has generally tracked the WSJF steelhead index over the period of monitoring. In addition to adult abundance data there are also steelhead smolt data for the East Twin River. These data are available for 2001 to 2006 and are included in Figure 61. Smolt production estimates have ranged from a high of 1,859 (2001), to a low of 690 (2004), averaging 1,157.

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[2] East Twin River index includes the mainstem from RM 0.0 to 2.6 (BPA power lines), escapement goal=86. Goal not agreed to by tribes.

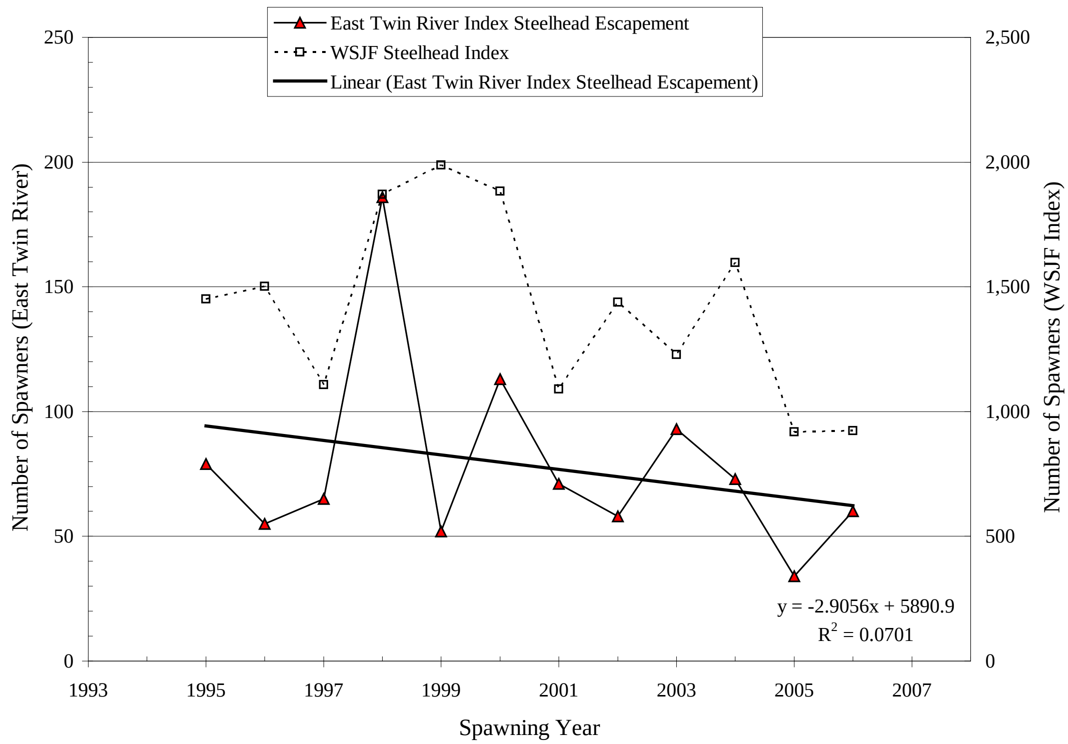

Figure 60. Estimated spawning escapement in the East Twin River spawning ground index (source: WDFW 2002; WDFW unpublished spawning ground survey data).

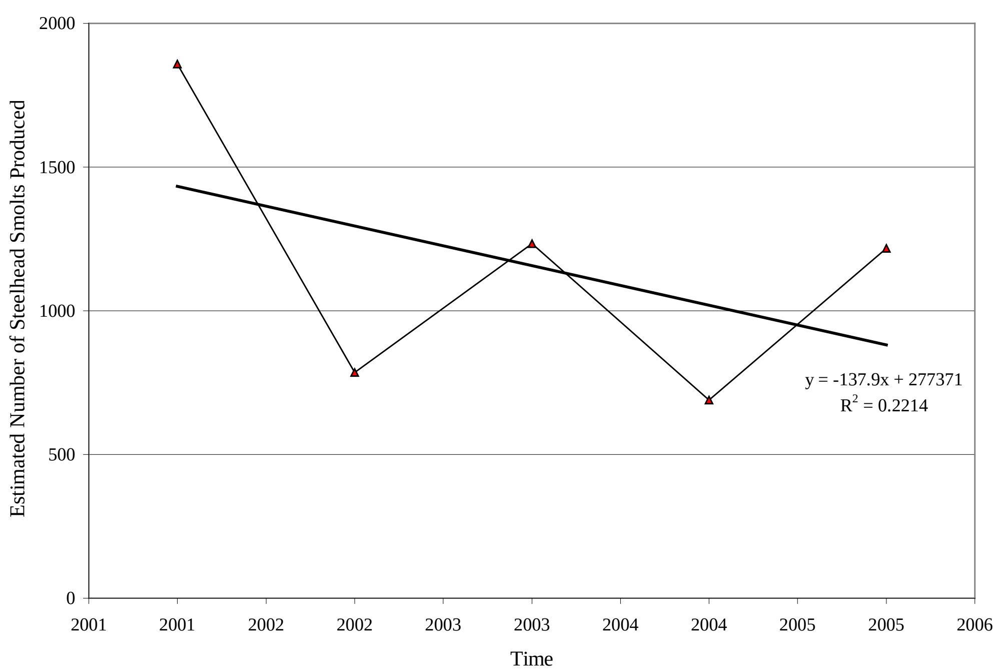

Figure 61.. East Twin River steelhead smolt emigration estimates for 2001 through 2005 (source: Lower Elwha Tribe, unpublished smolt data).

3.4.2.3 West Twin River

Spawning ground index escapement data are available for 1995 through 2006 in the West Twin River subbasin. Figure 62 depicts estimated spawning escapement in the West Twin River spawning ground index[3] contrasted with the WSJF steelhead index. The West Twin River index escapement estimates have a negative trend. The trend is not statistically significant (p=0.073). Escapement in the West Twin River index has ranged from a high of 188 (2000), to a low of 36 (2005), averaging 97. The data show an increasing trend in abundance from 1995 through 2000, followed by a strong downward trend from 2000 through 2006. The only statistically significant trend is the short-term downward trend from 2000 to 2006 (p=0.040). Abundance has generally tracked the WSJF steelhead index over the period of monitoring. In addition to adult abundance data there are also steelhead smolt data for the West Twin River. These data are available for 2001 to 2006 and are included in Figure 63. Smolt production estimates have ranged from a high of 2,343 (2001), to a low of 751 (2002), averaging 1,481.

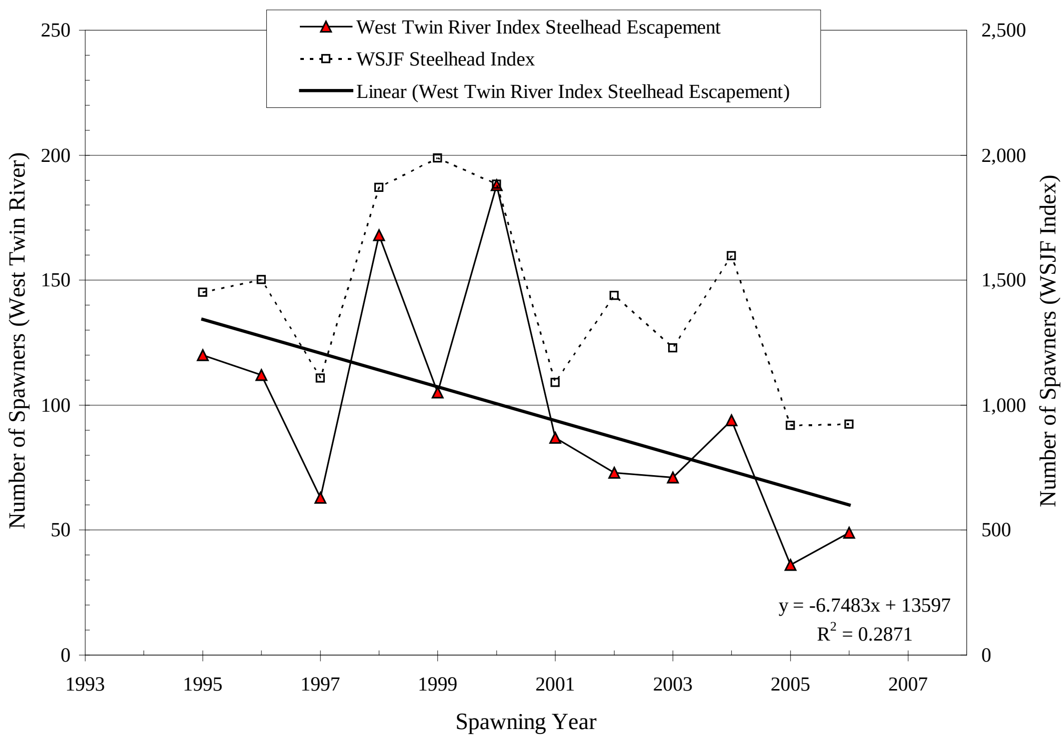

Figure 62. Estimated spawning escapement in the West Twin River spawning ground index (source: WDFW 2002, WDFW unpublished spawning ground survey data).

[3] West Twin River index includes the mainstem from RM 0.0 to 2.9, escapement goal=103. Goal not agreed to by tribes.

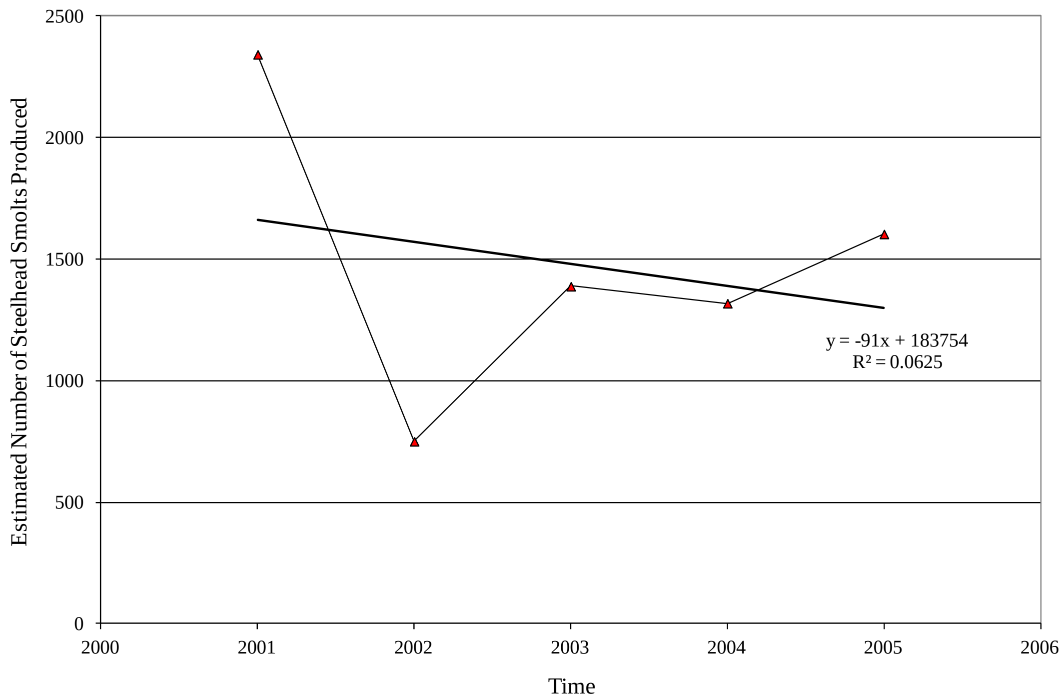

Figure 63. West Twin River steelhead smolt emigration estimates for 2001 through 2005 (source: Lower Elwha Tribe, unpublished smolt data).

3.4.2.4 Deep Creek

Spawning ground index escapement data are available for 1995 through 2006 in the Deep Creek subbasin. Figure 64 depicts estimated spawning escapement in the Deep Creek spawning ground index[4] contrasted with the WSJF steelhead index. The Deep Creek index escapement estimates have a negative trend. The trend is not statistically significant (p=0.119). Escapement in the Deep Creek index has ranged from a high of 211 (2000), to a low of 71 (2005), averaging 141. The data show an increasing trend in abundance from 1995 through 2000, followed by a moderate downward trend from 2000 through 2006. The only statistically significant short-term trend is the short-term trend from 2000 to 2006 (p=0.040). Abundance has generally tracked the WSJF steelhead index over the period of monitoring.

In addition to adult abundance data there are also steelhead smolt data for Deep Creek. These data are available for 1998 to 2006 and are included in Figure 65. Smolt production estimates have ranged from a high of 3,342 (2001), to a low of 1,569 (2003), averaging 2,298. Estimated smolt production from 2002 to 2005 is markedly less than production from 1998 through 2001. Overall the smolt production trend is negative and the trend is statistically significant (p=0.045).

[4]Deep Creek index includes the mainstem from RM 1.0 to 3.9 (confluence with W.F. Deep Creek), escapement goal=104. Goal not agreed to by tribes.

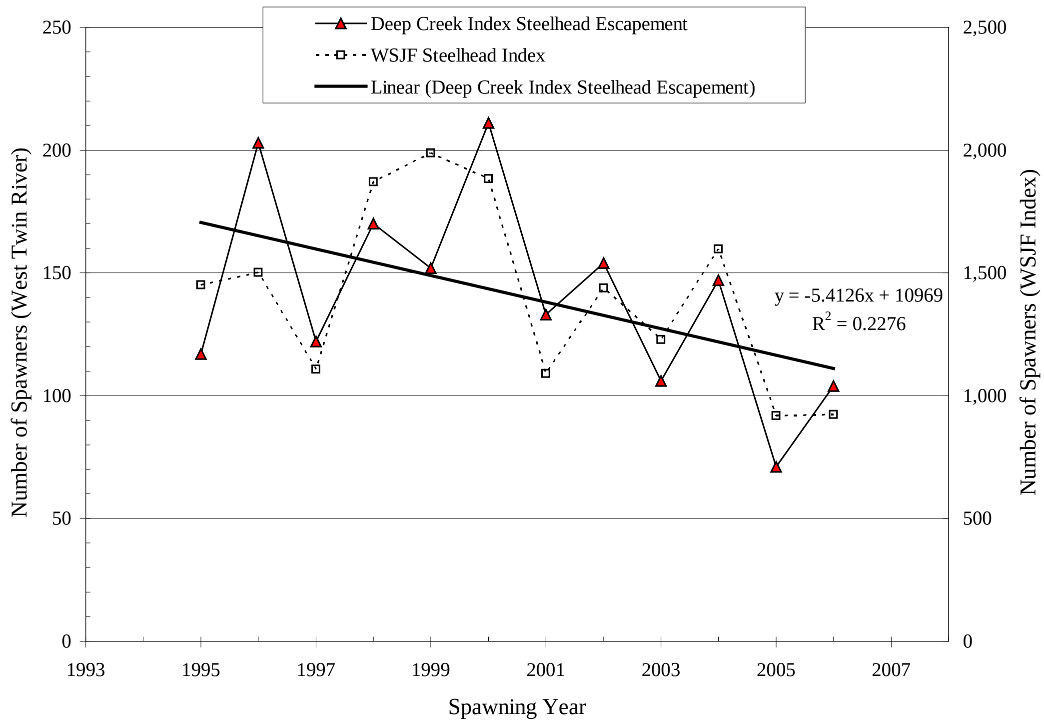

Figure 64. Estimated spawning escapement in the Deep Creek spawning ground index (source: WDFW 2002; WDFW unpublished spawning ground survey data).

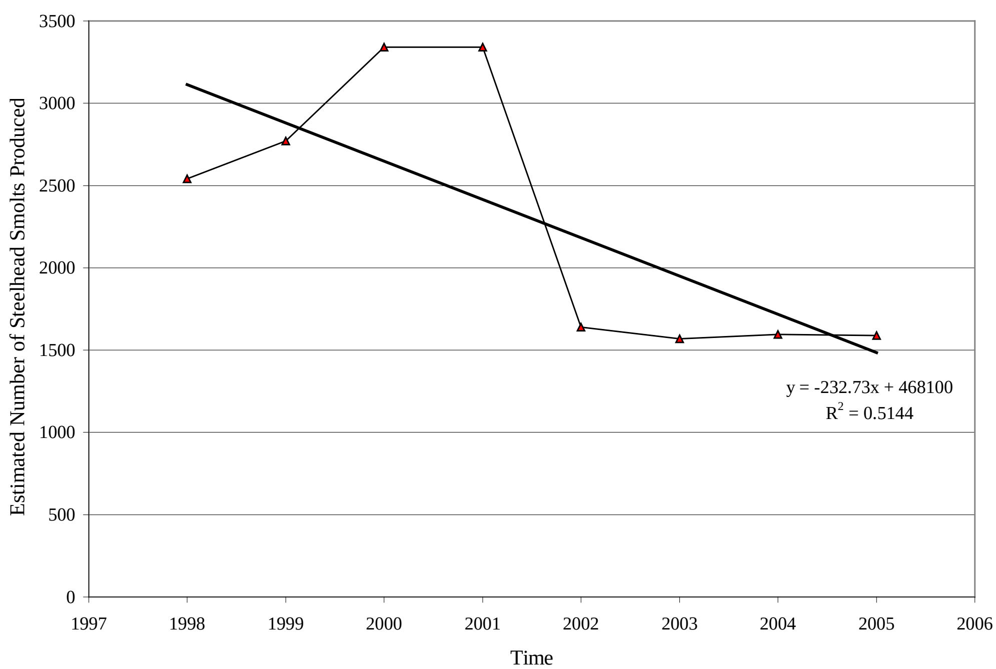

Figure 65. Deep Creek steelhead smolt emigration estimates for 1998 through 2005 (source: Lower Elwha Tribe, unpublished smolt data).

3.4.2.5 Pysht River

Spawning ground index escapement data are available for 1984 through 2006 in the Pysht River subbasin. Figure 66 depicts estimated spawning escapement in the Pysht River spawning ground index[5] contrasted with the WSJF steelhead index. The Pysht River index escapement estimates have a flat trend over the time series, and the trend analysis is not statistically significant (p=0.800). However, the data do show three distinct trends over the time series. From 1984 through 1994 there is a distinct negative trend (see Figure 66; p=0.049). A second trend, from 1994 through 1999 is strongly positive and statistically significant (p<0.001). The third trend, from 1999 through 2006 is strongly negative and is statistically significant (p=0.034). Escapement in the Pysht River index has ranged from a high of 452 (1999), to a low of 181 (2005), averaging 302.

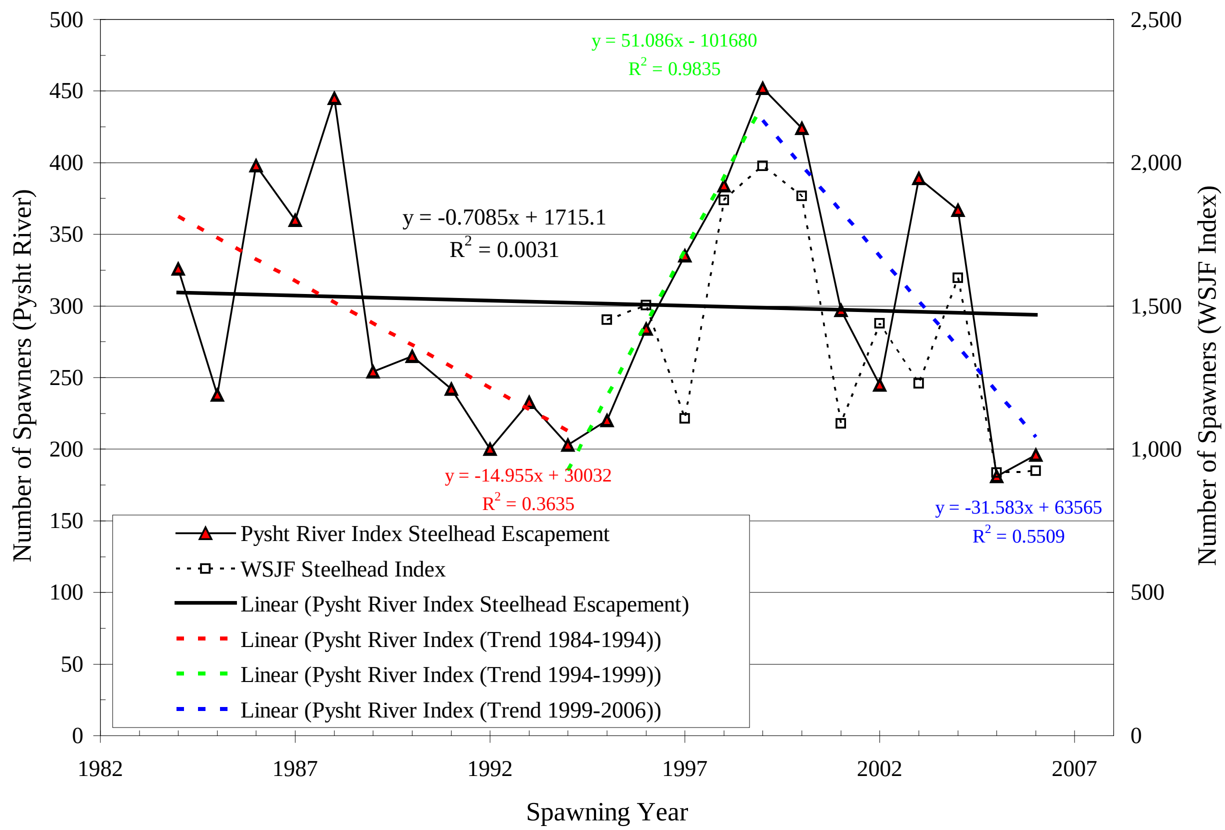

Figure 66. Estimated spawning escapement in the Pysht River spawning ground index (source: WDFW 2002; WDFW unpublished spawning ground survey data).

[5] Pysht River index includes the mainstem from RM 5.1 to 11.9 and S.F. Pysht River from RM 0.0 to 1.9, escapement goal=200. Goal not agreed to by tribes.

3.4.2.6 Clallam River

Spawning ground index escapement data are available for 1999 through 2006 in the Clallam River subbasin. Figure 67 depicts estimated spawning escapement in the Clallam River spawning ground index[6] contrasted with the WSJF steelhead index. The Clallam River index escapement estimates have a negative trend. The trend is not statistically significant (p=0.060). Escapement in the Clallam River index has ranged from a high of 284 (2000), to a low of 162 (2005), averaging 204.

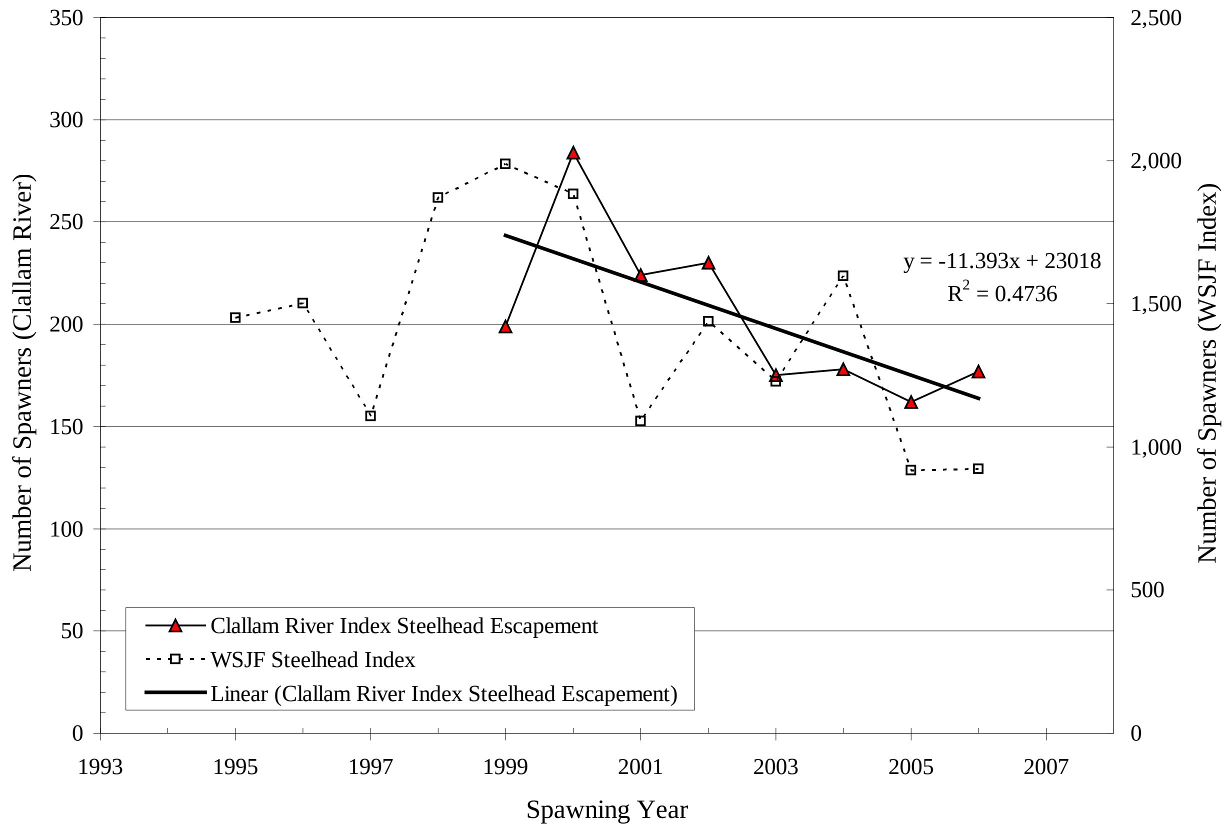

Figure 67. Estimated spawning escapement in the Clallam River spawning ground index (source: WDFW 2002; WDFW unpublished spawning ground survey data).

[6] Clallam River index includes the mainstem from RM 3.6 (middle SR112 bridge) to 9.5 (old P-1800 Rd bridge), escapement goal=159. Goal not agreed to by tribes.

3.4.2.7 Hoko River

Spawning ground index escapement data are available for 1985 through 2006 in the Hoko River subbasin. Figure 68 depicts estimated spawning escapement in the Hoko River spawning ground index[7] contrasted with the WSJF steelhead index. The Hoko River index escapement estimates have a negative trend over the time series. The trend is not statistically significant (p=0.113). The five-year average at the beginning of the time series was 786 adult spawners per year. The last five-year average (2002-2006) of the time series was 588 adult spawners per year, indicating that the most recent escapement has been reduced by about 25 percent over the time series. Escapement in the Hoko River index has ranged from a high of 990 (1999), to a low of 365 (2001), averaging 660.

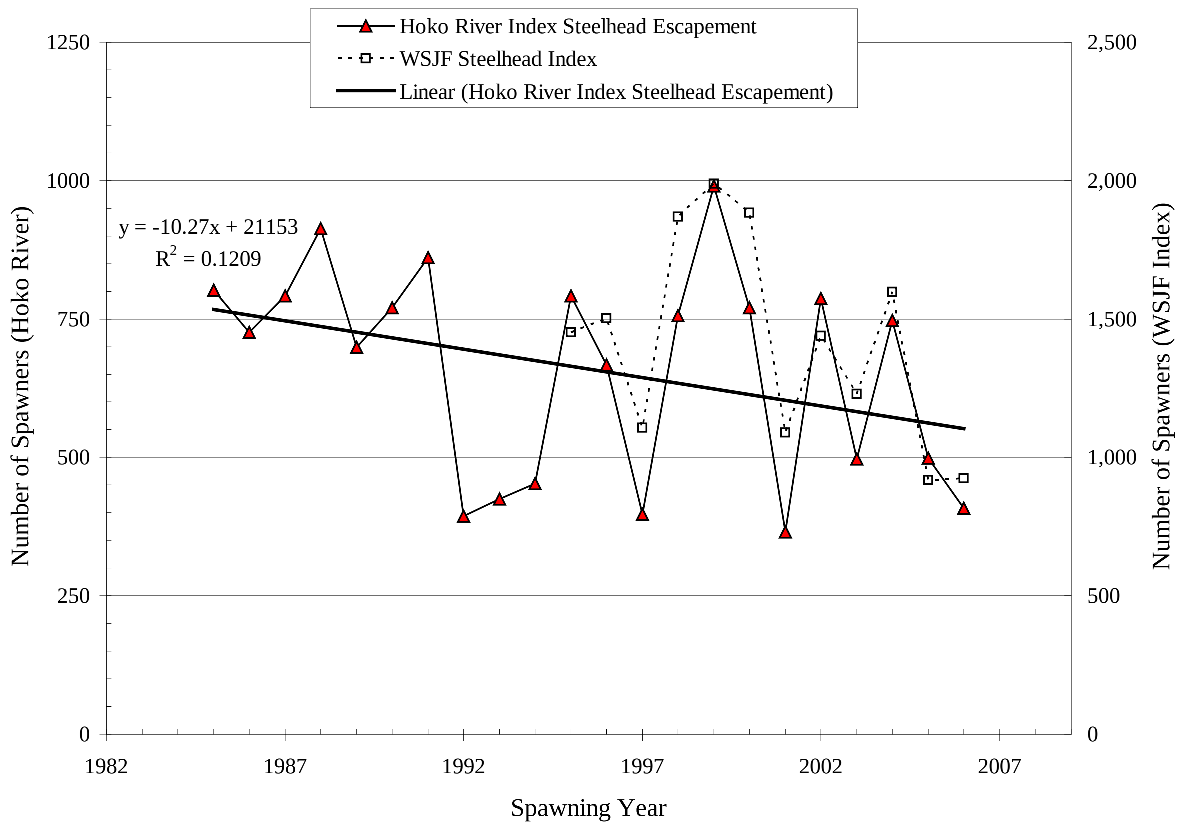

Figure 68. Estimated spawning escapement in the Hoko River spawning ground index (source: WDFW 2002; WDFW unpublished spawning ground survey data).

[7] Hoko River index includes the mainstem from RM 3.5 to 21.3, plus Little Hoko River RM 0 to 3.5, escapement goal=400. Goal not agreed to by tribes.

3.4.3 Steelhead Trout Fisheries and Harvest

Steelhead sport fisheries throughout WRIA 19 have been limited since the late 1990s, with restrictions on locations, seasons, gear types, and retention of wild steelhead. Retention of wild steelhead has been prohibited in all WRIA 19 streams since the 2010/11 season. Retention of hatchery steelhead has been allowed in specific streams including Salt Creek, Deep Creek, and the Lyre, Pysht, Clallam, Hoko, and Sekiu Rivers. Detailed regulations for WRIA 19 streams are specified in the annual WDFW fishing pamphlet.

3.4.3.1 Salt Creek

Annual sport and tribal steelhead harvests for Salt Creek are depicted in Figure 69. No treaty directed tribal net fishery has occurred since 1989 (McHenry et al. 2004). As seen in Figure 69, wild steelhead harvest impacts have decreased significantly since the 1980s. McHenry et al. (2004) report that the available harvest records (those described above and included in Figure 69) do not include the highest harvest by sport fishers, which took place from the 1940s through the 1960s, or the spike in harvest by the Makah and Lower Elwha tribes in the 1970s, immediately following the Boldt decision (for further details see McHenry et al. 2004).

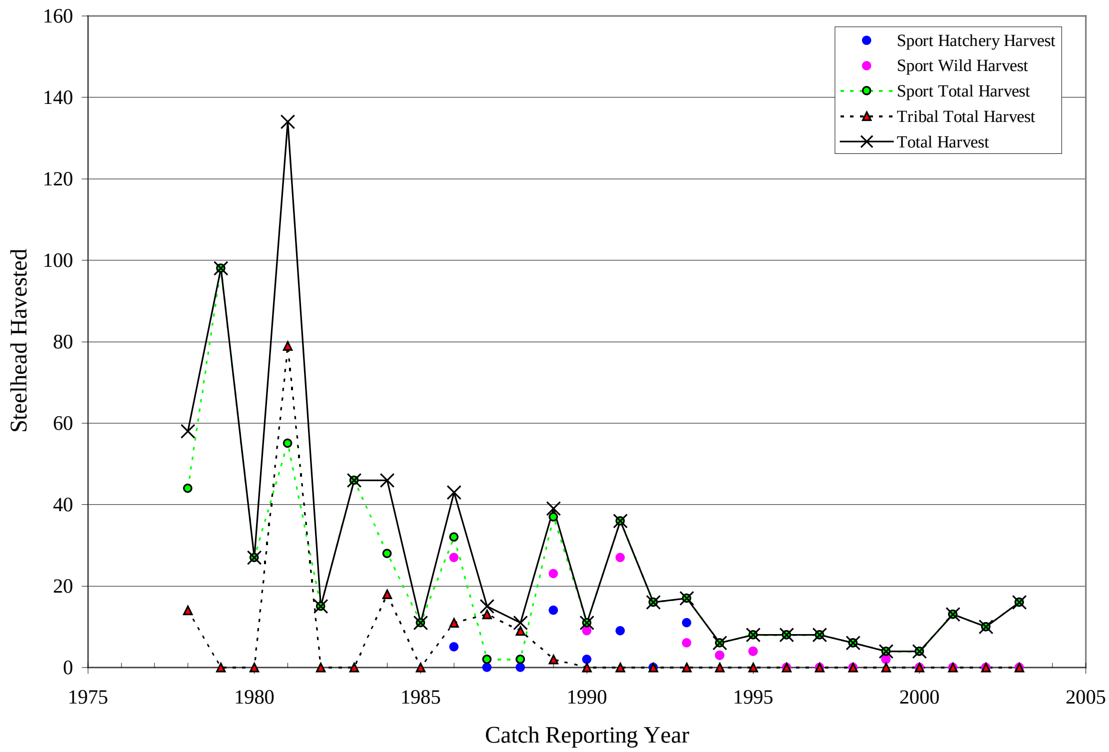

Figure 69. Salt Creek annual sport and tribal harvest of wild and hatchery origin steelhead (source: WDFW 2008).

3.4.3.2 Lyre River

Sport fishery regulations restricting the harvest of wild steelhead from the Lyre River have significantly reduced the fishery impact on wild steelhead. From 1986 to 1995 an average of 128 wild steelhead per year were harvested by sport fishers. From 1996 to 2003 only 12 wild steelhead per year were harvested by sport fishers (WDFW 2008). Annual sport and tribal steelhead harvests of winter-run steelhead are depicted in Figure 70. The treaty directed tribal net fishery impacts have been substantially reduced during the last 20 years. From 1978 to 1989 tribal harvest averaged 335 steelhead per year. Since 1990 the treaty harvest has averaged only 16 steelhead per year, a reduction in harvest of 95 percent.

The Lyre River, unlike other WRIA streams has both a winter-run and a summer-run steelhead fishery. Annual sport and tribal steelhead harvests of summer-run steelhead are depicted in Figure 71. The Lyre River has been managed for summer-run wild steelhead non-retention since 1992.

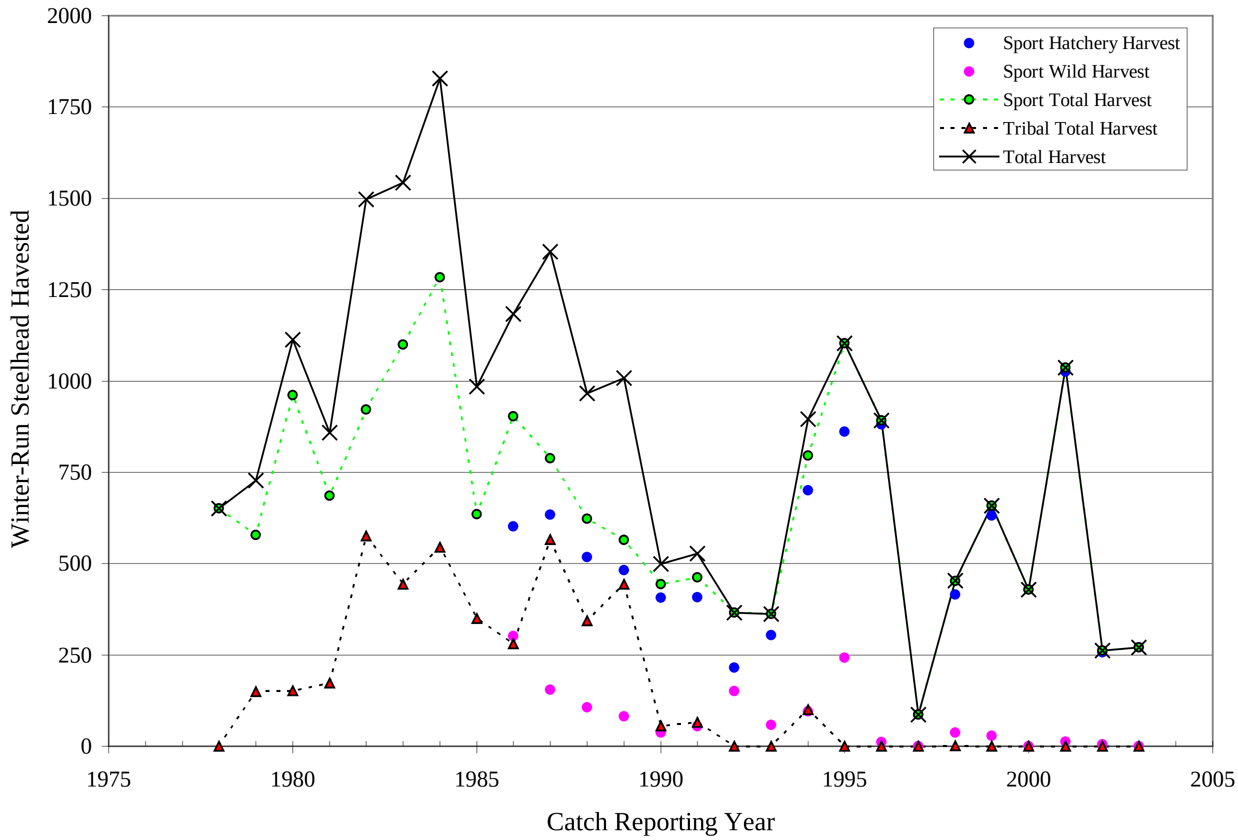

Figure 70. Lyre River annual sport and tribal harvest of wild and hatchery origin winter-run steelhead (source: WDFW 2008). Note wild steelhead non-retention took effect winter of 1997/1998.

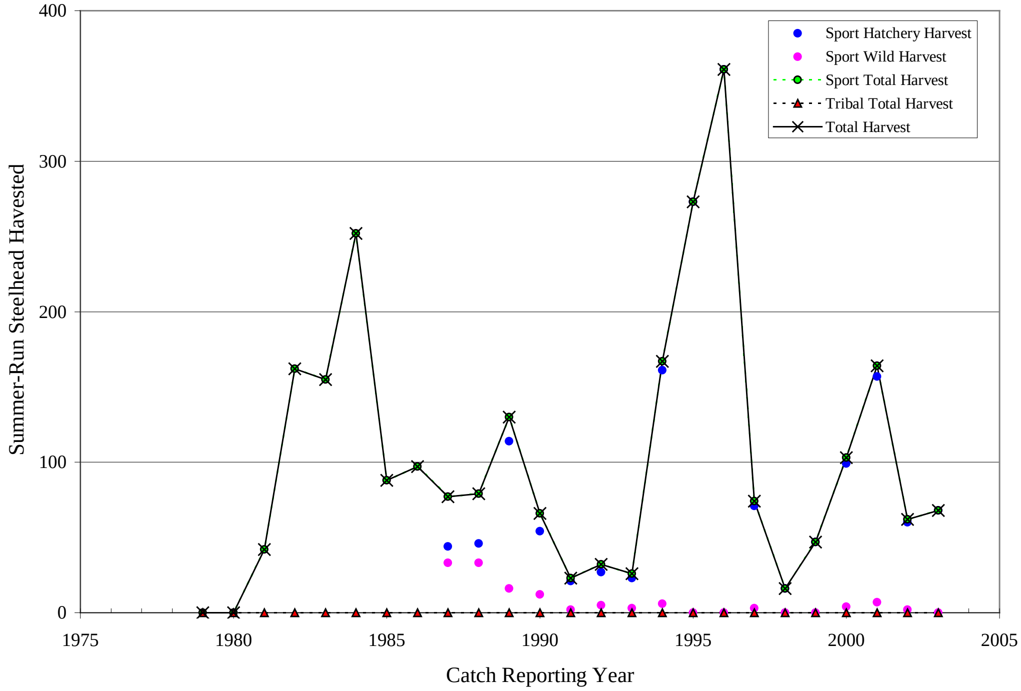

Figure 71. Lyre River annual sport and tribal harvest of wild and hatchery origin summer-run steelhead (source: WDFW 2008).

3.4.3.3 East Twin River

The East Twin River steelhead sport fishery has undergone significant rule changes over the last 10 years. Wild steelhead non-retention regulations were first implemented during the 1998/99 steelhead season. In 2002, the river was closed to fishing during the winter-run steelhead season from November 1 through May 31. No treaty directed tribal net fishery has occurred since 1991. Annual sport and tribal steelhead harvests are depicted in Figure 72.

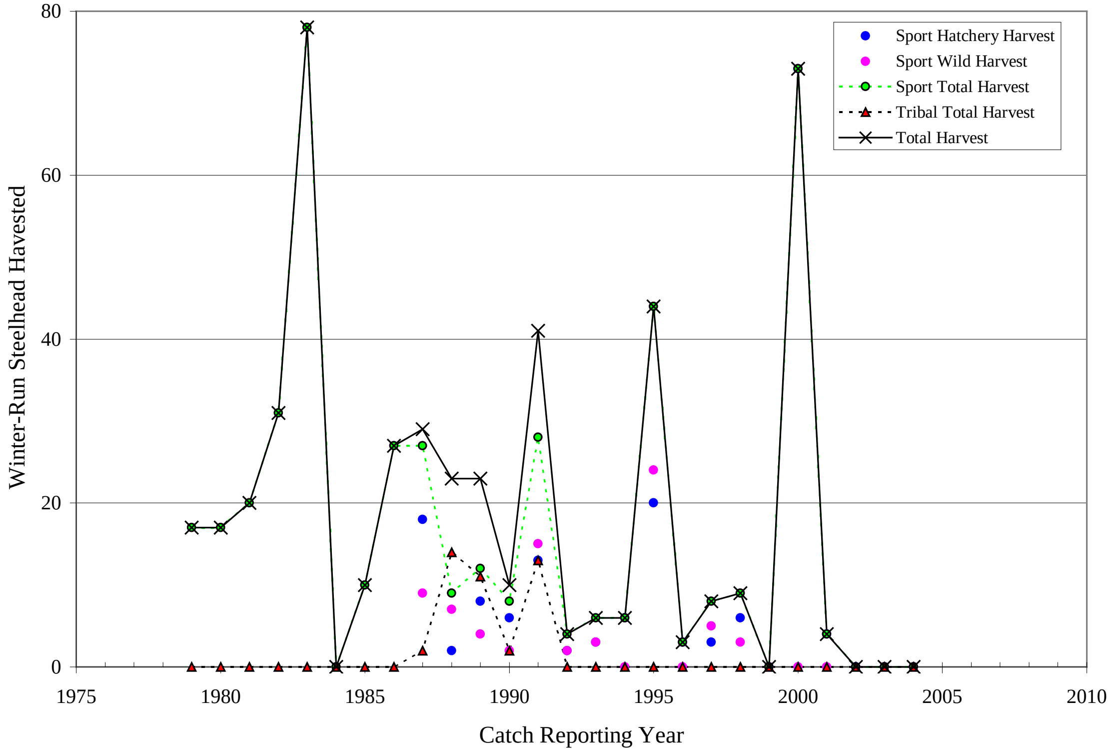

Figure 72. East Twin River annual sport and tribal harvest of wild and hatchery origin winter-run steelhead (source: WDFW 2008).

3.4.3.4 West Twin River

The West Twin River steelhead sport fishery has undergone significant rule changes over the last 10 years. Wild steelhead non-retention regulations were first implemented during the 1998/99 steelhead season. In 2007, the river was closed to fishing during the winter-run steelhead season from November 1 through May 31. No treaty directed tribal net fishery has occurred since 1989 (McHenry et al. 2004). Annual sport and tribal steelhead harvests are depicted in Figure 73.

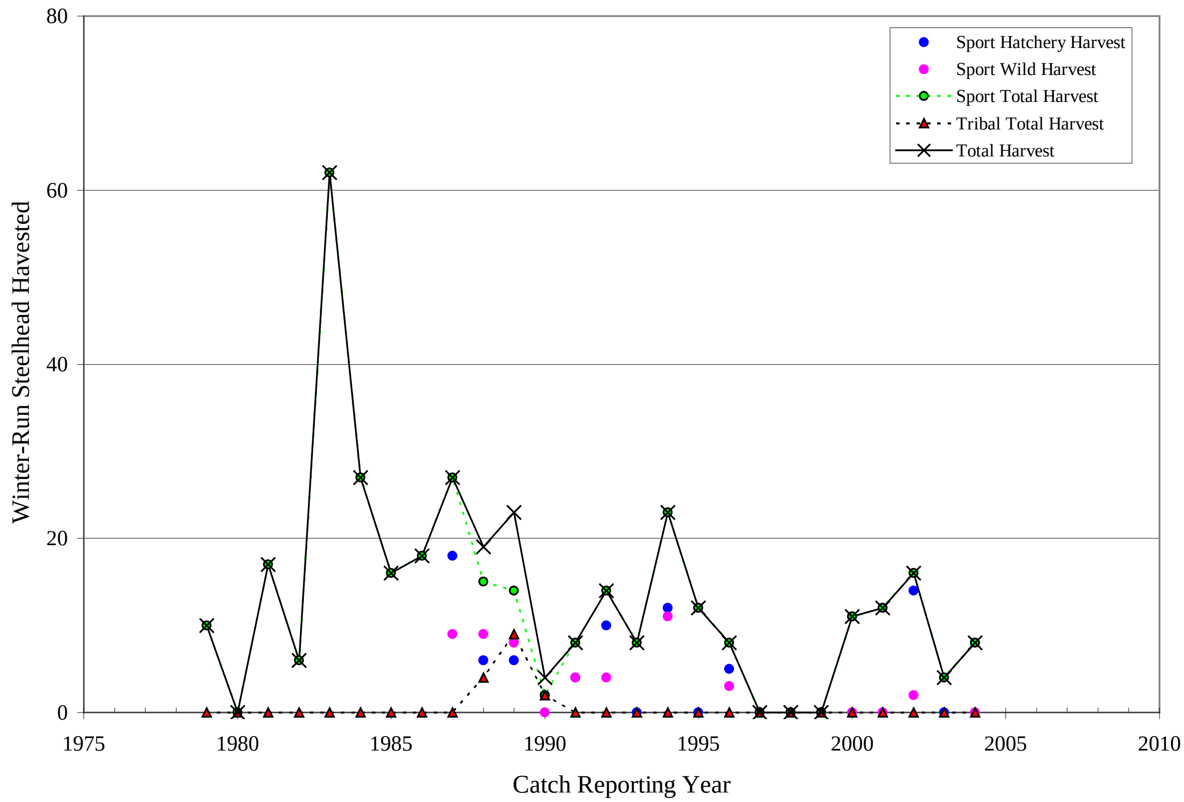

Figure 73. West Twin River annual sport and tribal harvest of wild and hatchery origin winter-run steelhead (source: WDFW 2008).

3.4.3.5 Deep Creek

The Deep Creek steelhead sport fishery has undergone significant rule changes over the last 25 years. Due to a landslide in 1990 and severely degraded habitat conditions, the tribal net fishery was voluntarily closed during the 1991/92 season (McHenry et al. 1996; WDFW 2008). The sport fishery was closed to all fishing in 1992 (McHenry et al. 1996; WDFW 2008). Annual sport and tribal steelhead harvests are depicted in Figure 74. Some sport fishing continued during the closure, as can be seen by the harvest of steelhead during the closure period in Figure 74. In 2002, the river was re-opened to fishing from December 1 through the last day of February. The new regulation requires the release of all wild steelhead and allows the retention of two hatchery steelhead per day.

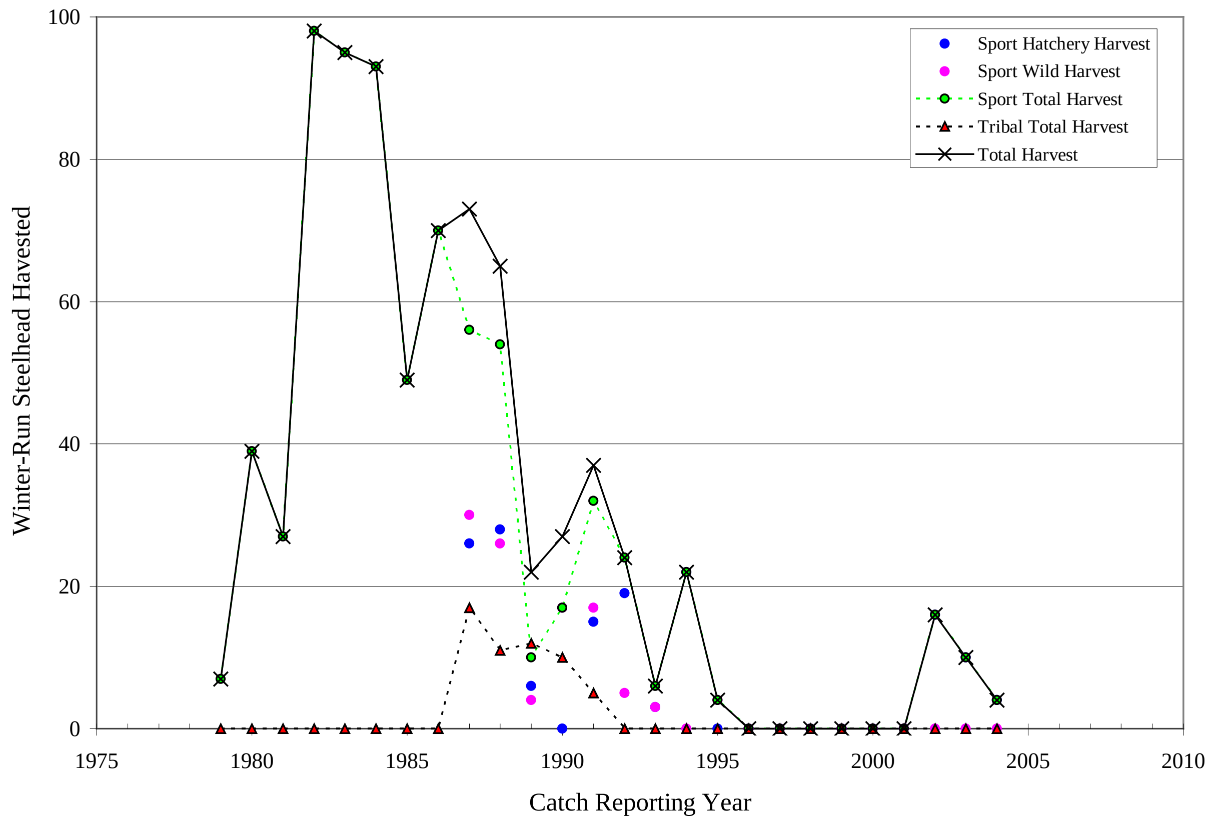

Figure 74. Deep Creek annual sport and tribal harvest of wild and hatchery origin winter-run steelhead (source: WDFW 2008).

3.4.3.6 Pysht River

The Pysht River steelhead sport fishery has undergone multiple rule changes over the last 15 years. State-wide wild steelhead non-retention rules were implemented during the 1998/99 season replacing the June 1 to November 30 wild steelhead release regulation. The Pysht River was exempted from this rule and anglers were allowed to harvest up to 30 wild steelhead per year. In 2003, the wild steelhead daily limit was reduced from 2 to 1 fish and the annual limit was reduced from 30 to 5. In 2004, a statewide ban on retention of wild steelhead was implemented with no exceptions. Annual sport and tribal steelhead harvests are depicted in Figure 75. The harvest data in Figure 75 show a clear downward trend. In the 1980s total harvest averaged 381, in the 1990s total harvest averaged 231, and in the early 2000s harvest has averaged 154 steelhead per year. Total steelhead harvest during the time series has declined by approximately 59 percent. At least a portion of the reduction can be attributed to wild steelhead harvest restrictions implemented during the last 12 years.

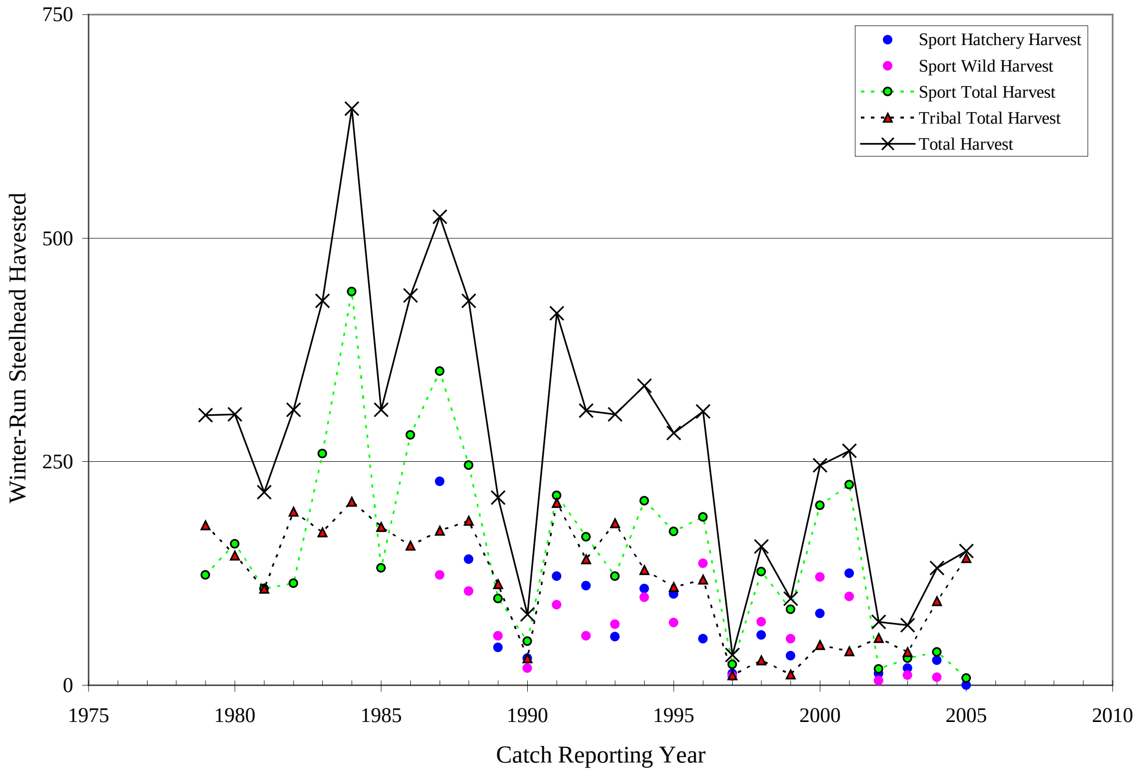

Figure 75. Pysht River annual sport and tribal harvest of wild and hatchery origin winter-run steelhead (source: WDFW 2008; PNPTC 2006). Note wild steelhead release in effect winter of 1997/1998 and no sport fisher data for 2005/06.

3.4.3.7 Clallam River

Sport fishery regulations restricting the harvest of wild steelhead have significantly reduced the fishery impact on wild steelhead. From 1986 to 1996, an average of 27 wild steelhead per year were harvested by sport fishers. From 1997 to 2004, it is estimated that only 3 wild steelhead per year were harvested by sport fishers (WDFW 2008). Annual sport and tribal steelhead harvests of winter-run steelhead are depicted in Figure 76.

The tribal net fishery that occurs in the Clallam River is directed at the hatchery component of the run. From 1983 to 1993, an average of 86 steelhead were harvested per year in the tribal net fishery; from 1994 to 2004, the average number of steelhead harvested per year dropped to 19.

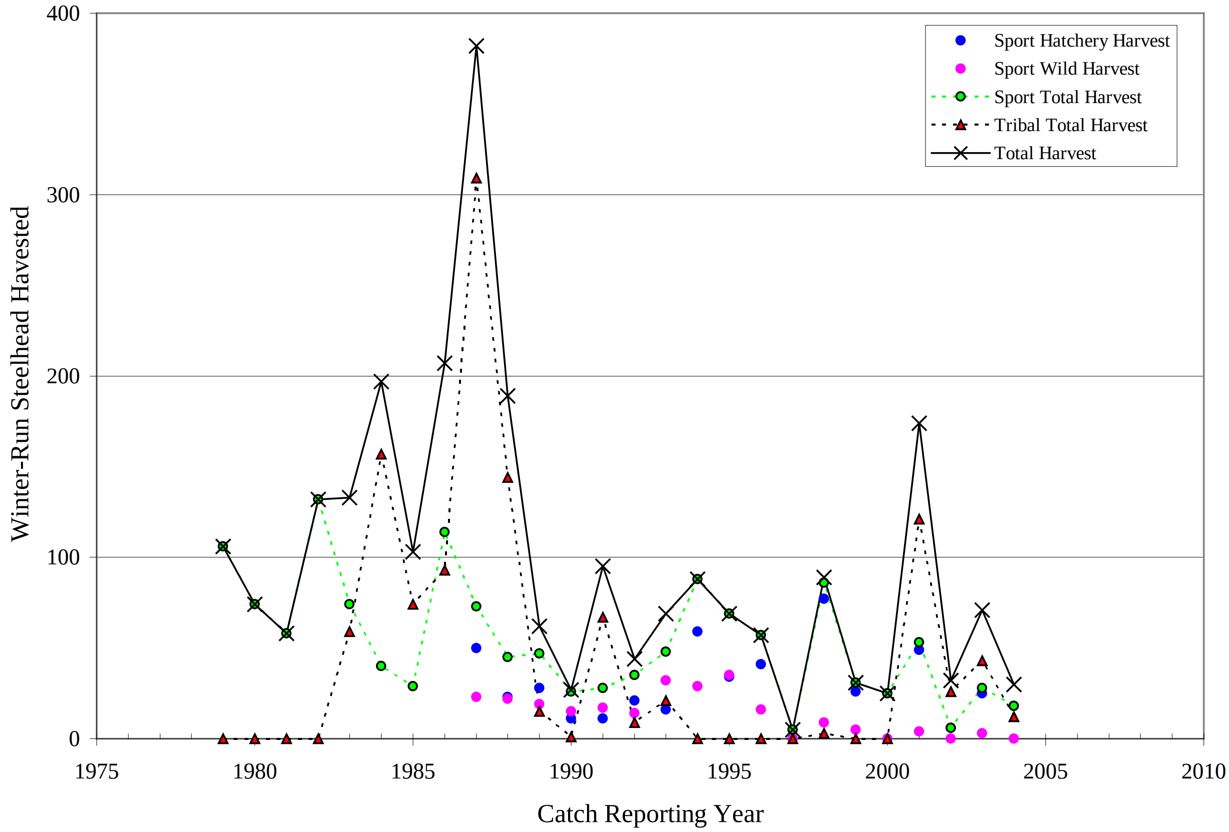

Figure 76. Clallam River annual sport and tribal harvest of wild and hatchery origin winter-run steelhead (source: WDFW 2008). Note wild steelhead release in effect winter of 1997/1998.

3.4.3.8 Hoko River

The Hoko River steelhead sport fishery has undergone multiple rule changes over the last decade. When state-wide wild steelhead release rules were implemented during the 1998/99 season, the Hoko River was exempted and anglers were allowed to harvest two wild steelhead per day and up to 30 wild steelhead per year. In 2003, the wild steelhead daily limit was reduced from 2 to 1 fish and the annual limit was reduced from 30 to 5. In 2004, a statewide ban on retention of wild steelhead was implemented with no exceptions. Annual sport and tribal steelhead harvests are depicted in Figure 77.

The harvest data in Figure 77 show a less steep downward trend in harvest than the harvest data for the Pysht River. In the 1980s, total harvest averaged 545, in the 1990s total harvest averaged 433, and in the early 2000s harvest averaged 355 steelhead per year. Total steelhead harvest during the time series has declined by approximately 35 percent. At least a portion of the reduction can be attributed to wild steelhead harvest restrictions implemented during the last 12 years.

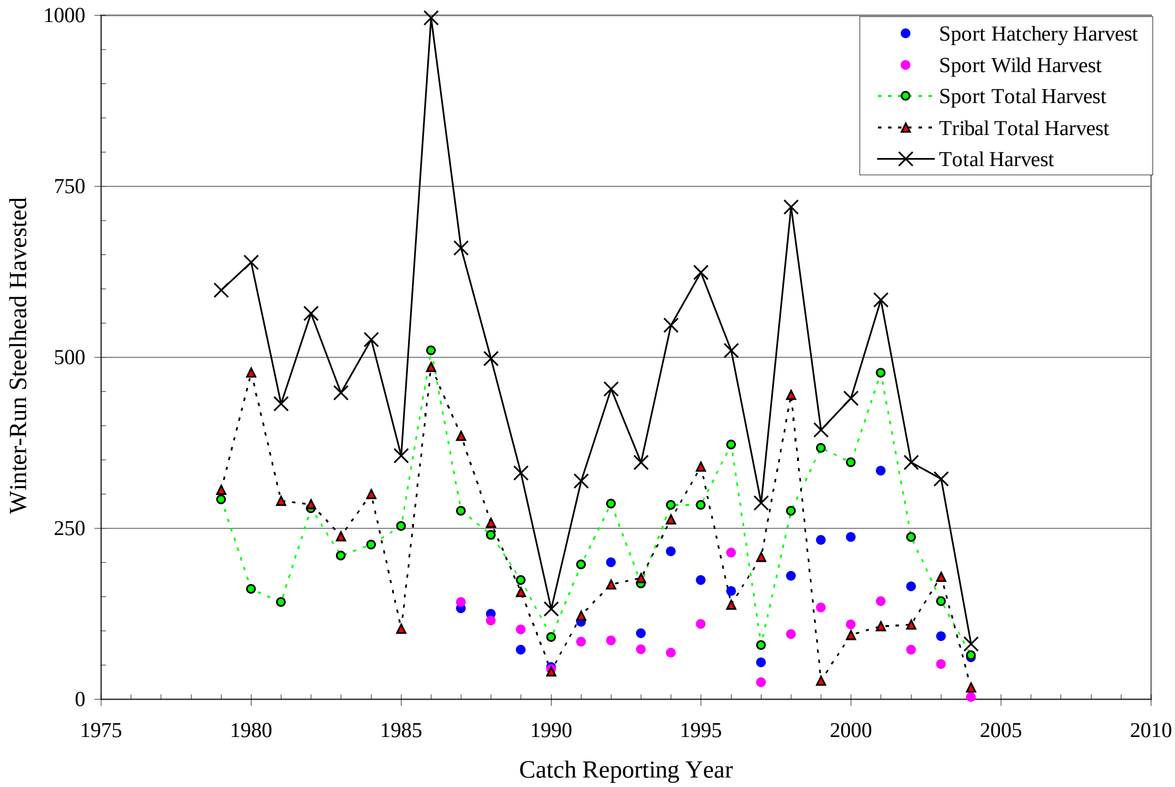

Figure 77. Hoko River annual sport and tribal harvest of wild and hatchery origin winter-run steelhead (source: WDFW 2008; MFM, unpublished data). Note wild steelhead release in effect winter of 1997/1998.

3.4.3.9 Sekiu River

The Sekiu River steelhead sport fishery has been limited to wild steelhead release since the winter of 1998/99. These restrictions have reduced the fishery impact on wild steelhead. From 1986 to 1998, an average of 16 wild steelhead per year were harvested by sport fishers. From 1999 to 2003 it was estimated that only 3 wild steelhead per year were harvested by sport fishers (WDFW 2008). Annual sport and tribal steelhead harvests of winter-run steelhead are depicted in Figure 70.

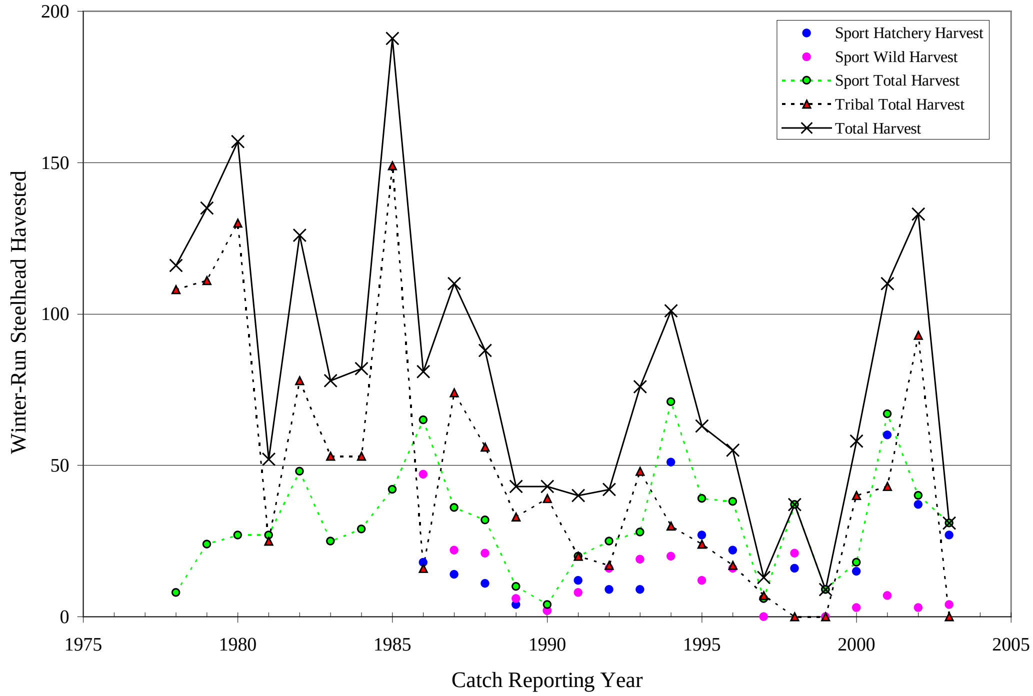

Figure 78. Sekiu River annual sport and tribal harvest of wild and hatchery origin winter-run steelhead (source: WDFW 2008). Note wild steelhead release in effect winter of 1997/1998.

3.4.3.10 Western Strait Independents

WDFW does not permit sport fisheries in any of the Western Strait Independent subbasin tributaries. The Makah Tribe allows sport fishing for steelhead in the Sail River. Steelhead sport harvest data for the Sail River are not available. The Makah Tribe also opens Sail Bay annually to tribal steelhead gillnet fishing. Harvest data from this fishery is not available.

3.4.4 Steelhead Trout Hatchery Practices

Steelhead trout were planted in several WRIA 19 streams up to 2009 in order to provide harvest opportunity. As of 2010, hatchery steelhead releases occur only in the Hoko, Sekiu and Sail Rivers and two streams within the Makah Reservation. Both winter-run and summer-run steelhead have been planted in WRIA 19 streams. However, the Lyre River is the only stream that has consistently received summer-run plants. The off station hatchery release of summer- and winter-run steelhead in the Lyre River were discontinued in 2009. Off station hatchery releases in the Pysht and Clallam rivers were also discontinued in 2009.

Complete hatchery outplanting records for steelhead trout prior to 1982 could not be located at the time this report was being prepared. Incomplete records for some WRIA

19 streams were available and are included in the summary below. From 1962 to 2010 a total of 3.01 million juvenile winter-run steelhead were planted in WRIA 19 streams (see Table 12.

Table 12. WRIA 19 steelhead trout hatchery releases by WRIA 19 subbasin (source: RMIS database; McHenry et al. 2004; WDFW 2008). Note the RMIS database data were used for releases from 1982-2010, pre-1982 data were taken from WDFW 2008 and McHenry et al. (2004).

Subbasin Name	First Year Steelhead Released	Last Year Steelhead Released	Number of Brood Years Planted	Number of Release Years	Number of Steelhead Released	Number of Brood Stock Sources Released
Salt Creek	1962	1993	9	9	50,611	2+
Lyre River	1978	2009	32	32	824,842	3
East Twin	No Hatchery Releases					
West Twin	No Hatchery Releases					
Deep Creek	1965	1965	1	1	7,600	1
Pysht River	1978	2009	32	32	376,404	3
Clallam River	1978	2009	31	32	217,873	5+
Hoko River	1978	2010[1]	33	33	591,146	3
Sekiu River	1989	2010[1]	21	21	187,783	2
WSJF Independents	1987	2010[1]	18	19	753,155	2
Total (Winter-run)	**1962**	**2010**	**n=40**	**n=40**	**3,009,414**	**n=6**
Lyre River (summer-run)	1981	2009	27	27	272,630	n=6
Grand Total	**1962**	**2010**	**n=40**	**n=40**	**2,803,912**	**n=12**

[1]These releases are ongoing; all other releases have been discontinued.

An additional 272,630 summer-run steelhead were released into the Lyre River from 1981 to 2009. Winter-run steelhead broodstock sources included the following 6 stocks: Bogachiel, Dungeness, Elwha, Hoko, Quinault, and Sooes Rivers. The vast majority of winter-run steelhead hatchery outplants came from the Bogachiel (1.21 million) and Hoko (1.17 million) River stocks. The remaining (638,562) winter-run steelhead released were derived from the following stocks: Sooes River (133,081), Elwha River (75,435), Quinault River (36,187), Dungeness River (24,933) and unknown (368,926). The Bogachiel River hatchery stock is a composite stock of Chambers Creek steelhead mixed with native steelhead from the Bogachiel and Calawah rivers. The Hoko River hatchery stock is a composite stock of native Hoko River steelhead and Bogachiel River and Quinault River hatchery stocks.

Most (81%) of the winter-run steelhead released were released at the smolt stage when juveniles weighed from 40 to 128 grams. Approximately 10 percent of the winter-run steelhead released were released as fry with weights less than 5 grams per fish. The remaining steelhead released were fingerlings. All summer-run steelhead released were released as smolts. Appendix D includes a detailed summary by brood year of steelhead trout hatchery plants for WRIA 19 subbasins.

3.5 COASTAL CUTTHROAT TROUT (*O. clarki*)

Coastal cutthroat trout are the most widely distributed salmonids in WRIA 19. They inhabit nearly all of the accessible low to moderately high gradient (generally less than 20%) streams draining into the Strait of Juan de Fuca. Cutthroat trout are also found upstream of most anadromous barriers where suitable habitat exists (WDFW 2000). Figure 79 depicts coastal cutthroat trout distribution in WRIA 19 streams.

In general, coastal cutthroat trout exhibit four discrete life history forms: sea-run/anadromous, adfluvial, fluvial, and resident (Johnson et al. 1999). Very little data exists regarding the specific life-history forms of cutthroat trout in WRIA 19 streams. The coastal cutthroat population within WRIA 19 consists of at least three discrete life history forms: sea-run/anadromous, adfluvial, and resident (WDFW 2000). The fluvial life history form of cutthroat trout may also exist in the larger river systems (e.g. Hoko River) but the small tributaries feeding most of the SJF may not provide the habitat types required by this life history form of coastal cutthroat trout.

The resident life-history form differs significantly from the anadromous form. Most importantly, resident cutthroat populations are isolated from one another spatially. The resident life history form does not typically undertake significant migrations, generally maintaining a small home territory (Johnson et al. 1999). In the WDFW salmon and steelhead inventory (2000), the authors speculate that the later spawn timing of resident cutthroat further isolates them from the anadromous form. The adfluvial form only exists within Lake Crescent and is formally recognized as a subspecies of coastal cutthroat trout, *O. clarki crescenti*.

3.5.1 Coastal Cutthroat Trout ESA Status Review (Johnson et al. 1999)

Coastal cutthroat trout within the WRIA 19 watershed are part of the Olympic Peninsula coastal cutthroat ESU. This ESU includes coastal cutthroat trout from the Strait of Juan de Fuca west of the Elwha River to the coast and south to, but not including, streams draining into Grays Harbor. Designation of the ESU is based primarily on ecological characteristics of the Olympic Coast, such as high precipitation, cool water temperatures, and relatively short high-gradient streams entering the open ocean. The 1999 NMFS status review noted that cutthroat trout from this ESU are relatively large as smolts, and a higher proportion appears to mature at first return from the marine environment than in most Puget Sound populations. Genetically, the Olympic Peninsula populations sampled at the time of the status review were distinct from other ESUs. Interestingly, the populations sampled on the Olympic Peninsula showed a stronger genetic affinity to populations in Puget Sound and Hood Canal than to populations sampled along the Strait of Juan de Fuca east of the Elwha River.

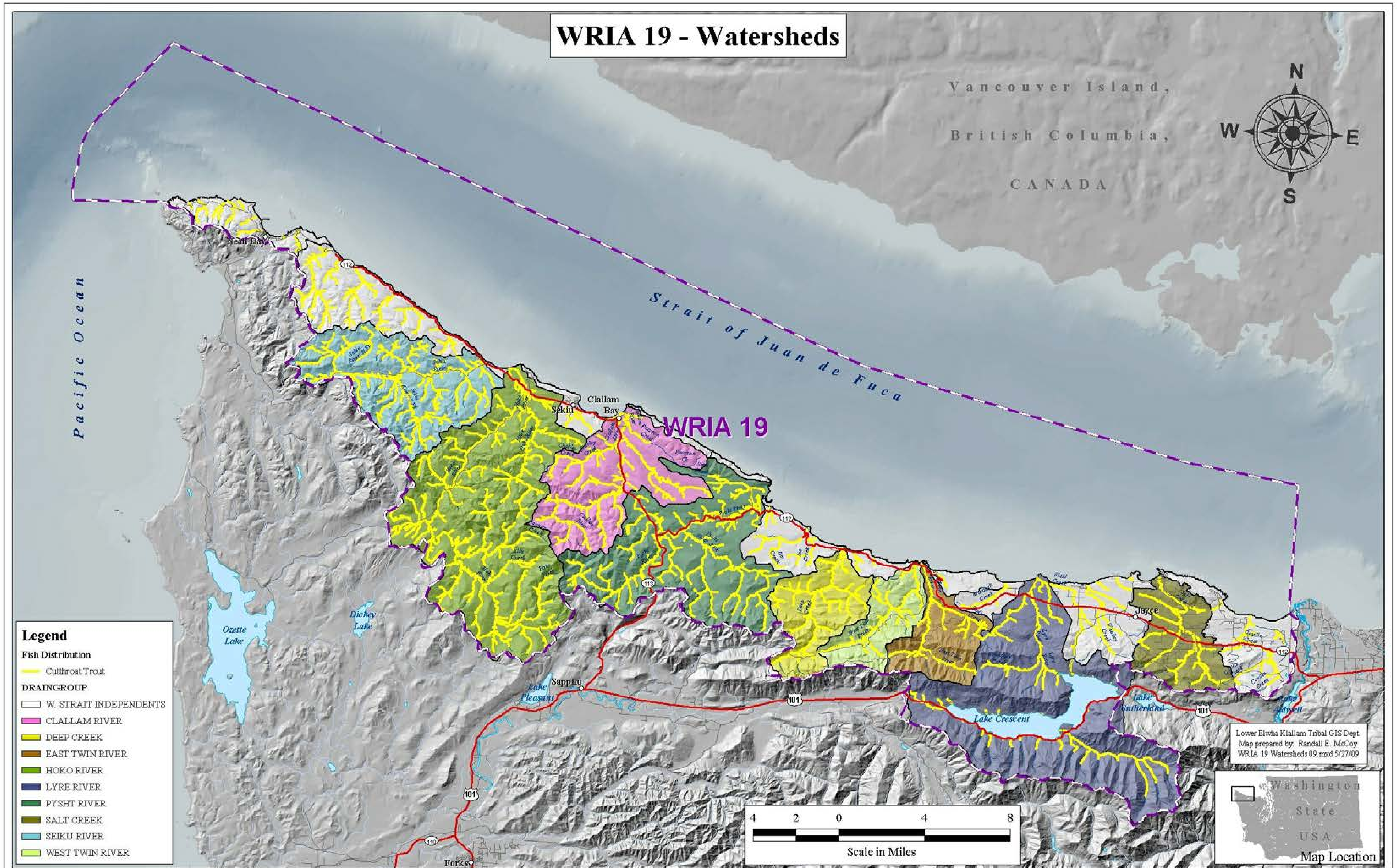

Figure 79. WRIA 19 coastal cutthroat trout distribution map (source: modified from WDNR hydrography).

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Johnson et al. (1999) noted that there was little information available to estimate coastal cutthroat trout population abundance in this ESU. Juvenile coastal cutthroat trout are believed to be widely distributed in streams in WRIA 19, and the Biological Review Team believed there are probably some highly productive coastal cutthroat trout streams in this ESU, but noted that ongoing habitat destruction, primarily from logging and associated activities, is a source of risk to coastal cutthroat trout in many Olympic Peninsula streams (Johnson et al. 1999).

The only quantitative data available to the BRT for WRIA 19 were counts of downstream migrants on the Hoko River (1986-1989) and in Salt Creek (1998). The BRT did not weigh increasing trends from the Hoko River heavily in its risk determinations because the data were not current.

Risks to the Olympic Peninsula ESU from loss of life-history diversity were identified in the status review as relatively low. This ESU received a lower risk score for this source of risk than did any other ESU. Risks associated with hatchery coastal cutthroat trout also are considered low in this ESU.

A majority of the BRT concluded that the Olympic Peninsula ESU is not presently in danger of extinction, nor is it likely to become so in the foreseeable future; however, one member dissented, and considered the ESU likely to become endangered in the foreseeable future. The Status Review noted that there was very high uncertainty in this risk assessment, however. Certainty scores for this risk assessment were the lowest of all cutthroat trout ESUs.

3.5.2 Coastal Cutthroat Trout WDFW Status Review

WDFW (2000) identified two stocks in WRIA 19: Western Strait and Mid-Strait stock complexes. The Mid-Strait complex includes several streams in WRIA 18 including Morse, Lees, Ennis, Peabody, Valley, Tumwater, and Dry creeks, as well as the Elwha River. Therefore this stock complex overlaps with two separate coastal cutthroat ESUs. WRIA 19 streams included in the Mid-Strait stock complex include Colville, Salt, Whiskey, Field, Murdock, Deep, Joe, and Jim creeks. Rivers in the Mid-Strait complex include the East and West Twins, and the Lyre. The status review determined that the Mid-Strait stock complex is of native origin with wild production, but the status of the stock (critical, depressed, etc.) is unknown.

The Western Strait stock complex includes the Pysht River and all drainages containing coastal cutthroat trout west of the Pysht River. The lack of data for cutthroat trout in this stock complex resulted in similar findings as those described above for the Mid-Strait stock complex, i.e., the stock is of native origin, with wild production, and the status is unknown.

3.5.3 Coastal Cutthroat Trout Hatchery and Harvest

There are no hatcheries dedicated to rearing coastal cutthroat trout in WRIA 19. A hatchery was built on Lake Crescent in 1913 and propagated Crescenti trout until 1946. Between 1932 and 1946, some coastal cutthroat trout that were used to stock waters in western Washington originated from Lake Crescent (Johnson et al. 1999).

No commercial fisheries target cutthroat trout in WRIA 19. Sport fisheries exist throughout the watershed. The seasons are the same as those described above for steelhead in the major stream systems. Within the major streams the harvest of cutthroat trout is either restricted (catch and release) or limited to a daily limit of 2 trout, in excess of 14 inches. The minimum 14-inch size limit was established to protect first time spawners and some repeat spawners. There is no catch reporting system for cutthroat trout and therefore no estimates of the number of fish harvested are available.

4 RECOVERY GOALS AND OBJECTIVES

4.1 RECOVERY GOALS

4.1.1 Interim Recovery Goals:

Recovery of WRIA 19 salmonids will require actions that conserve, preserve, restore, and enhance ecosystem processes and dynamics in the watershed and adjacent nearshore environment. Actions addressing instream processes and conditions, riparian habitat diversity and complexity, and upland watershed health need to be applied in concert with complementary management of harvest and hatcheries. Recovery is a process that leads to salmonid populations that not only exhibit the characteristics of viability, but that also provide a harvestable surplus for the treaty tribes and citizens of the region.

The technical work group for the development of the WRIA 19 Salmonid Recovery Plan has included interim recovery goals as part of the rebuilding effort for salmonid populations in WRIA 19. The interim goals were based on a combination of recent and/or historical information where available, or extrapolations between watersheds where data were not available. It should be noted that the interim recovery goals described in this document have been reviewed by state and tribal co-managers and may be used as a guide for restoration, research, and management actions on an interim basis. ESA mandates for the development of technical recovery goals are not applicable for WRIA 19 salmonid populations as of June 2015, but the viable salmonid population (VSP) concept was used as a basis for the interim goals. For WRIA 19 populations, an adaptive management approach to recovery goals is recommended in order to incorporate new data, future changes in population status, or major changes in harvest and hatchery approaches in the region.

4.1.2 Viable Salmon Population Parameters:

Population viability criteria and principles are described in a NMFS technical memorandum, *Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units* (McElhany et al. 2000). They define a viable salmonid population as an independent population of any Pacific salmonid (genus Oncorhynchus) that has a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100-year time frame. An independent population is defined as any collection of one or more local breeding units whose population dynamics or extinction risk over a 100-year time period are not substantially altered by exchanges of individuals with other populations. In other words, if one independent population were to go extinct, it would not have much impact on the 100-year extinction risk experienced by other independent populations. Independent populations are likely to be smaller than a whole evolutionarily significant unit (ESU).

McElhany et al. (2000) describe viable salmonid populations (VSP) in terms of four parameters: abundance, productivity or growth rate, spatial structure, and diversity.

Abundance: Population abundance, or the total number of individuals in a salmon population, is generally expressed as the escapement (the number of returning adult fish) in a given watershed or a collective group of watersheds.

Productivity: The productivity of the population, or growth rate, is a measure of the population's ability to sustain itself, or the ability to rebound from low abundance. Productivity can be measured as spawner-to spawner ratios, annual population growth rate, or through trends in abundance of naturally produced salmon. It is assumed that if a population growth rate is stable or increasing that the population can sustain itself. Until a population recovers, the growth rate should exceed one returning adult per spawning parent in successive generations. Once a population recovers, the growth rate should average one.

Spatial structure: A population's spatial structure is described as being made up of both the geographic distribution of a population and the processes that generate that distribution. A population's spatial structure is dependent upon habitat quality, spatial configuration and dynamics, and the dispersal characteristics of individuals within the population. Populations with limited spatial distribution (e.g., few spawning areas) are at greater risk of extinction or precipitous population declines resulting from catastrophic events than populations with complex and widespread spatial structures.

Diversity: Salmonid traits often exhibit considerable diversity within and among populations. These traits include morphology, fecundity, run timing, spawn timing, anadromy, juvenile behavior, age at smoltification, age at maturity, egg size, developmental rate, ocean distribution patterns, spawning behavior, physiology and molecular genetic characteristics.

4.1.3 SPECIES SPECIFIC RECOVERY GOALS

4.1.3.1 WRIA 19 Chinook Salmon

Although there are no ESA-listed species in WRIA 19 as of 2010, species such as Chinook salmon have been eliminated or are functionally extinct throughout much of their historical range within WRIA 19 subbasins. There is some uncertainty regarding the historical distribution of Chinook salmon in WRIA 19 streams. For the purposes of restoration planning, Chinook salmon recovery and restoration projects should focus primarily on the Sekiu, Hoko, and Pysht rivers where historical populations were clearly present. Chinook salmon usage in other streams where Chinook salmon presence has been documented, such as Salt Creek, Lyre River, Clallam River, and Sail River (Kramer 1952a; Phinney and Bucknell 1975; WDF et al. 1993) should be evaluated through the adaptive management process.

Abundance: The Pysht River's interim goal is 360 adult spawners. This interim goal is based on 8.25 miles of spawning habitat from Razz Creek (RM 3.75) to river mile 12 in the mainstem, the lower 3 miles of the S.F. Pysht River, and 0.75 miles of Green Creek (from confluence with Pysht River to the confluence with the N.F. Green Creek). Assumed Chinook spawning densities used to determine the interim goal were 12 redds per mile and 2.5 adult Chinook/redd (WDF 1977). The potential to manage for additional Chinook spawning in the S.F. Pysht River and other tributaries will be evaluated during the run-building period.

The Hoko River's current escapement goal is 850 naturally spawning Chinook (WDF 1977). In addition, there is a hatchery broodstock goal of 200 spawners, making the total run-size goal of 1,050 Chinook salmon for the Hoko River (Haggerty et al. 2001c). The 200 additional Chinook used for supplementation are currently being used to rebuild under-utilized portions of the upper mainstem and tributaries to levels that can provide surplus broodstock to re-seed the Sekiu and Pysht Rivers.

The Sekiu River's interim goal is 260 adult spawners. This interim goal is based on 8.65 miles of spawning habitat from Carpenters Creek to midway between Sonny Brook and the falls on the N.F. Sekiu River. Assumed Chinook spawning densities used to determine the interim goal were 12 redds per mile and 2.5 adult Chinook/redd (WDF 1977). The potential to manage for Chinook spawning in the S.F. Sekiu River will be evaluated during the recovery period. The S.F. Sekiu River habitat could provide at least an additional 3.5 miles of spawning habitat and increase the goal to 365 using the same criteria described above. A summary of Chinook escapement goals is included below in Table 13.

Table 13. Summary of WSJF interim Chinook salmon recovery goals.

Watershed	Adult Spawning Escapement Goal
Pysht River	360 adult spawners (interim goal)
Hoko River	850 natural spawners + 200 broodstock
Sekiu River	260 adult spawners (interim goal)
Total	**1,470 adult spawners + 200 broodstock**

Productivity: Goals for WRIA 19 Chinook population abundance and growth rate should be developed by Co-managers, and reflect recovery growth rates exceeding one.

Spatial Structure: A restored WRIA 19 Chinook population should include well distributed, self-sustaining spawning aggregations in the Pysht, Hoko, and Sekiu Rivers. Ideally the spawning distribution within the Pysht River will include the majority of the mainstem and S.F. Pysht Rivers, as well as at least one of the larger tributaries. The spawning distribution in the Hoko River should include spawning habitat in the mainstem from tidewater to the barrier falls, as well as the Little Hoko River and Brownes, Herman, and Bear creeks. The spawning distribution in the Sekiu River should include the mainstem and North Fork Sekiu River from above tide water to the barrier falls.

Diversity: There is little existing information about the historical diversity of the WSJF Chinook salmon population. It appears (based on anecdotal reports, e.g., John Cowan personal communication, 1994) that the early or spring/summer run component of the population is no longer present within WRIA 19. Additional research is needed in order to define long term diversity goals.

4.1.3.2 WRIA 19 Chum Salmon

Abundance: Currently there are no escapement goals or recovery goals established for WRIA 19 chum salmon. Many of the current and/or proposed chum salmon spawning escapement goals in western Washington were established based on historical abundance (e.g., SJF and Hood Canal summer chum [HCCC 2005]). These data are not directly available for western Strait of Juan de Fuca chum salmon spawning aggregations.

PYSHT RIVER

During the ten year period from 1980-1989 escapement averaged 2,459 (median 2,230), from 1990-1999 escapement averaged 1,328 (median 1,076), and from 2000-2006 escapement averaged 1,279 ([median 896]; WDFW 1997; Unpublished WDFW data). These data indicate that the average escapement declined by approximately 48 percent between the first period (1980-1989) and the last period (2000-2006). Based on these data it is recommended that the interim recovery goal for Pysht River chum salmon should be an average annual ten-year escapement of 2,460 chum salmon.

DEEP CREEK

During the ten year period from 1980-1989 escapement averaged 703 (median 516), from 1990-1999 escapement averaged 225 (median 75), and from 2000-2006 escapement averaged 29 ([median 25]; WDFW 1997; Unpublished WDFW data). These data indicate that the average escapement declined by approximately 96 percent between the first period (1980-1989) and the last period (2000-2006). Based on these data it is recommended that the interim recovery goal for Deep Creek chum salmon should be an average annual ten-year escapement of 700 chum salmon.

HOKO RIVER

As described above there is insufficient data to establish an escapement goal for Hoko River chum salmon based on historical data. Spawning ground survey data for the Hoko River were evaluated along with paired survey data for the Pysht and Hoko rivers. These data are included below in Table 14. The average number of chum salmon per mile surveyed in the Hoko River was 29; within the Pysht River it was 109, yielding a ratio of Hoko to Pysht River chum salmon per mile of 0.27; whereas the average annual proportion averaged 0.37. The average of these two ratios is 0.32.

Table 14. Hoko and Pysht river paired chum salmon counts (source: WDFW unpublished spawning ground survey database).

Year	Hoko River			Pysht River		
	Counts	Miles surveyed	Chum/mi surveyed	Counts	Miles surveyed	Chum/mi surveyed
1982	90	4.8	18.8	23	1	23.0
1984	236	3.9	60.5	967	3.6	268.6
1987	89	2.2	40.5	571	2.9	196.9
1992	21	2.9	7.2	102	3.5	29.1
1993	322	12.3	26.2	888	12.4	71.6

The Pysht River interim goal of 2,460 chum salmon equates to 53 chum salmon per square mile (watershed area equal to 46.3 sq. mi.). We estimated the interim Hoko River escapement goal by scaling the Pysht River goal of 53 chum salmon per square mile to the Hoko watershed area (71 sq mi) and multiplying the average Hoko to Pysht ratio of 0.32 to yield an escapement goal of 1,200 chum salmon per year.

CLALLAM RIVER

As described above there is insufficient data to establish an escapement goal for Clallam River chum salmon based historical data. We evaluated the spawning ground survey data for the Clallam River and found sufficient data to compare peak chum salmon per mile in the Clallam and Pysht Rivers. The results are depicted in Figure 80. For the period of record included (1997-2006) the Clallam River peak chum spawners per mile averaged 58, while in the Pysht River the average was 92, yielding a ratio of 0.64. The average annual ratio was 0.84. Averaging these two ratios yielded an average ratio of 0.74.

The Pysht River interim goal of 2,460 chum salmon equates to 53 chum salmon per square mile (watershed area equal to 46.3 sq. mi.). We estimated the interim Clallam River escapement goal by scaling the Pysht River goal of 53 chum salmon per square mile to the Clallam watershed area (31 sq mi) and multiplying the average Clallam to Pysht ratio of 0.74 to yield an escapement goal of 1,220 chum salmon per year.

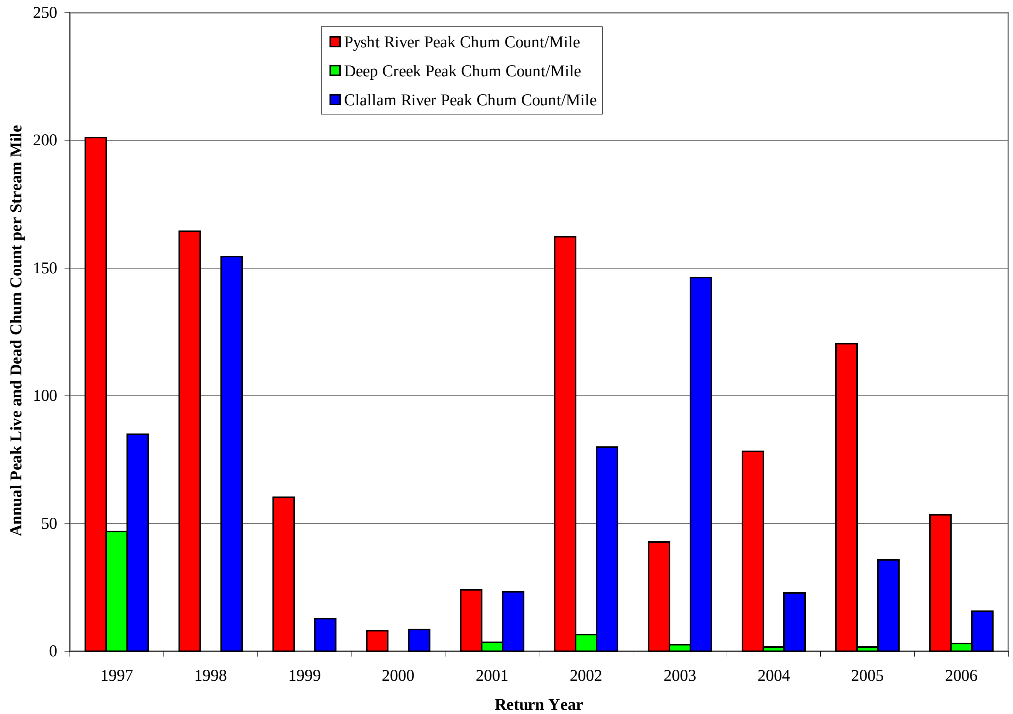

Figure 80. Comparison of Pysht River, Deep Creek, and Clallam River peak live and dead chum salmon counts per mile (source: unpublished WDFW spawning ground survey data).

LYRE RIVER

As described above there is insufficient data to establish an escapement goal for Lyre River chum salmon based on historical data. We evaluated the spawning ground survey data for the Lyre River and found sufficient data to compare chum salmon per mile in the Lyre and Pysht rivers. For the period of record included (1980-2003) the Lyre River chum per mile surveyed averaged 43, while in the Pysht River the average was 72, yielding a ratio of 0.60. The average annual ratio was 1.05. Averaging these two ratios yielded an average ratio of 0.83.

The Pysht River interim goal of 2,460 chum salmon equates to 53 chum salmon per square miles (watershed area equal to 46.3 sq. mi.). We estimated the interim Lyre River escapement goal by scaling the Pysht River goal of 53 chum salmon per square mile to the Lyre watershed area (67.9 sq mi) and multiplying the average Lyre to Pysht ratio of 0.83 to yield an estimate of 2,990 chum salmon.

SEKIU RIVER

As described above there is insufficient data to establish an escapement goal for Sekiu River chum salmon based historical data. We evaluated the spawning ground survey data for the Sekiu River and found there were insufficient data for comparisons between the Pysht River and Deep Creek. Therefore the interim recovery goal for the Sekiu River was based upon the chum salmon per square mile watershed area used in the adjacent Hoko River watershed (17/sq. mi.); yielding a goal of 560.

TWIN RIVERS and WESTERN STRAIT INDEPENDENTS

We evaluated the spawning ground survey data for the Twin Rivers and WSI subbasins and found there were insufficient data for comparisons between the Pysht River and Deep Creek. Therefore the interim recovery goals for the Twin Rivers and WSI subbasin were based upon the chum salmon per square mile watershed area used in the Hoko River watershed (17/sq. mi.) averaged with Deep Creek (40.9), yielding a value of 28.95 chum per square mile. This value was then applied to the East Twin River, West Twin River, and WSI subbasin (including only Colville, Whiskey, and Bullman creeks, and Sail River) basin areas, producing interim goals of 390, 360, and 750 chum salmon spawners respectively.

SALT CREEK

We evaluated the spawning ground survey data for the Salt Creek and found there were insufficient data for comparisons between the Pysht River and Deep Creek. Therefore, it was assumed that the chum salmon per square mile in the Salt Creek subbasin should be roughly equal to that of Deep Creek. Applying this value (40.9 chum/sq. mi.) to the watershed area (19.1 sq. mi) yielded an interim escapement goal of 780 chum salmon.

Summary of Abundance Goals

Table 15 depicts a summary of the WRIA 19 interim chum salmon abundance recovery goals.

Table 15. Summary of the WRIA 19 interim chum salmon abundance recovery goals.

Subbasin	Watershed Area (sq mi)	Chum/Sq Mi.	Abundance Ratio	Interim Recovery Goal
WSI (Colville, Whiskey, Bullman, and Sail only)	25.9	28.95	1	750
Salt Creek	19.1	40.9	1	780
Lyre River	67.9	53.1	0.83	2,990
East Twin River	13.6	28.95	1	390
West Twin River	12.6	28.95	1	360
Deep Creek	17.2	40.9	1	700
Pysht River	46.3	53.1	1	2,460
Clallam River	31	53.1	0.74	1,220
Hoko River	71	53.1	0.32	1,210
Sekiu River	33.2	17	1	560
Total				**11,420**

Productivity: Interim chum salmon population abundance and growth rate goals need to be developed by the Co-managers.

Spatial structure: A restored WSJF chum salmon population should include well distributed, self-sustaining spawning aggregations within all subbasins. Within the WSI subbasin chum salmon distribution should include at a minimum chum salmon spawning aggregations in Colville, Whiskey, and Bullman Creeks, as well as the Sail River.

Diversity: The historical diversity of the WRIA 19 chum salmon population has not been studied in depth. It appears that there are both fall and winter (Lyre River) run chum salmon within the WRIA 19 chum salmon "population(s)". Additional research is needed in order to define long term diversity goals; in the interim it is critical to protect both the fall and winter runs.

4.1.3.3 WRIA 19 Coho Salmon

Abundance: Recovery goals for WRIA 19 coho have not been established, however, there are escapement goals for WRIA 19 coho since they make up part of the Strait of Juan de Fuca coho stock. The original goals were set forth in Zillges (1977) and were later modified by the U.S. District Court's Fisheries Advisory Board #83-39 (Pacific Fishery Management Council[PFMC], 1997). The current escapement goal for WRIA 19 is 9,400 coho salmon. It should be noted that the Salmon Technical Team for the PFMC conducted an investigation of overfishing in 2010, and their report lists a total escapement goal for the western Strait of Juan de Fuca as 11,900. However, the PFMC analysis included additional management units to those in WRIA 19.

A summary of the FAB#83-39 escapement goal by stock group/ watershed is included below in Table 16. Another approach to WSJF coho management has been to manage for smolt production. The current goal is to manage for a ratio of 0.21 smolt per square yard low flow wetted habitat; this is assumed to be average carrying capacity.

Table 16. Summary of WRIA 19 coho salmon escapement goals by stock group (source: FAB#83-30 *in* PFMC 1997).

Stock Group	Coho Escapement Goal
Western Strait Miscellaneous	2,200
Lyre River	250
Twin Rivers	1,050
Pysht River	1,650
Clallam River	1,150
Hoko River	2,200
Sekiu River	900
Total	**9,400**

Fishery managers maintain a database that includes estimated low flow wetted widths by watershed and stream; a summary is included below in Table 17. Smolt production is monitored annually in four or five streams; these data are then used to develop a smolt production estimate for the entire WSJF coho stock. The smolt production estimate is then input into the Fishery Regulation Assessment Model (FRAM) in order to estimate ocean abundance. Ocean abundance is then used to project fishery impacts to WSJF coho salmon in U.S. and Canadian fisheries. Coho salmon spawning ground surveys are then conducted to determine escapement for the entire WSJF coho population. These estimates are conducted in a way that allows for the estimate of escapement within each of the independent tributaries to the WSJF. A summary of spawning escapement by production unit as a proportion of the total escapement is depicted in Table 18.

Table 17. Summary of WRIA 19 coho habitat areas, smolt production goals, and percent habitat area by coho salmon production unit.

Production Unit	Habitat Area (sq. yds.)	Smolt Production Goal	Percent Habitat Area
Salt Creek	83,072	17,445	5.7%
Lyre River	47,168	9,905	3.2%
East Twin	69,168	14,525	4.7%
West Twin	61,072	12,825	4.2%
Deep Creek	48,224	10,127	3.3%
Pysht River	236,632	49,693	16.2%
Clallam River	198,088	41,598	13.6%
Hoko River	396,968	83,363	27.2%
Sekiu River	146,960	30,862	10.1%
WSJF Independ	174,064	36,553	11.9%
Total	**1,461,416**	**306,897**	**100.0%**

Productivity: The 2004 NOPLE status review (see Table 8) determined that only the Salt Creek spawning aggregation was healthy. For Salt Creek coho the growth rate should average at least one returning adult per spawner to maintain productivity. All other spawning aggradations were classified as depressed or critical, thus within these watersheds the population growth rate (productivity) should exceed one.

Spatial structure: A restored WSJF coho salmon population should include well distributed, self-sustaining spawning aggregations within all subbasins. Within the WSJF independent subbasin coho salmon distribution should include coho salmon spawning aggregations in Colville, Whiskey, Murdock, Joe, Jim, Butler, Olsen, Jansen, Rasmussen, Bullman, Snow, Agency, Halfway, and Village Creeks, as well as the Sail River.

Diversity: Little information exists about the historical diversity of the WSJF coho salmon population. Multiple persistent spawning aggregations from each major genetic and life history group should be historically present within the population(s).

Table 18. Summary of production unit habitat areas, average proportion of WRIA 19 escapement by production unit, and - average proportion of escapement

Production Unit	Percent Habitat Area	1998-2005 Average Proportion of Escapement	1998-2005 Average Proportion of Escapement/Percent Habitat Area
Salt Creek	5.7%	10.4%	183.0%
Lyre River	3.2%	2.6%	79.3%
East Twin	4.7%	2.4%	50.5%
West Twin	4.2%	2.7%	65.3%
Deep Creek	3.3%	2.6%	78.8%
Pysht River	16.2%	22.9%	141.4%
Clallam River	13.6%	20.5%	151.2%
Hoko River	27.2%	24.9%	91.5%
Sekiu River	10.1%	7.4%	73.7%
WSJF Independ	11.9%	3.7%	30.8%
Total	**100.0%**	**100.0%**	**NA**

4.1.3.4 WRIA 19 Steelhead/Rainbow Trout

Abundance: Recovery goals for WRIA 19 steelhead have not been established. Escapement goals for some WRIA 19 steelhead subbasins were established by the Washington Department of Game (later Wildlife) in the 1980s but were not agreed to by state and tribal co-managers. A description of the state-approved goals may be found at: https://fortress.wa.gov/dfw/score/score/species/species.jsp.

Productivity: The 2004 NOPLE status review (see Table 11) determined that only the Pysht and Hoko Rivers, and Salt Creek spawning aggregations were healthy. For these spawning aggregations the growth rate should average at least one returning adult per spawner. All other spawning aggregations were classified as depressed or unknown thus within these watersheds the population growth rate should exceed 1 until the populations have recovered.

Spatial structure: Multiple spatially distinct and persistent spawning aggregations across the historical range of the population(s).

Diversity: Multiple persistent spawning aggregations from each major genetic and life history group historically present within the population(s).

4.1.3.5 WRIA 19 Cutthroat Trout

Abundance: There are insufficient data to develop abundance recovery goals for WRIA 19 cutthroat trout at this time. Few if any adult abundance data exist. However, it is assumed that the population has declined significantly throughout their range within the majority of WRIA 19 watersheds.

Productivity: Population growth rate should be stable or increasing depending upon the status of the spawning aggregation.

Spatial structure: Multiple spatially distinct and persistent spawning aggregations across the historical range of the population(s).

Diversity: Multiple persistent spawning aggregations from each major genetic and life history group historically present within the population(s).

5 HABITAT CONDITIONS AND LIMITING FACTORS

Factors thought to have contributed to the decline of WRIA 19 salmonid populations include: loss of adequate quality and quantity of spawning and rearing habitat; over-exploitation; poor ocean conditions; and the interaction of these factors. In addition, reduced numbers of spawning salmon in WRIA 19 also resulted in less delivery of marine derived nutrients. Marine nutrients from decaying salmon carcasses have been documented to significantly increase lower trophic level productivity (Wipfli et al. 1998; Wipfli et al. 1999), leading to further decreases in salmonid productivity.

Little WRIA 19 specific analysis exists regarding fisheries harvest and hatchery impacts and their influence on salmonid populations. However, over-fishing was likely a major factor for decline for some species within WRIA 19. Past hatchery practices may have also contributed to the decline of some species but no direct evidence of this has been documented. A distinction must be made between factors for decline and factors that currently limit salmonid abundance and productivity (limiting factors), as they are not necessarily the same. Certain activities that may have contributed to the decline of some species may no longer operate to limit abundance or productivity.

WRIA 19 Limiting Factors

- Floodplain development and alterations
- Loss of large woody debris
- Estuary and nearshore alterations
- Degraded water quality and high stream temperatures
- Barriers that block access to spawning and rearing habitat
- Conversion of riparian forests to non-forest uses
- Excess sedimentation, including fine sediment in spawning gravels
- Degraded riparian conditions (e.g., conversion from conifer to hardwood dominated riparian forests)
- Stream channelization and bank armoring
- Stream cleaning
- Channel destabilization and channel incision
- Loss of adequate quality and quantity of spawning gravel
- Increased peak flows
- Unauthorized water withdrawals and low flows

Sections 5.1 through 5.10 summarize habitat conditions and limiting factors within each of the ten WRIA 19 subbasins. A brief description of nearshore conditions and related limiting factors across WRIA 19 is included below. In addition, a summary of nearshore and estuarine conditions specific to each of the ten subbasins is included in the subbasin summaries.

WRIA 19 Nearshore Habitat

The WRIA 19 nearshore extends from the mouth of Colville Creek west to, and including, Cape Flattery. The WRIA 19 nearshore habitat, delineated by the physical features of tidal influence and light limitation, is generally defined as the area that extends from the upper end of tidal mixing to 30 meters (~98 feet) depth. The Puget Sound Nearshore Ecosystem Restoration Project (PSNERP 2009) characterizes uplands within 200 meters of the shoreline as part of the nearshore ecosystem (zone 1). Fresh et al. (2004) describe nearshore ecosystem boundaries as not easily defined because linkages in the system occur longitudinally, laterally, and vertically. Fresh et al. (2004) conclude that nearshore ecosystems should be viewed in three dimensions as a suite of overlapping ecosystems that vary in extent as a function of the different environmental and ecological linkages.

The nearshore within WRIA 19 offers greater than 130 linear kilometers of shoreline and is a critical component of the marine ecosystem. The WRIA 19 nearshore environment is an important migratory corridor and rearing environment for several ESA-listed ESUs including Puget Sound Chinook (Shaffer et al. 2010), Strait of Juan de Fuca/Hood Canal Summer Chum, Puget Sound Steelhead, and Columbia River Chinook. In addition, sea run cutthroat trout, bull trout (ESA-listed), and pink, sockeye, chum, and coho salmon, as well as forage fish are also known to utilize the nearshore and estuarine habitat within WRIA 19 (Shaffer et al 2008). Strait of Juan de Fuca nearshore habitat function including species, populations, and life history strategies of juvenile salmon and forage fish that use the nearshore, and linkages with the wider Puget Sound are not well understood, but are necessary for defining nearshore restoration priorities (Shaffer et al 2008). Shaffer et al. (2008) offered a series of restoration priorities based on fish use. The recommendations from this study are included in Chapters 5 and 7 of this Plan.

Fresh et al. (2004) describe nearshore ecosystems as dynamic and continuously changing as a result of the interactions between processes, structures, and functions and responses to different types and intensities of natural and anthropogenic disturbances. Processes that define the nearshore ecosystem of the central and western Strait of Juan de Fuca are equally diverse (Shaffer et al. 2008). The Strait is a dynamic, high energy environment and has high variability in its physical and biological features. Sedimentation is a critical process in defining nearshore habitats within the central Strait (Downing 1983 *In* Shaffer et al. 2008). Sediment within the nearshore ecosystem is contributed from a combination of sources including coastal bluffs and rivers/streams. Hydrologic and sediment processes are the dominant limiting factors for the central Strait nearshore (NOPLE 2004). Forage fish, including surf smelt, sand lance, and herring, use Strait shorelines for spawning, feeding, and migration. This use depends on physical and biological features (Shaffer 2008). Shaffer et al. (2008) hypothesized that central and western Strait nearshore habitats that are the most critical for juvenile salmon survival are lower rivers and estuaries, eelgrass and kelp beds, and sandy shorelines.

5.1 SALT CREEK

Habitat conditions and limiting factors are described and summarized in several technical reports including:

- WRIA 19 Limiting Factors Report (Smith 2000)
- Salt Creek Watershed Assessment (McHenry et al. 2004)
- NOPLE Salmon Habitat Recovery Strategy (NOPLE 2004)
- Historical Changes to Estuaries, Spits, and Associated Tidal Wetland Habitats in the Hood Canal and Strait of Juan de Fuca Regions of Washington State (Todd et al. 2006)

Overall habitat conditions within Salt Creek represent a paradox, containing both largely functional areas such as the estuary, combined with greatly simplified stream and riparian habitats throughout the majority of the stream network (McHenry et al. 2004). Stream habitat has been most directly affected by the chronic loss of large woody debris which has caused fundamental changes in the functional condition of stream types. Loss of in-channel wood is directly attributable to repeated removal of riparian forests over time, combined with intentional LWD removal (e.g., Kramer 1952a). Riparian forest conditions are currently inadequate to fully support habitat forming processes. The vast majority of riparian forests are dominated by young to medium aged stands of deciduous species. Riparian forests are old enough to shade the channel network, but are generally incapable of providing adequate sources of LWD.

Key or major limiting factors include:

- Loss and/or lack of large woody debris
- Land conversion and floodplain development
- Increased demand for water and unauthorized water withdrawals
- Loss of freshwater wetland and salt marsh habitat
- Barriers to migration (primarily culverts)

Harvest and hatchery practices are currently not considered major limiting factors to salmonid populations in the Salt Creek subbasin. A summary of habitat conditions and limiting factors are included below in Sections 5.1.1 through 5.1.6.

5.1.1 Estuary and Nearshore Conditions

The Salt Creek estuary is located within Crescent Bay and is bound by a sand spit pointing east. A salt marsh and numerous tidal channels occur landward of the spit, with the mainstem of Salt Creek winding sinuously through the salt marsh, eventually reaching the Strait on the far east end of the spit (Todd et al. 2006). Salt Creek experiences regular tidal influence allowing it to remain open year-round (McHenry et al. 2004). The Salt Creek subbasin is home to one of the only salt marsh complexes in the WRIA 19 watershed and is surpassed in scale only by the Pysht River estuary complex

(Todd et al. 2006). A number of estuarine fish including: smelt, gunnels, sculpins, sand lance, flounder, and juvenile salmonids rear in this area (Shaffer et al. 2002). The Salt Creek estuary complex and Crescent Bay nearshore support one of the highest densities of juvenile salmon, surf smelt, and sand lance in the Strait of Juan de Fuca (Shaffer et al. 2003 in McHenry et al. 2004). Recent (2007) beach seine sampling in Crescent Bay documented Chinook salmon utilization of the nearshore during the months of June through September (Shaffer et al. in prep). A total of 49 juvenile Chinook were captured in Crescent Bay. Genetic tissue analysis of fin clips documented 13 discrete populations, including several populations that belong to ESUs that are currently listed under the ESA (Shaffer et al. 2010).

Todd et al. (2006) describe relative habitat condition of the Salt Creek estuary as moderately impaired based on the measurable loss of tidal marsh and impairment of connectivity between the Salt Creek marsh and the mainstem Salt Creek. The primary habitat alteration within the Salt Creek estuary is related to a north-south orientated road that bisects the tidal marsh. This road functions similarly to a dike and was constructed sometime around the mid-1920s (McHenry et al. 2004).

The road alters estuarine hydrology and vegetation patterns in the west side of the estuary. Tidal exchange to the west marsh is greatly diminished by drainage of water upstream of the road through drainage ditches, and the presence of two under-sized decaying wooden culverts placed under the road (Todd et al. 2006). Juvenile fish, including salmon, have been observed "stranded" above this road during the spring (A. Shaffer, personal communication); the road accommodates very limited fish passage (Shaffer 2006 *in* Todd et al. 2004). Other alterations include fill associated with the Camp Hayden Road and bridge crossing, parking lot, and at least one residence and driveway near the mouth of the creek and along the inside of the spit (Todd et al. 2006). For additional details see McHenry et al. 2004 and Todd et al. 2006.

5.1.2 Habitat Connectivity

McHenry et al. (2004) inventoried a total of 41 culverts on state, Clallam County, and private ownership in the Salt Creek basin in 2003. Of these, 8 (19.5%) were identified as complete barriers to fish passage and 21 (51.2%) were considered partial barriers, mostly to juvenile fish. Barriers associated with culverts were most commonly related to outfall drops or velocity conditions within the pipe as a result of slope, smooth bottom (concrete), or size. These barriers currently limit fish access to 4,075 acres (34.5%) of the entire watershed (49.1% of the watershed excluding areas above natural barriers). Impassible culverts limit access to 12.6 miles of fish habitat and partially impassible culverts limit access to an additional 13.2 miles.

Correction of all culvert barriers would improve access for fish to the majority of their historical habitat in the Salt Creek basin. An additional 25 miles of streams less than 20 percent gradient could be accessed, an increase of 100 percent. Figure 81 depicts the location of each culvert in relation to the stream network. Nearly every culvert evaluated presented serious impediments to habitat forming processes in Salt Creek.

The majority of culverts measured were undersized and have reduced sediment and LWD transport capacities. Salt Creek contains numerous older drainage structures mostly constructed of concrete and almost universally undersized. Many of these have been installed on small, low gradient streams that may be intermittent in the summer. Streams such as Hoffman Creek, likely have been blocked for decades and their relative contribution to Salt Creek has been overlooked. Small streams in the Salt Creek watershed historically supported spawning fish, and their associated wetlands supported important rearing habitat.

Since the 2004 Salt Creek Watershed Assessment (McHenry et al. 2004) many of the barriers identified have been corrected or funding has been obtained to correct the barriers. Section 5.1.7 includes detailed list of implemented or funded work to address fish passage issues in the Salt Creek subbasin. Section 7.2.1.2 includes a list of remaining fish passage issues in the Salt Creek subbasin.

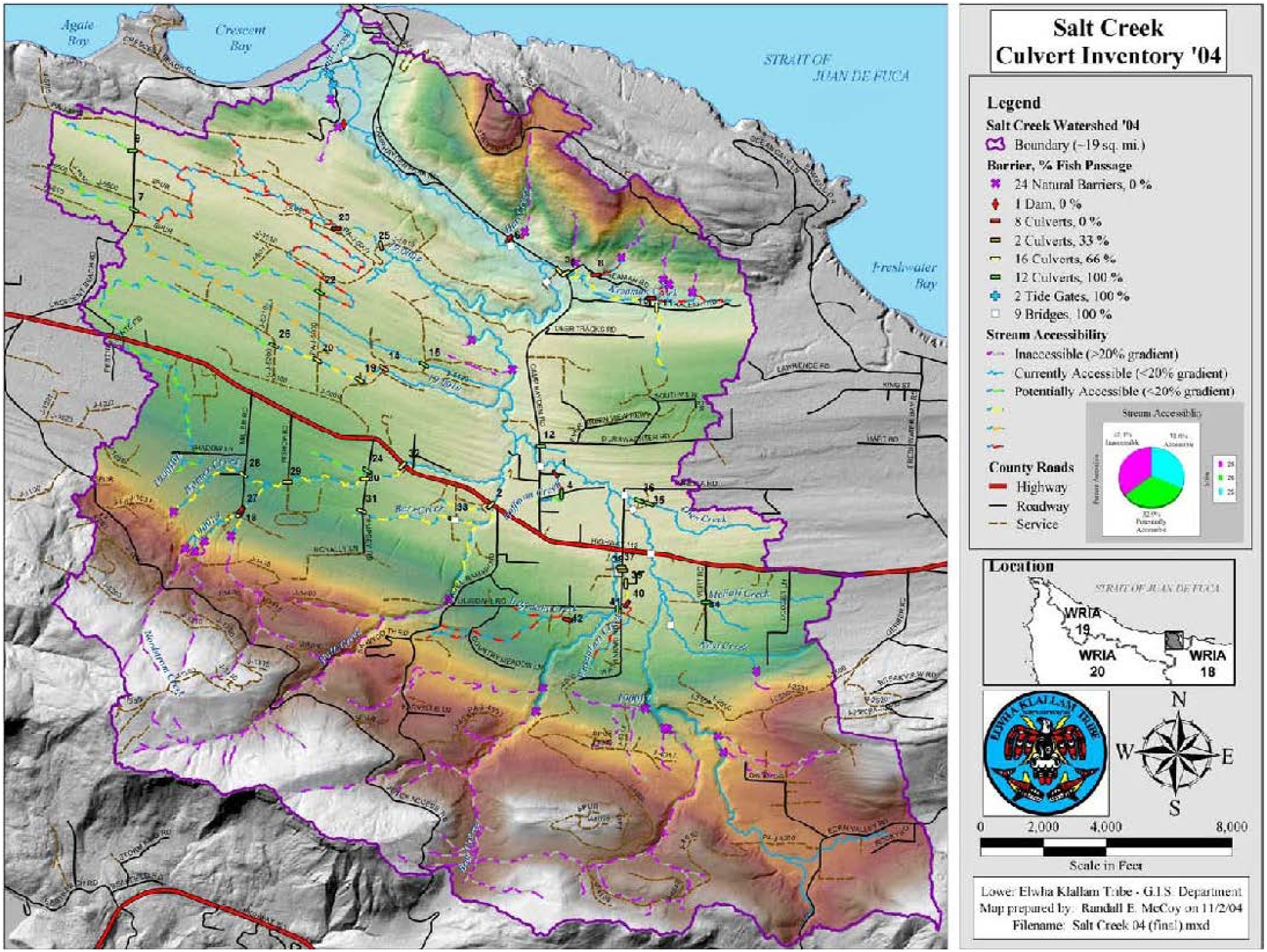

Figure 81. Salt Creek watershed culvert inventory (source: McHenry et al. 2004).

5.1.3 Spawning and Rearing Habitat Conditions

McHenry et al. (2004) conducted habitat surveys in 14 stream reaches in the Salt Creek subbasin. They found that freshwater habitat quality in Salt Creek was variable depending upon geomorphology, land use history, and the age and composition of riparian forests. Salt Creek is unique in that a very high proportion (59%) of the total stream network is dominated by low gradient channel types (<4%). In general, the lowest gradient stream reaches (<2.0%) exhibited the highest variability in conditions, while moderate gradient reaches (2.0-5.0%) were almost universally degraded. No habitat assessments were conducted in higher gradient channels (>6.0%). Habitat conditions were compared within and between categories of stream gradient and confinement to graphically describe habitat conditions using various pool, substrate, LWD and riparian parameters as descriptors. A summary of the findings by McHenry et al. is included below.

Pool Conditions

Pool surface area, measured as a percentage of the total stream habitat, was very low throughout Salt Creek, except for portions of the low gradient (<1%), unconfined segments in the lower river. These reaches of Salt Creek contained either very high channel sinuosity or frequency of large woody debris that resulted in excellent pool structure. In contrast, the other measured low gradient (<1%), unconfined segments which had low pool surface area had either been channelized or had completely lost their in-channel LWD component. Moderate gradient channels in Salt Creek had extremely low pool area: All nine reaches sampled with gradients between 2-6 percent had pool areas below 40 percent, while four had pool areas below 20 percent. Pool frequency exceeded 4.0 channel widths/pool for 11 of 14 of the reaches measured. Ten reaches exceeded 8.0 channel widths/pool, indicating very low levels of pool habitat. Residual pool depth exceeded 1 meter in only one stream reach surveyed, four other stream reaches exceed 0.75 meters. Residual pool depth in Salt Creek was positively correlated ($r=0.60$, $P<0.05$) to the number of key pieces of LWD found within each sampled reach.

Large Woody Debris

LWD frequency was chronically low throughout Salt Creek, except in portions of the lower mainstem below river mile 1.5, where a few large logjams have formed in the last decade. The majority of reaches sampled (12 of 14) had less than 2 pieces of large wood per channel width and three were completely devoid of any LWD. LWD volume was also very low in Salt Creek. None of the sampled reaches were within ranges found in unmanaged old growth forests within the region, and most were far less than those found in streams draining managed (logged) forests in the region. The extremely low volumes of LWD in Salt Creek ($0.06m^3/m$) reflect a legacy of riparian forest removal, in-stream salvage of LWD, and a current lack of adequately sized riparian trees to provide functional LWD. McHenry et al. (2004) estimate that Salt Creek's in-channel LWD volume is only 9 percent of historical values. Key piece frequency was well less than

0.25 pieces/channel width for all reaches sampled. Most sites had less than 0.1 key pieces/channel width, with seven of fourteen (50%) sites containing no key pieces.

Channel Substrate

McHenry et al. (2006) conclude that the chronic loss of LWD in Salt Creek has likely affected stream substrate conditions, particularly in moderate gradient stream types (2-6%). Loss of LWD can increase sheer stress forces on stream beds resulting in bed coarsening and channel incision. Channel incision of 0.5-1.5 m was observed in several locations in Salt Creek. The most dramatic effects were observed in the mainstem of Salt Creek between river mile 2.0-6.0, and in portions of Nordstrom Creek where exposed bedrock appears much more prevalent than expected given the geomorphology. In a two mile reach above the cascades 60 percent of the stream substrate area was composed of bedrock. Observations by long time residents of the watershed describe the area containing little if any bedrock but instead beautiful spawning gravels.

Other more subtle effects of chronic LWD depletion on channel substrate were observed in many low to moderate gradient (1-3%) channel segments. Channel morphology conditions were converted from channels being dominated by well-sorted spawning gravels and abundant pools (forced pool-riffle) to those dominated by cobble and bedrock and containing little pool habitat (plane-bed). Plane–bed channels are now prevalent in many portions of Salt, Bear, Falls and Nordstrom creeks. Where sorted stream gravels were found, they appeared mostly clean, with no obvious signs of recent accelerated sedimentation.

Below river mile 2.0 the levels of subsurface sediment were substantially higher than other portions of the basin and likely exceed 20 percent (<0.85 mm) based upon visual estimates. The source of this material was identified to be a landslide scarp feature located at river mile 2.8. This feature is composed of a steeply sloping exposure of marine sedimentary rocks (mudstone/siltstone). The exposed area has a vertical relief of 100’ and a horizontal extent of approximately 500’. Mechanical weathering combined with continual erosion along the toe provides a persistent source of fine sediment to lower Salt Creek. Historically, lower Salt Creek had a high density of spawning salmon, including chum salmon.

High quality spawning habitat can still be found in the mainstem of Salt Creek between river mile 4.5-6.5, Nordstrom Creek above Bishop Road, and in some of the small tributaries (Kreaman, Lilhedahl, Kasi and Wasankari Creeks). Indeed, the mainstem Salt Creek between river mile 4.0-6.5 currently supports the highest densities of coho and steelhead spawners in the basin.

5.1.4 Riparian Forest and Floodplain Conditions

McHenry et al. (2004) conducted a detailed analysis of riparian forest conditions within the Salt Creek subbasin. A summary of their findings is included below.

Riparian forest conditions adjacent to the stream reaches where habitat surveys were conducted were primarily composed of medium aged alder stands (12-20" dbh). Understory conditions were often dominated by dense brush including salmonberry (*Rubus spectabilis*) and stink currant (*Ribes bracteosum*). Exotic plants were well established in some stream reaches. Japanese knotweed *(Polygonum cuspidatum*) is in the early stages of colonizing Salt Creek's stream network. Colonies of Japanese knotweed were found along Nordstrom Creek and upper Salt Creek. Reed canary grass (*Phalaris arundinacea*), was introduced as livestock forage, and is very well established along streambanks, floodplains, and associated wetlands. It tends to displace native species, and will be a factor in any efforts to reforest riparian forests with native conifers.

A total of 290 Riparian Channel Units (RCU) were classified along 51.3 miles of stream within the Salt Creek watershed. Within the 290 RCUs, a total of 102.6 miles of riparian forest were classified. At the watershed scale RCUs were summarized based upon four stream gradient classes: 0-2%, 2-4%, 4-8%, and >8%. Riparian forest conditions varied widely across the watershed and within individual tributaries. At the watershed scale approximately 24 percent, 10 percent, 56 percent, and 10 percent of the riparian vegetation were classified as dominated by conifer, hardwood, mixed, and non-forested vegetation types respectively. Conifer-dominated riparian areas contained a wide range of coniferous tree species including: western red cedar (*Thuja plicata*), Douglas-fir (*Psuedotsuga menziesii*), Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*), grand fir (*Abies grandis*), and Pacific silver fir (*Abies amabilis*). Harwood stands consisted mostly of red alder (*Alnus rubra*) with minor components of big-leaf maple (*Acer macrophyllum*) and willow (Salix spp.). Mixed stands were highly variable in their vegetation types but in most cases it was estimated that hardwoods made up 50-69 percent of the riparian trees. In mixed stands red alder often formed the core riparian area directly adjacent to the stream banks with a mix of conifer and hardwoods outside of the core area.

A simplistic model was developed to estimate near-term LWD recruitment potential. The near-term LWD recruitment potential for each RCU was classified/rated as one of the following: high, moderate-high, moderate, moderate-low, or low (see McHenry et al. 2004). At the watershed scale nearly 52 percent of the channel lengths surveyed rated low for near-term LWD recruitment potential. Only 18 percent of the channel lengths inventoried rated high for near-term LWD recruitment potential (Figure 82). Low gradient channels (0-2%), were determined to have the lowest near-term LWD recruitment potential within the watershed. High gradient channels (>8%) were found to have the highest near-term LWD recruitment potential. This result is thought to reflect differences in land use. Higher gradient channels in Salt Creek are almost exclusively managed for forestry, while lower gradient channels are often managed for agricultural and residential uses.

A total of 96 road crossings and 9.3 miles of stream adjacent roads were inventoried within the 51.6 miles of channel network surveyed. Collectively road crossings and riparian adjacent roads affect about 11.2 miles of riparian forests. Unfortunately, road crossings and riparian adjacent roads are not evenly distributed throughout the watershed. In fact, over 66 percent of the affected riparian areas are adjacent to low gradient channels (<2%), whereas only 7 percent of the affected riparian areas are adjacent to high gradient channels (>8%). Some but not all of these road segments were constructed on floodplains. Camp Hayden Road is one example of a floodplain road where the road prevents lateral migration of stream and disconnects the stream from potential wetlands and side channels (Smith 2000).

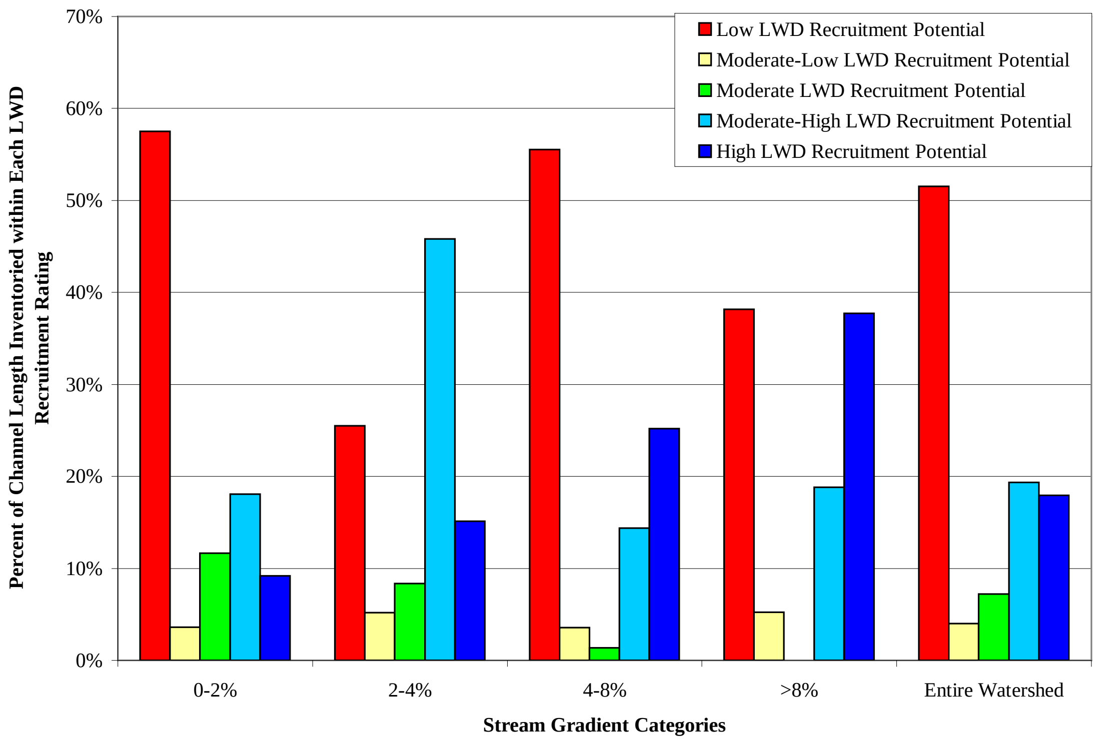

Figure 82. Near-term LWD recruitment potential ratings as a percentage of channel length for different gradient classes of streams in Salt Creek (modified from: McHenry et al. 2004)

5.1.5 Water Quality Conditions

Very limited water quality data are available for the Salt Creek subbasin. A review of available information indicates that only summer stream temperature data are available. McHenry et al. (2004) summarize stream temperature data collected during the summers of 2002 and 2003 for 5 and 7 sites respectively. The temperature patterns in Salt Creek were similar between 2002 and 2003. With the exception of one reach in the vicinity of river mile 3.0, temperatures were generally excellent for juvenile fish rearing. In 2002, four thermographs were deployed with the emphasis placed on assessing conditions in the mainstem. Temperature conditions were good in the upper mainstem above river mile 4.0, heated considerably in the vicinity of river mile 3, and then cooled in the lower mainstem in the vicinity of river mile 1.5. Both the peak temperature (18º C), and diurnal variation (2-6º C) at river mile 3.5, were the highest measured during their study, and are considered to be out of compliance with state water quality criteria for temperature. Temperature was measured in a single tributary in 2002, Nordstrom Creek, and average temperatures were consistently less than 15º C during the summer. Diurnal variation was also low, averaging about 1.5º C during the peak heating period.

Temperature profiles in the major tributaries (Bear, Falls, and Nordstrom) were remarkably similar averaging between 11-15º C during the summer monitoring period. Peak daily temperatures were generally less than 16º C. Bear Creek's daily peak temperature was slightly warmer (0.5-1.5º C) than the other major tributaries, but only out of compliance with state water quality criteria for temperature during four of seventy-seven (5.2%) days measured.

In 2003, in the mainstem of Salt Creek, peak temperatures (17.3º C) were less than in 2002. At river mile 2.5 a peak temperature of 17.3º C was documented. McHenry et al. (2004) suggest that increased temperatures around river mile 3 are related to channel incision processes and an increase in exposed bedrock on the stream bottom. Stream temperatures cooled appreciably below river mile 1.5 where no temperatures were measured above 16º C. Cool temperatures in most of the Salt Creek subbasin were attributed to groundwater contributions and that presence of closed canopy along most of the stream network monitored. Within the 14 stream reaches surveyed by McHenry et al (2004) canopy closure averaged 84 percent.

Benthic community diversity data were collected by Streamkeepers in Salt Creek, these data can be used as an indicator of water quality and overall stream health. Cumulative BIBI scores for Salt Creek suggest that stream health is "compromised". For more information see McHenry et al. 2004.

5.1.6 Hydrologic Conditions

Summer-time stream flows within the Salt Creek subbasin are very low. McHenry et al. (2004) measured flow in the major tributaries and at several sites along the mainstem during the summer of 2003 and found that flows were less than 1 cfs in the tributaries and less than 2 cfs in the mainstem. Washington State Department of Ecology (DOE) continuous stream flow monitoring in Salt Creek began during the summer of 2005. Three years of data collected in July, August, and September for water years 2005, 2006, and 2007 indicate that average streamflow was less than 2.17 cfs, 1.93 cfs, and 1.93 cfs respectively.

EES Consulting (2005) report that, based on physical habitat simulation (PHABSIM) modeling work conducted in Salt Creek, fish habitat requirements exceed existing year-round flows. Figure 83 depicts synthesized dispersed stream flow duration curves for Salt Creek at the confluence with the Strait.

McHenry et al. (2004) reviewed water rights in the Salt Creek subbasin and found that there were 37 perfected water rights totaling an instantaneous 2.7 cfs, which exceeds existing average low flow. DOE closed the basin to new water rights in 1953 at the request of WDF (now WDFW). McHenry et al. (2004) concluded that conservation of water from Salt Creek needs to be considered by residents at the watershed scale as part of any effort to restore fish resources.

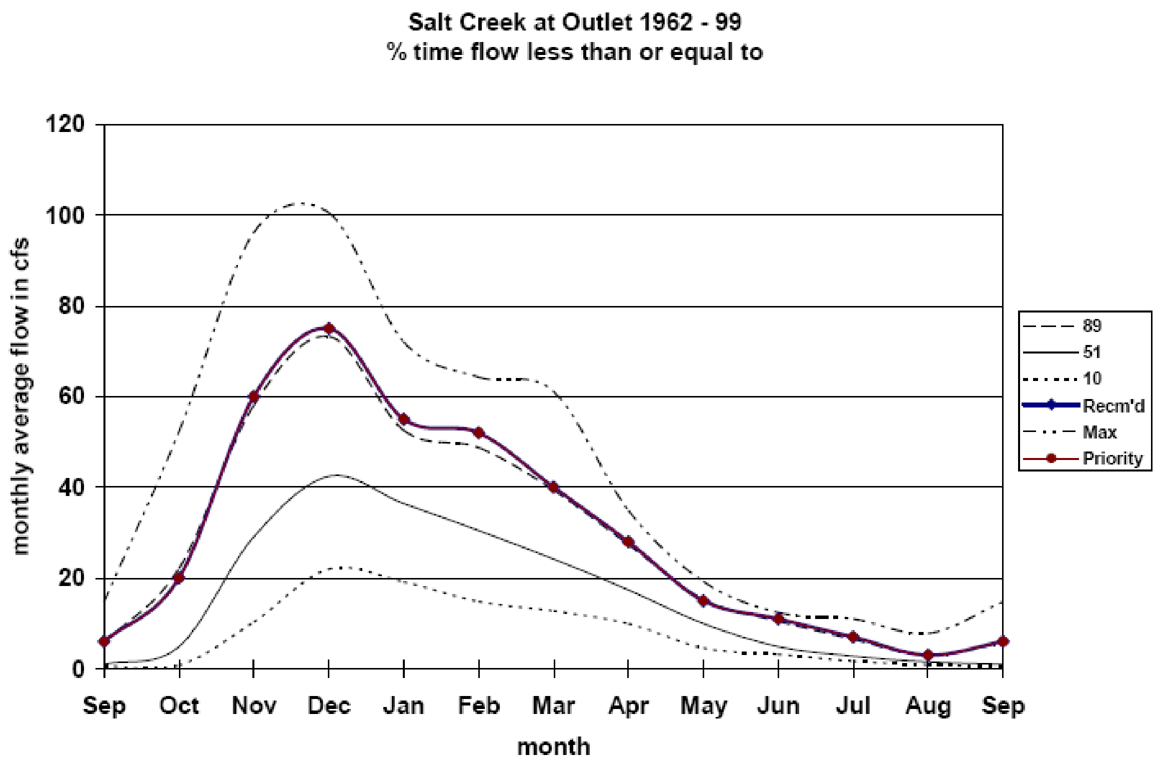

Figure 83. Salt Creek at confluence with Strait, synthesized annually (1962-1999) dispersed flow duration curve (source: EES Consulting 2005).

5.1.7 Funded and/or Implemented Restoration and Protection Projects

The list below includes a detailed inventory of recent (last 20 years) restoration projects implemented or funded in the Salt Creek subbasin.

- Various farm conservation plans and BMPs (Clallam Conservation District).
- Fish passage correction and reconnection of wetlands and over-wintering habitat in tributary to Salt Creek (date unknown, Clallam Conservation District).
- Approximately 120 pieces of LWD were placed between RM 2.0 and 3.0 using a helicopter (2006; Lower Elwha Tribe).
- Approximately 120 pieces of LWD were placed between RM 1.0 and 2.0 using a helicopter (2010; Lower Elwha Tribe).

- Replaced partial barrier culvert on unnamed tributary 19.0009 with new fish passable culvert, opened access to 0.38 miles of 1-4 percent habitat. Note additional habitat were also made accessible in this creek by the culvert replacement described directly below (2006; Lower Elwha Tribe and WDNR).
- Replaced impassable culvert on unnamed tributary 19.0009 with new fish passable culvert, opened access to 3.3, 1.54, 0.25, and 0.15 miles of <1%, 1-2%, 2-4%, and 4-8% gradient habitat respectively. Note no further blockages are known to exist in this stream system (2006; Lower Elwha Tribe/WDNR).
- Unnamed tributary 19.0010 comprehensive fish passage work:
    - Replaced partial barrier culvert near confluence with mainstem of Salt Creek with fish passable structure (2006; Lower Elwha Tribe/WDNR)
    - Removed two partial barrier stream crossings (2006; WDNR)
    - Collectively all fish passage issues on this tributary have been addressed opening approximately 4.69, 0.43, 0.49, and 0.55 miles of <1%, 1-2%, 2-4%, and 4-8% gradient fish habitat.
- Planned replacement of total barrier culvert on Hoffman Creek. Replacement of this culvert provides access to 0.4 miles of low gradient (<1%) fish habitat and associated wetlands (funded 2007; Lower Elwha Tribe)
- Nordstrom Creek comprehensive fish passage work:
    - Replaced partial barrier culvert on Nordstrom Creek at Nordstrom Road with countersunk, fish passable culvert (1999; Clallam County).
    - Planned replacement of partial barrier culvert on Dempsey Road with bridge or passable culvert (funded 2007; Lower Elwha Tribe/Clallam County).
    - Replaced partial barrier culvert on Bishop Road with bridge. Project also implemented LWD introduction and rock weirs to maintain channel stability and provide fish habitat (2007; Lower Elwha Tribe).
    - Planned replacement of partial and complete barrier culverts on Miller Road (funded 2007; Lower Elwha Tribe/Clallam County).
    - Planned replacement of partial barrier culvert on Wanner Creek (tributary to Nordstrom Creek (funded 2007; Lower Elwha Tribe/Clallam County).
    - Collectively planned (funded) and implemented fish passage projects have enhanced and/or restored fish access to 0.78, 1.27, 0.80, and .048 miles of 1-2%, 2-4%, 4-8%, and 8-20% gradient fish habitat respectively. Note one additional partial barrier remains at the SR 112 crossing of Nordstrom Creek (see Section 7.2.1.2).
- Planned replacement of two partial barrier culverts on Barr Creek (tributary of Falls Creek) with fish passable structures. Replacement of these two structures will provide access to 0.77 miles of 1-2 percent gradient habitat (funded 2007; Lower Elwha Tribe). Note SR 112 culvert on Falls Creek is a partial barrier (see Section 7.2.1.2).
- Replaced partial barrier culvert on Bear Creek with bottomless concrete structure (2006; WDOT).
- Replaced total barrier culvert on Liljedahl Creek (tributary to Bear Creek) with 11 foot diameter, 100 percent passable culvert opening access to 0.2, 1.16, and 0.52 miles of 1-2%, 2-4%, and 4-8% gradient habitat respectively. Note potential

barriers may also be present upstream of the culvert as a full inventory of this stream system was not conducted. The SRFB proposal states 0.89 miles of habitat would be opened.

- Planned and funded replacement of 3 partial barrier culverts and one total barrier culvert on Wasankari Creek. Project will enhance or restore access to 0.51, 0.11, and 0.21 miles of 1-2%, 2-4%, and 4-8% gradient habitat respectively (planned 2008; Lower Elwha Tribe).
- John McFall restoration projects- John McFall owns 60 acres on upper Salt Creek and has been quietly restoring salmon on his property since the late 1940s. His efforts to restore habitat began in earnest in the 1990s when he began improving fish access to two small tributaries that flow across the farm. These very small tributaries had become overgrown with sod and grass, which he removed, along with old culverts and other debris. As spawning habitat was fairly limited, small gravel was added to create spawning beds and log controls to hold the gravel and encourage flow vertically within the newly created spawning areas. He has worked to improve fish passage over a historic grist mill dam on his property and in 2003 constructed a rearing pond between Salt Creek and one of the restored tributaries described above.
- Liljedahl Creek fish barrier corrections:
    - An impassible culvert (4 ft outfall drop) and associated road fill on an abandoned logging road were removed, restoring fish passage (2001; WDFW and McCabe [landowner]).
    - An earthfill dam that created a pond was removed restoring fish passage (2001; WDFW and Baker [landowner]). Following removal of the dam, habitat restoration and riparian fencing and planting were conducted on the property.

5.2 LYRE RIVER

Habitat conditions and limiting factors have not been described and summarized to a large extent for the Lyre River subbasin. A few technical reports mention habitat conditions and limiting factors within this subbasin and they include the following:

- WRIA 19 Limiting Factors Report (Smith 2000)
- NOPLE Salmon Habitat Recovery Strategy (NOPLE 2004)
- Historical Changes to Estuaries, Spits, and Associated Tidal Wetland Habitats in the Hood Canal and Strait of Juan de Fuca Regions of Washington State (Todd et al. 2006)

Key or major limiting factors include:

- Loss and/or lack of large woody debris
- Floodplain development and channelization
- Increased demand for water and unauthorized water withdrawals
- Excess sedimentation

A summary of habitat conditions and limiting factors for the Lyre River are included below in Sections 5.2.1 through 5.2.6.

5.2.1 Estuary and Nearshore Conditions

The Lyre River enters the Strait just west of Low Point. The channel is relatively steep at the confluence with the Strait and tidal influence only extends upstream approximately 150 meters. Todd et al. (2006) suggest that no tidal marsh habitat historically existed at the mouth; however, historical mapping information lacks sufficient detail to definitively describe the historical estuarine environment. Todd et al. (2006) further state that impacts to the lower Lyre River and its delta may have occurred quite early as a result of the proximity of Gettysburg, logging, and agricultural development. Gettysburg was a community established in the late 1800s and was located along the east side of Low Point, just east of the mouth of the Lyre River.

The lower Lyre River has been channelized and armored along the west side of the river. In addition, large woody debris has been removed and nearly all riparian forest vegetation has been removed along both the east and west banks. Todd et al. (2006) concluded that the Lyre River estuary and nearshore habitat were “moderately impaired” based on the visible impairment of the lower stream channel connectivity with floodplain and riparian habitat, and bulk heading along the shoreline immediately west of the confluence with the Strait. The total length of bulk heading is approximately 700 feet based on aerial and shoreline photo interpretation.

5.2.2 Habitat Connectivity

No systematic survey of fish blocking culverts has occurred in the Lyre River subbasin. A series of cascades and waterfalls between river mile 2.7-3.5 blocks anadromous fish from reaching Lake Crescent. Local legend contends that fish passage to the Lyre was blocked during blasting associated with railroad construction in the early twentieth century. Extensive surveys by WDFW (Unpublished) in the 1960s concluded that the blockages were natural. Smith (2000) describes only one blocking culvert; on Nelson Creek at RM 1.6, a cement box culvert on SR 112 MP 47.1 blocks about 0.3 miles of coho, steelhead, and cutthroat habitat. This barrier needs field verification of fish passage conditions above and below the culvert prior to restoration planning. Note that aerial photos and GIS road and stream data indicate that this culvert may block slightly more fish habitat. There is another 1.0 miles of 4-8 percent gradient stream channel upstream of the point described by Johnson and Rymer before the West Fork Nelson Creek joins the mainstem. Additional unquantified habitat exists upstream of the W.F. Nelson Creek. For a complete description of barriers in Nelson Creek see Section 7.2.2.2.

One additional potential barrier may exist on a tributary to Susie Creek. An unnamed tributary to Susie Creek (SSHIAP segment 15/3/1//1) has a potential culvert barrier blocking 0.25 miles of 4-8% gradient stream habitat. The culvert and channel should be inspected. Loss of access to spawning and rearing habitat doesn’t appear to be a major limiting factor in the Lyre River subbasin.

5.2.3 Spawning and Rearing Habitat Conditions

Very few data are available with respect to spawning and rearing habitat conditions in the Lyre River. Smith (2000) describes spawning habitat conditions as “fairly good,” but notes that Boundary Creek introduced high quantities of fine sediment into the Lyre River following major landslides and dam break flood events in 1998. LWD levels are described as good with the exception of the lower river where the stream is channelized and LWD have been cleaned from the channel. Smith also notes that pool development is good as a result of adequate levels of LWD in the mainstem. Conversely, Goin (Personal Communication 2008) notes that the Lyre has lost most of the logjams that provided stability to the system. Smith indicates that Susie Creek provides good spawning and rearing habitat. Nelson Creek was noted as having low levels of LWD.

5.2.4 Floodplain and Riparian Habitat Conditions

Riparian and floodplain conditions are poor along the lower 0.6 miles of the Lyre River where most of the native vegetation has been removed along the west bank of the river. Smith (2000) notes that this section of the river is also channelized. In general, riparian conditions in the Lyre River subbasin are better than many systems within the WRIA 19 watershed. Older second growth conifer forests are present within much of the Lyre

River canyon. Smith (2000) notes that riparian conditions are good in Susie Creek but that the Nelson Creek riparian forest is primarily composed of hardwoods.

5.2.5 Water Quality Conditions

The Lyre River is the only subbasin in WRIA 19 that is fed by a lake, resulting in a unique flow, temperature, and water chemistry regime (Smith 2000). Very little water quality monitoring has occurred downstream of the barrier falls at RM 3.7. Susie and Boundary Creeks are described in Smith (2000), as sources of increased fine sediment levels in the Lyre River. She also concludes that increased fine sediment production and delivery from Boundary and Susie Creeks has degraded spawning habitat and increased turbidity levels. Smith notes that turbidity in the Lyre River is currently a problem and that local residents stated that prior to the watershed being logged in the 1950s, the stream never had a turbidity problem.

The Washington State Department of Ecology conducted a stream bio-assessment in 1993 for the Lyre River near the WDNR campground and rated it as “fair, slight impairment of biological condition” (DOE 1999a *in* Smith 2000). A Benthic Index of Biological Integrity (BIBI) survey was conducted in 2004. Data were collected at two sites on the Lyre River. The lower site was located near the DOE sample site from 1993, while the upper site was located near the confluence with Boundary Creek (Tetra Tech/KCM 2005). The lower and upper sites had BIBI scores of 34 and 32 respectively. Both scores were rated as impaired, demonstrating that healthy ecosystem functions were impaired (Tetra Tech/KCM 2005).

5.2.6 Hydrologic Conditions

Lyre River hydrology is distinctly different from the hydrology of all other subbasins within WRIA 19. Maximum elevations approach 5,500 feet and a significant portion of the watershed is above an elevation of 2,500 feet. The Lyre River subbasin is the only subbasin within WRIA 19 that contains alpine meadows and seasonal snow fields. Snow fields provide for a portion of the annual precipitation to be stored as snow and ice during the winter months, running off during the spring melt period. Lake Crescent also acts to buffer stream peaks by temporarily storing water within the lake. Lyre River stream discharge at the lake’s outlet is controlled by lake level. Lake level or lake stage is a complex response to the timing inputs (e.g., snow and snow melt), base flow runoff, direct precipitation, evaporation (controlled by seasons and cloud cover), and the rate (i.e., discharge) of outflow down the Lyre River.

Washington State Department of Ecology (DOE) continuous stream flow monitoring in the Lyre River began during the summer of 2005. Three years of data collected in July, August, and September for water years 2005, 2006, and 2007 indicate that average streamflow was less than 63 cfs, 60 cfs, and 92 cfs respectively. Annual maximum instantaneous discharge for water years 2006 and 2007 were 1,680 and 1,470 cfs, while instantaneous low flows were 14 and 35 cfs.

EES Consulting (2005) reported that, based on physical habitat simulation (PHABSIM) modeling work conducted in the Lyre River, fish habitat requirements exceed existing year-round flows. Figure 84 depicts synthesized dispersed stream flow duration curves for the Lyre River at the confluence with the Strait.

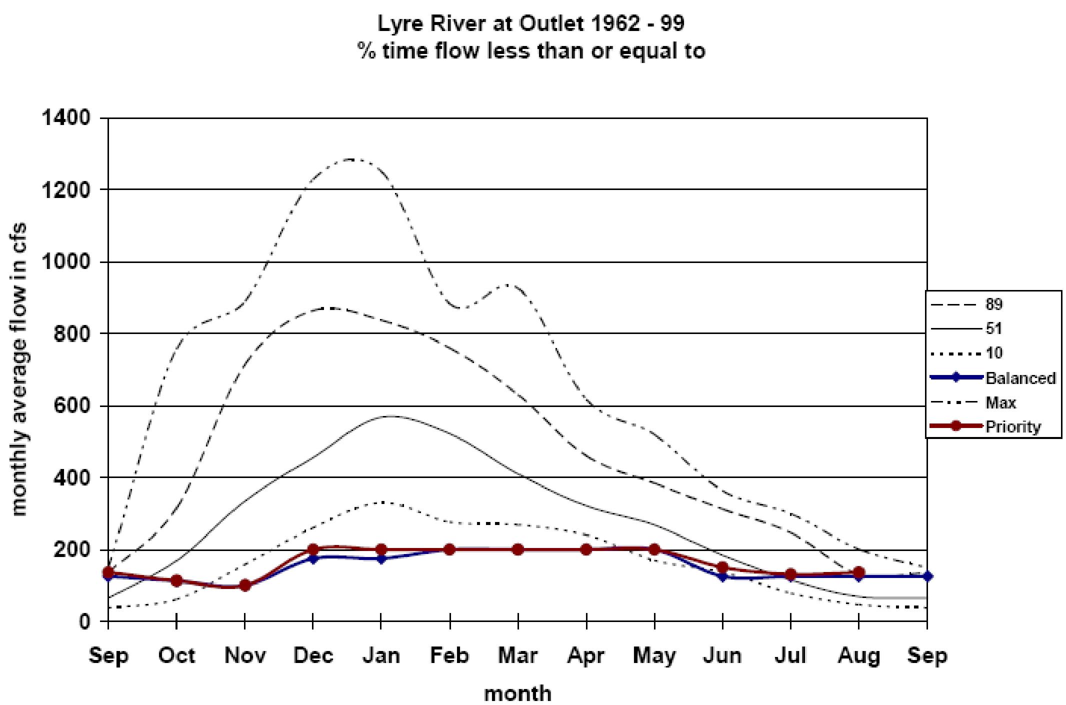

Figure 84. Lyre River at confluence with Strait, synthesized annually (1962-1999) dispersed flow duration curve (source: EES Consulting 2005).

5.2.7 Funded and/or Implemented Restoration and Protection Projects

Very few restoration actions have been taken to date on the Lyre River, primarily because of the lack of a completed watershed analysis. This should be the highest priority for action in the watershed. It should be noted that Lake Crescent, because of its unique assemblage of economically valuable salmonids, has a long history of fishery management actions. For further information see Pierce (1984) and unpublished records at Olympic National Park. The list below includes an inventory of recent (last 20 years) restoration projects implemented or funded in the Lyre River subbasin:

- Boundary Creek LWD reintroduction: project pulled LWD into the active channel (RM 0.0 to 1.0) following dam break flood event, revegetated riparian areas (1998; Lower Elwha Tribe).
- Three culvert barriers located on private land in Nelson Creek have been identified for correction under the Family Forest Fish Passage Program (FFFPP) (Clallam Conservation District 2009-2010).

5.3 EAST TWIN RIVER

Habitat conditions and limiting factors are described and summarized in several technical reports including:

- An assessment of watershed and channel condition in Deep, Boundary and East Twin River (Benda 1999).
- WRIA 19 Limiting Factors Report (Smith 2000)
- Deep Creek and East Twin and West Twin River Watershed Analysis (USDA FS et al. 2002)
- NOPLE Salmon Habitat Recovery Strategy (NOPLE 2004)
- Historical Changes to Estuaries, Spits, and Associated Tidal Wetland Habitats in the Hood Canal and Strait of Juan de Fuca Regions of Washington State (Todd et al. 2006)

The East Twin River subbasin is part of the Intensively Monitored Watersheds Program and additional habitat and water quality data have recently been collected but are not summarized as part of this plan.

Key or major limiting factors include the following (from NOPLE 2004):

- Excess sediment delivery due to elevated rates of mass wasting (IMWSOC 2007)
- Stream scour from channelized mass wasting events
- Loss and/or lack of large woody debris (Smith 2000; IMWSOC 2007)

Harvest and hatchery practices are currently not considered major limiting factors to salmonid populations in the East Twin River subbasin. A summary of habitat conditions and limiting factors are included below in Sections 5.3.1 and 5.3.6.

5.3.1 Estuary and Nearshore Conditions

The confluence of the East and West Twin Rivers with the Strait are separated by only a quarter mile of beach dominated by cobble and gravel substrate. Because the estuary and nearshore habitat forming processes are the same, these estuary delta complexes will be summarized together. The East Twin River enters the Strait approximately 5.5 miles west of Low Point; the West Twin River enters the Strait just 0.25 miles west of the East Twin. Both river channels are relatively steep at the confluence with the Strait and tidal influence only extends upstream approximately 150 meters in each stream.

Todd et al. (2006) suggest that no tidal marsh habitat historically existed at the deltas of these two river systems. Drift cell processes are complex along the shoreline adjacent to the East Twin River. Todd et al. (2006) state that habitat changes brought about by direct impacts such as filling or diking are not obvious in the immediate Twin Rivers stream-deltas. State Route 112 crosses the East Twin River and West Twin River 250 and 50 meters respectively upstream from the confluence with the Strait. Road crossings may locally constrict the channels but the impacts to estuaries from the road are likely fairly limited.

Increased sedimentation has occurred in the both Twin river subbasins. Gravel removal took place historically along the beach separating the East and West Twin Rivers (Smith 2000). Just west of the West Twin River a small clay mining operation ceased operation in the early 1990s. While operating, the mine contributed sediment to the nearshore environment. The mine products were shipped via barge from the mine landing. This required the development of an earthen pier. The pier occupies approximately 3 acres of intertidal zone and is protected from erosion by rip-rap and sheet pile. Access to the pier to ship the clay to market required the periodic dredging of a small shipping/barge channel.

Eelgrass habitat, important for juvenile salmon rearing, has been reduced in the nearshore environment. It has been suggested that altered sediment inputs into the nearshore may have reduced the quantity of eelgrass habitat (Anne Shaffer, personal communication *in* Smith 2000). Todd et al. (2006) concluded that Twin Rivers estuary and nearshore habitat were “moderately impaired” based on the presumed impacts of the highway stream crossings and fill materials along the coastal shoreline.

5.3.2 Habitat Connectivity

Waterfalls, cascades, log jams, and steep gradients limit anadromous fish distribution and habitat utilization in the East Twin River subbasin. A comprehensive road crossing inventory has not been conducted within the watershed. The only documented road-related fish barrier in the watershed analysis was for a culvert on the Forest Service 3040 Road. The culvert blocks fish migration in the East Fork (E.F.) East Twin River. Historical fish distribution within this section of the subbasin is uncertain. A series of falls and cascades at river mile 3.6 on the East Twin River has been considered to be an impassable barrier to anadromous fish migration (De Cillis 2002; Phinney and Bucknell 1975). De Cillis (2002) reports that habitat surveys conducted by the USDA Forest Service identified an anadromous barrier consisting of a fall/debris jam at river mile 3.9. Above the confluence of the East Fork and the mainstem there is a series of debris jams that prevent upstream migration and isolate resident trout populations (De Cillis 2002). However, observations of both steelhead and coho salmon in the E.F. East Twin River have been recorded (Lower Elwha Tribal Fisheries, Unpublished Data).

5.3.3 Spawning and Rearing Habitat Conditions

Habitat conditions in the East Twin River watershed indicate an almost watershed-wide lack of large conifers in stream channels. De Cillis (2002) concluded that increased sediment loading combined with the loss of scour elements (e.g., reduction in LWD size and volume), have significantly reduced the number of pools, pool depth, and the complexity of habitat types, reducing the amount of rearing habitat for juvenile salmonids. The Deep/Twins Watershed Analysis summarizes several years of data collection for these three subbasins. Over 26 miles of fish habitat surveys were conducted in 1992, 1998, and 1999 using Region 6 Level II stream inventory protocols. In 1998 the East Twin River mainstem was surveyed from the confluence with the SJF to the confluence of the E.F. East Twin River at river mile 5.1. De Cillis notes that "Extreme channel conditions relating to valley geology and numerous logjams prevented complete surveys in reaches 3 and 4 (data collection in these reaches was limited to LWD counts). Basic habitat parameters are summarized in Table 19. (De Cillis 2002)

Table 19. Reach summaries for East Twin River habitat conditions (Modified from De Cillis 2002).

Stream Reach	Length (Mi)	Total LWD/Mi	Percent Pools	Percent Riffle	Pools per Mi.	Pools>3 ft/mile	Resid. Pool Depth (ft)	Width to Depth Ratio	Channel Widths per Reach
East Twin River 1	1.9	409	44.3%	49%	31.4	23	3.2	23.3	209
East Twin River 2	2	424	28.7%	71%	27.2	11	1.8	22.5	293
East Twin River 3	0.45	468	–	–	–	–	–	–	–
East Twin River 4	0.5	1211	–	–	52	12	–	–	–

In 2000, limited habitat surveys were conducted in Sadie Creek. These surveys covered one stream reach over a 1.8 mile length. A total of 437 LWD pieces per mile were inventoried. This equates to 0.54 pieces per channel width. Key piece counts in Sadie Creek were very poor with only 0.05 key pieces/channel width. McHenry (2002) notes that in the steeper stream reach of Sadie Creek (reach #6986), LWD historically formed obstructions and/or steps in forced step-pool channel type and has now lost almost its entire in-channel LWD load and is now predominantly a plane-bed channel. General habitat ratings for all five stream reaches inventoried are included below in Table 20.

Table 20. Rating of fish habitat indices for the East Twin River subbasin (source: De Cillis 2002).

Stream Reach	Segment ID	Key Pieces	Total LWD	Percent Pools	Pools Freq.	Holding Pools	Gravel Quality	Migration Barriers
East Twin River 1	6970	Poor	Good	Fair	Poor	Good	Good	None
East Twin River 2	6971	Fair	Good	Poor	Poor	Poor	Good	None
East Twin River 3	7463–7464	Fair	Good	N/A	N/A	N/A	N/A	None
East Twin River 4	7465–7466	Good	Good	N/A	Good	Poor	N/A	None
Sadie Creek 1	6986–6987	Poor	Good	N/A	Good	Poor	N/A	None

5.3.4 Floodplain and Riparian Habitat Conditions

Riparian conditions in the East Twin River were evaluated as part of the Deep Creek and East Twin and West Twin Rivers Watershed Analysis. Riparian conditions in the East Twin have been impacted by human activity since the late 1800s (Toal 2002). Most of the watershed has been impacted by timber harvest and road and railroad construction. Hardwoods have always been a component of the riparian forests along the mainstem and large tributaries; however, the present stand composition shows a greater ratio of hardwoods to conifers, and in younger seral stages (Toal 2002). Historical riparian forests supported large conifers, especially Sitka spruce, Douglas fir, and western red cedar (Toal 2002). Current riparian stand conditions indicate higher percentages of small conifers and hardwoods.

Currently riparian stands are predominately composed of young conifer and red alder; however, remnant stands of mature and old growth conifer still exist, but are fragmented and limited in width (Toal 2002). Toal concluded that the East Twin watershed has been used heavily for timber production and that the existing riparian conditions reflect past land use practices. The watershed analysis inventoried riparian conditions and LWD recruitment potential along the mainstem (lower and upper), the E.F. East Twin, and Sadie Creek. Within the E.F. East Twin River, LWD recruitment potential was rated low or moderate along 77.3 percent of the stream length (see Table 21). For the lower and upper mainstem LWD recruitment potential was rated low or moderate along 34.7 and 60.9 percent of the stream length respectively. LWD recruitment potential rated high for 81.3 percent of the stream length in Sadie Creek. Detailed riparian shade evaluations were also made and are available in the watershed analysis synthesis module (USDA FS et al. 2002).

Table 21. East Twin River subbasin LWD recruitment potential as a percentage of riparian length (modified from Toal 2002).

Stream Drainage/Segment	LWD Recruitment Potential as a Percentage of Riparian Length					
	Right Bank			Left Bank		
	Low	Moderate	High	Low	Moderate	High
East Fork East Twin River	47.7%	29.6%	22.7%	47.7%	29.6%	22.7%
East Twin River Lower	15.0%	19.3%	65.8%	15.0%	19.3%	65.8%
East Twin River Upper	22.0%	38.9%	25.0%	41.8%	33.2%	25.0%
Sadie Creek	3.9%	14.8%	81.3%	3.9%	14.8%	81.3%

McHenry (2002) notes that very little channel alteration (e.g., riprap, diking) has occurred within the watershed. The only known channelization efforts in the East Twin River consisted of the construction of low dikes composed of river sediments. LWD removal also occurred adjacent to the home sites in this channelized reach. Kramer (1952a) describes a highly dynamic river and floodplain in the lower East Twin River prior to large scale wood removal that occurred in the lower 1.5 miles of the East Twin during

June 1952. Functional habitat conditions appear to be reestablishing following both natural recruitment of wood and intentional LWD restoration efforts.

5.3.5 Water Quality Conditions

Water quality conditions in the East Twin River subbasin have changed over time due to altered watershed processes (Stoddard and De Cillis 2002). Watershed processes have been altered from natural and human-induced disturbances over a long-term, prehistoric scale; large, stand-replacing fires occurred in 1308, 1508, and 1701 (Stoddard and De Cillis 2002). Stand replacement disturbance events would have resulted in increased surface erosion and mass wasting, substantially increasing sediment supply to the channel network. In addition, loss of riparian forests and canopy cover over streams can cause an increase in solar radiation to surface waters, elevating stream temperatures. Human activities such as land clearing, clearcut timber harvest, and road construction can affect water quality at scales similar to prehistoric-stand replacing fires.

Stream Temperature

Temperature data summarized in the watershed analysis indicate that the East Twin River is in compliance with the Washington State water quality standards. East Twin River maximum stream temperatures were less than 14ºC at all four sites monitored (Table 22). Overall stream temperatures are within the preferred range for juvenile rearing in the East Twin River (Stoddard and De Cillis 2002). Stream temperature data were also collected by the Lower Elwha Tribe from 1996 through 2002 at various sites in the mainstem and E.F. East Twin River. A total of 961 site-days of daily average stream temperature data indicate that the average daily stream temperature was 10.9ºC, and maximum daily average was 14.8ºC. Maximum daily temperature exceeded 16ºC on 7 days, six days were in 1998, in the E.F. East Twin River and one day occurred in the mainstem at the SR 112 bridge in 2002.

Table 22. Select summary of water temperature data for the East Twin River (modified from Stoddard and De Cillis 2002).

Stream	Site Location (RM)	Sampling Period	Avg. Daily Max. Temp. ºC	Avg. Daily Min. Temp. ©	Max Temp. and Date	No. Days 16-18 C	No. Days >18C	Percent Canopy Cover
East Twin River	0.8	7/2/98 - 9/8/98	12.0	10.9	13.9, 7/28	0	0	96.2
East Twin River	4.6	7/2/98 - 9/15/98	11.5	10.7	13.4, 7/27	0	0	97.3
East Twin River	6.2	6/26/01 - 9/10/01	8.9	8.4	10.5, 8/12	0	0	Not measured
East Twin River	2.7	6/26/01 - 9/10/01	11.7	11.2	13.1, 8/10	0	0	Not measured

Dissolved Oxygen

Dissolved oxygen data were collected from July 2 to September 8, 1998 at RM 0.8 in the East Twin River. Dissolved oxygen ranged from 9.5 to 10.7 mg/L, suggesting that the needs of salmonids are more than adequately met in the East Twin River (Stoddard and De Cillis 2002).

Macroinvertebrates

The USDA Forest Service collected a macroinvertebrate sample from RM 0.8 in 1998, however, the results were inconclusive. A Benthic Index of Biological Integrity survey was conducted in 2004. Data were collected at two sites on the East Twin River. The lower site was located near river mile 1.1, while the upper site was located near the confluence with Sadie Creek (Tetra Tech/KCM 2005). The upper site had a BIBI score of 46, which rated as “healthy.” The lower site had a BIBI score of 44, which rated as “compromised” (Tetra Tech/KCM 2005).

5.3.6 Hydrologic Conditions

Summer-time stream flows within the East Twin River subbasin are quite low. Washington State Department of Ecology (DOE) continuous stream flow monitoring in East Twin River began during the summer of 2004. Three years of data collected in July, August, and September for water years 2004, 2006, and 2007 indicate that average streamflow was 5.5 cfs, 3.1 cfs, and 7.33 cfs, respectively.

EES Consulting (2005) reported that, based on physical habitat simulation (PHABSIM) modeling work conducted in the East Twin River, fish habitat requirements exceed existing year-round flows. Figure 83 depicts synthesized dispersed stream flow duration curves for the East Twin River at the confluence with the Strait. Stoddard (2002) estimates that annual average discharge for the East Twin River is 41 cfs. Annual peak flows measured at the USGS East Twin River gage for the 16 years of record range from 526 cfs in WY 1964 to 1,220 cfs in 1963 (Stoddard 2002). During the period of record there were six years with peak flows greater 1,100 cfs.

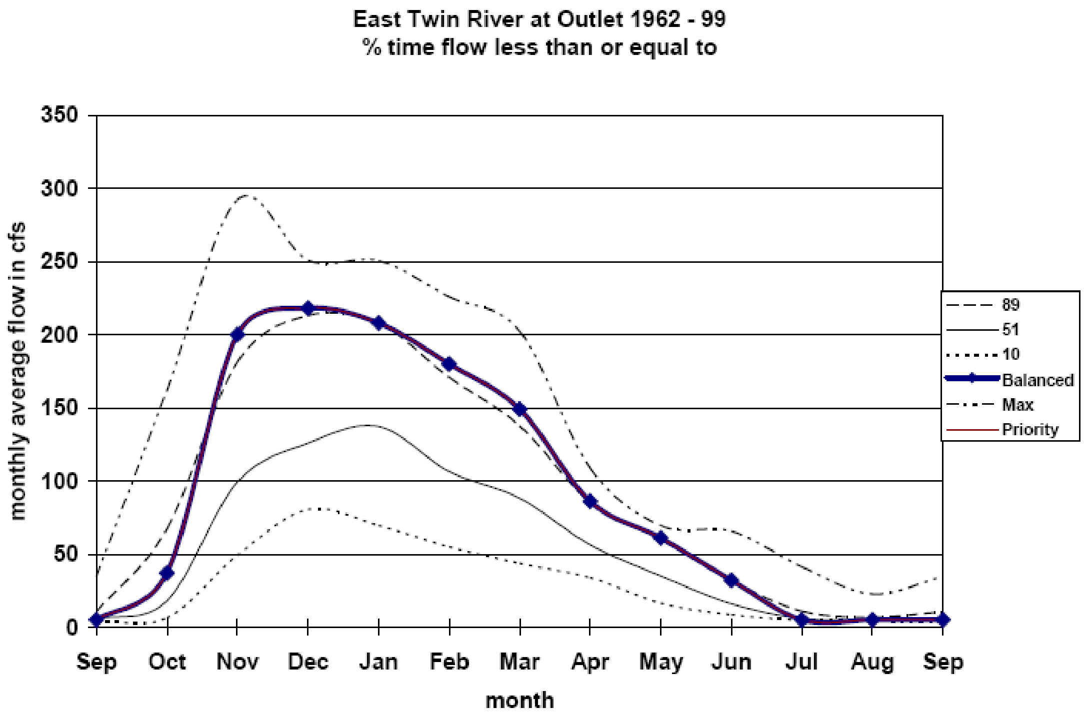

Figure 85. East Twin River at confluence with Strait, synthesized annually (1962-1999) dispersed flow duration curve (source: EES Consulting 2005).

5.3.7 Funded and/or Implemented Restoration and Protection Projects

The list below includes a detailed inventory of recent (last 10 years) restoration projects implemented or funded in the East Twin River subbasin.

- Construction of an off-channel, over-wintering habitat on private property near RM 1.0 (1998)
- Sadie Creek drainage, comprehensive fish passage work:
  - Replaced four partial or complete barrier culverts in tributaries to upper Sadie Creek (2005; WDNR/Lower Elwha Tribe)
- Systematic LWD introduction into mainstem East Twin River (RM 0.0 to 3.0):
  - 2002 treated 30 sites in the East Twin River from river mile 2.0-3.0 using a helicopter (Lower Elwha Tribe)
  - 2003-2004 treated RM 1.2 to 2.0 using ground-based placement at 35 sites (Lower Elwha Tribe)
  - 2005 treated lower river from RM 0.3 to 1.0 using ground-based placement at 16 sites (Lower Elwha Tribe)
- Extensive riparian planting between river mile 0.5 and 2.0 (year unknown, Lower Elwha Tribe)
- Systematic LWD introduction into Sadie Creek RM (0.0 to 2.0):

    - In the summer of 2002 LWD was placed with a helicopter into Sadie Creek at forty sites from river mile 0.0-2.0 (Lower Elwha Tribe)
- Road maintenance and abandonment were conducted on some hazardous road segments within the watershed (1999-2001; USDA FS)
- A recently completed NEPA analysis of the entire 3040 road system concluded that significant portions (~30 miles) of the road system should be decommissioned. Project implementation to remove the remaining 11 miles of road system in the Twin rivers and Deep Creek subbasins is underway (funded 2006; USDA FS and NOSC).
- Stream restoration (date and specifics unknown, Clallam Conservation District)

5.4 WEST TWIN RIVER

Habitat conditions and limiting factors are described and summarized in several technical reports including:

- WRIA 19 Limiting Factors Report (Smith 2000)
- Deep Creek and East Twin and West Twin River Watershed Analysis (USDA FS et al. 2002)
- NOPLE Salmon Habitat Recovery Strategy (NOPLE 2004)
- Historical Changes to Estuaries, Spits, and Associated Tidal Wetland Habitats in the Hood Canal and Strait of Juan de Fuca Regions of Washington State (Todd et al. 2006)

The West Twin River subbasin is part of the Intensively Monitored Watershed Program and additional habitat and water quality data have recently been collected but are not summarized as part of this plan.

Key or major limiting factors include the following (from: NOPLE 2004).

- Excess sediment delivery due to elevated rates of mass wasting (IMWSOC 2007)
- Stream scour from channelized mass wasting events
- Loss and/or lack of large woody debris (Smith 2000; IMWSOC 2007)
- Elevated stream temperatures due to loss of riparian cover (IMWSOC 2007)

Harvest and hatchery practices are currently not considered major limiting factors to salmonid populations in the West Twin River subbasin. A summary of habitat conditions and limiting factors are included below in Sections 5.4.1 and 5.4.6.

5.4.1 Estuary and Nearshore Conditions

See section 5.3.1.

5.4.2 Habitat Connectivity

Waterfalls, cascades, log jams, and steep gradients limit anadromous fish distribution and habitat utilization in the West Twin River subbasin. A comprehensive road crossing inventory has not been conducted within the watershed. There are no documented road related fish barriers in the watershed analysis.

De Cillis (2002) considered the waterfall at river mile 4.2 the upper extent of anadromous fish use. However, De Cillis states that some question remains about whether the waterfall is a complete barrier or only a partial barrier. Coho salmon have been observed upstream of the waterfall on some years, suggesting the waterfall is only a partial barrier (Lower Elwha Fisheries, unpublished spawning ground surveys).

5.4.3 Spawning and Rearing Habitat Conditions

The Deep/Twins Watershed Analysis summarizes several years of data collection for these three subbasins. Over 26 miles of fish habitat surveys were conducted in 1992, 1998, and 1999 using Region 6 Level II stream inventory protocols (De Cillis 2002). The West Twin River mainstem was surveyed in 1992 and again in 1999. The watershed analysis uses data collected in 1999 from the confluence with the SJF to river mile 7.7. Basic habitat parameters are summarized in Table 23.

Table 23. Reach summaries for West Twin River habitat conditions (Modified from De Cillis 2002).

Stream Reach	Length (Mi)	Total LWD/Mi	Percent Pools	Percent Riffle	Pools per Mi.	Pools>3 ft/mile	Resid. Pool Depth (ft)	Width to Depth Ratio	Channel Widths per Reach
West Twin River 1	1.5	166.4	53	47	21	14	3.3	49.6	168.5
West Twin River 2	2	155	27	73	17	10	2.9	40	270.8
West Twin River 3	0.9	184.8	17	79	21	6	2.3	45	182.8
West Twin River 4	1.5	159.4	22	77	22.5	7	2.5	48.2	240
West Twin River 5	2	143.3	17.5	80	19	3	2	24.5	459

General habitat ratings for all five stream reaches inventoried are included below in Table 24. The West Twin River rated poor for key piece frequency and pool frequency in all 5 stream reaches. One reach rated fair for percent pools; the other 4 reaches rated poor. Three reaches rated fair for total LWD frequency and two rated poor. Holding pools were good in reach 1, fair in reach 2, and poor in reaches 3 through 5. Gravel quality was rated fair in reach 1 and good in all other reaches.

Table 24. Rating of habitat indices, West Twin River subbasin (source: De Cillis 2002).

Stream Reach	Segment ID	Key Pieces	Total LWD	Percent Pools	Pools Freq.	Holding Pools	Gravel Quality	Migration Barriers
West Twin River 1	7020 - 7021	Poor	Fair	Fair	Poor	Good	Fair	None
West Twin River 2	7022 - 7023	Poor	Fair	Poor	Poor	Fair	Good	None
West Twin River 3	7024	Poor	Poor	Poor	Poor	Poor	Good	None
West Twin River 4	7551 - 7553	Poor	Fair	Poor	Poor	Poor	Good	None
West Twin River 5	7428 - 7432	Poor	Poor	Poor	Poor	Poor	Good	None

De Cillis (2002) concluded that increased sediment loading combined with the loss of scour elements (e.g., reduction in LWD size and volume), have significantly reduced the number of pools, pool depth, and the complexity of habitat types, reducing the amount of rearing habitat for juvenile salmonids. He also noted that sediment inputs from mass wasting and surface erosion are part of the natural processes in the watershed. The West Twin River subbasin is susceptible to landslides and debris flows following natural disturbance (e.g., fire, large precipitation events). The inner gorge along portions of the West Twin River is susceptible to erosion and hillslope failure (De Cillis 2002).

5.4.4 Floodplain and Riparian Habitat Conditions

Riparian conditions in the West Twin River were evaluated as part of the Deep Creek and East Twin and West Twin Rivers Watershed Analysis. Riparian conditions in the West Twin have been impacted by human activity since the late 1800s (Toal 2002). Most of the watershed has been impacted by timber harvest and road and railroad construction. Hardwoods have always been a component of the riparian forests along the mainstem and large tributaries; however, the present hardwood composition shows a greater ratio of hardwoods to conifers, and in younger seral stages (Toal 2002). Historical riparian forests supported large conifers, especially Sitka spruce, Douglas fir, and western red cedar (Toal 2002). Current riparian stand conditions indicate higher percentages of small conifers and hardwoods.

Riparian stands in the West Twin watershed are predominately composed of young conifers and red alder, however, remnant stands of mature and old growth conifer still exist, but are fragmented and limited in width (Toal 2002). Toal concluded that the watershed has been used heavily for timber production and that the existing riparian conditions reflect past land use practices. The watershed analysis inventoried riparian conditions and LWD recruitment potential along the mainstem (above No Name Creek, lower, middle, and upper) and in No Name Creek. For the lower, middle, upper, and upstream of No Name Creek mainstem, LWD recruitment potential was rated low or moderate along 71.8, 64.7, 81.3, and 90.6 percent of stream length respectively (Table 25). LWD recruitment potential rated high for 84.9 percent of the stream length in No Name Creek. Detailed riparian shade evaluations were also made and are available in the watershed analysis synthesis module (USDA FS et al. 2002).

Table 25. West Twin River subbasin LWD recruitment potential as a percentage of riparian length (modified from Toal 2002).

Stream Drainage/Segment	LWD Recruitment Potential as a Percentage of Riparian Length					
	Right Bank			Left Bank		
	Low	Moderate	High	Low	Moderate	High
West Twin River above No Name Creek	24.0%	66.6%	9.4%	24.0%	69.0%	7.0%
West Twin River Lower	47.1%	23.7%	29.2%	46.0%	23.7%	30.2%
West Twin River Middle	38.2%	26.5%	35.3%	24.1%	46.5%	29.4%
West Twin River Upper	57.5%	23.7%	18.7%	59.8%	21.4%	18.7%
No Name Creek	14.0%	1.1%	84.9%	14.0%	1.2%	84.9%

5.4.5 Water Quality Conditions

Water quality conditions in the West Twin River subbasin have changed over time due to altered watershed processes. Watershed processes have been altered from natural and human induced disturbances, at the long-term, prehistoric scale; large, stand-replacing fires occurred in 1308, 1508, and 1701 (Stoddard and De Cillis 2002). Stand replacement disturbance events would have resulted in increased surface erosion and mass wasting, substantially increasing sediment supply to the channel network. In addition, loss of riparian forests and canopy cover over streams can cause an increase in solar radiation to surface waters, elevating stream temperatures. Human activities such as land clearing, clearcut timber harvest, and road construction can affect water quality at scales similar to prehistoric stand-replacing fires.

Stream Temperature

Temperature data summarized in the watershed analysis indicate that most of the West Twin River is in compliance with the Washington State water quality standards. West Twin River daily average temperature ranged from 11.1 to 15.8ºC (Table 26). The coolest stream temperatures occurred at the highest upstream site at RM 5.8. The warmest temperatures were recorded at the lowest downstream site at RM 0.2 and 0.3. In 1998, stream temperature exceeded 16ºC on 29 days. In 1999, at RM 0.2 stream temperature exceeded 16ºC on 3 days.

Table 26. Summary of water temperature data for West Twin River (Stoddard and De Cillis 2002)

Stream	Site Location (RM)	Sampling Period	Avg. Daily Max. TempºC	Avg. Daily Min. TempºC	Max Temp. and Date	No. Days 16-18ºC	No. Days >18ºC	Percent Canopy Cover
West Twin River	0.3	7/2/98 - 9/8/98	15.8	11.6	19, 7/28	29	2	53.2
West Twin River	0.2	7/2/99 - 9/15/99	14.5	11.9	16.4, 8/27	3	0	56.4
West Twin River	2.8	7/1/95 - 9/13/95	13.2	11.7	16.4, 7/19	2	0	Not measured
West Twin River	3.3	6/30/99 - 9/15/99	12.4	10.6	14.3, 8/28	0	0	71.6
West Twin River	5.8	7/1/95 - 9/15/95	12.0	10.2	14.5, 7/20	0	0	84.4
West Twin River	5.8	7/2/98 - 9/15/98	11.7	10.4	14.1, 7/28	0	0	Not measured
West Twin River	5.8	7/2/99 - 9/15/99	11.2	9.7	12.7, 8/28	0	0	Not measured
West Twin River	3.3	6/27/01 - 9/10/01	12.4	10.7	14.2, 8/10	0	0	Not measured
West Twin River	5.8	6/27/01 - 9/10/01	11.1	9.7	12.4, 8/10	0	0	Not measured
West Twin River Tributary	3	6/30/99 - 9/15/99	12.7	11.2	14.3, 8/28	0	0	91.5

Dissolved Oxygen

Dissolved oxygen data were collected at seven different sites within the West Twin River subbasin in 1994, 1998, and 1999. The data show that DO levels were below 9.5 mg/L at three of the seven sites (Table 27). The lowest DO levels were measured at the RM 0.3 site. Stoddard and De Cillis (2002) concluded that exceedence of state standards did occur but that DO levels were high enough during all sampling periods to adequately meet the needs of freshwater salmonids.

Table 27. Summary of dissolved oxygen data collected in the West Twin River subbasin (from Stoddard and De Cillis 2002).

Stream Name	Site Location (RM)	Sampling Period	DO Range mg/L
West Twin River	5.8	6/21/94 - 9/7/94	10.0 - 11.1
West Twin River	0.3	7/2/98 - 9/8/98	8.6 - 10.5
West Twin River	5.8	7/2/98 - 9/15/98	9.8 - 10.9
West Twin River	3.3	6/29/99 - 8/18/99	9.4 - 11.0
West Twin River	0.2	6/29/99 - 8/18/99	9.4 - 11.0
West Twin River	5.8	7/1/99 - 8/18/99	9.8 - 11.2
West Twin River Tributary	3	6/29/99 - 8/18/99	9.8 - 11.5

Macroinvertebrates

The USDA Forest Service collected a macroinvertebrate sample from RM 0.3 in 1998; the results were inconclusive. A BIBI survey was conducted in 2004. Data were collected at two sites on the West Twin River. The lower site was located near river mile 0.3. The upper site was located near RM 1.0 (Tetra Tech/KCM 2005). The upper site had a BIBI score of 46, which rated as "healthy." The lower site had a BIBI score of 44, which rated as "compromised" (Tetra Tech/KCM 2005). Interestingly the scores at the upper and lower sites for the East and West Twin rivers were exactly the same.

5.4.6 Hydrologic Conditions

Summer-time stream flows within the West Twin River subbasin are quite low. Washington State Department of Ecology (DOE) continuous stream flow monitoring in West Twin River began during the summer of 2004. Two years of data collected in July, August, and September for water years 2004 and 2007 indicate that average streamflow was 5.5 cfs and 6.6 cfs respectively.

EES Consulting (2005) reported that, based on physical habitat simulation (PHABSIM) modeling work conducted in the West Twin River, fish habitat requirements exceed existing year-round flows. Figure 83 depicts synthesized dispersed stream flow duration curves for the West Twin River at the confluence with the Strait. Stoddard (2002) estimates that annual average discharge for the West Twin River is 40 cfs. Annual peak flows measured at the DOE West Twin River gage for WY 2007 and 2006 were 997 and 341 cfs.

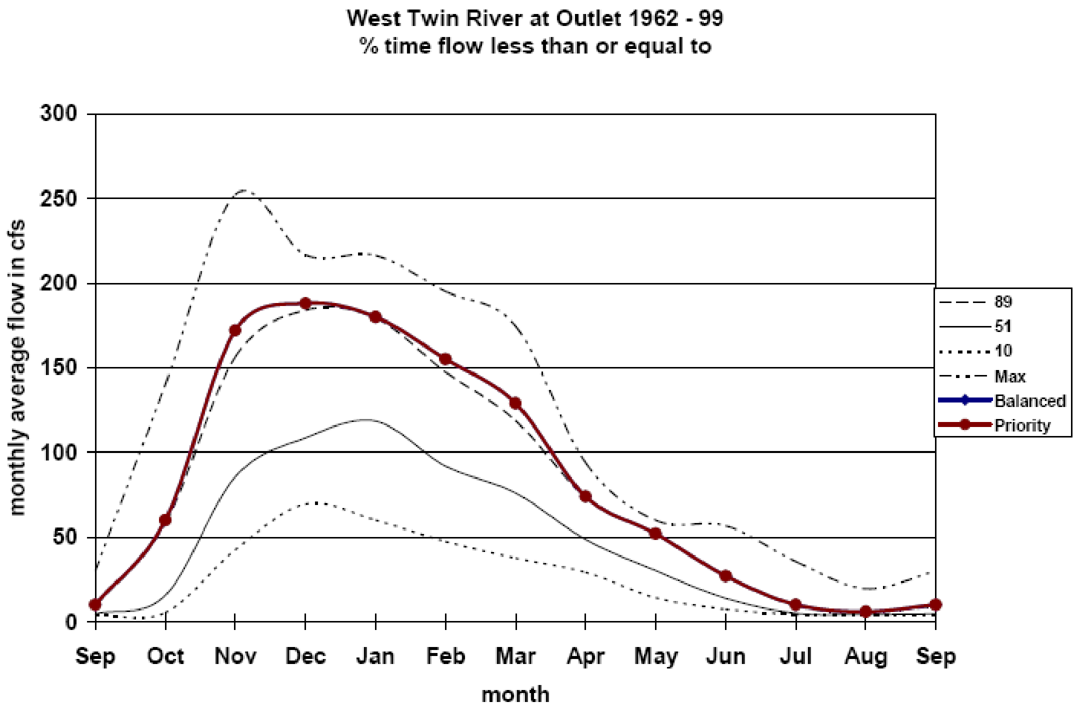

Figure 86. West Twin River at confluence with Strait, synthesized annually (1962-1999) dispersed flow duration curve (source: EES Consulting 2005).

5.4.7 Funded and/or Implemented Restoration and Protection Projects

The West Twin River is part of the Intensively Monitored Watershed Program and is acting as the no-restoration action, control watershed. Two road decommissioning projects have recently been completed but this is the limit of restoration work planned for the West Twin River.

- Road maintenance and abandonment were completed on some hazardous road segments within the watershed (1999-2001; USDA FS)
- A recently completed NEPA analysis of the entire 3040 road system concluded that significant portions (~30 miles) of the road system should be decommissioned. Project implementation to remove the remaining 11 miles of road system in the Twin rivers and Deep Creek subbasins is underway (funded 2006; USDA FS and NOSC).

5.5 DEEP CREEK

Habitat conditions and limiting factors are described and summarized in several technical reports including:

- Assessment of physical and biological conditions within the Deep Creek watershed (McHenry et al. 1995).
- WRIA 19 Limiting Factors Report (Smith 2000)
- Deep Creek and East Twin and West Twin River Watershed Analysis (USDA FS et al. 2002)
- NOPLE Salmon Habitat Recovery Strategy (NOPLE 2004)
- Historical Changes to Estuaries, Spits, and Associated Tidal Wetland Habitats in the Hood Canal and Strait of Juan de Fuca Regions of Washington State (Todd et al. 2006)

The Deep Creek subbasin is part of the Intensively Monitored Watershed Program and additional habitat and water quality data have recently been collected but are not summarized as part of this plan.

Key or major limiting factors include the following (from NOPLE 2004).

- Excess sediment delivery due to elevated rates of mass wasting (IMWSOC 2007)
- Stream scour from dam-break flood events (IMWSOC 2007)
- Loss and/or lack of large woody debris (Smith 2000; IMWSOC 2007)
- Loss of off-channel and floodplain habitat due to channel incision (IMWSOC 2007)
- Elevated stream temperatures due to loss of riparian cover (IMWSOC 2007)

Harvest and hatchery practices are currently not considered major limiting factors to salmonid populations in the Deep Creek subbasin. A summary of habitat conditions and limiting factors are included below in Sections 5.5.1 and 5.5.6.

5.5.1 Estuary and Nearshore Conditions

Deep Creek enters the Strait approximately 4.75 miles east of Pillar Point. The Deep Creek delta-estuary complex is small, and characterized by a pattern of erosion and advance, presumably depending on lower channel changes, watershed sediment inputs and fluvial sediment transport dynamics, and also possibly longshore wave action (Todd et al. 2006). No sizeable tidal marsh habitat was ever present based on historical records of the area (Todd et al. 2006).

Todd et al. (2006) summarized lateral channel migration of Deep Creek across the delta using maps and photos from 1864 to present. They concluded that the mouth appears prone to considerable east-west migrations across the delta. For example, the 1864 GLO survey suggests the mouth of Deep Creek was about 200 feet west of its present-day location, while the 1908 and 1926 T sheets indicate the channel was approximately 150-200 feet to the east of its present location in the early 1900s. Collectively their observations suggest that stream location has shifted east approximately 350-400 feet from the mid-1800s to the early-1900s.

Smith (2000) includes a contemporary analysis of the movement of the delta's seaward edge. Aerial photos from 1957 and 1997 suggest that the delta experienced a net seaward growth of approximately 250 feet over this 40 year period. Erosion is evident immediately west of the delta front during this same time period (Todd et al. 2006). Todd et al. suggest that the delta front retreated from 1926 to 1955 and then advanced from the 1950s to the 1990s. Smith concluded that logging and associated road building activity in the Deep Creek watershed have resulted in accelerated sediment delivery and transport to the channel, influencing sediment characteristics and dynamics in the lower Deep Creek and at the delta.

Development around the delta is limited to a series of dirt paths and roads that service a primitive private camping and picnicking area. The roads and paths lie on the surface of the delta. Very limited upper elevation salt marsh and transitional vegetation are apparent on both sides of the mainstem of Deep Creek along the delta. In recent years a large logjam has developed downstream of the SR 112 bridge, adding habitat complexity. Todd et al. (2006) concluded that the Deep Creek estuary and nearshore habitat were "moderately impaired" based on sedimentation impacts from upstream sources and the effects of roads on and near the delta.

5.5.2 Habitat Connectivity

Waterfalls, cascades, log jams, and steep gradients limit anadromous fish distribution and habitat utilization in the Deep Creek subbasin. A comprehensive road crossing inventory has not been conducted within the watershed. There are no documented road-related fish barriers in the watershed analysis. However, Smith (2000) mentions two anadromous barriers in tributaries to Deep Creek. An impassible culvert near RM 1.5 in the E.F. Deep Creek blocks about 0.5 miles of steelhead and cutthroat habitat. This impassible culvert was removed during the winter of 2008/09. A logjam near RM 1.5 in the W.F. Deep Creek blocks about 1.5 miles of coho, steelhead, and cutthroat trout habitat.

A natural barrier at RM 4.4 is considered the upper extent of anadromous fish use in the mainstem. The upper extent of anadromous fish use in smaller tributaries to Deep Creek are presumed to be limited by geological features, stream flow, and stream gradient (De Cillis 2002).

5.5.3 Spawning and Rearing Habitat Conditions

De Cillis (2002) concluded that increased sediment loading combined with the loss of scour elements (e.g., reduction in LWD size and volume), have significantly reduced the number of pools, pool depth, and the complexity of habitat types, reducing the amount of rearing habitat for juvenile salmonids. He also noted that sediment inputs from mass wasting and surface erosion are part of the natural processes in the watershed. The Deep Creek subbasin is susceptible to landslides and debris flows following natural disturbance (e.g., fire, large precipitation events). Peak mass wasting periods in the Deep Creek subbasin occurred in the 1940s and 1990s following intensive land disturbance (logging) activities (McHenry 2002).

Channel responses such as channel widening, aggradation, migration and avulsion can occur during periods of increased mass wasting frequency. Channel responses can be very dramatic; for example, Shaw (1995 *in* McHenry 2002) describes the impacts of the November 1990 landslide in Deep Creek:

> The ensuing debris flow traveled approximately 2 stream miles, burying the USFS 30 road crossing and temporarily damming water flow in the upper main channel of Deep Creek. . . . Where the channel makes a 90 degree turn to the west, the debris flow super-elevated around the bend tossing material approximately 100 feet out of the channel. The debris dam broke some hours later and released a flood wave that traveled to the vicinity of Gibson Farm, some 4.5 miles downstream, before losing momentum in the lower-gradient alluvial reaches. The dam-burst flood scoured the main channel to as much as 10 feet vertical depth, tossing old growth logs outside of the active channel margins.

McHenry et al. (1995) report that channel widening and aggradation from the 1990 landslides in Deep Creek resulted in a visible increase in channel width of 2 to 3 times when comparing the 1971 and 1992 aerial photo records. The aerial photo observation was corroborated through analysis of channel conditions from bulk samples of the channel bed and measurements of pool depth and channel widths and depths in 1992 (McHenry 2002). Benda (1999 *in* McHenry 2002) found evidence of several discrete sediment waves associated with repeated logging entries into the watershed. Aerial photos comparing gravel bars in the lower 2 miles of Deep Creek from 1964 to 1997 support the contention that channel sedimentation increased from the 1930s to the 1960s, followed by a sediment wave in the 1990s. The 1990s sediment wave was associated with landslides generated from USDA Forest Service road building and clearcut timber harvesting (McHenry 2002).

The Deep/Twins Watershed Analysis summarizes several years of data collection for these three subbasins. Over 26 miles of fish habitat surveys were conducted in 1992, 1998, and 1999 using Region 6 Level II stream inventory protocols (De Cillis 2002). Habitat surveys were conducted in the mainstem Deep Creek and portions of the East and West forks 1992. The mainstem was surveyed again in 1999. The watershed analysis uses mainstem data collected in 1999 and 1992 for the East and West forks. Basic habitat parameters are summarized in Table 28

Table 28. Reach summary habitat conditions for the Deep Creek subbasin (Modified from De Cillis 2002).

Stream Reach	Length (Mi)	Total LWD/Mi	Percent Pools	Percent Riffle	Pools per Mi.	Pools>3 ft/mile	Resid. Pool Depth (ft)	Width to Depth Ratio	Channel Widths per Reach
Deep Creek 1	2.4	223	71	29	20.2	13.5	3.7	39.5	248.8
Deep Creek 2	1.3	213	73	27	21	12.8	3	29.6	119.8
Deep Creek 3	1	116.7	35	65	23	4.2	2	24.8	92.1
Deep Creek 4	0.7	70.4	39	60	31	25.3	3.4	25.1	64.5
Deep Creek 5	1.8	154	15	82	18	3	2	28.4	165.9
Deep Creek 6	1.4	71.5	6	90	17	5.1	2.3	15.9	129
E.F. Deep Creek 1	1.1	262.5	33	60	55.5	1	1.2	14	166.7
W.F. Deep Creek 1	2.3	392	55	45	75.6	12	1.9	14	666

General habitat ratings for all five stream reaches inventoried are included below in Table 29. Deep Creek rated poor for key piece frequency in all 6 reaches. In Deep Creek 2 reaches rated good for LWD frequency and percent pool, 2 rated fair, and 2 rated poor. Holding pools were good in 1 reach, fair in 2 reaches, and poor in 3 reaches. Gravel quality was rated poor 2 reaches, fair in 1 reach, and good in all other reaches. No habitat conditions were rated good in the East or West Forks.

Table 29. Rating of habitat indices, Deep Creek subbasin (source: De Cillis 2002).

Stream Reach	Segment ID	Key Pieces	Total LWD	Percent Pools	Pools Freq.	Holding Pools	Gravel Quality	Migration Barriers
Deep Creek 1	6802-3	Poor	Good	Good	Poor	Fair	Poor	None
Deep Creek 2	6804-5	Poor	Good	Good	Poor	Fair	Poor	None
Deep Creek 3	6806	Poor	Fair	Fair	Poor	Poor	Good	None
Deep Creek 4	6807, 7339	Poor	Poor	Fair	Fair	Good	Good	None
Deep Creek 5	7340 - 42	Poor	Fair	Poor	Poor	Poor	Fair	None
Deep Creek 6	7343 - 45	Poor	Poor	Poor	Poor	Poor	Good	Possible
E.F. Deep Creek 1	6835	Fair	Fair	Poor	Fair	Poor	Poor	None
W.F. Deep Creek 1	6882 - 85	Fair	Poor	Fair	Fair	Poor	N/A	None

Spawning gravel quality data were collected in lower Deep Creek and in the East Fork Deep Creek by the Lower Elwha Tribe. McHenry et al. (1995) summarize spawning gravel samples collected in 1991 (n=6), 1992 (n=30), and in 1993 (n=20). In the mainstem, at RM 0.4 fine sediment levels (<0.85mm) were 20, 17.6, and 17.8 percent in 1991, 1992, and 1993 respectively. At RM 1.4 fine sediment levels were 22.8 and 18.3 in 1992 and 1993. The East Fork Deep Creek was sampled in 1991 and had 28 percent fines less than 0.85 mm.

5.5.4 Floodplain and Riparian Habitat Conditions

Riparian conditions in the Deep Creek subbasin were evaluated as part of the Deep Creek and East Twin and West Twin Rivers Watershed Analysis. Riparian conditions in the Deep Creek watershed have been impacted by human activity since the late 1800s (Toal 2002). Most of the watershed has been impacted by timber harvest and road and railroad construction. Hardwoods have always been a component of the riparian forests along the mainstem and large tributaries; however, the present stand composition shows a greater ratio of hardwoods to conifers, and in younger seral stages. Historical riparian forests supported large conifers, especially Sitka spruce, Douglas fir, and western red cedar (Toal 2002). Current riparian stand conditions indicate higher percentages of small conifer and hardwoods.

Riparian stands in the Deep Creek watershed are predominately composed of young conifers and red alder, however, remnant stands of mature and old growth conifers still exist, but are fragmented and limited in width (Toal 2002). Toal concluded that the watershed has been used heavily for timber production and that the existing riparian conditions reflect past land use practices.

The watershed analysis inventoried riparian conditions and LWD recruitment potential along the mainstem (lower, middle, upper, and above the E.F. Deep Creek), the W.F. Deep Creek and the E.F. Deep Creek. Within the E.F. and W.F. Deep Creek, LWD recruitment potential was rated low or moderate along 63.1 and 72 percent of the stream length respectively (see Table 30). For the lower, middle, upper, and above the East Fork mainstem Deep Creek, LWD recruitment potential was rated low or moderate along 78.2, 63.2, 61.4, and 86.8 percent of the stream length, respectively. Detailed riparian shade evaluations were also made and are available in the watershed analysis synthesis module (USDA FS et al. 2002).

Table 30. Deep Creek subbasin LWD recruitment potential as a percentage of riparian length (modified from Toal 2002).

Stream Drainage/Segment	LWD Recruitment Potential as a Percentage of Riparian Length					
	Right Bank			Left Bank		
	Low	Moderate	High	Low	Moderate	High
Deep Creek Lower	52.4%	18.8%	28.8%	58.9%	26.3%	17.3%
Deep Creek Middle	0.0%	61.0%	39.3%	4.2%	61.0%	34.9%
Deep Creek Upper	54.5%	0.0%	37.5%	68.3%	0.0%	31.7%
Deep Creek Above E.F	75.1%	11.7%	13.2%	75.1%	11.7%	13.2%
Deep Creek West Fork	11.7%	60.0%	28.3%	11.7%	42.8%	45.5%
Deep Creek East Fork	32.0%	34.9%	22.9%	42.2%	34.9%	22.9%

McHenry (2002) notes that very little channel alteration (e.g., riprap, diking) has occurred within the watershed. The only known channelization efforts in the Deep Creek subbasin occurred in Gibson Creek. Gibson Creek was cleaned of LWD and straightened, and low dams were built to supply water for agriculture (McHenry 2002). Channel incision of up to 10 feet following the dam-break flood event in 1990 has disconnected portions of the mainstem from the floodplain and altered floodplain processes in the Deep Creek subbasin.

5.5.5 Water Quality Conditions

Water quality conditions in the Deep Creek subbasin have changed over time due to altered watershed processes (Stoddard and De Cillis 2002). Watershed processes have been altered from natural and human induced disturbances; at the long-term, prehistoric scale; large, stand replacing fires occurred in 1308, 1508, and 1701 (Stoddard and De Cillis 2002). Stand replacement disturbance events would have resulted in increased surface erosion and mass wasting, substantially increasing sediment supply to the channel network. In addition, loss of riparian forests and canopy cover over streams can cause an increase in solar radiation to surface waters elevating stream temperatures. Human activities such as land clearing, clearcut timber harvest, and road construction can affect water quality at scales similar to prehistoric stand-replacing fires.

Stream Temperature

Very few temperature data were summarized for Deep Creek as part of the watershed analysis. Deep Creek daily average temperature ranged from 14.1 to 10.8ºC (Table 31). The coolest stream temperatures occurred at the highest upstream site at RM 6.5. The warmest temperatures were recorded at the lowest downstream site at RM 3.0. In 2001 stream temperature exceeded 16ºC on 3 days.

Table 31. Summary of stream temperature data collected in the Deep Creek subbasin (from Stoddard and De Cillis 2002).

Stream	Site Location (RM)	Sampling Period	Avg. Daily Max. TempºC	Avg. Daily Min. TempºC	Max Temp. and Date	No. Days 16-18ºC	No. Days >18ºC	Percent Canopy Cover
Deep Creek	3.0	6/27/01 - 9/13/01	14.1	11.3	16.3, 7/24	3	0	Not measured
Deep Creek	6.5	6/26/01 -	10.8	9.9	12.3, 8/12	0	0	Not measured

Stream temperature data for Deep Creek were collected in 1992 at RM 0.25 and 2.5, and at RM 0.04 in the East Fork Deep Creek (Schuett-Hames and Malkin 1993 *in* Stoddard and De Cillis 2002). The data indicated that water temperatures exceeded State temperature criteria for all three sites on several days. WDOE concluded that the warm water temperatures observed in 1992 were an artifact of unusually warm weather (1.5 to 1.6ºC above average) and unusually low streamflow (Stoddard and De Cillis 2002).

Stream temperature data were also collected by the Lower Elwha Tribe from 1996 through 2000 at various sites in the mainstem and the East and West Forks Deep Creek. A total of 858 site-days of daily average stream temperature data indicate average daily stream temperature was 13.1ºC; maximum daily average was 18.0ºC. Daily average temperature exceeded 15ºC approximately 9 percent of the time. Maximum daily temperature data are only available for 293 site-days. Maximum daily temperature equaled or exceeded 16ºC on 42 days. Temperatures equal to or exceeding 16ºC were observed in all years monitored suggesting that elevated stream temperatures are common in Deep Creek. Currently three segments of Deep Creek are listed on the State's 303(d) List.

Dissolved Oxygen

Dissolved oxygen data have only recently been collected in Deep Creek. From 2004 through 2008, a total of 41 DO measurements were taken (EIM Database, accessed May 2008, http://www.ecy.wa.gov/eim/). All sampling (occurs monthly) took place at one site near the confluence with the SJF. Results to date have ranged from 9.1 to 13 mg/L, averaging 11.2 mg/L. The data show a clear seasonal trend with lower DO levels during summer months and significantly higher DO levels in late-fall and winter months.

Macroinvertebrates

The USDA Forest Service collected macroinvertebrate samples from sites on Deep Creek, RM 0.2 and 3.0 in 1999. The results from this sampling were inconclusive. A BIBI survey was conducted in 2004. Data were collected at two sites on Deep Creek. The lower site was located near river mile 0.9. The upper site was located near RM 1.4 (Tetra Tech/KCM 2005). The upper site had a BIBI score of 46, which rated as "healthy." The lower site had a BIBI score of 44, which rated as "compromised" (Tetra Tech/KCM 2005). Interestingly the scores at the upper and lower sites for the East and West Twin rivers and Deep Creek were exactly the same.

Sediment

The lower 3.7 miles of Deep Creek are listed on the Washington State 303(d) list for fine sediment in spawning gravel. Listing data are described in Section 5.5.3.

5.5.6 Hydrologic Conditions

Summer-time stream flows within the Deep Creek subbasin are quite low. Washington State Department of Ecology (DOE) continuous stream flow monitoring in Salt Creek began during the summer of 2004. Four years of data collected in July, August, and September for water years 2004, 2005, 2006, and 2007 indicate that average streamflow was 6.9 cfs, 7.0 cfs, 4.0 cfs, and 10.5 cfs respectively. Low flow streamflow data for Deep Creek and the Twin Rivers indicate that average summer lows are about 35 percent higher in Deep Creek than in the East and West Twin Rivers.

EES Consulting (2005) reported that, based on physical habitat simulation (PHABSIM) modeling work conducted in Deep Creek, fish habitat requirements exceed existing year-round flows. Figure 83 depicts synthesized dispersed stream flow duration curves for Deep Creek at the confluence with the Strait. Stoddard (2002) estimates that annual average discharge for Deep Creek is 66 cfs. Annual peak flows measured at the DOE Deep Creek gage for WY 2005 through 2007 were 1,210, 896, and 1,000 cfs.

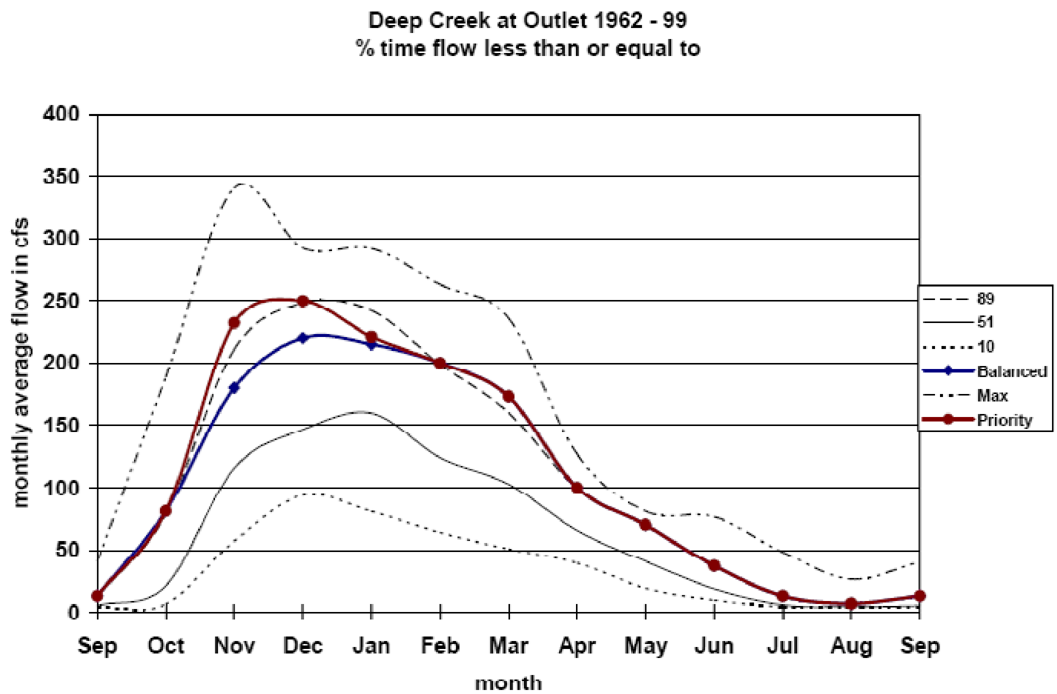

Figure 87. Deep Creek at confluence with Strait, synthesized annually (1962-1999) dispersed flow duration curve (source: EES Consulting 2005).

5.5.7 Funded and/or Implemented Restoration and Protection Projects

The list below includes a detailed inventory of restoration projects implemented or funded in the Deep Creek subbasin from 1997-2010.

- Comprehensive in-channel treatments-
  - Between 1997 and 2002 LWD and rock were placed in an attempt to convert a 3 mile plane-bed reach into a forced pool-riffle reach. Over 1,500 individual pieces of LWD have been used to form log revetments, engineered log jams, constructed log jams, deflectors, log weirs, and rock/log structures (Lower Elwha Tribe)

    - In 2004 and 2005 restoration work focused on lower Deep Creek (RM 0-1.3). Large, complex logjams, including channel spanning jams were constructed at 23 locations.
    - Sampson Creek, 0.5 miles of channel received in-stream LWD restoration treatments.
    - Gibson Creek, 0.4 miles of channel received in-stream LWD restoration treatments.
    - W.F. Deep Creek, 50 LWD placement sites between river mile 0.0-1.0 by helicopter (2007, Lower Elwha Tribe).
- 2.5 miles of riparian forest vegetation improvements have been completed (date unknown, Lower Elwha Tribe). Riparian treatments have included manipulation of existing stands to promote the growth of conifer-dominated riparian stands
- Four off-channel , over-wintering habitat projects have been implemented (date unknown, Lower Elwha Tribe)
- Road maintenance and abandonment work were completed on some hazardous road segments within the watershed (1999-2001; USDA FS).
- A recently completed NEPA analysis of the entire 3040 road system concluded that significant portions (~30 miles) of the road system should be decommissioned. Project implementation to remove the remaining 11 miles of road system in the Twin rivers and Deep Creek subbasins is underway (funded 2006; USDA FS and NOSC).
- Deep Creek restoration work (date and specifics unknown, Clallam Conservation District).

5.6 PYSHT RIVER

Habitat conditions and limiting factors for the Pysht River subbasin are described and summarized in several technical reports including:

- Early Days at Pysht (Hall undated)
- Watershed Characteristics and Conditions Inventory: Pysht River and Snow Creek (Jones and Stokes 1991)
- Spawning Gravel Quality, Watershed Characteristics and Early Life History Survival of Coho Salmon and Steelhead in five North Olympic Peninsula Watersheds (McHenry et al. 1994)
- Riparian and LWD Demonstration Projects in the Pysht River, Washington (1992-1996; McHenry and Murray 1996)
- WRIA 19 Limiting Factors Report (Smith 2000)
- Pysht River Floodplain Habitat Inventory and Assessment (Haggerty et al. 2006)
- NOPLE Salmon Habitat Recovery Strategy (NOPLE 2004)
- Historical Changes to Estuaries, Spits, and Associated Tidal Wetland Habitats in the Hood Canal and Strait of Juan de Fuca Regions of Washington State (Todd et al. 2006)

Key or major limiting factors include:

- Sedimentation from road network and mass wasting events
    - Increased fine sediment levels in spawning gravel
- Loss and/or lack of large woody debris resulting in decreased pool habitat formation and channel complexity. Loss of in-channel wood also contributes to channel instability through incision processes.
- Conversion of native conifer forest to open areas or hardwood-dominated riparian areas. This has also resulted in decreased shade levels which in turn have impacted summer stream temperatures.
- Floodplain development from roads and other infrastructure have altered habitat forming processes.
- Loss of habitat connectivity; human caused barriers have significantly reduced the quantity of habitat available for spawning and rearing
- Estuary impacts of reduced the quantity and quality of estuary habitat available for rearing.

Harvest and hatchery practices are currently not considered major limiting factors to salmonid populations in the Pysht River subbasin. A summary of habitat conditions and limiting factors are included below in Sections 5.6.1 through 5.6.6

5.6.1 Estuary and Nearshore Conditions

The Pysht River enters the Strait immediately east of Pillar Point. The Pysht River estuary complex includes the lower river, an associated tidal marsh and estuarine channel complex, large unvegetated tidal flats, and a north-south orientated spit. The Pysht River estuary complex is the largest tidal marsh system in WRIA 19 (Todd et al. 2006). There is a long history of attempts to settle and cultivate the mouth of the Pysht River. The 1864 GLO survey includes a description of two settlers who attempted to settle the area in 1862, but one was killed by local Indians and the other fled. By the late-1870s most of the tidal marsh area was being cultivated, presumably used as pasture (Shoecraft 1877 *in* Todd et al. [2006]). Todd et al. describe in great detail the history of changes and alterations to the Pysht River complex. They concluded that the Pysht River estuary and nearshore habitat conditions were “severely impaired” based on the loss and/or alteration of half of the historical tidal marsh. Below is a brief summary of the primary alterations that have occurred within the estuary complex.

Aerial photos only extend back to 1951 for this area, so pre-development conditions in the estuary are not well documented. A hand drawn map from 1877 (GLO 1877), shows little change in the general channel pattern in the estuary; however the map lacks sufficient detail to assess changes. A recently discovered topographic survey of the 1915 Pysht estuary has revealed detailed information on the pre-impact condition of this area. The primary impacts to this area resulted from historical water based log transport. The most significant impacts were associated with dredging and channelization of the estuary and lower Pysht (below RM 1.5). These impacts are currently being assessed in detail under the Pysht Estuary Restoration Engineering Assessment Project (SRFB).

Beginning in the mid-1910s, suction dredges were used to deepen the channel to stage logs for marine transport by rafts. Dredge deposits were apparently discharged into tidally flooded marsh lands which were ultimately converted to agricultural lands (Hall undated). Clam shell dredging also was conducted in the vicinity of RM 0.5, and a large spoils pile was deposited along the south bend of the first large river meander. This deposit is approximately 600 m in length, 60 m in maximum width, and up to 13 m high, and has disconnected a portion of the estuary from the lower river Figure 88). In addition there are also more dredge spoils located downstream and upstream of those described above. These spoil piles are more discontinuous and characterized by a much smaller volume and footprint. However, these deposits also disconnect what appear to be historically connected estuarine channels and wetlands. They are located along the right bank from RM 1.75 (southwest corner of Figure 88 to the northeast corner) downstream to RM 0.

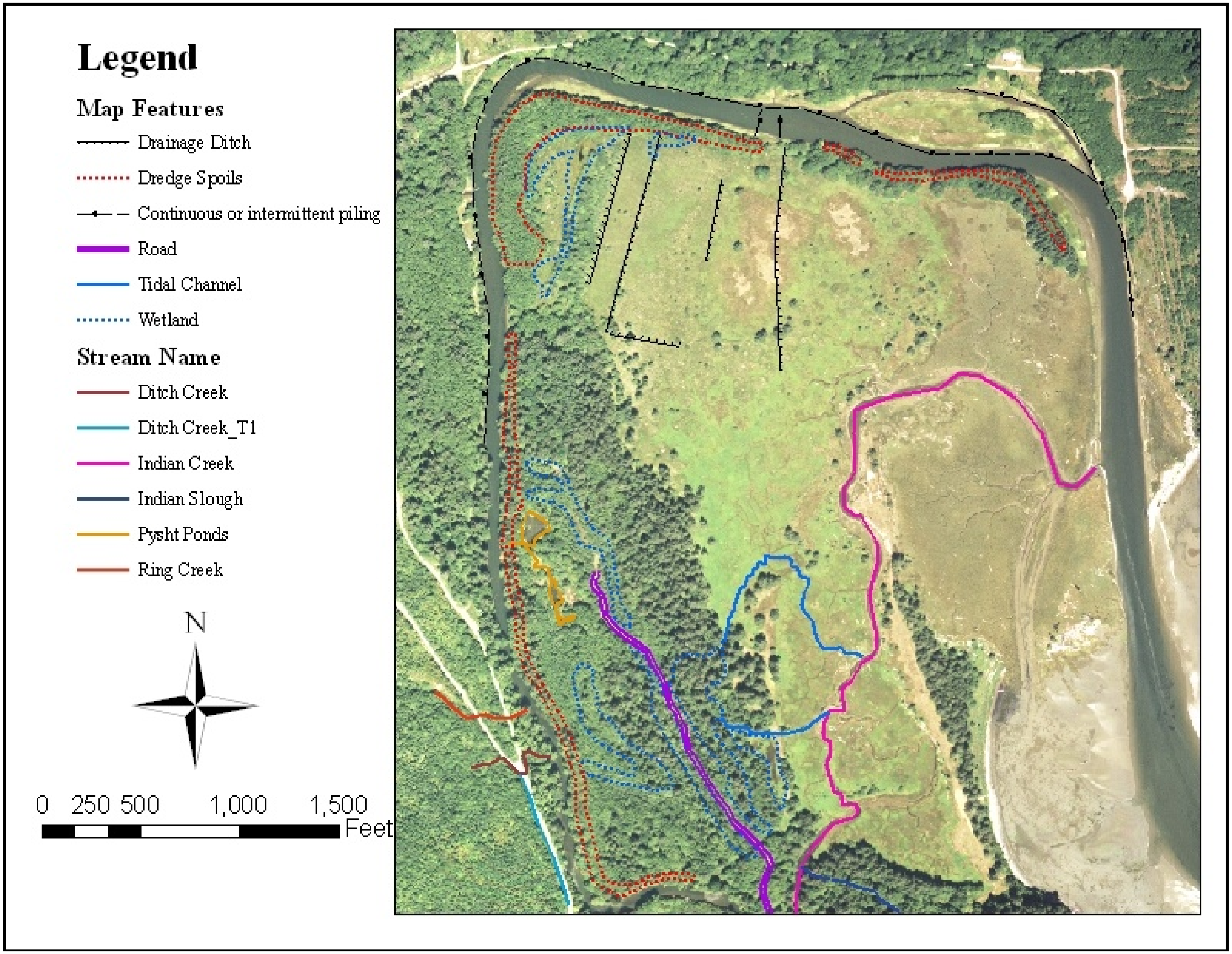

Figure 88. Map depicting streams and development features in the lower Pysht River and estuary (source: Haggerty et al. 2006).

The lower river has also been channelized by driven log piling. Most log piles are located along the left bank of the river from RM 0 to RM 1.0. There are also piling located mid channel in the lower 0.5 miles of the river. Log pilings placed in several locations in the estuary have resulted in decreased channel migration and bank erosion, which in turn has decreased LWD recruitment and perpetuated simplification of habitat in the estuarine portion of the lower Pysht River. Additional habitat alterations include road construction that has filled and disconnected wetland habitats. Road construction through wetlands was not conducted with consideration for fish passage to the mainstem or between fragmented wetland habitats.

5.6.2 Habitat Connectivity

No comprehensive basin wide fish passage assessment for the entire Pysht River subbasin has been completed. Partial surveys of stream crossings and fish passage barriers in the Pysht watershed are included in road maintenance and abandonment plans (RMAPs), and in the WDFW culvert inventory database. Haggerty et al. (2006) completed a systematic inventory of all road-related fish blockages along the floodplain of the Pysht River. However, this inventory did not include the larger tributaries to Pysht River.

Haggerty et al. (2006) inventoried a total of 45 stream crossings. Stream crossings were divided into three categories: bridges, hardened/removed stream crossings, and culverts. A total of 37 (82%) stream crossings were culverts. Five (11%) stream crossings consisted of either previously-removed fill with a natural streambed, or a hardened crossing where a portion of the fill was removed but the channel flowed across part of the old road prism, or rocks placed across the crossing. The remaining three stream crossings were all bridges. With the exception of one stream crossing, all of the bridges and hardened crossings were properly functioning and 100 percent passable for both adult and juvenile salmonids. Of the 37 culverts, 35 were included in the comprehensive culvert inventory and two culverts were only surveyed as part of the floodplain habitat inventory. Both of these culverts were complete barriers to juvenile and adult salmonids.

A total of 29 of the 37 (78%) culverts were classified as partial or complete barriers. Only 9 (24%) culverts were classified as 100 percent passable and of these, only four were considered properly functioning. In all 34 out of 37 (92%) of the culverts were either partial or complete fish barriers and/or not properly functioning (undersized, blocking tidal exchange, or preventing natural sediment and LWD transport). Culverts were estimated to represent barriers (partial or total) to almost 53 percent (8.1 mi; 12.9 km) of the total length of floodplain habitat.

Haggerty et al. (2006) identified 74.9 acres of fish bearing wetlands along the Pysht River floodplain. Only 29 percent of this habitat was classified as 100 percent accessible to fish; just over 27 percent of the habitat is upstream of culverts classified as 0 percent passable. Over 21 percent of the wetland area is downstream of culverts or in systems without culverts; therefore only 8 percent of the off-channel wetland habitat area upstream of culverts was classified as 100 percent accessible.

Haggerty et al. (2006) identified several different types of habitat alterations that were a result of poorly designed and placed culverts. Several culverts that were undersized and improperly placed acted to alter sediment and LWD transport, disconnect the tidal prism of the lower river from floodplain tributaries, cause downstream erosion through accelerated velocities and outfall drops, and cause backwater flooding and habitat disconnection. Where altered sediment and LWD transport were identified due to culverts, there was also a measurable loss of habitat. At one site (Ring Creek) a large sediment wedge developed upstream of the culvert which was placed several feet above the natural streambed elevation. This resulted in the stream flow traveling subsurface through the sediment deposit for approximately 30 m (98 ft). Disconnection of the tidal prism as a result of culvert elevations was observed at two sites. In another case (Indian Creek) undersized culverts caused the roadway to be overtopped by the stream, causing significant downstream erosion and deposition, which in turn altered the tidal stage influence on upstream habitat, resulting in a net loss of estuarine habitat.

5.6.3 Spawning and Rearing Habitat Conditions

No watershed analysis or basin scale assessment of fish habitat conditions has occurred in the Pysht River subbasin. However, a large quantity of habitat data were collected in the early 1990s and are summarized in McHenry and Murray (1996). They assessed riparian and select stream features in approximately 27.5 miles (35 km) of the Pysht River and its largest tributaries. A summary of these data and existing habitat conditions are described below.

Pool Conditions

McHenry and Murray (1996) collected 13.7 miles (22 km) of pool habitat data in seven Pysht River tributaries. Habitat surveys were conducted during the low flow period of 1993. They found that pool habitat, measured as percent area, was highly variable across the watershed. Pool depths were fairly homogenous within the surveyed streams. The majority of pools were less than 1 meter deep. McHenry and Murray suggest that the distribution of LWD strongly influences pool formation and the quality of pools. When LWD was absent, pools were either not present or other channel features contributed to pool formation. They found that streams with a very high percent of pools also had the highest levels of instream LWD. A summary of select stream and pool habitat measurements for Pysht River tributaries is included in Table 32.

Table 32. Summary of select stream and pool habitat measurements for Pysht River tributaries (McHenry and Murray 1996).

Stream Name	Location (RM)	Gradient (%)	Percent Pools	Avg. Max Pool Depth (M) w/ Range	Bankfull Width
S.F. Pysht River	RM 0-8.7	0.5-4.5	42.8	0.82 (0.62-2.0)	14.2
Needham Creek	RM 0-2.0	1.5-3.5	40.8	0.60 (0.36-0.75)	7.7
Salmonberry Creek	RM 0-0.8	1.5-3.0	25	0.68 (0.61-1.0)	11.2
Middle Creek	RM 0-0.4	2.0-3.5	17.9	0.64 (0.55-0.80)	8.9
Green Creek	RM 0-1.1	1.0-2.5	57.3	0.64 (0.50-0.92)	8.8
N.F. Green Creek	RM 0-0.6	0.5-3.0	86	0.55 (0.48-0.64)	8.8

Large Woody Debris

McHenry and Murray (1996) measured a total of 3,431 individual LWD pieces greater than 0.30 cm diameter and 7,132 pieces of LWD between 10 and 30 cm diameter in ten tributaries and the mainstem Pysht River. The average diameter and length of measured pieces (>30 cm diameter and >2 m length) in each tributary was generally less than 35 cm diameter and 5 meters length. Five of the ten streams surveyed had no LWD pieces with diameter greater than 35 cm. The number of LWD pieces per 100 meters of channel ranged from 2 to over 60, averaging approximately 30. LWD volume averaged less than 35 m^3/100 m for all streams within the Pysht River subbasin. McHenry and Murray note that the average LWD volume was less than half that found by Grette (1985) for streams in old-growth forests on the Olympic Peninsula.

More than 50 percent of the LWD load found in the Pysht River by McHenry and Murray (1996) was derived from deciduous sources. They characterize the distribution and quality of LWD in the Pysht River subbasin as highly decayed and distributed along the channel margins. They found that less than half of the LWD contacted the low-flow channel. They attributed the distribution along the margin of the channels to the fact that most LWD was small and easily pushed to margins of the channel during high water. The reduced LWD loading observed by McHenry and Murray (1996) is at least partially attributable to lost recruitment potential of the riparian forests due to degraded riparian conditions (see Section 5.6.4). Large woody debris was actively removed from many portions of the mainstem and in larger tributaries. Historical documentation of LWD removal is very limited and or difficult to obtain. During the early 1950s the WDF stream clearance unit was active throughout WRIA 19 and wide-spread systematic removal of LWD was common (see Kramer 1952a, 1952b).

Spawning Habitat

Channel stability and fine sediment levels in spawning gravels are the two primary factors that affect spawning habitat quality in the Pysht River subbasin. A study conducted from 1989 to 1991 found large stream bed elevation and channel form shifts in the mainstem Pysht River (Ralph *in* Smith 2000). During the study it was determined that significant channel aggradation occurred at 15 of the 27 sites monitored. McHenry et al. (1994) note that they observed significant bed aggradation and degradation, and accompanying channel changes following storm events. Egg basket studies conducted by McHenry et al. (1994) in Pysht River tributaries found that significant channel instability occurred during their study. A total of 45 egg baskets were placed in spawning gravels and 13 (30%) were lost during high water events. McHenry et al. (1994) concluded that "Channel instability appears to be a significant limiting factor for the early life history of salmonids."

Smith (2000) suggested that the cause of the channel instability problem in the Pysht River subbasin is likely a combination of low LWD levels and excess sediment within the channel network. McHenry et al. (1994) suggest that the primary sources of excess sediment within the watershed are roads and mass wasting. In 1993 a sediment budget was developed for the Green Creek subbasin and it was determined that 90 percent of the mass wasting-derived sediment delivered to the system during the preceding four decades are stored in the valley floor (Benda 1993 *in* Smith 2000).

The level of fine sediment (<0.85 mm) in spawning gravel can significantly affect egg-to-fry survival. At high levels (>13%) a threshold condition exists, above which survival dramatically decreases (McHenry et al. 1994). High levels of fine sediment were found in spawning gravel throughout the Pysht River subbasin. Fine sediment levels in the mainstem ranged from a high of 22.6 percent (RM 3.5) to a low of 13.4 percent (RM 14.7). Fine sediment levels in spawning gravel in tributaries ranged from 22.3 percent in Salmonberry Creek to 13 percent at RM 4.8 in the S.F. Pysht River. A complete summary of fine sediment levels in spawning gravel is included in Table 33.

McHenry et al. (1994) determined that fine sediment levels are consistently higher in watersheds that have been managed for timber harvest than in unlogged watersheds on the Olympic Peninsula and that this relationship appears consistent regardless of differences in watershed geology. They also found that coho salmon egg-to-alevin survival was extremely poor in the Pysht River subbasin.

One interesting fact in the study conducted by McHenry et al. (1994) was that they found high levels of sediment throughout their study area but were unable to correlate the level of fine sediment in spawning gravels (using four size classes of fine sediment and two indices of gravel quality) to either natural or managed watershed characteristics. Haggerty et al. (2009) developed a hypothesis that explains why McHenry et al. (1994) were unable to correlate land management practices with fine sediment levels in spawning gravels. Haggerty et al. suggest that there is a threshold (~50% clearcut and road density > 3.0 mi/mi^2) at which road density and percent watershed clearcut no longer explain the variability between sites within highly disturbed landscapes. When comparing only the most heavily impacted watersheds, no significant relationships between fine sediment levels in spawning gravels and road density or percent of watershed area clearcut could be found in any study conducted on the Olympic Peninsula (e.g. Cederholm et al. 1980; Rittmueller 1986).

Table 33. Summary of fine sediment levels in spawning gravel, Pysht River subbasin (McHenry et al. 1994). Note: samples collected summer 1991; samples processed using gravimetric methods (dry-sieve) and then converted to volumetric equivalents (wet-sieve).

Stream Name	Location (RM)	No. of Samples	Percent Fines < 0.85 mm
Reed Creek	RM 1.4	10	21.2
Needham Creek	RM 0.3	10	16.2
Salmonberry Creek	RM 0.4	10	22.3
Middle Creek	RM 0.1	10	19.4
Green Creek	RM 0.8	10	15.3
N.F. Green Creek	RM 0.4	10	18.4
S.F. Pysht River	RM 0.5	10	17
S.F. Pysht River	RM 2.2	10	18.8
S.F. Pysht River	RM 4.8	10	13
S.F. Pysht River	RM 5.9	10	19.1
Pysht River	RM 3.5	10	22.6
Pysht River	RM 5.2	10	15.6
Pysht River	RM 7.2	10	16.6
Pysht River	RM 7.4	10	18.4
Pysht River	RM 9.7	10	15.2
Pysht River	RM 9.7	10	13.4

As noted above, channel stability and fine sediment levels in spawning gravels are the two primary factors that affect spawning habitat quality in the Pysht River subbasin; however the quantity of habitat available can be significantly affected in streams with reduced LWD loading. Significant correlations between the surface area of sediment accumulations and LWD volume have been shown for streams draining old-growth forests in western Washington (Bilby and Ward 1989). Beechie and Sibley (1997) studied streams draining second-growth forests and found no correlation between percent gravel (percent of habitat with dominant gravel substrate, 16-64 mm) and LWD/m, LWD volume/m, or LWD volume/m^2. They speculated that debris volumes within their survey sites may have been too low to see a correlation between percent gravel and LWD debris volumes. In old-growth Alaskan streams, Martin (2001) found that gravel dominance within habitat units increased with both increased LWD frequency and volume. Bilby and Ward (1991) found that streams draining old-growth forests had larger areas of LWD-associated sediment accumulations than those found in streams draining second-growth forests.

5.6.4 Floodplain and Riparian Habitat Conditions

The WRIA 19 limiting factors analysis technical advisory group considered the Pysht River to have the greatest degree of floodplain impacts per stream mile than any other subbasin in WRIA 19 (Smith 2000). Haggerty et al. (2006) assessed Pysht River floodplain habitat between river mile 0.0 and 11.5 to evaluate impacts to salmon habitat productivity within the basin. They found that road and railroad grade construction, road maintenance and protection (e.g. rip-rap), channelization, channel relocation, logging, in-channel wood removal, dredging, homesteading, agricultural development, wetland filling, and rural development have all contributed to floodplain habitat alterations in the Pysht Watershed.

Haggerty et al. (2006) determined that floodplain encroachment by roads was the greatest floodplain impact because roads prevent lateral migration of the river and reduce riparian influence (LWD recruitment, shade). SR 112 contains the greatest length of stream parallel road network and contained more stream parallel length than all roads combined in all four encroachment zones (0-10, 10-20, 20-30, 30-60 meters) evaluated by Haggerty et al. (2006). Road construction and protection, channelization, and wood-removal have affected the river's ability to migrate across the valley, hence decreasing the river's ability to form off-channel habitats now and into the future. Figure 89 depicts floodplain infrastructure within 20 meters of the Pysht River bankfull edge.

In addition to the mainstem floodplain road and infrastructure encroachment, Haggerty et al. (2006) documented floodplain degradation on tributary floodplain habitats. They made no attempt to quantify these impacts at a watershed scale. However, they noted roads and infrastructure encroachment affecting the quality and quantity of habitat in the following tributaries: Lee Creek, Lee Creek_T4, Hamerquist Creek, Rymer Creek, Ditch Creek, Shop Creek, Lost Creek, and Piling Creek. Haggerty et al. observed fish mortalities as a result of floodplain encroachment in Hamerquist, Andis Slough, and Shop Creeks.

Historically, large conifer trees growing adjacent to the banks of the Pysht River provided sufficient shade to moderate stream temperatures and supply LWD. Currently, large stretches of river contain only small riparian zones or none at all along the south side of the stream (from RM 5 to 2.5). McHenry and Murray (1996) assessed riparian conditions, including dominant over- and under-story tree species. They found very little variability in riparian vegetation in the Pysht River. Riparian stands were overwhelmingly dominated by hardwood species (mostly red alder and bigleaf maple). McHenry and Murray describe understory vegetation as dominated by dense mixtures of salmonberry, stink currant, and devils club. They found that less than 5 percent of the riparian areas were dominated by mature conifer forests.

Noxious weed inventories and control projects have been active throughout various WRIA 19 subbasins (CCNWCB 2005, 2006, 2007). The Pysht River floodplain is infested by several species of noxious weeds. Himalayan blackberry, morning glory, reed canary grass, and knotweed are all present within portions of the Pysht River.

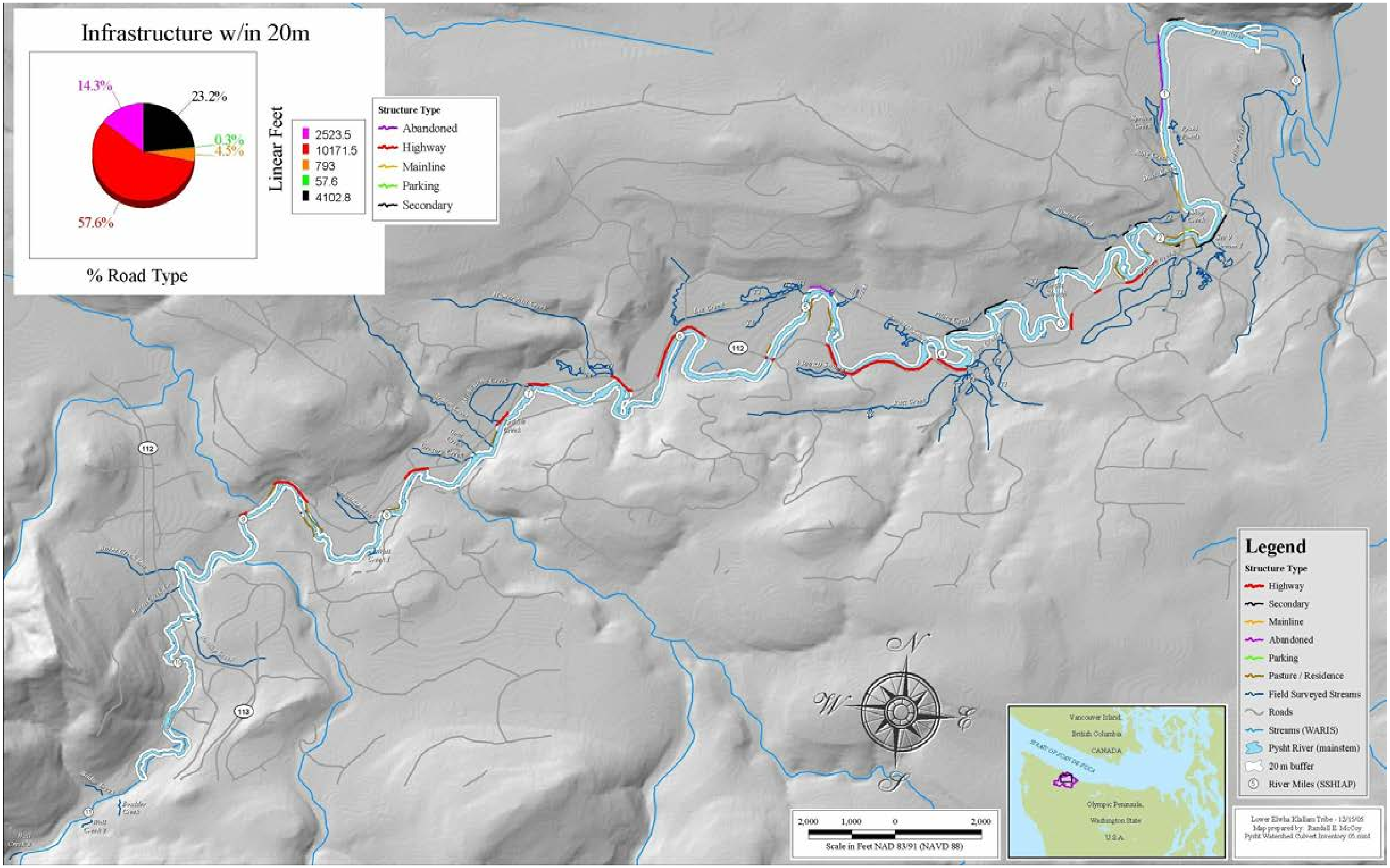

Figure 89. Infrastructure within 20 meters of the bankfull edge of the Pysht River and SSHIAP river miles. (source: Haggerty et al. 2006).

5.6.5 Water Quality Conditions

No watershed analysis or basin scale assessment of water quality conditions has occurred in the Pysht River subbasin. Elevated stream temperature in the Pysht River subbasin has been hypothesized to be a limiting factor affecting salmonids (Smith 2000; Haggerty et al. 2006). Limited stream temperature data collected from the Pysht mainstem in the 1990's suggests that summer temperature conditions were out of compliance with the previous state water quality standard of 16°C, particularly in the lower Pysht River. As described above, a significant portion of the Pysht River floodplain contains infrastructure that has altered the natural river-riparian-floodplain processes. Historically, large conifer trees growing adjacent to the banks of the Pysht River provided sufficient shade to help moderate stream temperatures. Stream reaches with reduced shade levels are a source of increased solar radiation, which has likely increased stream temperatures above their pre-disturbance levels.

Recent stream temperature data collected during the summers of 2005 through 2007 indicate that Pysht River mainstem maximum daily temperature exceeded the State's water quality standard for temperature for all sites, in all years. Stream temperatures were significantly lower in the S.F. Pysht River. In the South Fork, state water quality standards were only exceeded in 2006 and only on some of the reaches studied.

Table 34. Number of days the seven-day average daily maximum (7-DADMax) stream temperature exceeded 16 ºC for the Pysht River subbasin (Unpublished Lower Elwha Tribal Data). Note data are depicted as the number of days where the 7-DADMax exceeded 16 ºC followed by the number of days monitored, followed by the percent of days during monitoring period when threshold was exceeded in parentheses.

Stream Name	Location	7-DADMax Summer 2005	7-DADMax Summer 2006	7-DADMax Summer 2007
Pysht River	RM 2.5	28/44 (64%)	70/75 (93%)	43/93 (46%)
Pysht River	RM 3.5	31/44 (70%)	70/77 (92%)	51/93 (55%)
Pysht River	RM 5.5	25/43 (58%)	57/76 (75%)	21/93 (23%)
Pysht River	RM 7.5	32/43 (74%)	70/75 (93%)	32/92 (34%)
Pysht River	RM 8.0	26/44 (59%)	51/75 (68%)	(11/92 (12%)
Pysht River	RM 9.5	16/43 (37%)	12/75 (16%)	NA
Pysht River	RM 10.5	16/44 (36%)	NA	NA
S.F. Pysht	RM 0.5	14/44 (32%)	14/76 (18%)	NA
S.F. Pysht	RM 1.5	17/43 (40%)	15/76 (20%)	NA
S.F. Pysht	RM 2.0	16/43 (37%)	12/76 (16%	NA
S.F. Pysht	RM 4.0	19/44 (43%)	12/69 (17%)	NA
S.F. Pysht	RM 5.5	0/44 (0%)	NA	NA
S.F. Pysht	RM 6.5	0/43 (0%)	0/76 (0%)	NA
Salmonberry Creek	RM 0.1	19/44 (43%)	15/76 (20%)	NA

Sediment levels in spawning gravel, as well as suspended sediment concentrations are also a concern in the Pysht River. No suspended sediment level or turbidity data have been collected within the Pysht River subbasin. However, fine sediment levels in spawning gravel indicate there is cause for concern regarding sediment levels within the Pysht River subbasin.

A Benthic Index of Biological Integrity (BIBI) survey was conducted in 2004. Data were collected at three sites on the Pysht River. The lower site was located near river mile 4.7 (Note: Pysht River, river miles based on Phinney and Bucknell [1975] river miles), the middle and upper sites were located at RM 6.6 and 9.6 respectively (Tetra Tech/KCM 2005). The upper site had a BIBI score of 44, which rated as "compromised". The middle site had a BIBI score of 38, which rated as "compromised" (Tetra Tech/KCM 2005). The lower site had a BIBI score of 32, which rated as "impaired" (Tetra Tech/KCM 2005).

5.6.6 Hydrologic Conditions

Summer-time stream flows within the Pysht River subbasin are very low, whereas annual peak flows can be very high. No systematic analysis of changes in peak or low flows has been conducted within the Pysht River subbasin. Ample evidence has been collected and reviewed that shows extensive clearcutting and road building has occurred over the past 100 years. Very little old growth forest remains in the watershed and roads have been constructed throughout the entire watershed. The direct impact of alterations to hydrological maturity and road building have not been linked, but indirectly there are several indicators that peak flows have impacted salmon production (Smith 2000).

Washington State Department of Ecology (DOE) continuous stream flow monitoring in the Pysht River began during the spring of 2005. The stream gage is located at the SR 112 bridge (~RM 5.5). Three years of data collected in July, August, and September for water years 2005, 2006, and 2007 indicate that average streamflow was 26, 5.5, and 24 cfs respectively. DOE estimated an instantaneous low flow discharge of 1.1 cfs in September 2006. The DOE instantaneous low flow in 2005 and 2007 were 3.5 and 8.4 cfs. Peak instantaneous flows in WYs 2008, 2007, 2006, and 2005 were 2,330, 1,980, 4,320, and 1,570 respectively.

EES Consulting (2005) reported that, based on physical habitat simulation (PHABSIM) modeling work conducted in the Pysht River, fish habitat requirements are exceeded during winter months. Existing summer flows were required to meet fish habitat needs. Figure 90 depicts synthesized dispersed stream flow duration curves for the Pysht River at the confluence with the Strait.

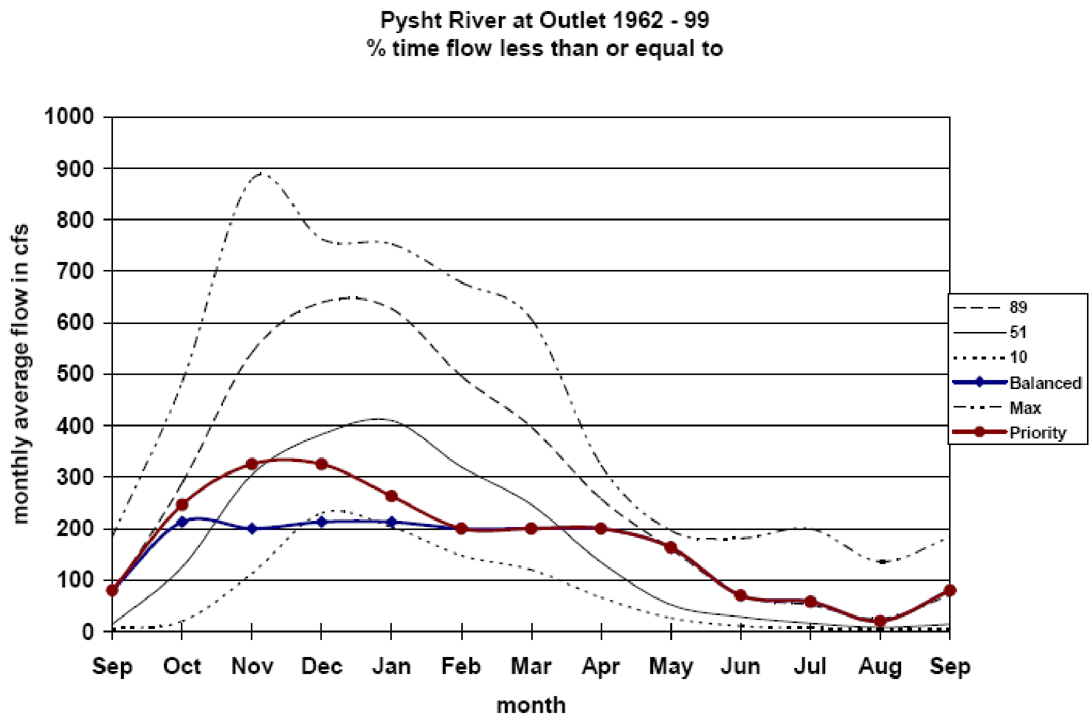

Figure 90. Pysht River at confluence with Strait, synthesized annually (1962-1999) dispersed flow duration curve (source: EES Consulting 2005).

5.6.7 Funded and/or Implemented Restoration and Protection Projects

Extensive habitat restoration has occurred within the Pysht River subbasin. Much more is needed in order to restore habitat conditions to their former level. The list below includes a detailed inventory of recent (~last 20 years) restoration, enhancement, and protection projects implemented or funded in the Pysht River subbasin.

Pysht River Mainstem

- Abandoned 0.5 miles of the 2000 Road that parallels the lower Pysht River (2001; Merrill & Ring (M&R).
  - Fish passage was restored to Spruce Creek opening up one of the most productive fish bearing forested wetlands in the subbasin to fish use.
  - Reed Creek culvert was pulled, allowing for better fish passage and tidal exchange.
- Constructed 6 logjams on mainstem near RM 10.5 to enhance fish habitat conditions (2000; Lower Elwha Tribe).
- Constructed several LWD structures along approximately 200 meters of the mainstem just upstream of SR 113 (Bowlby property). Project was designed to

reduce bank erosion and enhance habitat conditions while protecting private infrastructure within the channel migration zone (2003; NOSC).
- Treated knotweed along the Pysht River, complete description unavailable (2005-2007; CCNWCB, private citizens).
- Pysht River estuary and adjoining lands totaling 900 acres were put into a conservation easement that limits future development and protects current land use into the future (2006; M&R, Cascade Land Conservancy).
- Installation of several LWD structures from RM 10.0-11.5; was completed during the summer of 2008 (Lower Elwha Tribe).

South Fork Pysht Watershed

- S. F. Pysht River LWD treatment and alder conversion experiment (1993; M&R and Lower Elwha Tribe):
    - Seven small patch cuts removed alder to within 10 ft of the ordinary high water mark of the S. F. Pysht (RM 6.8 -8.0).
    - LWD was added to 4 of the 7 sites, a total of 55 pieces of LWD were added to the channel.
- S. F. Pysht River LWD treatment and alder conversion experiment (1996; M&R and Lower Elwha Tribe):
    - One 600 meter long clearcut at RM 5.5 was created on both sides of the South Fork. All hardwoods were removed, an 8-16 meter buffer was left on the south side, the north side was harvested using the 3 meter buffer as in 1993.
    - LWD was added to this site; a total of 80 logs, 35 rootwads, and 50 boulders were used to build structures.
- Constructed S. F. Pysht River off-channel rearing pond in 1990 and enhanced pond by adding depth in 1992 (1992; M&R).
- Constructed 2 ponds in old side-channels of the South Fork (date unknown; M&R).
- Ground based LWD placement in South Fork between River Mile 6.0-7.5. Relocation of ditch into created channel and reconnection with beaver pond and wetlands. (2003; Lower Elwha Tribe and M&R).
- Helicopter placement of 150 pieces of LWD in the South Fork (RM 1.5 to 2.0) and in Salmonberry Creek from RM 0.0 to 1.0 (2004; Lower Elwha Tribe).
- Helicopter placement of 150 pieces of LWD in the South Fork (RM 2.0-3.0) (2005; Lower Elwha Tribe).
- S. F. Pysht River LWD treatment and alder conversion experiment (2005; M&R and CMER):
    - One 800 meter long variable retention harvest unit was created along the southwest side of the South Fork Pysht River near RM 2.8. Hardwood removal near portions of the stream were used to promote conifer growth.
    - LWD was placed along 300 meters of the treatment reach.

Other Pysht River Tributaries

- Constructed an intertidal pond complex in the Pysht River estuary that contains a few hundred meters of low gradient channel and three ponds that provide over 0.5 acres of habitat (date unknown, M&R).
- Replaced partial or complete barrier on Rymer Creek, restoring access to 170 meters of overwintering habitat, 212 meters of 2-4% gradient spawning and rearing habitat, and approximately 365 meters of 4-8% gradient (1999; M&R).
- Created new channel to reconnect the Andis Slough complex with the mainstem Pysht River, providing occasional access to large over-wintering pond and upstream forested wetland complex. Replaced partial or complete culvert barrier on Razz Creek T4 (Razz Creek is also known locally as Fridge, Reefer, and Barn Creek) with a new bridge, improving access to over 500 meters of low gradient spawning and rearing habitat.
- Comprehensive channel restoration in Lee Creek (1999; Clallam Conservation District).
  - Developed stream diversion and overflow structure to route streamflow into newly created, meandering channel.
  - Planted native riparian vegetation along new channel reach.
  - Installed new fish passable culvert on farm road.
- Comprehensive stream restoration of Hamerquist Creek and tributary channel (2005-2007; private landowners, NOSC, PSC):
  - Installed LWD pieces and structures along a 250 meter reach of stream.
  - Built channel spanning logjam to divert all or most of the streamflow into old stream channel to prevent downstream sediment aggradation at the confluence with Tributary 2.
  - Constructed a new channel for Tributary 2 connecting it with the mainstem of Hamerquist downstream of alluvial fan.
  - Under planted red alder dominated riparian zone with conifer species.
- Replaced two partial barrier culverts on Trailer Creek (also known locally as Mossy Rock Creek) with bottomless arch structure. This improved fish access to 0.7 miles of low gradient spawning and rearing habitat and 0.23 miles of 4-8% gradient habitat (2006; WDOT)
- Replacement of 100% barrier culvert on Piling Creek (2008; Lower Elwha Tribe and M&R). This crossing restored fish passage to Piling Creek allowing juvenile salmonids access to a 3+ acre, high quality off-channel wetland habitat.
- New bridge installed on Lost Creek during the summer of 2009. In the past the stream flowed through the ditch and then fanned out across the 2100 Road. The stream was redirected towards the 2100 Road wetland complex. The rerouting of the stream course towards the wetland should provide a significant quantity of water into the wetland complex and reduce surface erosion of the road. In the past the wetland suffered from winter-time dewatering presumably due to lack of surface water inflow (2009; Lower Elwha Tribe and M&R).
- Replacement of partial barrier culvert on Cabin Creek (2014; Lower Elwha Tribe and M & R).
- Replacement of partial barrier culvert on Hamerquist Creek (2012; WDOT).

5.7 CLALLAM RIVER

Habitat conditions and limiting factors are described and summarized in several technical reports including:

- WRIA 19 Limiting Factors Report (Smith 2000)
- Draft Clallam River Watershed Stream Habitat Inventory and Assessment (Haggerty 2008)
- Spawning Gravel Quality, Watershed Characteristics and Early Life History Survival of Coho Salmon and Steelhead in five North Olympic Peninsula Watersheds (McHenry et al. 1994).
- NOPLE Salmon Habitat Recovery Strategy (NOPLE 2004)
- Historical Changes to Estuaries, Spits, and Associated Tidal Wetland Habitats in the Hood Canal and Strait of Juan de Fuca Regions of Washington State (Todd et al. 2006)
- Clallam River Mouth Synthesis Document (Shaffer et al. 2003)
- 2006 Geomorphic Assessment of the Clallam River Mouth (Shellberg 2006)

Key or major limiting factors include:

- Sedimentation from road network and mass wasting events:
    - Increased fine sediment levels in spawning gravel (McHenry et al. 1994)
- Loss and/or lack of large woody debris resulting in decreased pool habitat formation and channel complexity and increased channel instability.
- Conversion of native conifer forests to open areas or hardwood dominated riparian areas. This has also resulted in decreased shade levels, which in turn have impacted summer stream temperatures.
- Floodplain development from roads and other infrastructure have altered habitat forming processes.
- Estuary impacts have reduced the quantity and quality of estuary habitat available for rearing. These impacts may also play a role increasing the frequency and duration of mouth closures.
- Naturally low flows during summer and early fall contribute to high stream temperatures and negatively affect salmonid migrations. The naturally low stream flows are worsened by water withdrawals (Smith 2000).

Other limiting factors:

- Loss of habitat connectivity caused by human-made barriers have reduced the quantity of habitat available for spawning and rearing.

5.7.1 Estuary and Nearshore Conditions

The Clallam River enters the Strait of Juan de Fuca just east of Slip Point, near the middle of Clallam Bay. The river enters the bay through breached segments of a sand and gravel spit. The east end of Clallam Bay is defined by Slip Point, which is composed of erosion resistant marine-derived sandstone and conglomerates (Schasse 2003; Snavely 1993). Wave energy is deflected off Slip Point and directed westerly along the spit, yielding a net shore-drift to the west end of Clallam Bay (DOE GIS drift cell database). The west side of Clallam Bay is defined by an erosion resistant bedrock outcropping which forms Sekiu Point (Schasse 2003). Net shore-drift in this portion of the bay is to the east (DOE GIS drift cell database). The Coho Resort's marina breakwater forms the end of the easterly directed net shore-drift. The beach from Falls Creek to the Coho Resort's marina support surf smelt spawning and the kelp beds just off-shore provide critical rearing habitat for juvenile salmonids, as well as juvenile lingcod. During summer months the kelp beds that extend from Clallam Bay to the mouth of the Hoko River are also important feeding grounds to adult salmon.

The Clallam River spit is defined by the balance between sediment inputs, the volume of sediment stored in the spit, and output or net erosion of the spit (Shaffer et al. 2003). Seasonal variations in the shape and form of the spit, as well as the location of the river outlet are controlled by the balance of sediment transport and deposition from wind, waves, and flooding (Shaffer et al.). Over the last several decades seasonal closures of the mouth have been commonly observed. Seasonal closure of the mouth has been documented by maps from as early as 1934-35 (US Army Engineer Map 1934-1935). Attempts to open the mouth during seasonal closures have occurred frequently during the last 80 years. The first documented attempt to breach the spit is from the 1920s (Todd et al. 2006). Kramer (1952) describes opening the mouth of the river during the low flow season of 1952.

Modifications of the spit and Clallam River estuary complex started in the late-1800s. Todd et al. (2006) report that human modifications in the Clallam River and estuary included logging the lower river corridor, log rafting, and milling activity on the spit. They report that portions of the estuary and lower river were filled and diked, and over the decades a number of structures were built out on the spit or bridging the spit with the mainland. In addition, Shaffer et al. (2003) report that the beaches of Clallam Bay were mined for the construction of roads until the mid-1940s. Todd et al. (2006) were unable to quantify changes between the present and historical tidal marsh and wetland habitat. However, they describe the potential effects to the spit from development associated with the town of Clallam Bay, including filling of intertidal habitat in the early 1900s, residential development in the lower river near the spit, and the long history of building roads and structures on the spit. Shaffer et al. (2003) and Smith (2000) have suggested that the historical tidal prism has been reduced, and is probably among the causes for the greater frequency and longer duration of river mouth closure in recent years and decades.

Large scale juvenile salmonid mortalities in the thousands have been documented when juveniles are unable to emigrate to the marine environment. In 2004, when the Clallam

River became bar bound in May, large scale juvenile mortalities were documented when juvenile salmonids that were attempting to enter the Strait of Juan de Fuca were left stranded on the bar during the falling tidal cycle (Figure 91).

The mouth of the Clallam River closed off during spring of 1998 prior to the majority of salmonid smolts emigration to the Strait. The mouth was opened twice during a two day period and a few thousand juvenile salmonids were observed entering salt water (Carl Chastain, personal communication 2007). Despite efforts to open the mouth, the mouth quickly closed off. Subsequent adult coho returns to the Clallam River during the fall and winter of 1999 were the lowest ever documented despite the aforementioned efforts to allow access to the ocean for at least some of the juvenile salmonids.

For more details on the conditions of the Clallam River estuary complex and nearshore environment please see the following references: Smith (2000); Shaffer et al. (2003), Shellberg (2006), Todd et al. (2006), and Haggerty (2008).

Figure 91. Photograph depicting a portion of the May 2004 fish kill (most of the fish in the picture are coho salmon) at the mouth of the Clallam River (Photo by Jeff Shellberg).

5.7.2 Habitat Connectivity

Haggerty (2008) inventoried anadromous salmonid migration barriers using existing culvert databases and field surveys. Five types of barriers were identified in the Clallam River watershed.

- Impassable waterfalls
- Cascades (partial and complete barriers)
- Beach deposits (seasonally partial to complete barrier)
- Perched logjams (partial barriers)
- Culverts (8 passable, 2 partial, and 6 complete barriers)

The most significant quantities of habitat blocked to anadromous fish migration/ emigration were associated with beach deposits, waterfalls, cascades, perched logjams, and steep gradients (see Figure 92). Culverts hindered access to some anadromous fish habitat but not to the same degree that waterfalls, cascades, and logjams hindered fish passage to useable habitat.

For the size of the drainage basin there are few road crossings in the tributaries within the anadromous fish use zone. Several of the stream crossings that are present are bridges. Haggerty (2008) accessed culvert blockages within the watershed by using existing culvert databases, supplemented with field surveys where necessary. However, field surveys were limited in some portions of the watershed due to landowners denying access to inventory streams and stream crossings. A summary of each barrier culvert is included below:

- Within Swamp Creek (see Haggerty 2008) two total barrier culverts were identified by WDOT and are included in the WDOT culvert database.
    - The first culvert (WDOT #15286) is located at RM 0.59 along an abandoned road grade. The barrier consists of a corrugated metal pipe that is 36.6 meters long and has a gradient of 1.5 percent. There is a 0.45 meter drop at the downstream end of the culvert.
    - Just upstream from the culvert listed above is culvert the SR 112 culvert at RM 0.68, the culvert is a 112 meter long corrugated metal pipe. The pipe is set at a gradient of 3.5 percent and acts as a total barrier to fish migration. Just upstream from the culvert listed above is culvert the SR 112 culvert at RM 0.68, the culvert is a 112 meter long corrugated metal pipe. The pipe is set at a gradient of 3.5 percent and acts as a total barrier to fish migration.
    - Upstream of the second barrier culvert there are 0.63 miles of 2-4 percent gradient habitat. A significant length of stream runs in a ditch parallel to Charley Creek Road

- Within an unnamed tributary to Last Creek (unnamed tributary H; see Haggerty 2008) a total barrier culvert was identified. A 0.75 m diameter, perched culvert (1.7 m), at RM 0.03 blocks all anadromous fish migration. A total of 76 meters of steep (6-12%) habitat is available for potential use upstream of the barrier culvert. A 4 meter high waterfall blocks upstream migration beyond this point.

- A partial barrier culvert limits upstream access in an unnamed tributary (19.0135) to Charley Creek. A 1.6 m diameter, slightly perched culvert (0.1 m) at RM 0.53 partially blocks anadromous fish migration. The culvert flows under the county road that provides access to the Clallam Bay State Prison. The culvert is rusting out and partially collapsed. Lack of maintenance and poor culvert and road design resulted in the failure of two road crossings downstream of the county road in this stream. Only 15 meters of stream is present between the upstream end of the culvert and at a 1.7 to 2.0 meter high cascade/falls that has a small jam perched within the cascade. The falls does not appear passable at this time. Juvenile coho and steelhead were observed in the reach immediately downstream of the culvert. A total of 0.21 miles of 4-8 percent habitat is present upstream of the cascade/falls.
- A partial barrier culvert limits upstream access in Spruce Creek (see Haggerty 2008). A 0.47 m diameter, 2.7 percent slope, slightly perched culvert (0.25 m) at RM 0.01 completely blocks juvenile fish migration into a 0.4 acre forested wetland complex located directly upstream from the culvert. This culvert is located on Charley Creek Road. A short (13m) stream reach separates the culvert from the Clallam River. No adult salmonid habitat exists upstream of the culvert.
- A partial barrier culvert under SR 112 at RM 0.06 on Hamilton Creek (see Haggerty 2008) may block fish passage into a 1.23 acre forested wetland. Haggerty (2008) noted that the culvert appeared to be plugged or partially collapsed. The culvert is 0.63 m in diameter and approximately 23 m long. High densities of age 0 and 1+ coho were observed directly downstream of the culvert. No anadromous fish were identified upstream of the culvert. Note this stream is not included in the WDOT/WDFW culvert database and should be included and surveyed as part of the State's fish passage program.
- Unnamed Creek WP 450 is a right bank tributary to the Clallam River entering at RM 5.85. The SR 112 culvert is a total barrier. The culvert is 0.46 m diameter and is 15.5 meters long and has a slope of 6 percent. The culvert is perched and drops 1.15 meters. Little habitat exists upstream of the culvert. There is a significant cascade within 20-30 meters upstream of the culvert that would likely block access to all anadromous fish. The stream has an average gradient of 16 percent upstream of the culvert.
- Unnamed Creek WP 203 is a right bank tributary to the Clallam River entering at RM 6.24. The SR 112 culvert just upstream from the confluence with the Clallam River is a total barrier. The culvert is a 0.46 m diameter plastic pipe and is approximately 22 meters long. The slope of the culvert was not measured but the culvert outfall drops 1.5 meters. Currently WDFW and WDOT do not recognize this stream as a fish bearing stream. Road construction and road realignment have totally destroyed this potentially productive salmon stream. A moderately large 2.85 acre mixed open water/forested wetland currently exists upstream of the culvert but is completely blocked to anadromous fish by the road and culvert. The existing habitat upstream of the culvert may be some of the highest quality off-channel floodplain habitat within the entire floodplain of the Clallam River.

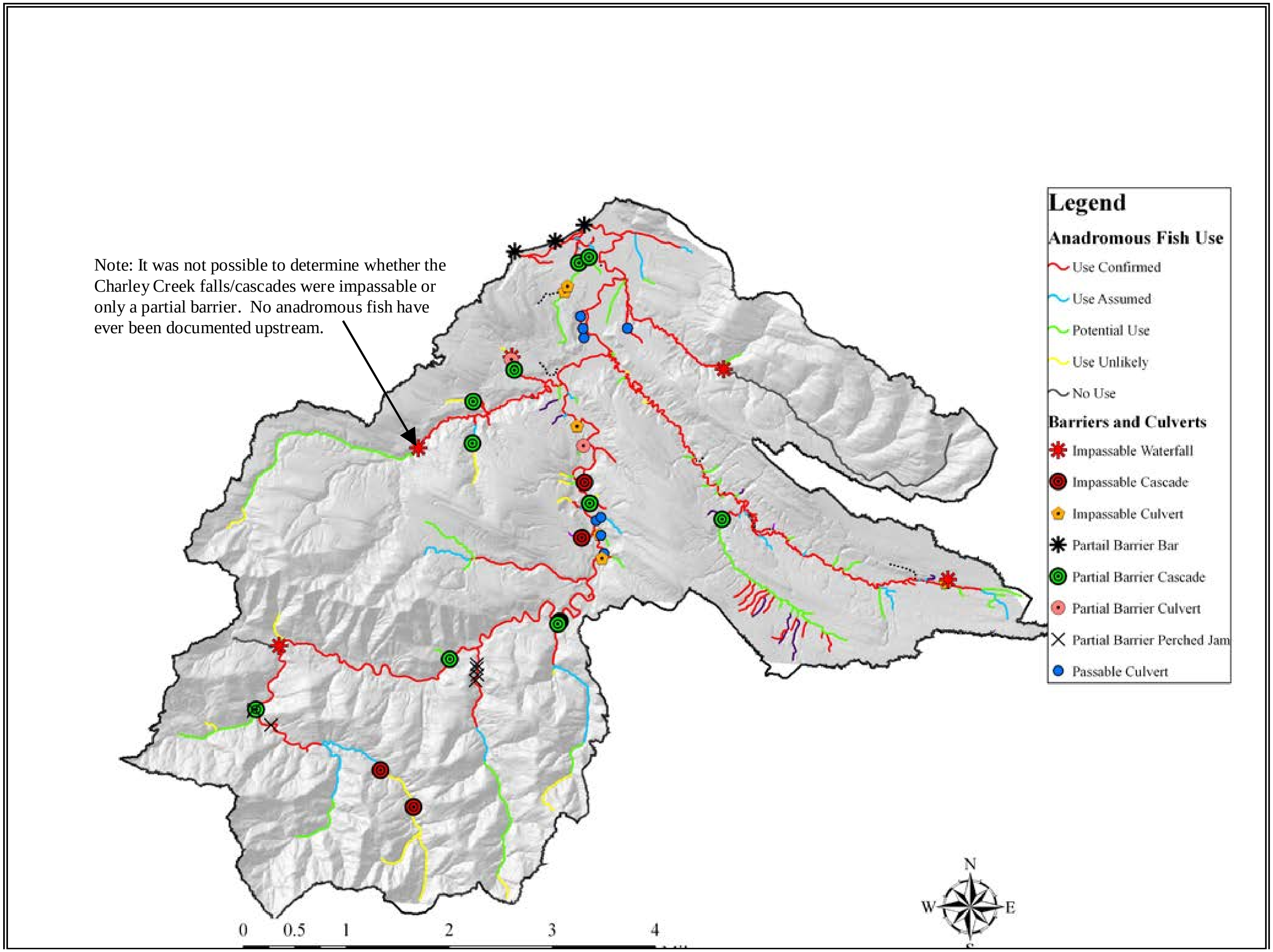

Figure 92. Clallam River watershed anadromous fish use and barriers (source: Haggerty 2008).

5.7.3 Spawning and Rearing Habitat Conditions

Haggerty (2008) conducted habitat surveys throughout the Clallam River watershed. Habitat surveys included detailed pool habitat and a large woody debris inventories. McHenry et al. (1994) studied spawning habitat quality at 9 sites in the watershed in the early 1990s. A summary of the findings from these investigations is included below.

Pool Conditions

Pool surface area data, measured as a percentage of the stream length, were collected in a total of 8 channel segments. A complete summary of pool habitat data is included below in Table 35. Pool habitat conditions in segment 2 and 5 of the mainstem rated good for percent pool, fair for pool frequency, poor for woody cover in pools. Holding pools rated good in segment 2 and fair in segment 5. Pool habitat conditions in segment 1 are tidally influenced and are less influenced by LWD and human infrastructure than other habitat segments in the lower river (segment 0 through 5). Haggerty (2008) suggests that pool habitat conditions in segments 3 and 4 are likely intermediate between those observed in segments 2 and 5. Field observations from continuous channel condition surveys suggest that pool habitat conditions in segments 6-8, 10-11, and 13 are similar to one another. The best pool structure is likely in segment 6. Pool conditions are significantly better in segments 9 and 12, where stream energy is lower and the channel is less confined.

Table 35. Summary of pool habitat data for the Clallam River and tributaries (source Haggerty 2008).

Stream Name	Seg ID	Surveyed Length (m)	Gradient	Number of Pools	Percent Pools	Pool Frequency	Percent Woody Cover in Pools	Pools >1 m Depth
Clallam River	2	1,313	0.1%	22	80%	3.0	0-5%	12.9
Clallam River	5	800	0.6%	9	66%	3.1	0-5%	7
Last Creek	4	299	0.8%	12	36%	3.0	6-20%	0
S.F. Last Crk	1	305	0-1%	16	49%	2.7	6-20%	16.3
Charley Creek	2	818	0.6%	30	63%	1.9	6-20%	9.8
Blowder Creek	1	390	5.4%	12	26%	3.7	0-5%	0
Stinky Creek	2	420	3.7%	18	25%	2.7	0-5%	0
Cougar Creek	1	699	3.9%	31	32%	2.3	6-20%	1.4

Within the tributaries, percent pool habitat ranged from a low of 25 percent (Stinky Creek segment 1), to a high of 63 percent (Charley Creek segment 2). Percent pool ratings based on the watershed analysis rating protocol rated good in one channel segment (Charley Creek), fair in three channel segments (Blowder, S.F. Last, Cougar Creeks), and poor in two channel segments (Last and Stinky Creeks). Pool frequency ranged from a low of 1.9 (Charley Creek) to a high of 3.7 (Blowder Creek). Pool frequency ratings rated good in Charley Creek and fair in all other segments surveyed. Percent woody cover in pools varied by channel segment surveyed; conditions were poor in Blowder and Stinky Creeks and fair to good in all other segments surveyed. Holding pools rated good in Charley and S.F. Last Creeks and poor in all other segments surveyed.

Large Woody Debris

Within the mainstem a total of 8,423 meters (5.23 mi) of LWD data were collected in segments 2, 5-11, and 13. A total of 1,025 pieces of LWD were inventoried. Conifer LWD made up 54 percent of the total LWD, while deciduous LWD made up 46 percent of LWD inventoried. Of the 1,025 pieces of LWD inventoried less than 1 percent were classified as key pieces. Large (> 50cm diameter) LWD accounted for almost 30 percent of the LWD count, while medium (51%) and small (19%) pieces made up the remaining 70 percent. A complete summary of LWD data collected is included below in Table 36. Within the mainstem LWD frequency ranged from a low of 0.8 pieces per channel width (segment 10) to a high 11.3 (segment 5). LWD pieces classified as conifer ranged from 33 to 76 percent. Key pieces of LWD per channel width was very low in all stream segments surveyed. LWD pieces greater than 50 cm diameter ranged from 9 percent (segment 11) to 56 percent (segment 2).

Table 36. Summary of large woody debris data for the Clallam River and tributaries (source: Haggerty 2008).

Stream Name	Seg ID	Length Surveyed (m)	BFW	Number of LWD Pieces	LWD Frequency (Pieces per channel width)	Percent of Pieces Conifer	Key Pieces per Channel Width	Percent of Pieces > 50 cm diameter
Clallam River	2	1,313	19.9	192	2.9	76%	0.03	56%
Clallam River	5	854	30.4	318	11.3	63%	0.07	29%
Clallam River	6	706	24.6	52	1.8	60%	0	27%
Clallam River	7	922	21.5	75	1.7	52%	0	24%
Clallam River	8	790	21.5	62	1.7	63%	0	29%
Clallam River	9	740	19.3	73	1.9	41%	0	26%
Clallam River	10	836	15.7	41	0.8	39%	0	10%
Clallam River	11	892	13.1	67	1.0	33%	0	9%
Clallam River	13	1,371	12.6	145	1.3	62%	0.02	19%
Blowder Creek	1	390	8.9	240	5.5	55%	0.14	27%
S.F. Last Creek	1	305	7.1	153	3.6	58%	0.07	24%
Last Creek	4	299	8.4	175	4.9	51%	0.14	16%
Charley Creek	1	818	14.4	278	4.9	41%	0.11	32%
Stinky Creek	1	420	8.7	231	4.8	60%	0.06	32%
Cougar Creek	1	699	9.7	456	6.3	62%	0.10	30%
Unnamed 19.0135	1	363	4.5	75	0.9	20%	0	17%
Unnamed 19.0135	2	157	5.2	71	2.4	51%	0	13%

Within Clallam River tributaries a total of 3,451 meters (2.15 mi) of LWD data were collected in Blowder, S.F. Last, Last, Charley, Stinky, and Cougar Creeks, as well as in two channel segments within tributary 19.0135. A total of 1,679 pieces of large woody debris were inventoried. Conifer LWD made up 54 percent of the total LWD inventoried. Within the tributaries LWD frequency ranged from a low of 0.9 pieces per channel width (tributary 19.0135 segment 1) to a high 6.3 (Cougar Creek segment 1). LWD pieces classified as conifer ranged from 30 to 62 percent. Key pieces of LWD per channel width ranged from 0 to 0.14. LWD pieces greater than 50 cm diameter ranged from 13 percent (19.0135 segment 1) to 32 percent (Charley and Stinky Creeks).

Channel Substrate

Haggerty (2008) provided detailed observations of spawning gravel within the mainstem based on substrate size and rock type. A summary of these observations are included below. Segments 1 and the lower half of segment 2 are dominated by sand size substrate and are tidally influenced and therefore provide less than ideal spawning habitat. Gravel substrate increases in the upstream direction in segment 2. Gravel is the dominant substrate in segments 3 and 4. Substrate transitions from mostly gravel to gravel mixed with cobble in segment 5. In segment 6 the substrate size is cobble and gravel. In segment 7 the channel substrate coarsens and is dominated by cobble, gravel, and small boulders. Segment 8 is the first segment where bedrock is the dominant substrate followed by boulders and cobble. Substrate is less coarse in segment 9 and is dominated by cobble and gravel. This is likely a function of the underlying geology of this segment, which is mostly composed of glacial deposits.

Bedrock, boulders, and cobble are the dominant substrate in segments 10 and 11. Small pockets of gravel occur at several locations in segment 10. Substrate size decreases significantly in segment 12 where it is dominated by cobble, gravel, and small boulders. Segment 12, like segment 9, is also underlain by glacial deposits and less confined than segments 6-8 and 10-11. In segments 13 and 14 the substrate again coarsens and is dominated by boulders, bedrock, and cobbles. Occasional gravel pockets are present and usually associated with LWD, logjams, or in some cases landslide deposits. Loss of LWD results in decreased channel roughness that can in turn result in channel substrate coarsening (i.e., adding roughness). Historical LWD conditions are unknown for the Clallam River but the quantity and quality of instream LWD currently is very low upstream of RM 7.

The level of fine sediment in spawning gravel was studied by McHenry et al. (1994) at four sites in the mainstem Clallam River and five tributary sites. Gravel samples were collected during the summer of 1991 and 1992. Fine sediment levels in spawning gravel are reported in percent fines less than 0.85 mm. Table 37 includes the results for percent fine sediment in spawning gravel at the nine sites within the Clallam River watershed. The results presented in Table 37 include the results as reported in Table 3 in McHenry et al. (1994), as well as results reported in wet-sieve equivalents. Within the mainstem the gravimetric results show increasing levels of fine sediment in spawning gravels in the downstream direction.

Table 37. Fine sediment levels in spawning gravel for nine sites in the mainstem Clallam River and tributaries, processed using gravimetric methods (source: McHenry et al. 1994).

McHenry Site	Clallam Study Equivalent Segment / RM	No. of Samples	Percent Fines < 0.85 mm (Gravimetric)	Percent Fines < 0.85 mm (Volumetric)
Mainstem RM 2.8	Seg 3 / RM 3.7	20	12.6%	19.4%
Mainstem RM 4.5	Seg 5 / RM 5.9	20	10.2%	19.8%
Mainstem RM 5.4	Seg 5 / RM 6.6	20	7.4%	10.5%
Mainstem RM 9.5	Seg 12 / RM 11.2	NA	4.8%	NA
Pearson Creek	Segment 3	10	16.9%	NA
Last Creek	Segment 2	10	11.9%	NA
Lower Charley Creek	Segment 2	10	10.3%	NA
Upper Charley Creek	Segment 5	10	8.8%	NA
Stinky Creek	Segment 2	10	7.2%	NA

5.7.4 Floodplain and Riparian Habitat Conditions

Haggerty (2008) collected and analyzed detailed riparian and floodplain habitat condition data within 60 meters of the bankfull edge of the mainstem Clallam River from the confluence with the Strait of Juan de Fuca to the end of segment 5 (RM 6.8). Riparian conditions were evaluated within four zones (10, 20, 30, and 60 meters from the bankfull edge) within each of the mainstem channel segments. A summary of the results are included below. The majority of riparian habitat in all six stream segments was classified as either impaired or non-functioning (for definitions see Haggerty 2008). Collectively, 74 percent of the riparian area within 60 meters of the bankfull edge from segment 0 to the end of segment 5 was classified as either impaired or non-functioning. Table 38 includes a complete summary of riparian conditions by habitat segment within each of the four zones adjacent to the mainstem. Segments 1 and 5 were the least impaired segments within all four zones. Within the 0-60 meter zone segments 5 and 1 had 54.8 and 38.6 percent of their respective areas classified as un-impaired/slightly impaired.

Haggerty (2008) found that riparian habitat that was classified as non-functioning had different levels of short and long-term impairment. Some riparian areas classified as non-functioning were on a long-term trajectory towards functional riparian habitat (e.g., young conifer stands), while other riparian areas classified as non-functioning were not on a trajectory towards improving conditions (e.g., stream parallel roads). Nearly 59 percent of all riparian areas within 60 meters of the bankfull edge were classified as non-functioning riparian habitat. Of this area approximately 32 percent contained young or very young forests, of which only 24 percent were on a trajectory towards recovery. The remaining 76 percent of young or very young forests were on a trajectory towards becoming alder dominated or mixed stands (greater than 30% deciduous trees). Haggerty (2008) found that 68 percent of the non-functioning riparian areas were on a long-term trajectory towards remaining non-functional. Of these areas approximately 14 percent were non-functioning or impaired riparian habitats naturally (e.g., the sand spit at the mouth). Nonetheless, approximately 34 percent of all riparian habitat (58.5% of non-functioning riparian habitat) from segment 0 to 5 were on a long-term trajectory towards continued non-functional conditions. Road and road prisms cover 7.6 percent of the riparian areas and pastures, high density housing, rural housing, and other disturbed areas cover an additional 27 percent of riparian areas within 60 meters of the bankfull edge of the Clallam River.

Table 38. Summary of riparian conditions by habitat segment within 10, 20, 30, and 60 meter distances from the bankfull edge of the mainstem Clallam River (source: Haggerty 2008).

Zone	Riparian Conditions	Seg 0	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	All Segs
0-10 Meters	Un-Impaired/Slightly Impaired	27.1%	44.6%	18.1%	10.2%	13.2%	61.8%	28.7%
	Impaired Function	8.5%	18.4%	11.8%	59.6%	32.5%	20.0%	24.3%
	Non-Functioning	64.4%	37.1%	70.1%	30.2%	54.4%	18.2%	47.0%
0-20 Meters	Un-Impaired/Slightly Impaired	25.4%	43.8%	15.8%	10.1%	13.6%	60.4%	27.8%
	Impaired Function	6.5%	13.9%	9.3%	58.2%	27.4%	15.6%	20.7%
	Non-Functioning	68.0%	42.3%	74.9%	31.7%	59.1%	24.0%	51.5%
0-30 Meters	Un-Impaired/Slightly Impaired	24.6%	42.6%	14.2%	10.3%	13.7%	59.3%	27.1%
	Impaired Function	5.6%	11.2%	8.1%	55.4%	23.7%	12.7%	18.2%
	Non-Functioning	69.8%	46.3%	77.7%	34.3%	62.7%	28.0%	54.7%
0-60 Meters	Un-Impaired/Slightly Impaired	25.8%	38.6%	12.7%	9.7%	15.2%	54.8%	25.8%
	Impaired Function	3.5%	9.0%	8.9%	49.0%	19.5%	8.0%	15.2%
	Non-Functioning	70.7%	52.4%	78.5%	41.3%	65.3%	37.2%	58.9%

Haggerty (2008) summarized riparian conditions for the Clallam River in segments 6 (RM 6.8) through 18 (RM 15). Conifer dominated stands were generally absent throughout these segments. However, few segments were dominated by deciduous stands. The vast majority of riparian stands from segment 6 to 18 were mixed stands and many of these stands were well stocked with conifer. The long-term outlook for most segments is fair based on the current conifer stocking and size of trees.

Haggerty (2008) also evaluated riparian conditions in Clallam River tributaries. A total of 26 miles of tributary riparian habitat were inventoried and evaluated. Table 39 depicts a simplified summary of riparian conditions ratings based on current riparian functionality. Just over 29 percent of the riparian length evaluated was classified as functional and 54 percent of the length was classified as impaired. Almost 17 percent of the riparian length was classified as non-functional. A large proportion (55%) of the riparian forest classified as impaired was on a trajectory towards becoming un-impaired/slightly impaired. Less than 2 miles (20% of length classified as non-functional; 3.5% of classified riparian forest) of the riparian forest classified as non-functional was on a long-term trajectory towards continued non-functional conditions.

Table 39. Summary of riparian conditions for Clallam River tributaries (source: Haggerty 2008).

Riparian Conditions	Left Bank (Miles)	Left Bank (Percent)	Right Bank (Miles)	Right Bank Percent
Un-Impaired/Slightly Impaired	6.94	27%	8.16	31%
Impaired Function	14.31	55%	14.00	54%
Non-Functioning	4.79	18%	3.88	15%
Total Length	26.04	na	26.04	na

5.7.5 Water Quality Conditions

Four major efforts to collect stream temperature data in the Clallam River watershed have been made during the past 15 years. WDNR collected stream temperature data during the 1990s at several sites over a two year period. The Lower Elwha Tribe collected continuous stream temperature data at several sites during the summers of 1997, 2000, and 2003. Streamkeepers and Clallam County collected stream temperature data during the summer of 2005. DOE has collected continuous stream temperature data at their stream gage since 2005.

Stream temperatures in the mainstem are significantly warmer than in the tributaries. Stream temperature data collected by the Lower Elwha Tribe indicate a general trend of increasing stream temperature in the downstream direction. Within the datasets collected the Weel Road site had consistently higher temperatures during all three years. Maximum stream temperatures recorded during the summers of 1997, 2000, and 2003 were 18.9, 17.8, and 19.5ºC respectively. The maximum seven-day average daily maximum (7-DADMax) stream temperatures at Weel Road for 1997, 2000, and 2003 were 18.2, 17.2, and 18.3ºC respectively. Temperatures were significantly cooler upstream at RM 6.0 where in 1997, 2000, and 2003 the maximum temperatures were 17.2, 16.5, and 18.5ºC respectively. The maximum 7-DADMax stream temperatures at RM 6.0 for 1997, 2000, and 2003 were 16.7, 16.1, and 17.3ºC respectively.

Figure 93 depicts Clallam River stream temperature from June 2005 to June 2007. The maximum stream temperatures recorded in 2005 and 2006 were 17.6 and 19.1ºC respectively. The maximum 7-DADMax stream temperatures recorded during 2005 and 2006 were 17.3 and 18.4ºC respectively. In 2005 the 7-DADMAX exceeded 16ºC on 25 days. Over the course of the 2006 summer the 7-DADMax stream temperature exceeded 17.5ºC on seven days and exceeded 16ºC on 24 days.

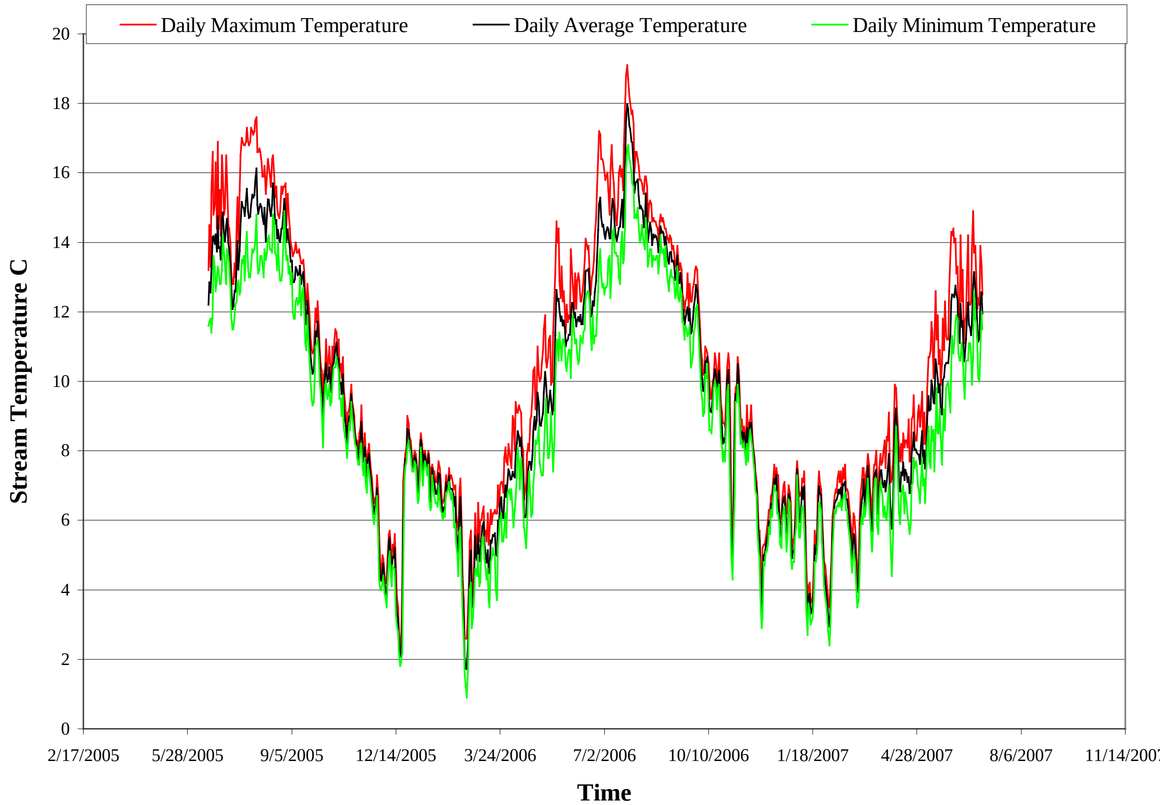

Figure 93. Clallam River daily maximum, minimum, and mean stream temperature at the DOE stream gage (source: DOE unpublished stream temperature data).

Several additional water quality parameters were measured monthly by Streamkeepers from the summer of 2005 through May 2007 (for map of sites see Haggerty 2008). Water quality parameters collected included: temperature, dissolved oxygen, conductivity, turbidity, and salinity. A complete summary of these water quality data is included in Haggerty (2008). Figure 94 depicts dissolved oxygen levels (mg/l) for five sites in the mainstem Clallam River. The data show seasonal fluctuations in dissolved oxygen levels that correspond to seasonal temperatures and flow conditions. In general the dissolved oxygen levels appear adequate to support salmonids in the mainstem during all months sampled. However, several occurrences were documented where the dissolved oxygen levels were below the State's water quality standard for "core summer habitat". Slightly lower levels of dissolved oxygen were documented at RM 1.0 during summer months. This is likely attributable to the fact that the river is fairly stagnate at this location in the inter-tidal zone during the summer months, when the mouth of the river is bar bound.

Dissolved oxygen levels during the same sampling period for Last, Charley, and Blowder creeks are depicted in Figure 95. Dissolved oxygen levels in Blowder Creek were good during all sampling events. Dissolved oxygen levels in Charley Creek during summer low flow periods were between 8 and 9.5 mg/l. Sampling in Last Creek clearly showed that dissolved oxygen levels fall far below the water quality standard for spawning, rearing, and migration. Weekly or monthly summer-time longitudinal dissolved oxygen monitoring recommended for Last Creek.

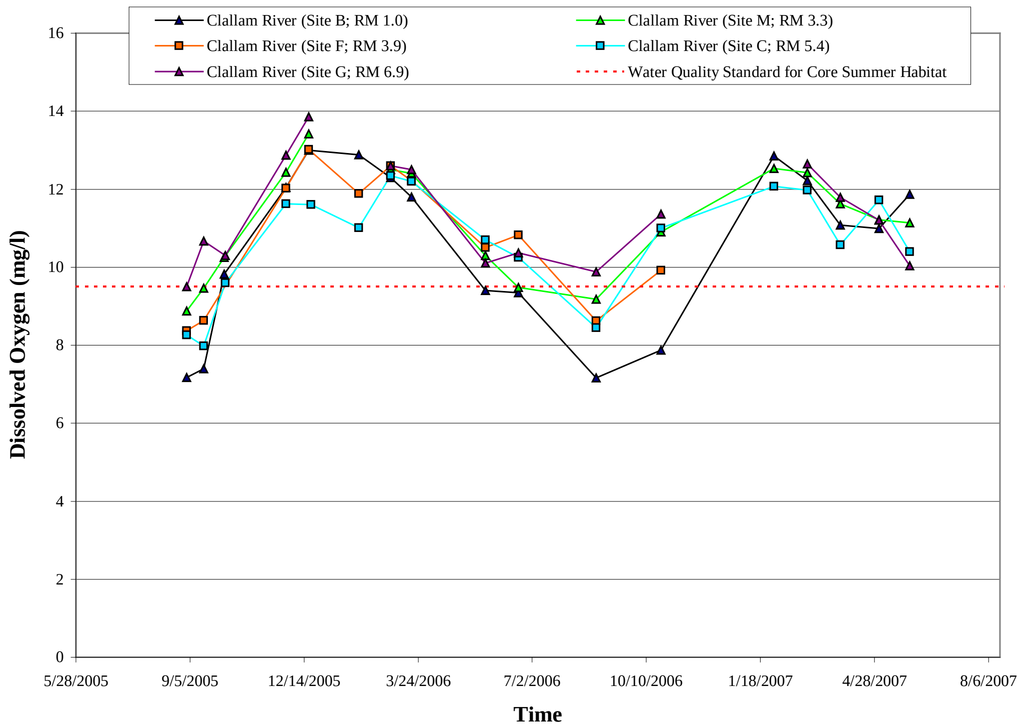

Figure 94. Monthly dissolved oxygen levels for five sites on the Clallam River (source: Streamkeepers unpublished data).

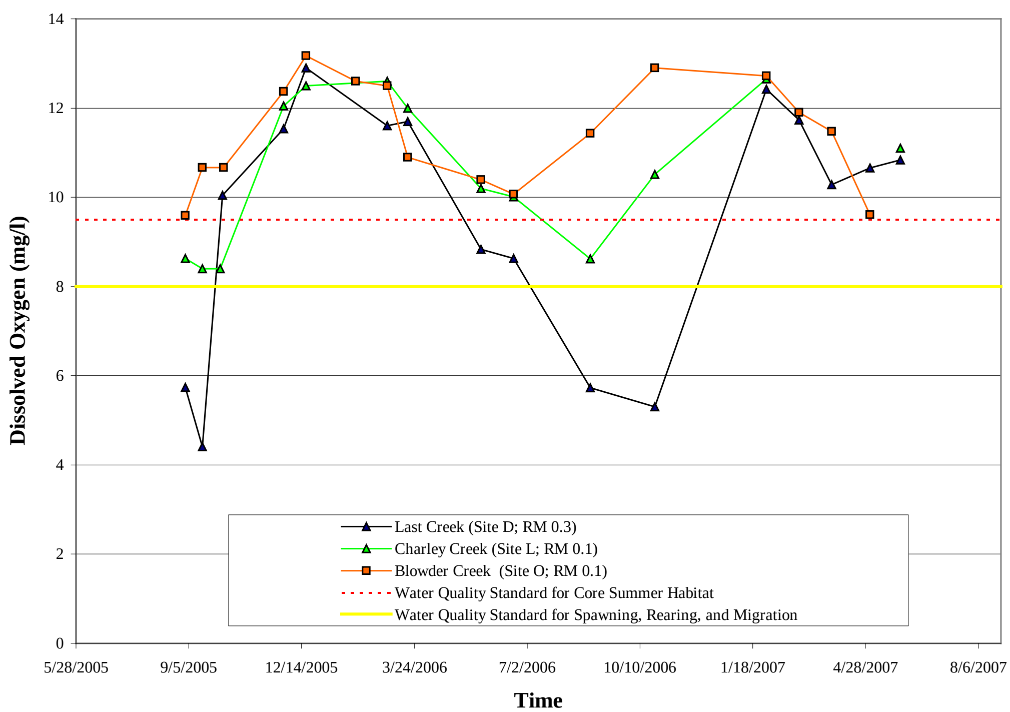

Figure 95. Monthly dissolved oxygen levels for Last, Charley, and Blowder creeks (source: Streamkeepers unpublished data).

A Benthic Index of Biological Integrity (BIBI) survey was conducted in 2004. Data were collected at two sites in the Clallam River. The lower site was located near river mile 2.5 and the upper site was located at RM 6.0 (based on GIS coordinates in Tetra Tech/KCM 2005). The upper site had a BIBI score of 42, which rated as “compromised.” The lower site had a BIBI score of 36, which also rated as “compromised” (Tetra Tech/KCM 2005).

5.7.6 Hydrologic Conditions

Summer-time stream flows within the Clallam River watershed can be very low (<10 cfs), whereas annual peak flows can be quite high (>1,000 cfs). No systematic analysis of changes in peak or low flows has been conducted within the Clallam River watershed. Ample evidence has been collected and reviewed showing that extensive clearcutting and road building has occurred over the past 100 years. Very little old growth forest remains in the watershed and roads have been constructed throughout the entire watershed. Hydrologic maturity has been improving for the last few decades. Smith (2000) estimates that 60 percent of the forest was composed of forest stands 40-80 years old.

Washington State Department of Ecology (DOE) continuous stream flow monitoring in the Clallam River began during the spring of 2005. The stream gage is located downstream of Last Creek near RM 3. Three years of data collected in July, August, and September for water years (WYs) 2005, 2006, and 2007 indicate that average streamflow was 23, 7.8, and 19 cfs respectively. DOE estimated an instantaneous low flow discharge of 1.9 cfs in September 2006. The DOE instantaneous low flows in 2005 and 2007 were 3.1 and 3.9 cfs. Peak instantaneous flows in WYs 2007, 2006, and 2005 were 1,200, 2,460, and 1,000 cfs respectively.

EES Consulting (2005) reported that, based on physical habitat simulation (PHABSIM) modeling work conducted in the Clallam River, fish habitat requirements are exceeded during winter months. Existing summer flows were required to meet fish habitat needs. Figure 96 depicts synthesized dispersed stream flow duration curves for Clallam River at the confluence with the Strait of Juan de Fuca.

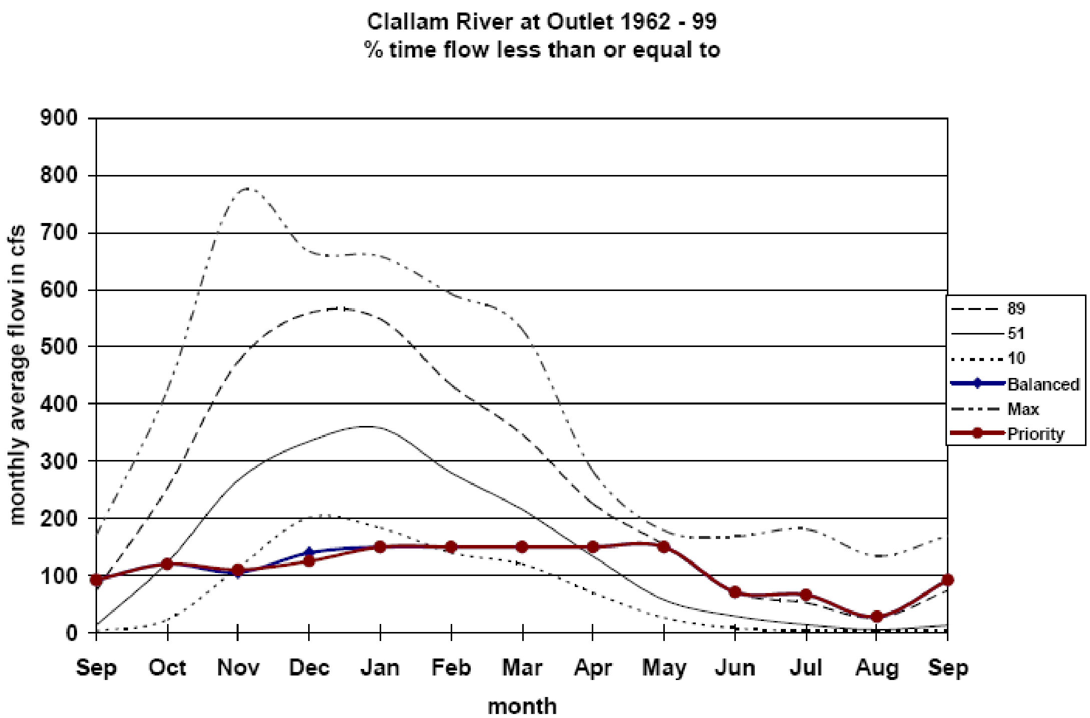

Figure 96. Clallam River at confluence with Strait, synthesized annually (1962-1999) dispersed flow duration curve (source: EES Consulting 2005).

5.7.7 Funded and/or Implemented Restoration and Protection Projects

- Clallam River riparian restoration project: fenced 0.6 miles of pasture adjacent to river, revegetated with native riparian trees and shrubs (2004, Clallam Conservation District)
- Clallam River (RM 1.6 to 1.7) bank protection demonstration project, constructed 5 ELJs, reshaped bank, fenced off pasture, and revegetated riparian area (2005; Lower Elwha Tribe/Clallam Conservation District)
- Upper Clallam River (RM 11.8 to 11.6; P-1800Rd) bridge removal and channel enhancement, constructed several boulder weirs, placed LWD in active stream channel (2004; Lower Elwha Tribe/WDNR)
- Cedar Creek fish passage enhancement, replaced partial barrier culvert (SR 112) with passable culvert providing fish passage to 0.34 miles of ~8 percent gradient habitat (2000; WDOT)
- Fish passage correction in unnamed tributary to Pearson Creek (year unknown, Clallam Conservation District)
- Knotweed control along lower mainstem (approximately 2002-2005, Clallam Conservation District/LEKT)
- Replacement of two partial barrier culverts at RM 0.13 in Sadilek Creek with bridge. Improved access to a 28 acre wetland complex (2013; NOSC)

5.8 HOKO RIVER

Habitat conditions and limiting factors for the Hoko River subbasin are described and summarized in several technical reports including:

- WRIA 19 Limiting Factors Report (Smith 2000)
- Hoko Watershed Analysis and Modules (Pentec 1996)
- Spawning Gravel Quality, Watershed Characteristics and Early Life History Survival of Coho Salmon and Steelhead in five North Olympic Peninsula Watersheds (McHenry et al. 1994).
- NOPLE Salmon Habitat Recovery Strategy (NOPLE 2004)
- Historical Changes to Estuaries, Spits, and Associated Tidal Wetland Habitats in the Hood Canal and Strait of Juan de Fuca Regions of Washington State (Todd et al. 2006)

Key or major limiting factors include:

- Sedimentation from road network and mass wasting events:
  - Increased fine sediment levels in spawning gravel (McHenry et al. 1994)
- Severe loss and/or lack of large woody debris resulting in decreased pool habitat formation and channel complexity. LWD depletion also contributes to channel instability through incision processes (Smith 2000).
- Conversion of native conifer forest to open areas (lower mainstem and Little Hoko River only) or hardwood dominated riparian areas. This has also resulted in decreased shade levels which in turn have impacted summer stream temperatures.
- Floodplain development from roads and other infrastructure have altered habitat forming processes and riparian conditions.
- Naturally low flows during summer and early fall contribute to high stream temperatures and salmonid migrations. The naturally low stream flows are worsened by water withdrawals (Smith 2000).

Other limiting factors:

- Loss of habitat connectivity: human-caused barriers have reduced the quantity of habitat available for spawning and rearing
- Estuary impacts of reduced the quantity and quality of estuary habitat available for rearing.

Harvest and hatchery practices are currently not considered major limiting factors to salmonid populations in the Hoko River subbasin. A summary of habitat conditions and limiting factors are included below in Sections 5.6.1 through 5.6.6

5.8.1 Estuary and Nearshore Conditions

The Hoko River enters the Strait of Juan de Fuca just west of Kydaka Point. Currently, the river and estuary complex are connected by a rather straight channel reach that is approximately 0.70 miles long. Tidal influence reaches approximately 1.5 miles upstream, to just past the SR 112 bridge. Historically, a well-formed spit deflected the river to the far east side of the valley against the bedrock outcroppings that form Kydaka Point. Two major differences exist between the current channel configuration and those documented in the late 1800s and early 1900s. The major changes include the breaching of the sand spit described above and the abandonment of the historical highly-sinuous main channel, which once meandered approximately 0.35 miles further west.

The abandonment of the historical westerly sinuous channel configuration to the current straight channel configuration occurred sometime between the 1920s and about 1940 (Todd et al. 2006). Todd et al. further speculated that, based on the channel configuration in the 1931 T sheet, the channel change may have occurred sometime after 1931. The cause of the channel shift is undocumented. Some people have speculated that the channel shift may have been facilitated in part to more efficiently transport logs through a shorter and less sinuous reach of channel (Randy Johnson, Personal Communication *In* Todd et al. 2006). More recently the channel has made a major shift at the confluence with the Strait, breaching the sand spit. Todd et al. (2006) reviewed a minimum of 12 historical maps and aerial photos from 1892 through the mid-1990s all of which documented the mouth of the river against the rock wall to the far east. Their photo and map review indicated that the breach occurred sometime between 1994 and 1997.

Todd et al. (2006) speculate that the present channel configuration with the spit breached at a right angle by the river may be at least partially a function of the upstream channel reconfiguration. Aerial photos from the 1950s to present appear to indicate progressive channel infilling and decreasing quantities of water being transported downstream in the old mainstem channel. Historically the channel approached the Strait at an angle almost parallel to the spit, whereas the river channel now approaches the spit at a right angle.

Another factor that could have contributed to the realignment of the mouth is the extensive rip-rap just to the west of the mouth. Approximately a quarter mile of shoreline is heavily armored to protect homes in a housing development. This rip-rap is likely disrupting the natural sediment erosion and transport process that formed and maintained the spit. Todd et al. (2006) concluded that the rip-rap was placed sometime between 1977 and 1994. They noted that the 1977 oblique aerial photo showed a broad, well-vegetated spit. By 1994 the photos show a much narrower, thinly vegetated spit and sometime between 1994 and 1997 the spit was breached by the river. GIS analysis of aerial photos indicates the vegetated spit was approximately 7, 5, 3, and 1.5 acres in 1957, 1973, 1994, and 2005 respectively.

One of the primary negative effects of the breaching and narrowing of the spit is that wave energy and coarse sediment are able to top the western margin of spit. This has caused extensive sediment deposition in and across the cutoff meander channel. This sediment deposit controls and limits tidal exchange throughout a long, complex inter-tidal channel network. The impacts to fish are currently unknown. The decreased tidal exchange creates the potential for degraded water quality conditions in portions of the estuary. During the past year water quality data including pH, turbidity, temperature, DO, salinity, and conductivity have been collected monthly at 12 sites in the lower river and estuary, including several sites in the old meander. A brief review of these data suggest that occasionally DO levels are very low (<3.0 mg/L) at two of the sites in the estuary. Collection and analysis of additional data is an important component of understanding water quality conditions in the estuary and potential water quality factors that might affect salmonids in the Hoko River subbasin.

5.8.2 Habitat Connectivity

No comprehensive basin-wide fish passage assessment for the entire Hoko River subbasin has been completed. Partial surveys of stream crossings and fish passage barriers in the Hoko watershed are included in road maintenance and abandonment plans (RMAPs), and in the WDFW culvert inventory database. Smith (2000) completed a partial inventory of all road related fish blockages within the Hoko River subbasin. This inventory included a ranking of culvert priorities but no justification or rationale were used in the ranking and therefore those rankings should not influence priorities but are included below for reference purposes only. The inventory has also been updated based on recent information and is presented below from downstream to upstream.

- 44) A partial barrier associated with SR 112 near MP 12.3 blocks access to a 1.6 acre wetland complex and 0.15 miles of 2-4 percent gradient spawning and rearing habitat. An additional 0.3 miles of 4-8 percent gradient habitat is also upstream of the barrier culvert.
- 25) A total barrier culvert on the mainstem Hoko River at the 9000 Road crossing blocks access to 0.53 miles of 1-2 percent gradient habitat and 0.35 miles of 4-8 percent gradient. A large waterfall at this point blocks further access to all fish (field verified by Makah Fisheries 1999).
- 66) A partial barrier culvert on Hoko Ozette Road blocks 0.25 miles of 2-8 percent gradient spawning and rearing habitat in Hoko Gage Creek (near Hoko RM 5.0).
- 35) A partial barrier at that Hoko Hatchery water diversion blocks about 0.3 miles of 3-7 percent gradient spawning and rearing habitat in Rights Creek (field verified by Makah Fisheries 1998).
- An undersized, perched culvert acts as a partial barrier in Johnson Creek at the confluence with the Hoko River. Currently adult coho and steelhead appear to easily pass upstream through the culvert. The road fill is extremely deep and the culvert is partially collapsed and poses a significant risk of catastrophic failure.
- 23) A perched culvert (Hoko Ozette Road) on an unnamed tributary to Johnson Creek (trib 19.0176) blocks access to 0.8 miles of low gradient (1-4%) habitat and 0.35 miles of 4-8 percent gradient habitat.

- A perched culvert (Hoko Ozette Road) on an unnamed tributary to Johnson Creek (trib 19.0178) blocks access to 0.68 miles of low gradient (2-4%) stream habitat.
- 68) A perched culvert on an unnamed tributary (19.0189; RM 0.18) to the Hoko River blocks access to 0.41 miles of 3-6 percent gradient spawning habitat (field verified by Makah Fisheries 1998).
- 72) An unmapped right bank tributary to unnamed tributary 19.0199 (RM 0.45) contains a barrier culvert at RM 0.06 that blocks access to about 0.1 miles of spawning habitat.
- 5) Two perched culverts on the 9000 Road block access to a 4 acre fish bearing wetland complex. No spawning habitat has been identified upstream of the barrier culverts.

The barriers listed above block or hinder access to 6-10 percent of the available habitat within the Hoko River subbasin. Waterfalls, cascades, log jams, and steep gradients naturally limit anadromous fish distribution and habitat utilization in several Hoko River tributaries. Another habitat connectivity issue that affects upstream migration is related to channel incision. Martin (1995) describes a bedrock barrier in the Little Hoko River that was exposed presumably due to channel incision and head-cutting following wood removal.

5.8.3 Spawning and Rearing Habitat Conditions

Martin (1995) conducted habitat surveys in 23 stream reaches in the Hoko River subbasin as part of the Hoko River Watershed Analysis (Pentec 2005). Martin (1995) collected LWD, substrate, and pool habitat data. McHenry et al. (1994) studied spawning habitat quality at several sites throughout the Hoko River subbasin. In general, habitat conditions were degraded or severally degraded throughout the watershed. A summary of the findings primarily from these two reports are included below.

Pool Conditions

Martin (1995) describes pool habitat in the Hoko River as being especially important for coho salmon. Pool habitat in the upper Hoko River mainstem ranged from 72 percent (near Ellis Creek) to 21 percent (upstream of 9000 Rd. culvert) and was variable depending on location (Martin 1995). Pool habitat data summarized by Martin (1995) are included TABLE X. The Martin (1995) data indicate that percent pool averaged approximately 47 percent across the watershed where surveys were conducted. Pool spacing rated good in less than 10 percent of the reaches surveyed. Pool spacing rated poor in 32 percent of the reaches surveyed.

Table 40. Pool habitat summary for the Hoko River subbasin (modified from Martin 1995).

Stream	Site	Percent Pool	Pool Spacing	Mean Residual Pool Depth (m)	Mean Woody Cover (%)
Hoko River	Cowan's Farm	33	4.6	0.39	0
Hoko River	Section 28	53	4.9	0.43	0
Hoko River	Near Herman	37	6	1.06	0
Hoko River	Upstream of Ellis	77	3.3	0.82	18
Hoko River	Upstream of 9000 Rd. Bridge	51	1.9	0.5	33
Hoko River	Downstream of 9000 Rd. culvert	48	3.1	0.24	11
Hoko River	Upstream of 9000 Rd. culvert	21	2.6	0.3	18
Little Hoko River	Cowan's Farm	34	4.5	0.8	19
Little Hoko River	Upstream of Leyh Cr. (Sec 26)	62	3.1	0.79	7
Brownes Creek	Lower Section 27	52	2.1	0.57	14
Herman Creek	Lower Section 29	54	3	0.71	32
Herman Creek	Middle Section 28	21	4.3	0.38	20
Herman Creek	Upper Section 27	19	5.1	0.32	0
Ellis Creek	Downstream of 6101 Rd.	58	1.7	0.56	15
Ellis Creek	Downstream of 9300 Rd.	27	2.4	0.33	8
Ellis Creek	Upstream of 9300 Rd.	31	3.4	0.37	13
Cub Creek	Downstream 6000 Rd.	56	2.2	0.38	21
Cub Creek	Upstream 6000 Rd.	47	2	0.2	0
Bear Creek	Downstream 6000 Rd.	60	2.1	0.75	24
Bear Creek	Near 9300 Rd.	51	2	0.66	30
Bear Creek	Downstream 9300 Rd. Bridge	39	2.8	0.32	19
Bear Creek	Upper Section 36	55	7.5	0.55	14

Currence (1994 *in* Martin 1995) conducted a review of pool habitat data collected and summarized by Martin and found that significantly different habitat conditions were present when TFW Ambient Monitoring protocols were applied to defining habitat units and conditions. Currence found that, when residual pool depth requirements were applied to the data collected by Martin, the basin-wide percent pools averaged less than 24 percent (versus 47 percent), which is less than half of the watershed analysis target. Caution should be used when considering the data summarized by Martin (1995) since these data were not collected according to TFW protocol and are not equivalent to datasets collected following this standard methodology.

Large Woody Debris

LWD frequency was chronically low throughout the Hoko River subbasin. Martin (1995) suggested that the amount of LWD was a good indicator of habitat quality for juvenile rearing. Large woody debris is a critical to forming high quality pool habitat and provides important cover to salmonids. Martin (1995) found that greater than 50 percent of the habitat sites surveyed within the anadromous fish use zone were rated as poor for habitat conditions based on low LWD frequency or poor pool habitat conditions. Currence (1994 *in* Martin 1995) found that only 1 of 22 sites in the Hoko River subbasin had greater than 2 pieces of LWD per channel width. The median number of pieces of LWD per channel width was only 0.5, more than 4 times less than the watershed analysis target.

LWD was actively removed from the Hoko River subbasin from the 1930s through the 1970s to eliminate barriers to salmon migration. LWD was also actively removed from the mainstem to facilitate downstream log rafting, which occurred from Blue Canyon downstream to the mouth (Martin 1995). Overall LWD conditions are very bad and the outlook is even worse considering that what remaining old wood continues to decay and the vast majority of riparian stands are alder.

Spawning Habitat

Channel stability and fine sediment levels in spawning gravels are the two primary factors that affect spawning habitat quality in the Hoko River subbasin. McHenry et al. (1994) note that they observed significant bed aggradation and degradation, and accompanying channel changes following storm events. Egg basket studies conducted by McHenry et al. (1994) in the Hoko River found that significant channel instability occurred during their study where egg basket loss ranged from 28 to 80 percent. The most significant egg basket losses occurred during the winter egg incubation period (based on coho egg basket losses relative to steelhead egg baskets).

Smith (2000) suggests that the cause of the channel instability problem in the Hoko River subbasin is likely a combination of low LWD levels and excess sediment within the channel network. Benda (1995) identified 330 landslides associated almost exclusively with logging (55% from clearcuts) and logging roads (40%). A total of 141 landslides occurred from 1981 to 1993 following intensive clearcut logging in the 1970s and 1980s (Benda 1995). Approximately 70 percent of these landslides directly delivered sediment to stream channels.

Smith (2000) also suggested that the lack of stable LWD contributes to channel instability. The low LWD levels currently present in the watershed are not expected to increase in the near-term. LWD can also play an important role in trapping and sorting spawning gravels. Martin (1995) concluded that gravel quantity was not likely a limiting factor based on the current quantity of spawning gravel available. Martin (1995) did note that some habitat concerns related to gravel loss were observed in Brownes and Cub Creeks where cobble and larger substrate were present upstream of the lower channel reaches.

As described above fine sediment is also a limiting factor affecting egg-to-fry survival. McHenry et al. (1994) suggest that the primary sources of excess sediment within the watershed are roads and mass wasting. The level of fine sediment (<0.85 mm) in spawning gravel can significantly affect egg-to-fry survival, at high levels (>13%) a threshold condition exists, above which survival dramatically decreases (McHenry et al. 1994). High to moderate levels of fine sediment were found in spawning gravel throughout the Hoko River subbasin.

Fine sediment levels in the mainstem ranged from a high of 18.2 percent (RM 3.5) to a low of 7.8 percent (RM 12.7). Fine sediment levels in spawning gravel in tributaries ranged from 18.7 percent in Rights Creek to 11.6 percent at RM 0.4 in Herman Creek. A complete summary of fine sediment levels in spawning gravel is included in Table 41. McHenry et al. (1994) determined that fine sediment levels are consistently higher in managed watersheds than in unlogged watersheds on the Olympic Peninsula, and that this relationship appears to be consistent regardless of differences in watershed geology.

Table 41. Summary of fine sediment levels in spawning gravel, Hoko River subbasin (McHenry et al. 1994). Note: samples collected summer 1991, samples processed using gravimetric methods (dry-sieve) and then converted to volumetric equivalents (wet-sieve).

Stream Name	Location (RM)	No. of Samples	Percent Fines (<0.85mm)
Hoko River	RM 3.5	10	18.2
Hoko River	RM 5.6	10	12.4
Hoko River	RM 9.8	10	16.5
Hoko River	RM 12.7	10	7.8
Hoko River	RM 15.6	10	10.2
Hoko River	RM 21.3	10	17.2
Little Hoko	RM 0.2	10	15.2
Little Hoko	RM 1.5	10	15.3
Little Hoko	RM 1.8	10	12.2
Leyh Creek	RM 0.1	10	14.9
Brownes Creek	RM 0.2	10	13.2
Rights Creek	RM 0.1	10	18.7
Johnson Creek	RM 0.4	10	13.7
Herman Creek	RM 0.3	10	11.6
Ellis Creek	RM 0.2	10	12.8
Bear Creek	RM 0.2	10	15.2
Cub Creek	RM 0.1	10	17.7

5.8.4 Floodplain and Riparian Habitat Conditions

Vagt (1995) assessed riparian conditions in the Hoko River subbasin as part of the Hoko Watershed Analysis and found that 91 percent of riparian stands were dominated by red alder. Historical photos of the watershed from 1948 indicate that prior to clearcut logging the majority of riparian stands were conifer-dominated, except in areas already converted from forest land to agricultural land use. Vagt (1995) concluded that the long-term outlook of LWD recruitment in the watershed is poor and that LWD loading is currently on a downward trend. McHenry et al. (1998) compared LWD frequency and volume at four sites in the Hoko Watershed that were surveyed by Grette (1985) in 1982 to levels measured in 1993 and found that old-growth derived LWD decreased significantly. Vagt (1995) reports that old, large key pieces of LWD are nearing the end of their useful life and red alder are now often the only LWD sources available for recruitment.

In addition to LWD recruitment potential, Vagt (1995) also evaluated shade levels within the Hoko River subbasin. Riparian areas currently used as pasture and for agricultural purposes had on average the lowest shade levels. Vagt (1995) classified the mainstem from the confluence with the Strait to the confluence with Ellis Creek as naturally below the watershed analysis shade target of 80 percent. This reach was classified as having 0-5 percent shade. The reach immediately upstream to Bear Creek was classified as having 0-50 percent shade. Currence (1994 *in* Martin 1995) found that shade met watershed analysis targets in only 4 of the 19 sites field surveyed. Reduced shade levels are a source of increased solar radiation. All or almost all stream reaches currently have reduced shade levels compared to their pre-disturbance levels, which has likely increased stream temperatures above their pre-disturbance levels (see Section 5.8.5).

Roads in riparian areas have greatly impacted the riparian forests in the Hoko River subbasin (Smith 2000). Smith reports that floodplain roads in the Hoko River floodplain are currently at levels above 5.4 miles of road per square mile and suggests that this level indicates that the floodplain is not properly functioning. A railroad grade that parallels the river's west bank hinders channel migration and alters riparian forest potential, shade levels, and LWD recruitment potential. Floodplain infrastructure (e.g., private homes) also limits natural floodplain and riparian processes in a few locations but the watershed contains a dozen or fewer homes directly adjacent to the banks of the mainstem.

Noxious weed inventories and control projects have been active throughout various WRIA 19 subbasins (CCNWCB 2005, 2006, 2007). The Hoko River floodplain is infested by at least three species of noxious weeds. Himalayan blackberry, reed canary grass, and knotweed are all present within portions of the Hoko River. Knotweed has been mapped from the confluence with the Strait to river mile 14.0.

5.8.5 Water Quality Conditions

No watershed analysis or basin scale assessment of water quality conditions has occurred in the Hoko River subbasin. Stream temperature was evaluated by Martin (1995) as part of the Hoko Watershed Analysis. Martin (1995) noted concern over high stream temperatures during summer rearing in the mainstem and in some of the tributaries. Water temperature data collected near Ellis Creek in 1985 recorded a maximum stream temperature of 23°C. During the summer of 1993, water temperatures in the mainstem near Cowan's farm ranged from 12 to 20°C.

The Makah and Elwha Tribes have collected a large amount of stream temperature data since the Hoko Watershed Analysis was conducted. From 1997 to 2004 the Makah Tribe collected 46 sets of water temperature data, at 11 monitoring sites from river mile 1.3 to 21.5. No comprehensive analysis of these data has occurred. A summary of maximum daily stream temperature and maximum 7-day average daily maximum (7-DADMax) stream temperature is included in Table 42. Maximum daily stream temperature downstream of the Little Hoko River ranged from 19 to 21.9°C and the maximum 7-DADMax exceeded 18°C every year data were collected. The mainstem site downstream of Brownes Creek had maximum daily stream temperatures ranging from 18 to 21.4°C and all six years the maximum 7-DADMax exceeded 16.0°C. The mainstem site downstream of Herman Creek had maximum daily stream temperatures ranging from 15.7 to 18.8°C and five out of six years the maximum 7-DADMax equaled or exceeded 16.0°C. These stream temperature data show that Hoko River mainstem maximum daily temperature exceeded the State's water quality standard for temperature at all three sites.

Table 42. Summary of Hoko River maximum daily stream temperature and maximum 7-DADMax stream temperature (source: Makah Tribe, unpublished data).

Stream Reach	Temperature Attribute °C	1997	1998	1999	2000	2001	2002	2003	2004
Hoko River Downstream of Little Hoko	Max. Temp	20.4	-	19	19.3	-	20.4	19.8	21.9
	7-DADMax	19.7	-	18.2	18.1	-	18.6	18.5	20
Hoko River Just Downstream of Brownes Creek	Max Temp	-	20	18.4	20.4	18	-	21.2	21.4
	7-DADMax	-	18.5	17.5	17.3	16.4	-	19.4	20.8
Hoko River Downstream of Herman Creek	Max Temp	-	18.6	16.6	16	-	17.8	18.9	19.2
	7-DADMax	-	17.6	16	15.7	-	16.9	17.7	18.8

The stream temperature data summarized in Table 42 show that the Hoko River mainstem maximum daily temperature exceeded the State's water quality standard for temperature at all three sites. Only three short reaches of the Little Hoko River are currently listed on the State's 303(d) list as impaired for temperature.

Fine sediment and turbidity problems in tributaries and the mainstem have been documented over the past two decades. The 5900 and 9000 Roads have been chronic fine sediment sources over the past few decades. No stream segments in the Hoko River are currently listed on the State's 303(d) list. The Hoko Watershed Analysis estimated that road derived sediment inputs were greater than 100 percent over background in several Hoko River subbasins. The subbasins with the greatest sediment inputs above background from highest to lowest (> 100% above background) include: Mainstem upstream of Bear Creek (195%), Johnson Creek (160%), Ellis Creek (146%), Brownes Creek (136%), Cub Creek (125%), mainstem (120%), and Little Hoko (103%).

Since approximately 2000, there has been concern over water quality conditions in the Hoko River estuary. During 2010, water quality data including pH, turbidity, temperature, DO, salinity, and conductivity were collected monthly for further analysis. A brief review of these data suggest that occasionally DO levels are very low (<3.0 mg/L) at two of the sites in the estuary. Collection and analysis of additional data is an important component of understanding water quality conditions in the estuary and potential water quality factors that might affect salmonids in the Hoko River subbasin.

A Benthic Index of Biological Integrity (BIBI) survey was conducted in 2004. Data were collected at three sites on the Hoko River. The lower site was located near river mile 3.5 (note: Hoko River, river miles based on Phinney and Bucknell [1975] river miles), the middle and upper sites were located at RM 9.8 and 18.4 respectively. The upper site had a BIBI score of 40, which rated as “compromised”. The middle site had a BIBI score of 38, which rated as “compromised”. The lower site had a BIBI score of 30, which rated as “impaired” (Tetra Tech/KCM 2005).

5.8.6 Hydrologic Conditions

Summer-time stream flows in the Hoko River subbasin are as low as 11 cfs, whereas annual peak flows can be very high (peak of record 19,400 cfs). No systematic analysis of changes in peak or low flows has been conducted within the Hoko River subbasin. Ample evidence has been collected and reviewed that shows extensive clearcutting and road building has occurred over the past 100 years. Very little old growth forest remains in the watershed and roads have been constructed throughout the entire watershed. The direct impact of alterations to hydrological maturity and road building have not been linked, but indirectly there are several indicators that peak flows have impacted salmon production (Smith 2000).

The Hoko River subbasin is the only subbasin within the WRIA 19 watershed that has an active, long-term USGS stream flow monitoring station. The stream gage is located adjacent to the Hoko Ozette Road at RM 5.7. Continuous low flow data are available for a 25-year period from water year 1983 to 2007. Fourteen-day low flows over the period of record range from 12.2 (1987) to 43 (2007) cfs, averaging 19.5 cfs (median 16.8cfs). Thirty-day low flow data over the same period of record range from 12.3 to 60 cfs, averaging 25 cfs (median 19.4 cfs). Peak instantaneous flows in Water Years 1963 through 1978 and 1996 through 2007 ranged from 3,620 cfs (WY 1977) to 19,400 cfs (WY 2000). A total of 28 years of peak flow data have been recorded. During this period 5 of the highest 8 annual peak flows occurred during the last 11 years, whereas only 3 of the highest 8 annual peak flows occurred during the preceding 17 years.

EES Consulting (2005) reported that, based on physical habitat simulation (PHABSIM) modeling work conducted in Hoko River, fish habitat requirements are exceeded during winter months. Existing summer flows were required to meet fish habitat needs. Figure 97 depicts synthesized dispersed stream flow duration curves for Hoko River at the confluence with the Strait.

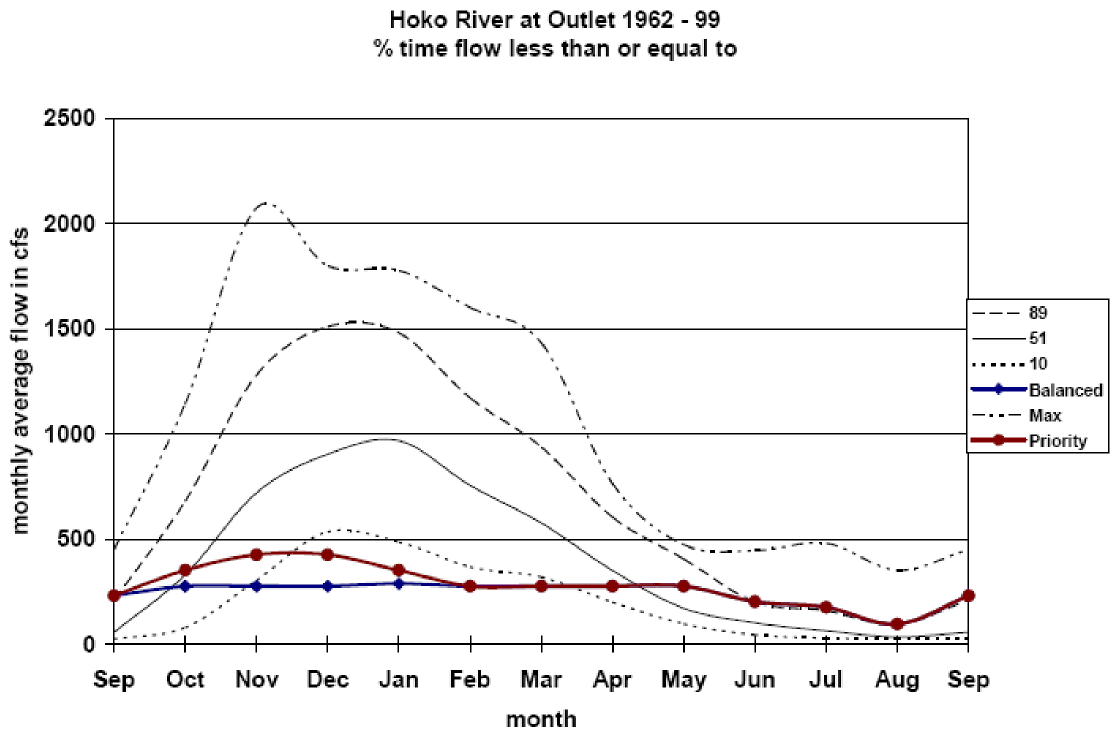

Figure 97. Hoko River at confluence with Strait, synthesized annually (1962-1999) dispersed flow duration curve (source: EES Consulting 2005).

5.8.7 Funded and/or Implemented Restoration and Protection Projects

Extensive habitat restoration has not occurred within most of the Hoko River subbasin. Extensive habitat restoration work has been conducted in the Little Hoko River. The list below includes a detailed inventory of restoration, enhancement, and protection projects implemented or funded in the Hoko River subbasin since 1994.

Hoko River Mainstem

- Experimental treatment of reed canary grass near RM 4.5 and riparian planting with conifer species (1998; Lower Elwha Tribe).
- Treated knotweed along the Pysht River, complete description unavailable (2005-2007; CCNWCB, private citizens).
- Four large logjams constructed near RM 5.2 in the mainstem Hoko River. Riparian planting occurred at the site along the river's right bank (1999; Lower Elwha, Makah Tribe, and Crown Pacific [supplied mitigation funds for forest practices violations]).
- Hoko River/Ellis Creek Restoration. A multiple site project that included the removal of the creosote bridge and fill approaches of the 6000 Road as well as the removal of the abandoned railroad trestle on Ellis Creek. Removal of culvert and fill on tributary 19.0191, abandonment of 0.5 miles of the 5900 road, construction of 8 engineered logjams in the mainstem Hoko and placement of LWD at 60 sites in lower Ellis Creek. (2008; Lower Elwha Tribe/WDNR/Rayonier).

Little Hoko River

Extensive habitat restoration work has been conducted in the Little Hoko River between 1994-1998 following the sale of the Cowan Ranch to Washington State Parks and Recreation. The bulk of the work was conducted in five phases by the Lower Elwha Tribe as follows:

- Phase 1 restoration, river mile 0.0 -1.7 (1994; Lower Elwha Tribe)
  - Livestock exclusion, constructed 4 livestock exclusion structures
  - Riparian planting: planted over 20,000 native trees and shrubs adjacent to the Little Hoko River.
  - LWD placement: placed LWD structures from RM 0.0 to 1.7.
- Phase 2 restoration, river mile 0.0 -3.5 (1995; Lower Elwha Tribe)
  - Riparian planting: additional native trees and shrubs planted adjacent to the Little Hoko River.
  - Development of three off-channel sites.
  - LWD placement: placed LWD structures from RM 0.0 to 3.5.
- Phase 3 restoration, river mile 0.0 -3.5 (1996; Lower Elwha Tribe)
  - Riparian planting: additional native trees and shrubs planted adjacent to the Little Hoko River. Maintenance and brushing of previously planted trees.
  - Abandonment of floodplain road upstream of RM 2.0

    - LWD placement: placed LWD structures from RM 0.0 to 4.0.
- Phase 4 additive restoration from previous years work from RM 2.8 to 4.0 (1997; Lower Elwha Tribe).
- Phase 5 additive restoration from previous years work from RM 0 to 4.0 (1998; Lower Elwha Tribe).
- Four LWD structures built near RM 3 using logging tower (2002; Makah Tribe, Lower Elwha Tribe, and Crown Pacific).

Other Tributaries

- Brownes Creek LWD and riparian restoration project (2003-2004; Makah Tribe)
    - During the fall of 2003 and 2004 a total of 100 key pieces of LWD and 1,000 pieces of LWD were added to Brownes Creek from RM 0.0 to 2.0.
    - A total of 9,300 cedar and spruce trees were planted in the Brownes Creek riparian zone; 250 pounds of grass seed were planted along the disturbed margins of the channel.
- Two collapsing, partial barrier culverts were removed from the mainstem Johnson Creek at RM 0.4 (2000; Crown Pacific).
- A total barrier culvert and fill was removed from an unnamed tributary (19.0176) to Johnson Creek. However, an additional barrier culvert exists directly upstream on the Hoko Ozette Road.
- A partial barrier culvert and fill on an unnamed tributary (19.0191) to the Hoko River was removed during the summer 2008. This restored access to 0.5 miles of 3-7 percent gradient habitat (2008; WDNR and Lower Elwha Tribe).
- Lower Ellis Creek restoration project. An old creosote piling bridge and associated fill will be removed from Ellis Creek and the Ellis Creek floodplain. LWD treatments are planned for the lower 1.0 mile of Ellis Creek. This project will occur in conjunction with the mainstem project described above.
- A partial barrier culvert was replaced on Wrights Creek (RM 0.03), restoring access to 0.25 miles of 2 to 6 percent gradient habitat (1997; Clallam County, Hoko-Ozette Road).
- A partial barrier culvert was replaced on an unnamed tributary to the Hoko River at MP 1.3 of the Hoko-Ozette Road, restoring access to 0.25 miles of 4 to 8 percent gradient habitat (1997; Clallam County).

5.9 SEKIU RIVER

Habitat conditions and limiting factors for the Sekiu River subbasin are described and summarized in several technical reports including:

- Spawning Gravel Quality, Watershed Characteristics and Early Life History Survival of Coho Salmon and Steelhead in five North Olympic Peninsula Watersheds (McHenry et al. 1994).
- WRIA 19 Limiting Factors Report (Smith 2000)
- Sekiu Watershed Analysis and Modules (WDNR 2001)
- NOPLE Salmon Habitat Recovery Strategy (NOPLE 2004)
- Historical Changes to Estuaries, Spits, and Associated Tidal Wetland Habitats in the Hood Canal and Strait of Juan de Fuca Regions of Washington State (Todd et al. 2006)

Key or major limiting factors include:

- Sedimentation from road network and mass wasting events:
    - Increased fine sediment levels in spawning gravel (McHenry et al. 1994)
    - Increased coarse sediment has resulted in channel instability in the mainstem (Perkins 2001)
- Severe loss and/or lack of large woody debris resulting in decreased pool habitat formation and channel complexity. Also contributes to channel instability (Currence 2001).
- Floodplain development primarily by roads have altered habitat forming processes and riparian conditions.
- Naturally low flows during summer and early-fall contribute to high stream temperatures that negatively affect juvenile salmonid rearing.

Other limiting factors:

- Loss of habitat connectivity: human caused barriers have reduced the quantity of habitat available for spawning and rearing

5.9.1 Estuary and Nearshore Conditions

The Sekiu River enters the Strait of Juan de Fuca approximately 1.75 miles west of Kydaka Point. Like most river systems in the western Strait, the Sekiu River has a very limited estuary with only fringing tidal marsh occurring just upstream of the mouth (Todd et al. 2006). Todd et al. describe historical changes at and near the mouth based on a time series analysis of aerial photos and maps. They found that since 1973 the shoreline around the mouth of the river is displaying a net seaward movement and is developing a grassland backshore in the most recent years. They further describe that spits and small bars have alternately formed and eroded both west and east of the mouth during the time period evaluated. They concluded that their historical data sources were insufficient in detail to determine the long-term changes at the mouth.

Strong tidal influence extends upstream for at least 1 mile. There are very limited side channels and associated wetlands within the tidally influenced reach and therefore limited inter-tidal off-channel habitat. One large wetland system enters along the right bank approximately 0.1 miles upstream from the SR 112 bridge. Todd et al. (2006) concluded that Sekiu River estuary and nearshore habitat were "moderately impaired" based on the high potential for indirect impacts on the small estuary from upstream floodplain roads, logging-related sediment supply, and altered longshore sediment processes.

Additional assessment found that physical nearshore habitat was impaired by structures within the CMZ and nearshore environment, the SR 112 bridge constricts flow and alters sediment transport processes, historical timber harvest has altered riparian composition, and there has been a reduction in tidal marsh area near the mouth and upstream of SR 112.

5.9.2 Habitat Connectivity

Waterfalls, cascades, log jams, and steep gradients limit anadromous fish distribution and habitat utilization in the Sekiu River subbasin. A natural waterfall at river mile 8.6 (river miles based on Phinney and Bucknell [1975]) stop all anadromous fish migration in the North Fork Sekiu River. Currence (2001) provides a detailed table that includes the known upper extent of anadromous fish use for all major streams within the Sekiu River subbasin. The comprehensive fish distribution table in Currence includes all known fish barriers in the Sekiu River subbasin. A list of human caused barriers is included below.

- A barrier culvert blocks 0.4 miles of 4-8 percent gradient habitat in an unnamed tributary to No Name Creek (near RM 0.6).
- When the CZ 1000 Road was constructed it cut off a major meander of the Sekiu River leaving a large ponded channel segment. This habitat is now partially blocked by an improperly placed culvert. Restoring fish access to this pond would substantially increase the off-channel habitat available to juvenile salmonids in this subbasin.
- A barrier culvert on the CZ 1000 Road blocks approximately 0.25 miles of spawning and rearing habitat in an unnamed right bank tributary to the Sekiu River (section 13).
- Near RM 0.18 in a left bank tributary to 19.0218 (RM 0.44), a culvert blocks an unquantified amount of coho, steelhead and cutthroat habitat. Upstream habitat quantification needs to occur prior to restoration planning.

5.9.3 Spawning and Rearing Habitat Conditions

Currence (2001) conducted habitat surveys in the mainstem, North Fork, and South Fork, as well as in several tributaries in 1997 as part of the Sekiu-Coastal Watershed Analysis. These surveys included pool habitat and large woody debris inventories. McHenry et al. (1994) studied spawning habitat quality at several sites within the watershed. A summary of the findings from these three investigations is included below.

Pool Conditions

Pool area data, measured as a percentage of the stream length, were collected in a total of 14 channel segments. A complete summary of pool habitat data is included below in Table 43. Percent pool ranged from a low of 3 percent (upper Sunny Brook) to a high of 90 percent (Upper North Fork Sekiu River). Percent pool ratings based on the watershed analysis rating protocol rated good in 8 (57%) segments, fair in 2 (14%) segments, and poor 4 (29%) segments. Pool frequency ranged from a low of 1.3 (No Name Creek segment M322) to a high of 17 (Upper Sunny Brook). Pool frequency rated good in 3 (21%) segments, fair in 9 (64%) segments, and poor in 2 (14%) segments. Percent woody cover in pools rated good in 2 (14%) segments, fair in 3 (21%) segments, and poor in 9 (64%) segments. Holding pool frequency (number of pools greater than 1 meter deep per km) rated good in one segment and poor in all other segments.

Currence (2001) concluded that pool quantity data indicate conditions may be degraded in some areas, but less so in other areas. The pool frequency data suggests that channel complexity has been reduced. Pool quality is generally quite degraded throughout the Sekiu River watershed, which may adversely affect adult migrations and juvenile salmonid rearing.

Table 43. Summary of pool habitat data for the Sekiu River and tributaries (Source Currence 2001).

Stream Name	Seg ID	Surveyed Length (m)	Gradient	Number of Pools	Percent Pools	Pool Frequency	Percent Woody Cover in Pools	Pools >1 m Depth
Sekiu River	M1b	722	<1%	10	71%	3	0-5%	1.4
S.F. Sekiu River	S1	275	<1%	5	82%	3.8	0-5%	3.6
S.F. Sekiu River	S2	297	1-2%	11	31%	2.2	0-5%	3.4
S.F. Sekiu River	S4	307	<1%	9	64%	2.8	0-5%	6.5
N.F. Sekiu River	N2	415	<1%	9	43%	1.9	>20%	2.4
N.F. Sekiu River	N3	315	<1%	8	67%	2.4	6-20%	9.5
N.F. Sekiu River	N5	228	<1%	6	66%	2.4	6-20%	4.4
N.F. Sekiu River	N7	215	1-2%	9	90%	2.4	0-5%	4.7
Carpenters Creek	M12	243	<1%	14	59%	1.5	>20%	4.1
E.F. Carpenters	M14	189	2-4%	8	30%	3.9	0-5%	0
No Name Creek	M31	213	2%	8	18%	4.2	0-5%	0
No Name Creek	M31	152	6.00%	14	32%	1.3	6-20%	0
Ice Creek	S12	140	2.00%	5	18%	3.4	0-5%	0
Sunny Brook	N58	79	7%	3	3%	17	6-20%	0

Large Woody Debris

Large woody debris data were collected in the same 14 channel segments described above. A summary of LWD data is included below in Table 44. Piece frequency ranged from a low of zero (S.F. Sekiu River) to a high of 4.2 pieces per channel width. LWD piece frequency rated good in 6 (42%) channel segments, fair in 5 (36%) segments, and poor in 3 (21%). Key pieces per channel width ranged from zero to 0.32 (N.F. Sekiu River segment N2). Key pieces per channel width rated poor in all segments expect for the N.F. Sekiu River segment N2, which rated fair. Currence (2001) noted that LWD in the Sekiu River watershed is extremely important, and that key and large functional LWD form steps and locally reduce gradient, trap gravel, aid in the formation of deep plunge and scour pools, create logjams, and add important cover and overwintering habitat. Within the sites monitored for the watershed analysis, Currence found that the larger the LWD, the more habitat related functions provided, and that key pieces formed the best habitats within the watershed. He concluded that the shortage of key and functional size pieces of LWD is probably the single greatest habitat issue within the Sekiu River watershed and that the shortage of key pieces has led to many additional habitat problems.

Table 44. Summary of large woody debris data for the Sekiu River and tributaries (Source Haggerty 2008).

Stream Name	Seg ID	Length Surveyed (m)	Gradient	LWD Frequency (Pieces per channel width)	LWD Frequency Rating	Key Pieces per Channel Width	Key Piece Rating
Sekiu River	M1b	722	<1%	2.3	Good	0	Poor
S.F. Sekiu River	S1	275	<1%	0	Poor	0	Poor
S.F. Sekiu River	S2	297	1-2%	0.3	Poor	0	Poor
S.F. Sekiu River	S4	307	<1%	1.3	Fair	0.04	Poor
N.F. Sekiu River	N2	415	<1%	2.1	Good	0.32	Fair
N.F. Sekiu River	N3	315	<1%	3.7	Good	0.04	Poor
N.F. Sekiu River	N5	228	<1%	2.3	Good	0	Poor
N.F. Sekiu River	N7	215	1-2%	1.6	Fair	0	Poor
Carpenters Creek	M12	243	<1%	4.2	Good	0.05	Poor
E.F. Carpenters	M14	189	2-4%	na	Poor	0.1	Poor
No Name Creek	M31	213	2%	1	Fair	0.03	Poor
No Name Creek	M32	152	6%	2.7	Good	0	Poor
Ice Creek	S12	140	2%	1.8	Fair	0	Poor
Sunny Brook	N58	79	7%	1.1	Fair	0	Poor

Channel Substrate

Spawning Gravel Quantity

Currence (2001) concluded that gravel quantity appeared inadequate within the watershed except in unconfined stream channel segments less than 1 percent gradient. The mainstem and North Fork below the falls have sufficient spawning gravel. A shortage of gravel was noted within the anadromous fish use segments in the South Fork, as well as in No Name and Carpenters Creeks. The analysis noted that LWD piece counts did not appear to be a useful indicator of whether LWD was trapping sufficient spawning gravel. The analyst noted that low quantities of spawning gravel correlated with low key piece counts. The fish habitat module concluded that sufficient gravel is routed through the stream network and that adequate amounts of functional LWD are lacking to trap and retain spawning gravel. Increasing functional and key piece size LWD could increase the quantity of available spawning gravel within the watershed.

Spawning Gravel Quality

The level of fine sediment in spawning gravel was studied by McHenry et al. (1994) at four sites in the mainstem Sekiu River and five tributary sites. Gravel samples were collected during the summer of 1991 and 1992. Fine sediment levels in spawning gravel are reported in percent fines less than 0.85 mm. Table 45 includes the results for percent fines in spawning gravel at the ten sites within the Sekiu River watershed. The results presented in Table 45 include the results as reported in Table 4 in McHenry et al. (1994), as well as in wet-sieve equivalents (volumetric). Percent fines in spawning gravel rated good in two segments (Carpenter Creek and N.F. Sekiu River segment N-1), fair in five segments, and poor in all other segments.

Table 45. Fine sediment levels in spawning gravel for ten sites in the mainstem Sekiu River and tributaries, processed using gravimetric methods (source: McHenry et al. 1994).

Stream Name	Sekiu Watershed Analysis Segment	No. of Samples	Percent Fines < 0.85 mm (Gravimetric)	Percent Fines < 0.85 mm (Volumetric)
Sekiu River	M-1a	10	10.3	16.4
Sekiu River	M-1b	10	10.3	16.7
Sekiu River	M-1b/M-1c	10	8.1	14.1
Sekiu River	M-2	10	7.1	12.1
N.F. Sekiu River	N-1	10	6.7	11.9
N.F. Sekiu River	N-4	10	9	15.4
S.F. Sekiu River	S-1	5	8.2	17.8
Sunnybrook	N-53	10	10.8	18.5
Carpenters Creek	M-12	na	na	9.6
E.F. Carpenters Creek	M-13	10	10.4	19.1

5.9.4 Floodplain and Riparian Habitat Conditions

The greatest floodplain impacts within the Sekiu River watershed are associated with the Sekiu River mainline road, which parallels the mainstem to the confluence between the North and South Forks. The road constrains the mainstem, resulting in increased channel instability and loss of critical off-channel rearing habitat (Smith 2000). In addition, the road has been a major source of fine sediment. The surface erosion assessment conducted as part of the Sekiu-Coastal Watershed Analysis estimated that road surfaces within the lower mainstem subbasin deliver more than 760 tons of sediment per year (WDNR 2001). Efforts to chip and seal portions of the mainline have helped reduce fine sediment inputs from the road surface but these reductions have not been quantified. The road also reduces the quality and quantity of riparian forest adjacent to the river, reducing shade and LWD recruitment. Labbe (*in* Smith 2000) estimated that there are 4.8 miles of floodplain road per square mile of floodplain. Smith (2000) notes that this estimate probably underestimates the true road density since many roads are not shown on maps and GIS layers.

The Sekiu-Coastal Watershed Analysis -- Riparian Function Assessment (WDNR 2001) inventoried the riparian vegetation conditions for 327 riparian segments (Note: this analysis contains some segments that are outside of the Sekiu River watershed). The analysis classified each riparian vegetation condition segment into low, moderate, and high hazards based on near-term LWD recruitment potential. The analysis concluded that the near term LWD recruitment potential was moderately impacted along 23 miles (22%) of stream channel and highly impacted along 38 miles (36%) of stream. The analysis suggested that the primary reason for these impacts is the lack of riparian buffers in areas that were logged prior to the current forest practice rules. Figure 98 depicts near-term riparian LWD recruitment potential within the Sekiu-Coastal Watershed Administrative Unit.

In addition to near-term LWD recruitment potential, the analysis also evaluated existing shade levels throughout the Watershed Administrative Unit (WAU). Shade levels were below shade targets along 27 percent of fish bearing streams and received high hazard calls in the Riparian Function Assessment. Target shade levels were met on 73 percent of the stream length. The analyst noted that some areas that did not meet the shade target may have naturally low shade levels (e.g., the lower mainstem). A detailed analysis using aerial photographs was conducted that compared current versus historical shade levels within areas that did not meet shade targets. This analysis suggested that significant stream lengths historically did not meet watershed analysis shade targets. The stream reaches that did not meet target shade levels included: the entire mainstem, the N.F. Sekiu River to the confluence with Sunny Brook, portions of the middle and upper S.F. Sekiu River, and Ice Creek.

Noxious weed inventories and control projects have been active throughout various WRIA 19 subbasins (CCNWCB 2005, 2006, 2007). Inventories conducted in 2006 found that the lower one mile of the Sekiu River floodplain is infested with Bohemian knotweed.

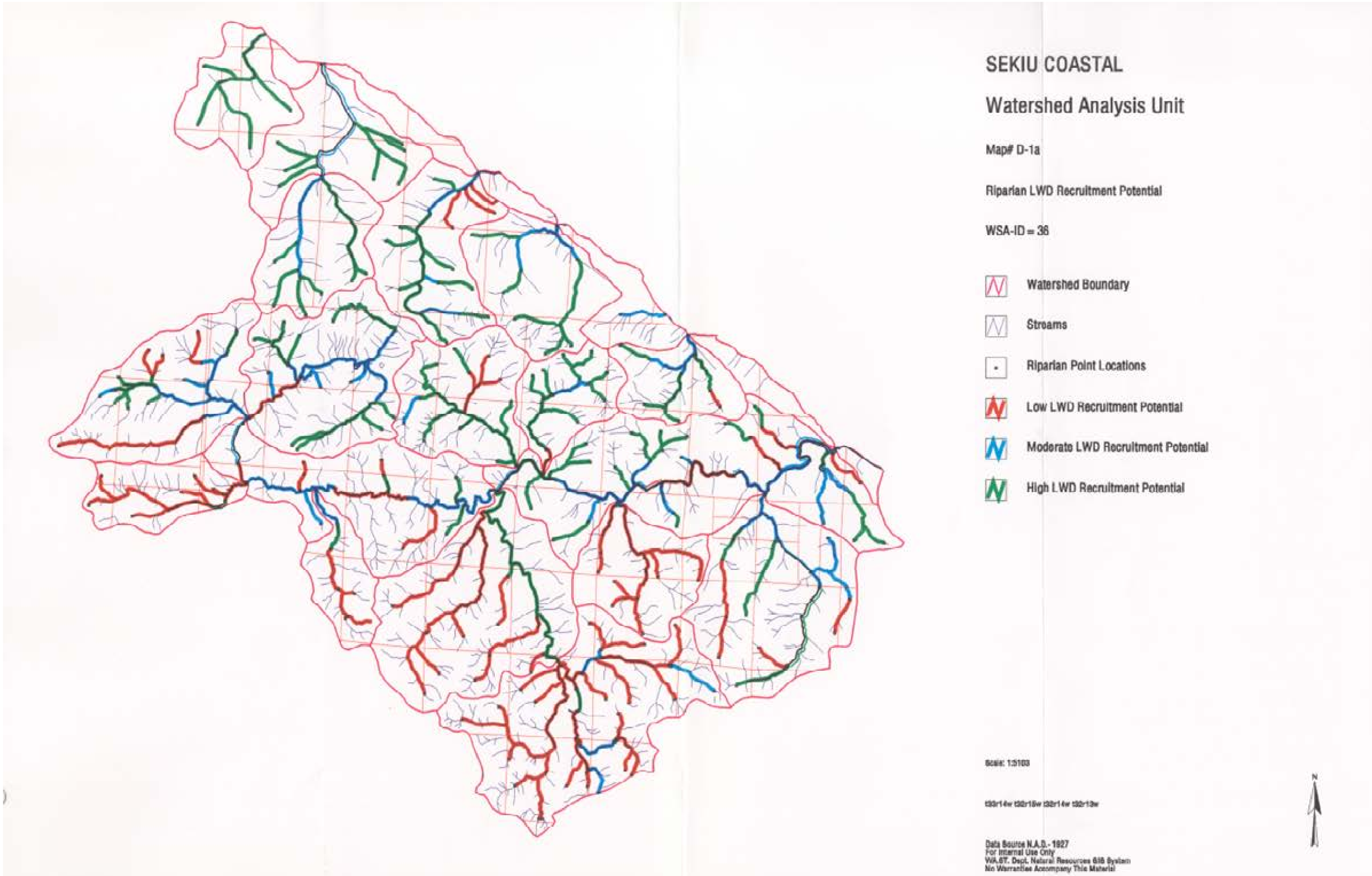

Figure 98. Near-term riparian large woody debris recruitment potential for the Sekiu Coastal WAU (source: WDNR 2001).

5.9.5 Water Quality Conditions

The main water quality problems that have been identified within the Sekiu River watershed include stream temperature and turbidity. Insufficient turbidity data exist to conduct an analysis of impacts. However, estimated sediment delivery from roads exceeds background sediment delivery rates in several Sekiu River sub-basins (WDNR 2001). Smith (2000) notes that turbidity is a problem in the Sekiu River, suggesting that elevated turbidity can affect juvenile salmonid feeding and growth. Currence (2001) recommended developing wet weather haul prescriptions for the Sekiu River watershed to reduce road related sediment inputs. In addition, Currence also recommended establishing a turbidity monitoring program.

Segments of the Sekiu River mainstem, North Fork, and South Fork were included on the 1996 303(d) list as water quality impaired for temperature. Temperature data records extend back to 1985 in the Sekiu River watershed. Since 1985 there have been approximately 150 thermograph deployments throughout the watershed (MFM unpublished data). Most of these deployments were from 1996 to present. A detailed analysis of stream temperature data has not been conducted. The highest stream temperatures measured were in 1985, at river mile 4.5, where daily maximum temperature reached 23.5ºC. Figure 99 depicts the maximum 7-DADMax stream temperature for two sites on the mainstem Sekiu River from 1985 through 2007.

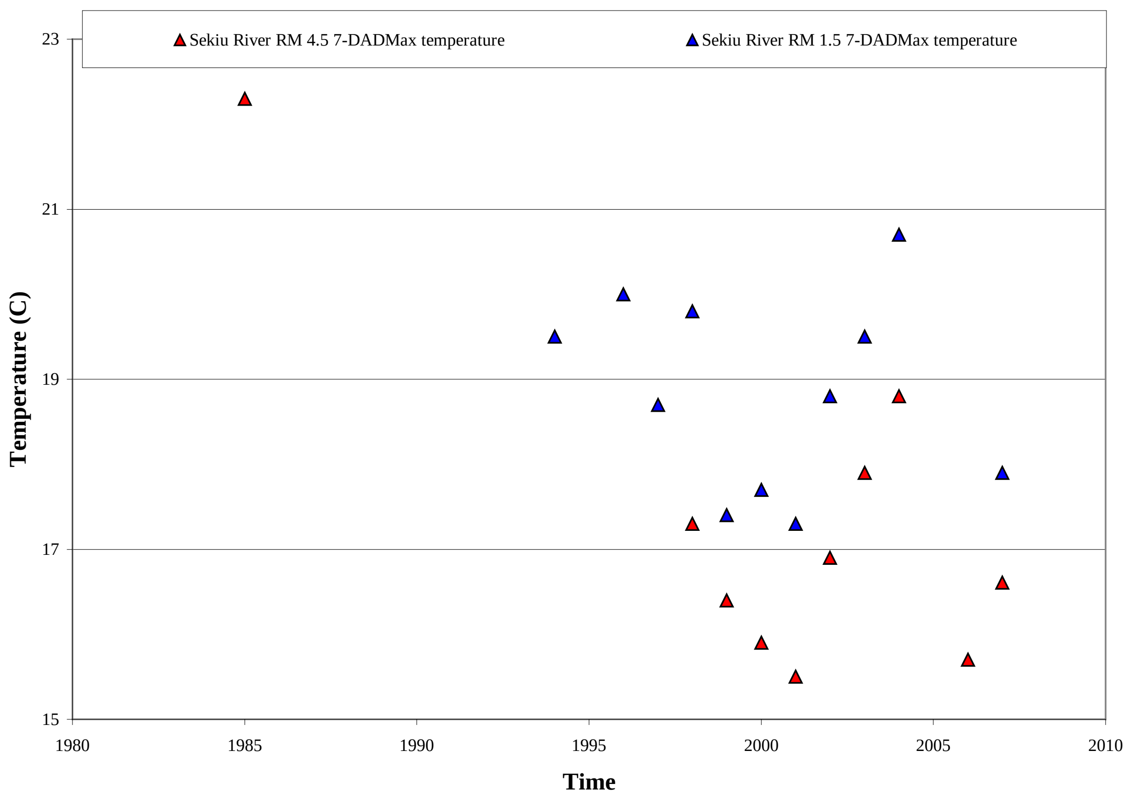

Figure 99. Sekiu River annual maximum seven-day average daily maximum stream temperature at river mile 1.5 and 4.5 (source: MFM, unpublished data).

The maximum 7-DADMax stream temperature exceeded 16ºC during all 11 years sampled at RM 1.5 (just upstream from Carpenters Creek). The maximum 7-DADMax stream temperature exceeded 16ºC during seven of the ten years sampled at RM 4.5 (downstream of the confluence of the North and South forks. At RM 4.5 the maximum stream temperature did not exceeded 20ºC during monitoring from 1998 through 2004, suggesting that daily maximum stream temperatures have decreased from levels measured in 1985. However, at RM 4.5 from July 1, 2004 to August 15, 2004 the 7-DADMax stream temperature exceeded 16ºC on 36 of 46 days (78%). During this same period at RM 1.5 the 7-DADMax stream temperature exceeded 16ºC on all 46 days. Currence (2001) evaluated 1994 and 1996 stream temperature data collected at RM 1.5, and determined that a serious stream temperature problem existed. He suggests that peak temperatures would be expected to reduce juvenile feeding efficiency, and in the mainstem, are occasionally above the threshold triggering growth cessation in juvenile coho.

Stream temperature data collected in 2004, at RM 8.1 (river miles based on Phinney and Bucknell [1975] river miles) show high temperatures also occur in the North Fork Sekiu River. At RM 8.1 from July 1, 2004 to August 15, 2004 the 7-DADMax stream temperature exceeded 16ºC on 38 of 46 days (83%). Data from 2004, collected in the South Fork at RM 2.8 indicate stream temperatures exceed water quality standards for temperature. During the same July/August time period the 7-DADMax stream temperature in the South Fork exceeded 16ºC on 9 of 46 days (20%). Currence (2001) speculated that temperatures were cooler in the South Fork Sekiu as compared to the North Fork and mainstem due to its north-south orientation. A preliminary review of Sekiu River tributary stream temperature data suggests that significant stream temperature problems are unlikely in Sunny Brook. Within Sonny Brook maximum stream temperature averaged only 13.4ºC from July 1, 2004 to August 15, 2004. Data collected during this same time period in unnamed tributary 19.0210 revealed significantly higher temperatures than in Sunny Brook. The maximum stream temperature reached 17.8ºC and the 7-DADMax exceeded 16ºC on 46 percent of the days monitored.

A Benthic Index of Biological Integrity (BIBI) survey was conducted in 2004. Data were collected at two sites in the Sekiu River. The lower site was located near river mile 2.1 and the upper site was located on the North Fork Sekiu River at RM 6.5 (note: Sekiu River, river miles based on Phinney and Bucknell [1975] river miles; from GIS coordinates in Tetra Tech/KCM 2005). Both sites had BIBI scores of 40, which rated as “compromised” (Tetra Tech/KCM 2005).

5.9.6 Hydrologic Conditions

Summer-time stream flows within the Sekiu River watershed can be very low (<5 cfs), whereas annual peak flows can be quite high (>1,000 cfs). No systematic analysis of changes in peak or low flows has been conducted within the Sekiu River watershed. Ample evidence has been collected and reviewed that shows extensive clearcutting and road building has occurred over the past 100 years. Very little old growth forest remains in the watershed and roads have been constructed throughout the entire watershed.

Washington State Department of Ecology (DOE) continuous stream flow monitoring in the Sekiu River began during August 2006. The stream gage is located upstream of Carpenters Creek near RM 2.2. Too few data are currently available to directly estimate meaningful stream flow statistics.

EES Consulting (2005) reported that, based on physical habitat simulation (PHABSIM) modeling work conducted in the Sekiu River, fish habitat requirements are exceeded during winter months. Existing summer flows were required to meet fish habitat needs. Figure 100 depicts synthesized dispersed stream flow duration curves for Sekiu River at the confluence with the Strait of Juan de Fuca.

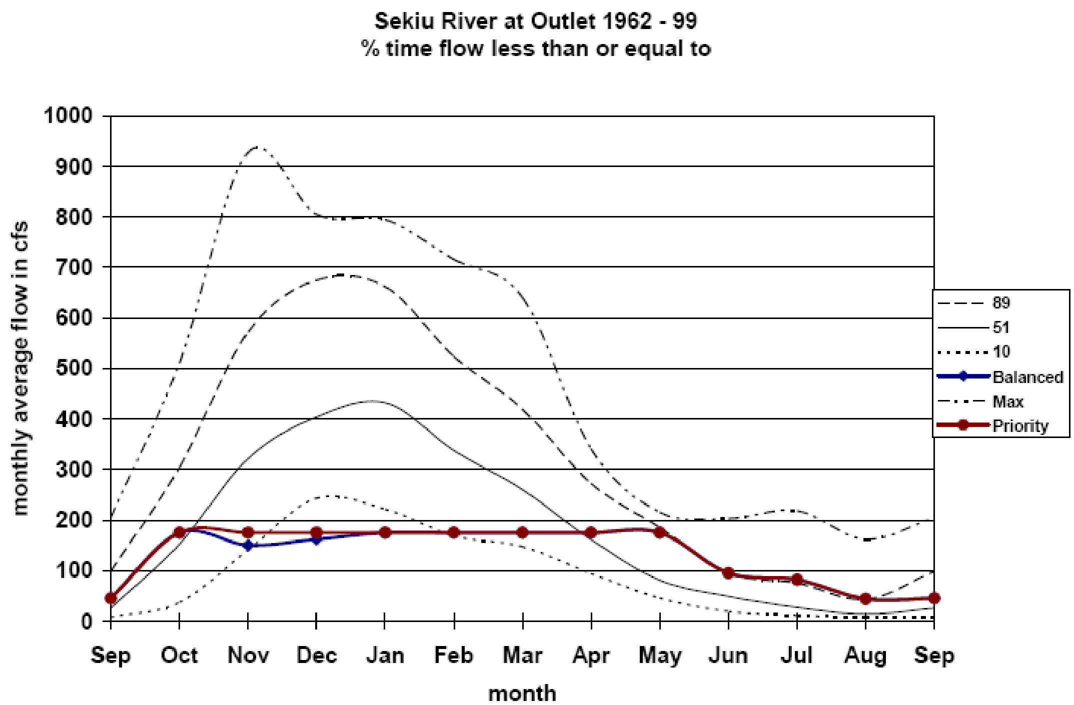

Figure 100. Sekiu River at confluence with Strait, synthesized annually (1962-1999) dispersed flow duration curve (source: EES Consulting 2005).

5.9.7 Funded and/or Implemented Restoration and Protection Projects

Extensive habitat restoration has not occurred in the Sekiu River subbasin. The list below includes a detailed inventory of restoration, enhancement, and protection projects implemented in the Sekiu River subbasin since the mid-1990s.

- Sekiu River LWD Jams, 5 logjams constructed in mainstem from RM 1.3 to 3.2 (2000; Makah Tribe)
- Sekiu River, S.F. Sekiu, N.F Sekiu, and No Name Creek LWD added to streams and river channels from bridges, approximately 30 log truck loads (1998 & 1999; Crown Pacific).
- Carpenters Creek LWD placement (RM 0.3 to 0.6) using logging tower (1999; Crown Pacific).
- Replaced impassable culvert on unnamed tributary 19.0215 with new fish passable culvert, opened access to 0.34 mile of 4-8 percent gradient habitat (2006; Green Crow).
- Enhanced channel, added meander, small pond, and LWD on unnamed tributary (RM 0.1 to 0.2) to Sekiu River just upstream of Carpenters Creek (2001; Crown Pacific).

5.10 WESTERN STRAIT INDEPENDENTS

5.10.1 Estuary and Nearshore Conditions

Habitat conditions for the WRIA 19 independent tributaries has been recently summarized by Todd et al. (2006) and include a range of conditions from functional to severely impaired. Functional systems include only Colville and Field Creeks. Whiskey, Jim, Bullman and Snow Creeks were all classified as moderately or severely impaired primarily as a result of human encroachment. Murdock, Rasmussen, Jansen and Olsen Creeks had insufficient historical information to make an assessment.

Colville Creek enters into Freshwater Bay as a stream delta that has had little evidence of human impacts. Like many small streams in the SJF a barrier beach forms during low flow periods when tidal energy exceeds hydrologic energy. These barriers typically breach during storms allowing anadromous fish to ingress or egress depending on life history stage. Similarly, Field and Murdoch creeks join the Strait as relatively steep, small stream delta complexes. Both are fairly isolated by steep, eroding bluffs and have no significant development. Whiskey Creek is a small steam delta, that Todd et al. (2006) characterize as severely impaired because of fill, bulkheading, and jetty construction to accommodate a boat launch. Jim Creek is similarly impacted with extensive filling and bulkheading in support of private boat launching facilities. Joe Creek was not included in the Todd et al. (2006) report. This small stream delta system flows into the Pysht estuary and has been impacted by filling to accommodate a parking lot and boat launch owned by Clallam County. Snow Creek is arguably the most impacted of the SJF independents. The lower portions of the Creek have been extensively channelized and filled and the estuary has been thoroughly rip-rapped in support of a fishing resort.

5.10.2 Habitat Connectivity

Waterfalls, cascades, log jams, and steep gradients limit anadromous fish distribution and habitat utilization in the WSI subbasin. A comprehensive road crossing inventory has not been conducted within the subbasin. Smith (2000) completed a partial inventory of all road related fish blockages within the WSI subbasin. This inventory included a ranking of culvert priorities but did not utilize a systematic rationale for the ranking; therefore those rankings are included below for reference purposes only. The inventory has also been updated based on recent information and is presented below from east to west.

- 50) A perched culvert barrier SR 112 MP 56.5 potentially blocks ~2.0 miles of coho, steelhead, and cutthroat habitat in tributary 19.0003 (RM 0.2) to Colville Creek. 41) A culvert on Oxenford Road potentially blocks about 0.7 miles of coho, steelhead, and cutthroat habitat in tributary 19.0001A to Colville Creek at RM 0.2.
- 28) In Whiskey Creek (RM 1.5), a 40 percent barrier at box culvert SR 112 MP 49.5 blocks 1.2 miles of coho steelhead, and cutthroat habitat. This documented

blockage requires field verification of fish passage conditions above and below the culvert prior to restoration planning.

- 62) At the mouth of an unnamed stream located between Deep Creek and West Twin River, a recently installed corrugated metal pipe associated with SR 112 near MP 34.8, blocks about 0.5 miles of coho, steelhead, and cutthroat habitat. This documented blockage needs field verification of fish passage conditions above and below the culvert prior to restoration planning.
- (NA) In Jim Creek at RM 0.1 a partial barrier culvert on a private road blocks several miles of habitat in Jim Creek (source: DOT culvert database).
- 36) In Joe Creek at RM 0.5, a 60 percent passable box culvert on SR 112 MP 32.8 blocks about one mile of coho, steelhead, and cutthroat habitat, based upon database documentation. This culvert needs field verification of conditions above and below the culvert prior to restoration planning
- 51) A barrier at the Pillar Point access road culvert blocks about 0.8 miles of coho, steelhead, and cutthroat habitat at the mouth of Butler Creek (19.0112). This requires field verification of fish passage conditions above and below the culvert prior to restoration planning.
    - 52) An 80 percent barrier at double 30" culvert on SR 112 MP 29.7 blocks about 0.5 miles of coho, steelhead, and cutthroat habitat in Butler Creek (19.0112 RM 0.3). This requires field verification of fish passage conditions above and below the culvert prior to restoration planning.
- 54) In a left bank tributary to the Sail River near Sail RM 0.1, a culvert potentially blocks at least 0.4 (2-4% gradient) miles of coho, steelhead, and cutthroat habitat (field verified by Makah Tribe).
- 67) On Village Creek (19.0240) near RM 0.25, a 185’ long perched culvert blocks 0.32 miles of coho, steelhead, and cutthroat habitat (0.23 miles of 2-4% gradient, moderately confined and 0.09 miles of 4-8 percent gradient, confined channel).

5.10.3 Spawning and Rearing Habitat Conditions

Currence (2001 *in* WDNR 2001) conducted habitat surveys in Jansen and Rasmussen Creeks in 1997 as part of the Sekiu-Coastal Watershed Analysis. Additional unreported data were collected during the spring and summer of 1998 by Makah Fisheries Management in Bullman, Snow, Agency, and Village Creeks, as well as the Sail River. These data include pool habitat and a large woody debris inventory. McHenry et al. (1994) studied spawning habitat quality at one site in Bullman Creek in the early 1990s. A summary of the findings from these three investigations is included below.

Pool Conditions

Pool surface area data, measured as a percentage of the stream length, were collected in a total of 14 channel segments. A complete summary of pool habitat data is included below in Table 46. Percent pool ranged from a low of 10 percent (Agency Creek segment 4) to a high of 43 percent (Rasmussen Creek). Percent pool ratings based on the watershed analysis rating protocol rated good in 2 (14%) segments, fair in 4 (29%)

segments, and poor in 8 (57%) segments. Pool frequency ranged from a low of 2.6 (Jansen Creek segment 2) to a high of 12.6 (Snow Creek). Pool frequency rated good in 0 segments, fair in 4 (29%) segments, and poor in 8 (71%) segments. Percent woody cover in pools rated good in 2 (14%) segments, fair in 6 (43%) segments, and poor in 6 (43%) segments. Holding pool frequency (number of pools greater than 1 meter deep per km) rated fair in two segments and poor in all other segments.

Table 46. Summary of pool habitat data for miscellaneous WSI subbasin streams (Source Currence 2001 *in* WDNR 2001 and MFM unpublished data).

Stream Name	Seg ID	Length (m)	Gradient	Number of Pools	Percent Pools	Pool Frequency	Percent Woody Cover in Pools	Pools >1 m Depth
Jansen Creek	1	140	3%	na	34%	4.2	0-5%	0
Jansen Creek	2	186	2-4%	na	41%	2.6	6-20%	0
Rasmussen Creek	1	180	1-5%	na	43%	2.8	0-5%	0
Snow Creek	1	640	2-4%	8	22%	12.6	0-5%	0
Sail River	1	1,712	1-2%	35	41%	3.9	0-5%	8
Sail River	2	3,333	1-3%	39	19%	8.0	0-5%	8
Sail River	3	640	2-4%	9	16%	6.7	0-5%	0
Sail River	4	1,219	2-4%	33	29%	4.3	6-20%	1
Agency Creek	1	411	1-2%	12	27%	10.4	>20%	0
Agency Creek	3	686	2-4%	37	31%	4.7	>20%	0
Agency Creek	4	492	4-6%	15	10%	9.7	6-20%	0
Village Creek	1	404	1-2%	8	25%	6.7	6-20%	1
Village Creek	2	366	2-4%	17	35%	3.4	6-20%	0
Village Creek	3	144	4-6%	5	29%	4.6	6-20%	0

Large Woody Debris

Large woody debris inventory data were collected in the same 14 channel segments as described above in the pool conditions subsection. A complete summary of the LWD data collected is included below in Table 47. Large woody debris frequency ranged from a low of 0.4 pieces per channel width (Agency Creek segment 1) to a high of 6.9 (Sail River segment 1). LWD pieces classified as conifer ranged from 30 to 76 percent. Key pieces of LWD per channel width was very low in all stream segments surveyed with the exception of Rasmussen Creek, which rated fair (0.17 pieces per channel width). LWD pieces greater than 50 cm diameter ranged from 3 percent (Sail River segment 3) to 26 percent (Village Creek segment 3). In general, larger size LWD is absent or occurs at low levels in most WSI subbasin streams. The poor pool habitat conditions measured in most WSI subbasin streams is likely related to the reduced levels of large (> 50 cm diameter) LWD in most channel segments.

Table 47. Summary of large woody debris inventory data for miscellaneous WSI subbasin streams (Source: Currence 2001 *in* WDNR 2001 and MFM unpublished data).

Stream Name	Seg ID	Length (m)	Gradient	Number of LWD Pieces	LWD Frequency (Pieces per channel width)	Percent of Pieces Conifer	Key Pieces per Channel Width	Percent of Pieces > 50 cm diameter
Jansen Creek	1	140	3%	72	4.2	na	0	na
Jansen Creek	2	186	2-4%	76	2.6	na	0.07	na
Rasmussen Creek	1	180	1-5%	66	2.8	na	0.17	na
Snow Creek	1	640	2-4%	215	2.1	50%	0.01	12%
Sail River	1	1,712	1-2%	931	6.9	40%	na	10%
Sail River	2	3,333	1-3%	874	2.8	30%	<0.01	7%
Sail River	3	640	2-4%	280	4.6	32%	0.02	3%
Sail River	4	1,219	2-4%	384	2.7	40%	0.01	7%
Agency Creek	1	411	1-2%	56	0.4	45%	0	14%
Agency Creek	3	686	2-4%	272	1.5	72%	0.03	20%
Agency Creek	4	492	4-6%	220	1.5	76%	0.07	20%
Village Creek	1	404	1-2%	28	0.5	61%	0	21%
Village Creek	2	366	2-4%	98	1.8	46%	0	9%
Village Creek	3	144	4-6%	43	1.9	70%	0	26%

Channel Substrate

The Sekiu Coastal Watershed Analysis (Currence 2001 *in* WDNR 2001) concluded that gravel quantity appeared to be inadequate in almost all stream reaches except in unconfined channel segments of less than 1 percent gradient. The WSI subbasin streams were found to be deficient in gravel. Currence suggested that both the quantity and quality of spawning gravel has been reduced due to a loss of functional large and key piece size LWD. He notes that key piece size LWD in Rasmussen Creek acts to trap gravel and helps provide most of the available spawning gravel within the stream system. Within Jansen Creek, where key piece size LWD is lacking, adequate spawning gravels are absent for much of the stream's length.

Currence (2001 *in* WDNR 2001) advised that the addition of key piece size LWD in Jansen Creek would help trap and restore spawning gravel. It was also noted that water quality conditions were poor due to high turbidity levels caused by wet weather log hauling. Currence suggests that spawning salmonids within the Sekiu-Coastal WAU prefer harder, glacial origin (glacial origin gravels contain different lithologies [e.g. granitic rock types]) gravel where available; however, the substrate in medium and smaller stream systems is often dominated by marine derived sedimentary rock types. Fine sediment levels in spawning gravel have only been measured in one WSI subbasin stream; McHenry et al. (1994) collected spawning gravel samples in lower Bullman Creek in 1991. Within the 10 spawning gravel samples collected, the average level of fine sediment (<0.85 mm) was 18.9 percent (volumetric equivalent).

5.10.4 Floodplain and Riparian Habitat Conditions

In general floodplain and riparian habitat data are lacking for most WSI subbasin streams. The Sekiu-Coastal watershed analysis included an inventory of riparian stands within Olsen, Trettevick, Jansen, Rasmussen, Bullman, and Snow Creeks. The analysis concluded that the highest proportions of mature conifer stands within the Watershed Administrative Unit were in Lower Bullman, Jansen, Olsen, and Snow Creeks. LWD recruitment potential within the anadromous fish use zone were rated moderate to high for all mainstem channel segments. Shade levels were rated as adequate in all mainstem channel segments.

No watershed analyses have been conducted to date on SJF Independent watersheds and as a result quantitative data is lacking for riparian/floodplain habitat conditions. Todd et al. (2006) note extensively logged lower river corridors in their assessment of nearshore conditions. The WRIA 19 Independent watersheds have also been extensively logged to their headwaters. Much of the earlier logging was accommodated by road construction adjacent to stream courses. Floodplain-adjacent roads are still evident in Whiskey, Jim, Jansen and Bullman creeks. As a result of these land use legacies, riparian forest conditions have been greatly altered. All late successional forests dominated by large diameter conifers have been removed on the WRIA 19 Independent watersheds. Subsequent second-growth, and in some cases third-growth, forests have also been logged. Resulting riparian forests are typically dominated by stands of red alder with understories of brush. Such conditions are evident in Colville, Whiskey, Field, Snow and the Sail watersheds. These forests are generally incapable of supplying high quality inputs of large wood necessary for habitat forming processes.

5.10.5 Water Quality Conditions

Little water quality data has been collected in WRIA 19 Independent streams. Summer water temperature data from Whiskey and Murdock creeks in the early 1990's, showed that these watersheds were within water quality criteria for this parameter (Unpublished Data, Lower Elwha Tribe). Because these streams are small, canopy cover afforded by stream side forests are typically adequate to prevent thermal impacts from solar heating. Other water quality concerns are likely predominately associated with sedimentation from logging, farming, and rural development. Nutrient enrichment from small farms and rural development are more of a concern in Colville, Whiskey, and Field Creeks where such development is more common than in the primarily forested sub-basins (Murdock, Joe, Jim, Snow, Sail, Bullman, Rasmussen and Olsen Creeks).

Most of the water quality data collected in the WSI subbasin were collected in Olsen, Jansen, Rasmussen, Bullman and Snow Creeks. Temperature data have been collected annually between June 15 and August 31 in these five streams. Figure 101 depicts annual maximum temperature and summer-time average temperature from 1996 through 2003. The highest stream temperatures were recorded in Rasmussen Creek (17.4°C) and the lowest summer-time average temperatures were recorded in Olsen Creek (12.5°C).

Smith (2000) notes that elevated turbidity levels have been a problem in Jansen Creek and that turbidity within the stream is long-lasting and occurs even in the absence of major storms. Smith (2000) states that log hauling on poorly surfaced roads is believed to be the major cause of the turbidity problem in Jansen Creek.

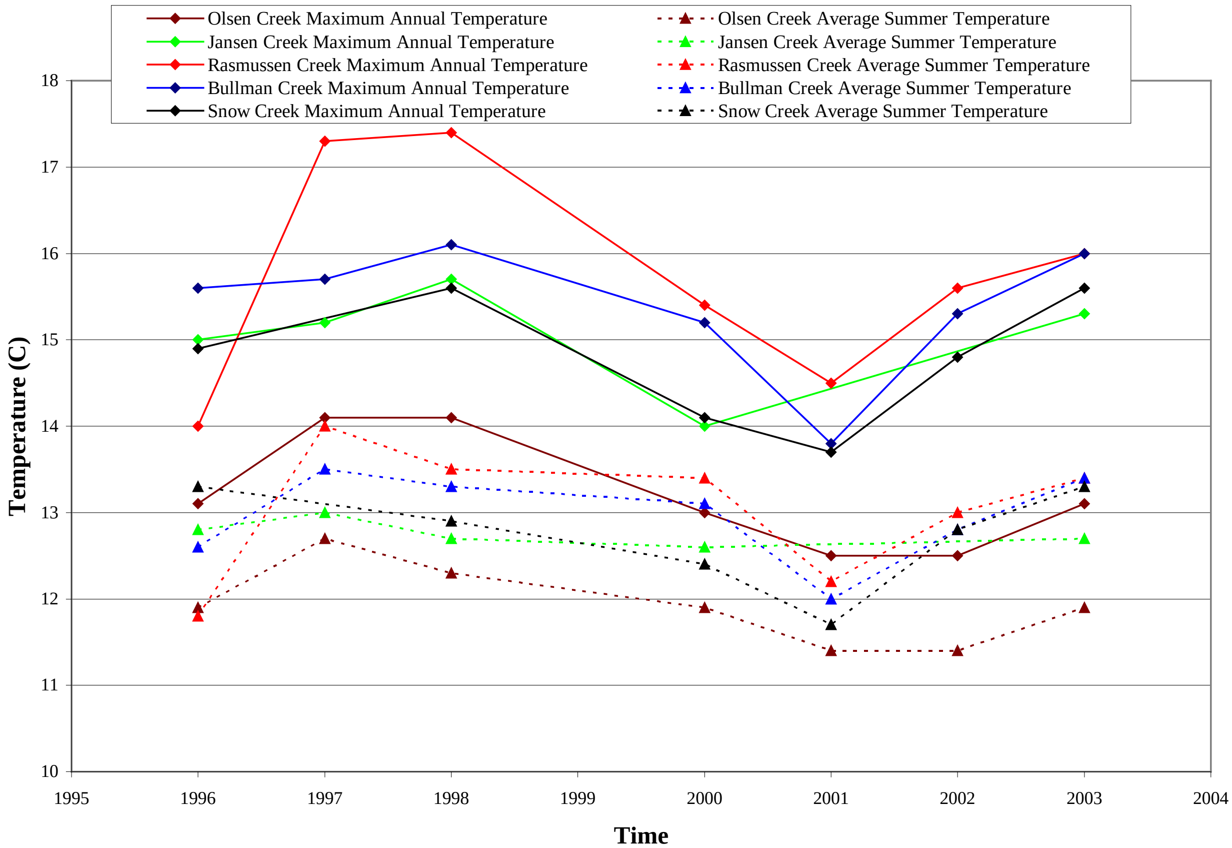

Figure 101. Maximum and average summer stream temperature for Olsen, Jansen, Rasmussen, Bullman, and Snow Creeks. Data collected annually from June 15 to August 31 within 400 meters from the confluence with the Strait of Juan de Fuca. Number of days data were collected varies by stream and year, averaging 63 days per summer period (source: MFM, Unpublished Data).

5.10.6 Hydrologic Conditions

The authors are not aware of any quantitative flow information for the WRIA 19 Independent watersheds. These watersheds, like others in the planning unit, have very high ratios of peak flow to low flow conditions. Peak flows have likely been affected by land use practices such as road construction and in some watersheds rural conversion (Colville, Field, Whiskey). Because of the low elevation and small size of the Independent watersheds, low flow conditions are naturally limiting. Base flow conditions result in flows less than 5 cfs in some watersheds. It is not known if consumptive water uses are further reducing available stream habitat in these subbasins.

5.10.7 Funded and/or Implemented Restoration and Protection Projects

Below is a list of stream enhancement and restoration projects that have been implemented since the mid-1990s in the Western Strait Independent subbasin. Currently there are no funded projects awaiting implementation in this subbasin.

- Whiskey Creek fish passage enhancement, replaced partial barrier culvert with bridge near confluence (1994; landowner/Lower Elwha Tribe)
- Whiskey Creek LWD introduction project, placed 8 LWD structures between RM 0.2 and 0.4 (1994; Lower Elwha Tribe)
- Rasmussen Creek fish passage enhancement, replaced partial barrier culvert (SR 112) with bottomless arch near confluence (1996; WDOT)
- Sail River LWD placement, 1 site near RM 1.0 (2000; Makah Tribe)
- Unnamed tributary to Sail River off-channel habitat development, 1 site near Sail River RM 1.0 (2000; Makah Tribe)
- Agency Creek channel meander redevelopment project (2000; Makah Tribe)

6 RECENT AND ONGOING CONSERVATION EFFORTS

As described in Chapter 1, salmon recovery planning occurs in a regional context with the cooperation of federal, tribal, state, and county governments and an array of volunteers, organizations, and corporations that retain an interest in habitat management, fishing, and development. Similarly, the implementation of conservation efforts to protect and restore salmonids and their habitats has occurred at multiple scales and approaches through Washington State and within WRIA 19.

Conservation efforts in WRIA 19 are directed at habitat, harvest, and hatchery factors affecting the salmonid species. The list of actions for salmonid restoration in WRIA 19 contains programmatic actions (e.g., changes in forest practice and land use regulations), as well as research, monitoring, and data improvement projects that are conducted with the intent to better understand limiting factors, habitat conditions, and/or to develop management actions. Site-specific projects to improve habitat processes, such as culvert replacement and engineered LWD projects, were described for each watershed in Chapter 5.

6.1 PROGRAMMATIC EFFORTS

Programmatic efforts to protect and restore salmonids have been undertaken directly by state, tribal, and county governments, or occur as part of the environmental analysis for land management and development. Some of the most relevant of these approaches for WRIA 19 are state rules and regulations pertaining to timber harvest, co-manager actions affecting fisheries harvest and hatchery practices, Clallam County land use plans and ordinances, and watershed coordination.

State Laws, Rules, and Regulations

- Development and implementation of increasingly protective State forest practices regulations prior to and since the 1970s
- Forest Practices Act enacted (1946)
- Current Forest Practices Act enacted (1974) and partially amended (1975)
- Rule changes in response to environmental review, including threatened and endangered species, forest roads, reforestation, and debris disposal (1980-1981)
- SEPA Rules developed requiring environmental review (1984)
- Development and implementation of the Timber/Fish/Wildlife agreement on private forest lands (1987)
- Class IV General Rules (1991)
- Rule changes addressing wetlands, cumulative effects analysis, critical wildlife habitat, and stream temperatures (1992)
- Forest and Fish legislation passed (1999)

- Forest Practices emergency rules adopted addressing water typing, unstable slopes, roads, and wetlands (2000)
- Revised permanent rules per Forest and Fish Report (2001)
- Development and implementation of the Forest and Fish agreement and subsequent Habitat Conservation Plan (regulates forest practices on private land; 1999) (WDNR 1999, WDNR 2005). (The Forests and Fish Law, a product of the Forests and Fish Agreement, was enacted in 1999, with rules to implement it adopted in 2001 by the Forest Practices Board.)
- Creation and implementation of Washington State Department of Natural Resources Habitat Conservation Plan for State Lands (provides minimum guidelines for forest practice activities on State Lands; 1994).

6.1.1 Fisheries Harvest Restrictions

- Tribal fisheries regulations limiting in-river gillnet salmon and steelhead fisheries.
- State fishing regulations restricting in-river wild steelhead and salmon retention, Hoko River fly fishing only closure during Chinook salmon run, and marine area salmon fishing closures near the mouths of the Sekiu and Hoko rivers.
- National Park Service fishing regulations restricting the harvest of Lake Crescent Beardslee and Crescenti Trout.

6.1.2 Clallam County Land Use Planning and Coordination

- Creation of the North Olympic Peninsula Lead Entity for Salmon (NOPLE) and WRIA 19 Citizen Facilitation Group (CFG), whose purpose is to identify and prioritize restoration actions, seek funding, oversee project implementation (1999).
- Clallam County conservation programs, ordinances, and plans:
    - Clallam County Shoreline Master Program (1989)
    - Clallam County Interim Critical Areas Ordinance (1992)
    - Clallam County Wide Planning Policies (1993)
    - Clallam County Comprehensive Plan and Sub-Area Plan (1995)
    - Clallam County Shoreline Code Amendment (1997)
    - Clallam County Critical Areas Code (1999)
    - Critical Areas GIS Mapping and Map Updates (1992, 1995, 1999, 2000)

6.2 Research, Monitoring, and Information

Reports and research and monitoring projects focused on better understanding and/or conserving and restoring WRIA 19 Salmonids can be broadly grouped within the following categories:

6.2.1 Juvenile and Adult Abundance Projects:

- Strait coho adult abundance project
- Strait smolt trapping projects
- Hoko Chinook indicator stock studies
- Strait adult steelhead abundance monitoring
- Pysht and Deep Creek adult chum salmon escapement monitoring.

6.2.2 Stock Status Reviews

- Nehlsen et al. 1991
- WDF et al. 1994
- Weitkamp et al. 1995
- McHenry et al. 1996
- Busby et al. 1997
- WDFW 2000
- WDFW 2002
- NOPLE 2004

6.2.3 Habitat Conditions and Habitat Limiting Factors Reports

- Spawning Gravel Quality, Watershed Characteristics and Early Life History Survival of Coho Salmon and Steelhead in five North Olympic Peninsula Watersheds (McHenry et al. 1994).
- Hoko Watershed Analysis (Pentec 1996)
- WRIA 19 LFR (Smith 2000)
- Sekiu/Coastal Watershed Analysis (WDNR 2001)
- Deep Creek and East Twin and West Twin Rivers Watershed Analysis (USDA FS et al. 2002)
- Clallam River Mouth Synthesis Document (Shaffer et al. 2003)
- Salt Creek Assessment (McHenry et al. 2004)
- NOPLE Salmon Habitat Recovery Strategy (NOPLE 2004)
- Pysht River Floodplain Habitat Inventory and Assessment (Haggerty et al. 2006)
- 2006 Geomorphic Assessment of the Clallam River Mouth (Shellberg 2006)
- Historical Changes to Estuaries, Spits, and Associated Tidal Wetland Habitats in the Hood Canal and Strait of Juan de Fuca Regions of Washington State (Todd et al. 2006)
- Draft Clallam River Habitat Inventory and Assessment (Haggerty 2008)

6.2.4 Hatchery and Genetic Management Plans

- Hoko River Fall Chinook Salmon HGMP (MFM 2000)
- Hoko River Winter Steelhead HGMP (MFM 2001)

7 RECOVERY STRATEGIES AND ACTIONS

WRIA 19 contains 27 salmonid-bearing watersheds, comprising 19 distinct stocks (WDFW) and 5 ESUs (NMFS/FWS). Since none of these ESUs are listed, there are no ESU viability criteria for any of the stocks. WRIA 19 provides a unique opportunity for protection and restoration of biological and landscape processes that will support long-term salmonid survival and recovery. There are relatively few individual landowners and a low human population density throughout most of the WRIA, which remains relatively undeveloped compared to other WRIAs closer to the metropolitan areas of the Puget Sound. Human population density increases around the towns of Clallam Bay, Joyce, and Neah Bay, and rural population density increases generally moving eastward toward Port Angeles, and along the lower mainstems of larger rivers in the watershed.
Several scientific studies have illustrated that habitat conditions and aquatic ecosystem function are a result of the interaction between watershed controls, watershed processes, and land use. Scientists and resource managers have recognized that restoration planning that carefully integrates watershed and ecosystem processes is more likely to be successful at restoring depleted salmonid populations (Beechie et al. 2003). The WRIA 19 restoration strategy focuses on the concepts presented in several salmonid habitat recovery planning documents and scientific studies (e.g., Beechie and Boulton 1999; Roni et al. 2002; Beechie et al. 2003; Roni et al. 2005; Stanley et al. 2005).

The WRIA 19 recovery strategy is thus based on the relationship between landscape processes and land use, the resulting habitat conditions, and the biological response. The various recovery strategies included in Sections 7.2.1 through 7.2.9 are based upon the protection, restoration, and/or rehabilitation of critical processes, inputs, and habitat conditions associated with limiting factors affecting WRIA 19 salmonids.

Figure 102 illustrates the basic concept of the interaction between watershed controls, watershed processes, habitat effects, and fish population responses.

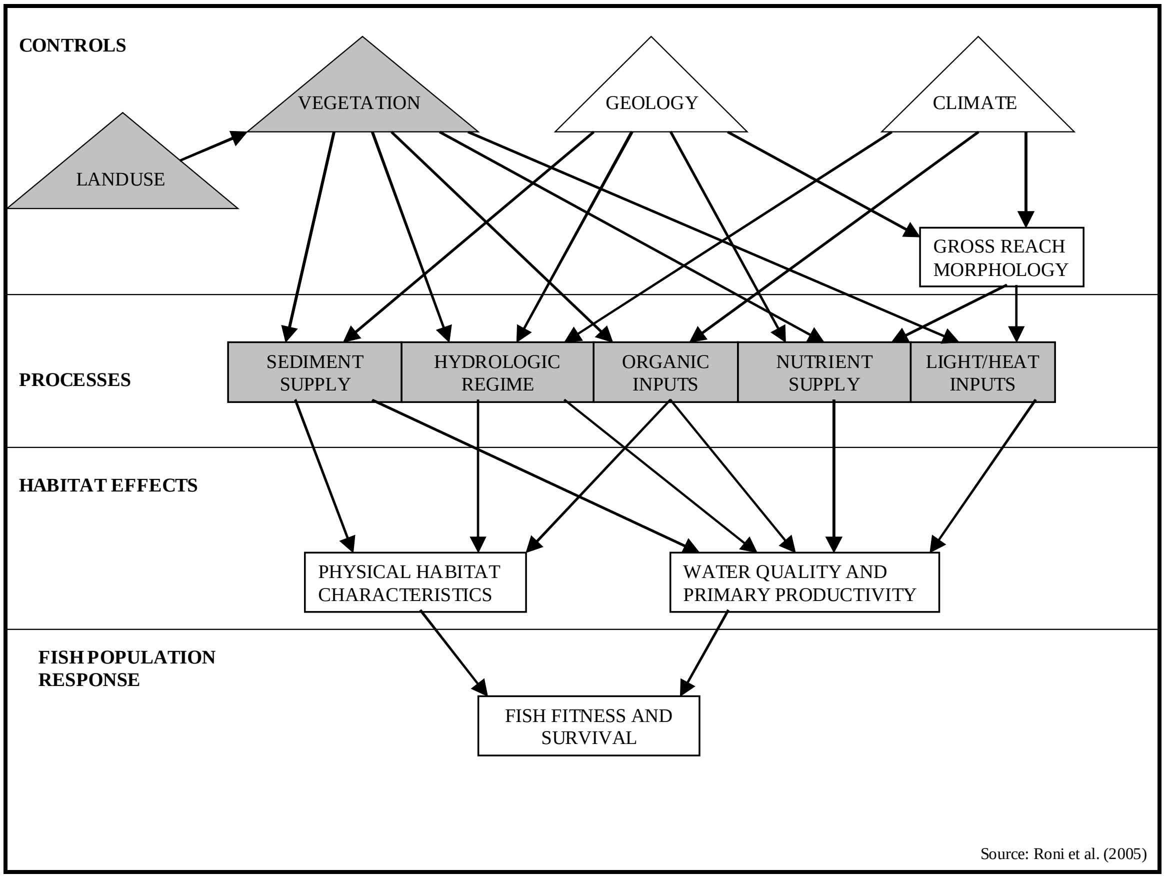

Figure 102. Schematic depicting the linkage between landscape controls and land use, habitat-forming processes, habitat conditions, and resulting fish population responses (modified from Roni et al. 2005).

The WRIA 19 recovery strategy incorporates a general hierarchical approach for prioritizing habitat restoration, protection, and enhancement activities with regard to habitat. This approach was adapted for conditions specific to each of the WRIA 19 subbasins. Within the WRIA 19 watershed, some limiting factors, habitat conditions, and life histories are shared among all subbasins, while others apply to some subbasins and not others. Also note that different species may also have different limiting factors, adding an additional layer of complexity to recovery and restoration strategy development. The recovery goals and strategies presented in Sections 7.1 through 7.2.9 are based on a generalized approach across the entire WRIA 19 watershed.

The WRIA 19 recovery strategy hierarchy is depicted in Figure 103. The tiers can be used to sequence and aid in prioritization of strategies and actions needed to restore processes, inputs, and conditions affecting salmonids within each of WRIA 19 subbasins.

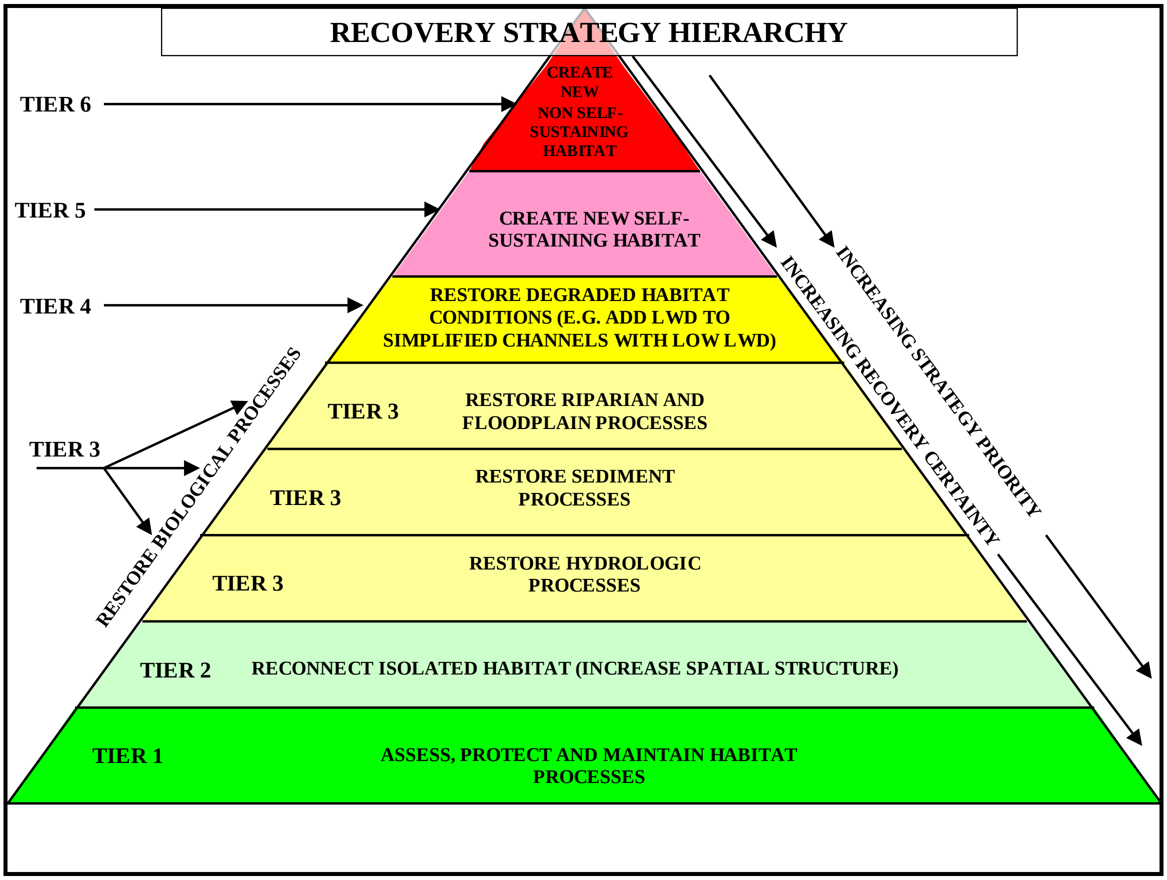

Figure 103. WRIA 19 recovery strategy and action hierarchy.

7.1 GOALS, STRATEGIES, AND ACTIONS TO RESTORE AND PROTECT HABITAT FORMING PROCESSES AND CONDITIONS

During the development of this Plan, the NOPLE Technical Review Group formed a technical workgroup composed of local fish biologists, watershed scientists, and other interested individuals. The purpose of the workgroup was to help develop subbasin specific restoration goals, strategies, and actions. Goals, strategies, and actions were developed for nine subbasins within WRIA 19; these subbasins included: Salt Creek, Lyre River, Twin Rivers, Deep Creek, and Pysht, Clallam, Hoko and Sekiu Rivers, as well as the WSI subbasin. Within each subbasin eight watershed processes and/or habitat conditions were evaluated:

- Estuary and nearshore processes and habitat conditions;
- Habitat connectivity;
- Biological processes;
- Hydrologic processes;
- Sediment processes;

- Riparian and floodplain processes and conditions;
- Habitat and LWD conditions; and
- Water quality conditions.

At the subbasin scale the WRIA 19 technical team qualitatively evaluated the impairment status of each watershed process and/or habitat condition. Impairment ratings were categorized as one of the following: high, medium, low, unimpaired, or unknown. A recovery goal narrative was then developed for each watershed process/condition assessed. A unique recovery goal ID was then assigned to each recovery goal narrative. One or more recovery strategy narratives were developed to address the recovery goal narrative for each watershed process and/or habitat condition. A unique recovery strategy ID was assigned to each recovery strategy narrative. A recovery strategy hierarchy was then assigned to each of the strategies based on Figure 103.
A summary table that includes every subbasin specific recovery goal and strategy can be found in Appendix E.

Restoration actions from previous reports and plans (e.g., Smith 2000), as well as newly developed actions were then associated with the primary strategy addressed by each of the actions. Some actions addressed multiple strategies, for multiple processes and/or conditions. Where strategies occurred but no actions were identified, new actions were proposed. It is important to note that the restoration actions identified within the Plan are voluntary. These actions are proposed for future consideration, and are not required or mandated as a result of being in the Plan.

Proposed restoration actions will need to be refined prior to implementation, as most actions are conceptual in nature. These actions were identified because they help address habitat, harvest, and hatchery factors that may limit WRIA 19 salmonids. The actions are intended to improve the viability and recovery of the different salmonid populations within WRIA 19. The recommended restoration and recovery actions were classified as one of the following: programmatic actions (PA), habitat restoration actions (HRA), and research, monitoring, and evaluation actions (RM&E). A summary table that includes all recommended restoration actions can be found in Appendix F.

Programmatic actions (PA) are part of a policy, program or process, as opposed to being specific projects or related to specific sites. They are generally part of a regulatory or planning process. For example, programmatic actions could be part of Clallam County’s land use and regulatory program or a watershed planning process. Comprehensive plans, critical area ordinances, shoreline management programs, and zoning could all be considered programmatic actions. Programmatic actions can include projects of a comprehensive or broadly encompassing nature e.g., riparian protection as part of a forest management plan. Within WRIA 19 most programmatic actions will be associated with the implementation of the following plans or regulations:

- Clallam County Critical Areas Ordinance and Storm Water Management Plan;
- Clallam County Road Maintenance Plan;

- Olympic National Park Management Plan;
- Makah Tribal Land Use Regulations;
- Makah Tribe Water Quality Standards;
- State and Tribal HGMPs;
- State and Tribal FMPs (e.g., comprehensive coho);
- ONF- Northwest Forest Plan;
- WDFW Hydraulic Code;
- WDOE Water Quality Standards;
- Washington State Forest Practices Habitat Conservation Plan (FPHCP); and
- WDNR State Lands HCP.

Habitat restoration actions (HRA) include a broad suite of actions types including: LWD placement, riparian planting and fencing, culvert barrier removal, nearshore fill removal, conservation easements, etc... The most important aspect of long-term habitat restoration involves the restoration and protection of habitat forming processes. Often habitat restoration projects are focused primarily on restoring or enhancing habitat conditions. However, failure to protect and restore habitat forming processes across the WRIA 19 watershed is unlikely to result in long-term habitat improvements.

An example of a long term approach to protecting and enhancing habitat-forming processes is the protection strategy for the Salt Creek subbasin. McHenry et al. (2004) identified land use conversion as the greatest risk to salmon in the Salt Creek subbasin. They considered protection of habitat in the Salt Creek subbasin especially important and established a goal to permanently protect, by means of conservation easements, the best existing functional spawning and rearing habitat for coho salmon. Many of the actions required to restore watershed processes go beyond the scope of this plan but should be considered important elements of the long term recovery strategy. Conservation easements and/or land acquisition along sensitive stream corridors, wetlands, or potentially unstable upland areas should be considered high priority projects.

Research, monitoring, and evaluation (RM&E) actions include all types of monitoring, research, and evaluation actions, from salmon abundance trend monitoring, to channel migration zone mapping and delineation, to effectiveness monitoring (for more details see Section 8).

7.2 SUBBASIN GOALS, STRATEGIES, AND ACTIONS

7.2.1 Salt Creek

7.2.1.1 Estuary and Nearshore Processes and Habitat Conditions

Process/Condition Status: Impaired – High

Salt Creek Recovery Goal 1: Protect and restore estuary and nearshore processes and habitat conditions so that current limiting factors are no longer limiting and future limiting factors do not develop.

Salt Creek Recovery Strategy 1: Protect estuarine processes and habitat conditions from degradation by employing environmental regulations and management plans. Where regulations are insufficient to protect estuarine processes and habitat conditions implement conservation easements or acquisitions with willing landowners.
Recovery strategy hierarchy: Tier 1

Salt Creek Recovery Strategy 2: Restore degraded estuarine habitat conditions where they exist.
Recovery strategy hierarchy: Tiers 2-4

Salt Creek Recovery Strategy 3: For properties that provide particularly important estuarine processes and nearshore habitat, implement conservation easements or acquisitions with willing landowners.
Recovery strategy hierarchy: Tier 1

Salt Creek Action 1 (SCRS#2): The Salt Creek estuary and salt marsh is partially disconnected from the mainstem of Salt Creek by a 1,000 foot long, 10 foot high road which was installed in the early 1920s (Shaffer et al. 2006). This road provides access to actively managed private forest lands and residences (Shaffer et al. 2006). The road prevents adequate tidal exchange and flushing that is needed for channel maintenance and fish passage. The road also limits up to 30 percent of the total potential water storage for the lower river (Shaffer et al. 2006). The road is completely on private property and the majority of it is owned by one landowner. WDFW and the landowner of the road are working together to restore the function of the Salt Creek estuary with the specific collective goals of: 1) Improving fish access; 2) Decreasing mosquito populations; and 3) Providing additional water storage during high flows, while maintaining the current level of access (Shaffer et al. 2006). Based upon these goals, WDFW and the land owner have proposed, at a minimum, replacing the two failed box culverts with a minimum of 6 foot diameter round concrete culverts (Shaffer et al. 2006). Shaffer et al. (2006) also recommend installation of a third culvert corresponding to a historically constructed trench that extends half the length of the west estuary and ends at the road. For more details on this project please see Shaffer et al. 2006.

Salt Creek Action 2 (SCRS#3): Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.

7.2.1.2 Habitat Connectivity

Process/Condition Status: Impaired – Medium

Salt Creek Recovery Goal 2: Restore and protect habitat connectivity so that habitat connectivity does not limit VSP parameters.

Salt Creek Recovery Strategy 4: Maintain and protect habitat connectivity where habitat connectivity is intact through the effective implementation of regulations.
Recovery strategy hierarchy: Tier 1

Salt Creek Recovery Strategy 5: Restore habitat connectivity where habitat is currently disconnected.
Recovery strategy hierarchy: Tier 2

Many of the fish passage issues created by culverts within the Salt Creek subbasin have been addressed (see Section 5.1.7), however, a few still remain. A list of remaining known fish blockages is included below:

Salt Creek Action 3a (SCRS#5): Install fish passable culvert on Hart Creek (Camp Hayden Road). A fish passable culvert will provide access to approximately 0.1 miles of low gradient (<4%) fish habitat.

Salt Creek Action 3b (SCRS#5): Implement comprehensive fish passage program directed at Kreaman Creek and tributaries. Currently 5 culverts partially or totally block access to 0.37, 1.08, 0.38, 0.50, and 0.40 miles of <1%, 1-2%, 2-4%, 4-8%, and 8-20% gradient habitat respectively.

Salt Creek Action 3c (SCRS#5): The Nordstrom Creek SR 112 culvert is a partial fish barrier, replacing this structure with a fully passable stream crossing structure will enhance fish passage to 0.78, 1.27, 0.81, and 0.48 miles of 1-2%, 2-4%, 4-8% and 8-20% gradient habitat respectively.

Salt Creek Action 3d (SCRS#5): The Falls Creek (tributary to Nordstrom Creek) SR 112 culvert is a partial barrier. Replacement of this stream crossing will provide passage to 1.15, 0.45, and 0.49 miles of 1-2%, 2-4%, and 4-8% gradient habitat respectively (see also funded and planned passage work that is upstream of SR 112 [Section 5.1.7]).

Salt Creek Action 3e (SCRS#5): Conduct fish passage culvert inventory in upper Nordstrom, Wasankari, and Liljedahl creeks. Prioritize and replace fish barriers within this portion of the watershed.

Salt Creek Action 4 (SCRS#5): Assess series of constructed private ponds throughout the watershed for fish passage issues affecting habitat connectivity. Prioritize streams/ponds for fish passage improvements and implement fish passage restoration program.

Salt Creek Action 5 (SCRS#4): Advocate for the enforcement of existing regulations that protect and provide for fish passage.

7.2.1.3 Biological Processes

Process/Condition Status: Impaired – Medium

Salt Creek Recovery Goal 3: Maintain, protect, and/or restore salmonid population abundance, spatial distribution, productivity, and diversity.

Salt Creek Recovery Strategy 6: Minimize or eliminate risks associated with hatchery origin salmonids to ensure that the genetic diversity of Salt Creek salmonids is maintained.
Recovery strategy hierarchy: Tier 1/3

Salt Creek Recovery Strategy 7: Evaluate in and out of basin fishing-related mortalities and influence fisheries regulations so that spawning escapement is sufficient to ensure VSP, as well as deliver adequate levels of marine nutrients from decaying salmon carcasses.
Recovery strategy hierarchy: Tier 1/3

Salt Creek Action 6 (SCRS#6): Advocate for implementation of the Hatchery Scientific Review Group (HSRG) recommendations set for forth in the 2004 Hatchery Reform Report (HSRG 2004), which recommend no hatchery fish outplanting into the Salt Creek watershed.

Salt Creek Action 7 (SCRS#7): Advocate for the adoption of harvest management regulations that ensure salmonid spawning escapement is sufficient to maintain, protect, and/or restore VSP parameters.

Salt Creek Action 8 (SCRS#7): Implement and/or continue to implement population abundance monitoring.

7.2.1.4 Hydrologic Processes

Process/Condition Status: Impaired – Medium

Salt Creek Recovery Goal 4: Restore hydrologic processes and natural hydrologic variability to the extent that hydrologic impacts no longer limit Salt Creek VSP parameters.

Salt Creek Recovery Strategy 8: Restore hydrologic processes by addressing issues related to water withdrawals, stream piracy, impermeable surfaces, loss of wetlands and wetland function, and deforestation. Protect intact hydrologic processes where they exist. **Recovery strategy hierarchy:** Tier 1/3

McHenry et al. (2004) conclude that the loss of historical wetland areas has had a significant impact to Salt Creek. Loss of wetlands has likely led to increases in peak flows, reductions in groundwater storage and reduced low flows, and resulted in the direct loss of habitat for rearing. Combined with simplification of instream habitat, these impacts present formidable obstacles to salmon recovery in Salt Creek. They suggest that efforts to protect and restore wetland function should be of high priority in Salt Creek. Projects to restore hydrology in Salt Creek could include the following:

Salt Creek Action 9 (SCRS#8): Reintroduction and management of beaver (*Castor canadensis)* in portions of the Salt Creek watershed could help restore wetland functions. Potential areas for consideration should include low gradient streams without significant human infrastructure (e.g., the mainstem below river mile 5.0, Kreaman Creek, Oien Creek, unnamed tributaries 19.0009 and 19.0010).

Salt Creek Action 10 (SCRS#8): Reforestation of unutilized pastures and other open areas could help improve hydrologic processes (see also Section 7.2.1.6).

Salt Creek Action 11 (SCRS#8): Reduce road related hydrologic impacts by reducing road densities and/or disconnecting road systems from the stream network.

Salt Creek Action 12 (SCRS#8): Limit future water withdrawals from the Salt Creek watershed through the implementation of the WRIA 19 Watershed Plan (WRIA 19 Planning Unit 2010).

7.2.1.5 Sediment Processes

Process/Condition Status: Impaired – Low

Salt Creek Recovery Goal 5: Maintain and restore sediment processes (production, routing, storage, and grain size frequency distribution) in Salt Creek to the extent that sediment processes do not limit VSP parameters.

Salt Creek Recovery Strategy 9: Eliminate road/culvert and other land use related mass wasting events that deliver sediment to streams.
Recovery strategy hierarchy: Tier 3

Salt Creek Recovery Strategy 10: Reduce surface runoff from existing road network to levels that meet or exceed existing Washington State Water Quality Standards.
Recovery strategy hierarchy: Tier 3

Salt Creek Recovery Strategy 11: Restore natural wood loading volume and density to the Salt Creek watershed to restore habitat forming processes and improve in-stream sediment routing (see also Section 7.2.1.7).
Recovery strategy hierarchy: Tier 4

Salt Creek Action 13 (SCRS#9, 10): Inventory roads for maintenance (use existing Road Maintenance and Abandonment Plans [RMAP] and other available data), side cast removal, and drainage structure improvements. Prioritize for project actions.

Salt Creek Action 14 (SCRS#11): Reforest riparian and floodplain areas to increase stream bank integrity and reduce bank erosion (see also Section 7.2.1.6).

7.2.1.6 Riparian and Floodplain Processes and Conditions

Process/Condition Status: Impaired – High

Salt Creek Recovery Goal 6: Restore riparian and floodplain processes and conditions so that they are at levels necessary to attain VSP goals.

Salt Creek Recovery Strategy 12: Hydrologically reconnect streams to their floodplains for the purposes of floodplain storage and reconnection of off-channel habitat.
Recovery strategy hierarchy: Tier 3/4

Salt Creek Recovery Strategy 13: Protect, maintain, and or restore riparian habitat conditions by implementing riparian acquisitions, conservation easements, and riparian and in-stream restoration projects.
Recovery strategy hierarchy: Tier 1/3/4

Salt Creek Recovery Strategy 14: Ensure that current and future regulatory mechanisms are in place to protect and provide sufficient riparian and floodplain conditions to maintain all necessary ecological function.
Recovery strategy hierarchy: Tier 1/3

McHenry et al. (2004) describe the horizontal habitat reconnection in the Salt Creek as very important. They describe the need to remove or modify barriers to lateral migration (e.g., floodplain roads) that impair habitat forming processes or that disconnect stream channels from their floodplains. McHenry et al. (2004) prioritized 7 projects that enhance or restore floodplain processes, these projects are included below. Note priority project 2 (from McHenry et al. 2004) is included in Section 7.2.1.1 and priority project 5 was completed in 2006 (see Section 5.1.7).

Salt Creek Action 15 (SCRS#12): Treatment of channel incision in the mainstem of Salt Creek from RM 0.5 to 6.0 (note RM 2.5 to 3.5 were treated with LWD placement in 2006; see Section 5.1.7, Priority 1).

Salt Creek Action 16 (SCRS#12): Develop and implement a treatment plan for channel incision from RM 0 to RM 1.0 in Nordstrom Creek (Priority 3).

Salt Creek Action 17 (SCRS#12): Develop and implement restoration treatment that includes the abandonment of the Camp Hayden spur road, LWD placement, and riparian planting. This will help restore channel migration processes and reconnect portions of the floodplain with the mainstem (Priority 4).

Salt Creek Action 18 (SCRS#12): Evaluate the Thompson Road Bridge across mainstem Salt Creek for impacts to flood flow and floodplain (Priority 6).

Salt Creek Action 19 (SCRS#12): Replace undersized Oien Road Bridge across mainstem Salt Creek (Priority 7).

McHenry et al. (2004) concluded that most of the Salt Creek had intact riparian forests, however, most of the riparian forests included in their inventory had reduced habitat forming capacity due to young forest conditions that contained mostly small diameter trees. They developed a prioritization system that suggested that the highest priority riparian restoration projects should focus on areas that have been converted from forest to pasture land. In some cases livestock exclusion should also be considered. The next highest priority for riparian restoration are forests dominated by young to medium aged deciduous trees (where conifers were historically the dominant species). Treatments of these sites could involve conifer under planting with a long-term commitment to brush control. McHenry et al. (2004) suggest that many of these sites could be combined with LWD placements designed to treat channel incision or improve stream habitat conditions.

Salt Creek Action 20 (SCRS#13): Implement riparian restoration projects within the 54 degraded riparian stream segments identified by McHenry et al. (2004). A total of 18.2 linear miles of riparian habitat could benefit from riparian restoration treatments. In addition, they identified 4.3 miles of stream adjacent roads within these 54 riparian segments that are affecting riparian conditions. For detailed riparian segment level data please refer to Table 20 in McHenry et al. (2004).

Salt Creek Action 21 (SCRS#13): Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.

Salt Creek Action 22 (SCRS#13): Map and delineate channel migration zones within the Salt Creek watershed.

Salt Creek Action 23 (SCRS#14): Advocate for and support a WRIA 19 representative of the NOPLE to participate in the Forest and Fish policy group. Individual would provide a conduit for information between the forest practices adaptive management program and the salmon recovery efforts of NOPLE.

7.2.1.7 Habitat and LWD Conditions

Process/Condition Status: Impaired – Medium

Salt Creek Recovery Goal 7: Maintain and improve existing habitat conditions to levels necessary to attain VSP goals.

Salt Creek Recovery Strategy 15: Where data are lacking assess instream meso-habitat conditions in the Salt Creek watershed.
Recovery strategy hierarchy: Tier 1

Salt Creek Recovery Strategy 16: Implement wood supplementation in identified wood deficient zones outlined in McHenry et al. (2004) and/or from future habitat monitoring results.
Recovery strategy hierarchy: Tier 4

A detailed list of projects to improve instream habitat and LWD conditions in the Salt Creek subbasin has not been developed. McHenry et al. (2004) recommend a systematic enhancement of habitat primarily by introducing LWD. They recommend focusing on channel types most responsive to change from LWD, with the highest priority in plane bed channels (1-4% gradient), followed by pool-riffle channels (1-2% gradient), and lastly in step-pool or forced step-pool channels (4-8% gradient). In addition, McHenry et al. (2004) developed examples of "model projects" and those are included below.

Salt Creek Action 24 (SCRS#5, 13, 15, 16): Work with landowners to develop comprehensive stream restoration and habitat access program for Barr Creek (Falls Creek tributary):

- Plan should address barrier culverts (note: Dempsey Road culvert replaced in 2009 and a private driveway barrier in 2010).

- Channelized portions of Barr Creek should be restructured to treat bank erosion and channel conditions, this could also include additions of LWD and spawning gravel.
- Work with landowners to control livestock access to Barr Creek, this may require new fencing adjacent to riparian area.
- Work with landowners to develop stream setback for developing riparian forest adjacent to stream. Upon completion of channel work planting of vegetation should occur.

Salt Creek Action 25 (SCRS#5, 13, 15, 16): Work with landowner(s) to develop comprehensive stream restoration program on lower Salt, Kreaman, and Hart creeks. The project area is located on lower Salt Creek and includes unconstrained portions of the floodplain channel, as well as lower Kreaman Creek, which enters Salt Creek across its floodplain. An unnamed tributary, Hart Creek drains into Salt Creek after crossing Camp Hayden Road. Project components could include the following:

- LWD additions designed to raise channel bed elevations thereby reconnecting Salt Creek with its floodplain (Part of Salt Creek Action 16 above).
- Kreaman Creek could be relocated to its original channel, increasing its sinuosity. It could then further be treated with LWD additions. Riparian areas could be planted with riparian vegetation.
- Fish passage issues in Kreaman Creek could also be addressed (see Section 7.2.1.2
- A stream crossing could be added to Hart Creek (see Section 7.2.1.2).
- Off channel habitat could be improved. The existing pond could be enhanced by increasing its connectivity to Salt Creek, deepening sections of the pond, adding habitat and structural cover, and adding native riparian vegetation. Additional off channel habitat could also be developed on the property.

Salt Creek Action 26 (SCRS#13, 16): Work with landowner to develop comprehensive stream restoration program on Bear Creek. The project area includes approximately 0.5 miles of Bear Creek south of Liljedahl Road. Project components could include:

- LWD additions designed to increase pool frequency and pool quality, as well as to trap, sort, and store spawning gravels.
- Following LWD placement trees should be planted in order to improve riparian conditions and future LWD recruitment.

7.2.1.8 Water Quality Conditions

Process/Condition Status: Impaired – Low

Salt Creek Recovery Goal 8: Protect and/or restore water quality conditions so that water quality conditions do not limit VSP parameters.

Salt Creek River Recovery Strategy 17: Develop water quality monitoring program for the Salt Creek watershed.
Recovery strategy hierarchy: Tier 1

Salt Creek River Recovery Strategy 18: Protect and restore water quality through the implementation of riparian/floodplain recovery strategies and actions that protect and restore riparian and floodplain habitat.
Recovery strategy hierarchy: Tier 1/3/4

Salt Creek Action 27 (SCRS#17): Implement long-term surface water quality monitoring program (e.g., temperature, dissolved oxygen, pH, conductivity, turbidity, BIBI). Also include monitoring of hydrocarbons and other potential contaminants.

Salt Creek Action 28 (SCRS#18): Advocate for effective implementation and enforcement of Forest Practice Rules and County Critical Areas Ordinances.

7.2.2 Lyre River

7.2.2.1 Estuary and Nearshore Processes and Habitat Conditions

Process/Condition Status: Impaired – Medium

Lyre River Recovery Goal 1: Protect and restore estuary and nearshore processes and habitat conditions so that current limiting factors are no longer limiting and future limiting factors do not develop.

Lyre River Recovery Strategy 1: Protect estuarine processes and habitat conditions from degradation by employing environmental regulations and management plans. Where regulations are insufficient to protect estuarine processes and habitat conditions implement conservation easements or acquisitions with willing landowners.
Recovery strategy hierarchy: Tier 1

Lyre River Recovery Strategy 2: Restore degraded estuarine habitat conditions where they exist. Include road maintenance and abandonment plans. Restore floodplain forest in the lower reaches to increase bank stability and reduce sediment introduction and transport to the estuary.
Recovery strategy hierarchy: Tier 3

Lyre River Recovery Strategy 3: For properties that provide particularly important estuarine processes and nearshore habitat, implement conservation easements or acquisitions with willing landowners.
Recovery strategy hierarchy: Tier 1

Lyre River Action 1 (LRRS#2): To the west of the mouth of the Lyre River investigate impacts of bulkhead structure to physical habitat forming processes and sediment movement within the drift cell.

Lyre River Action 2 (LRRS#3): Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.

7.2.2.2 Habitat Connectivity

Process/Condition Status: Impaired – Low

Lyre River Recovery Goal 2: Restore and protect habitat connectivity so that habitat connectivity does not limit VSP parameters.

Lyre River Recovery Strategy 4: Maintain and protect habitat connectivity where habitat connectivity is intact through the effective implementation of regulations.
Recovery strategy hierarchy: Tier 1

Lyre River Recovery Strategy 5: Restore habitat connectivity where habitat is currently disconnected.
Recovery strategy hierarchy: Tier 2

Lyre River Action 3a (LRRS#5): Work with Clallam County PUD, WDOT, WDNR, and private landowners to assess, prioritize, and correct potential fish barriers in the Nelson Creek subbasin. A list of currently known fish barriers in Nelson Creek is included below:

- SR 112 stream crossing is described in WDOT's road crossing database as a total barrier.
- Private road crossing located 0.1 miles upstream from SR 112 is defined as a partial barrier in WDOT's road crossing database.
- The Clallam County PUD power line service road stream crossing located approximately 0.6 miles upstream of SR 112 is a total barrier in WDOT's road crossing database.
- An unnamed right bank tributary to Nelson Creek entering approximately 1.1 miles upstream from SR 112 is also report to have a total barrier present. This culvert is on WDNR land.
- Approximately 1.15 miles upstream from SR 112 another total barrier is reported on WDNR land.

- Approximately 1.2 miles upstream from SR 112 another total barrier is reported on WDNR land.
- An unnamed left bank tributary to Nelson Creek entering approximately 1.1 miles upstream from SR 112 is also report to have a partial barrier present. This partial barrier is formed by a road washout.
- On the W.F. Nelson Creek approximately 0.2 miles upstream from the confluence with the mainstem a total barrier is reported on WDNR land.

Lyre River Action 3b (LRRS#5): The mainstem of Susie Creek is free of fish barriers, however, the status of barriers in tributaries to Susie Creek is undocumented. Work with WDNR and private landowners to assess, prioritize, and correct potential fish barriers in tributaries to the Susie Creek subbasin.

7.2.2.3 Biological Processes

Process/Condition Status: Impaired – Medium

Lyre River Recovery Goal 3: Maintain, protect, and/or restore salmonid population abundance, spatial distribution, productivity, and diversity.

Lyre River Recovery Strategy 6: Minimize or eliminate risks associated with hatchery origin salmonids to ensure that the genetic diversity of Lyre River salmonids is maintained.
Recovery strategy hierarchy: Tier 1/3

Lyre River Recovery Strategy 7: Evaluate in and out of basin fishing-related mortalities and influence fisheries regulations so that spawning escapement is sufficient to ensure VSP, as well as deliver adequate levels of marine nutrients from decaying salmon carcasses.
Recovery strategy hierarchy: Tier 1/3

Lyre River Action 4 (LRRS#6): Advocate for implementation of the Hatchery Scientific Review Group (HSRG) recommendations set for forth in the 2004 Hatchery Reform Report (HSRG 2004), which recommend the discontinuation of hatchery outplanting in the Lyre River watershed.

Lyre River Action 5 (LRRS#7): Advocate for the adoption of harvest management regulations that ensure salmonid spawning escapement is sufficient to maintain, protect, and/or restore VSP parameters.

Lyre River Action 6 (LRRS#7): Implement and/or continue to implement population abundance monitoring.

7.2.2.4 Hydrologic Processes

Process/Condition Status: Impaired – Low

Lyre River Recovery Goal 4: Restore hydrologic processes and natural hydrologic variability to the extent that hydrologic impacts no longer limit the Lyre River VSP parameters.

Lyre River Recovery Strategy 8: Restore hydrologic processes by addressing issues related to water withdrawals, stream piracy, impermeable surfaces, loss of wetlands and wetland function, and deforestation. Protect intact hydrologic processes where they exist.
Recovery strategy hierarchy: Tier 1/3

Lyre River Action 7 (LRRS#8): Reforestation of riparian forest and wetlands associated with floodplains to improve hydrologic processes related to flood capacity within the flood plain areas.

Lyre River Action 8 (LRRS#8): Reduce road related hydrologic impacts by reducing road densities and/or disconnecting road systems from the stream network.

Lyre River Action 9 (LRRS#8): Limit future water withdrawals from the Lyre River watershed through the implementation of the WRIA 19 Watershed Plan (WRIA 19 Planning Unit 2010).

7.2.2.5 Sediment Processes

Process/Condition Status: Impaired – Medium

Lyre River Recovery Goal 5: Maintain and restore sediment processes (production, routing, storage, and grain size frequency distribution) in the Lyre River to the extent that sediment processes do not limit VSP parameters.

Lyre River Recovery Strategy 9: Eliminate road/culvert and other land use related mass wasting events that deliver sediment to streams.
Recovery strategy hierarchy: Tier 3

Lyre River Recovery Strategy 10: Reduce road and other land use related surface erosion to levels that achieve Lyre River Recovery Goal 5.
Recovery strategy hierarchy: Tier 3

Lyre River Action 10 (LRRS#9): Inventory roads for maintenance (use existing RMAP and other available data), side cast removal, and drainage structure improvements. Prioritize for project actions.

Lyre River Action 11 (LRRS#10): Inventory roads for decommissioning, drainage structure removal and restoration of stream segments within the crossing structure.

7.2.2.6 Riparian and Floodplain Processes and Conditions

Process/Condition Status: Impaired – Medium

Lyre River Recovery Goal 6: Restore riparian and floodplain processes and conditions so that they are at levels necessary to attain VSP goals.

Lyre River Recovery Strategy 11: Hydrologically reconnect streams to their floodplains for the purposes of floodplain storage and reconnection of off-channel habitat.
Recovery strategy hierarchy: Tier 3

Lyre River Recovery Strategy 12: Protect, maintain, and or restore riparian habitat conditions by implementing riparian acquisitions, conservation easements, and riparian and in-stream restoration projects.
Recovery strategy hierarchy: Tier 1/3/4

Lyre River Recovery Strategy 13: Ensure that current and future regulatory mechanisms are in place to protect and provide sufficient riparian and floodplain conditions to maintain all necessary ecological function.
Recovery strategy hierarchy: Tier 1/3

Lyre River Action 12 (LRRS#8): Reduce road related hydrologic impacts by reducing road densities and/or disconnecting road systems from the stream network.

Lyre River Action 13 (LRRS#12): Treatment and restoration of the lower 2.0 miles of the mainstem Lyre River including LWD placement, and riparian planting. This will help restore channel migration processes and reconnect portions of the floodplain with the Lyre mainstem (see Section 7.2.2.7).

Lyre River Action 14 (LRRS#11, 12): Based on results of a watershed assessment, implement riparian restoration projects within degraded riparian stream segments. Identify stream adjacent roads within these riparian segments that are affecting riparian conditions (see Section 7.2.2.7).

Lyre River Action 15 (LRRS#12): Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.

Lyre River Action 16 (LRRS#12): Map and delineate channel migration zones within the Lyre River watershed.

Lyre River Action 17 (LRRS#13): Advocate for and support a WRIA 19 representative of the NOPLE to participate in the Forest and Fish policy group. Individual would provide a conduit for information between the forest practices adaptive management program and the salmon recovery efforts of NOPLE.

7.2.2.7 Habitat and LWD Conditions

Process/Condition Status: Unknown

Lyre River Recovery Goal 7: Maintain and improve existing habitat conditions to levels necessary to attain VSP goals.

Lyre River Recovery Strategy 14: Protect, maintain, and or restore large woody debris (LWD) loading and physical habitat conditions through implementing riparian acquisitions, conservation easements, and riparian and habitat restoration projects.
Recovery strategy hierarchy: Tier 1/3/4

Lyre River Action 18 (LRRS#1, 5, 13, and 14): Conduct a comprehensive watershed assessment to investigate current habitat conditions and better identify limiting factors affecting salmonids. Upon completion of a Lyre River watershed assessment develop a detailed list of projects to improve instream habitat and LWD conditions in the Lyre river sub basin. Implement a systematic enhancement of habitat by introducing LWD. Focus on channel types most responsive to change from LWD, with the highest priority in plane bed channels (1-4% gradient), followed by pool-riffle channels (1-2% gradient), and lastly in step-pool or forced step-pool channels (4-8% gradient).

7.2.2.8 Water Quality Conditions

Process/Condition Status: Unknown

Lyre River Recovery Goal 8: Protect and/or restore water quality conditions so that water quality conditions do not limit VSP parameters.

Lyre River Recovery Strategy 15: Develop water quality monitoring program for the Lyre River watershed.
Recovery strategy hierarchy: Tier 1

Lyre River Recovery Strategy 16: Protect and restore water quality through the implementation of riparian/floodplain recovery strategies and actions that protect and restore riparian and floodplain habitat.
Recovery strategy hierarchy: Tier 1/3/4

Lyre River Action 19 (LRRS#15): Implement long-term surface water quality monitoring program (e.g., temperature, dissolved oxygen, pH, conductivity, turbidity, BIBI).

Lyre River Action 20 (LRRS#16): Develop and implement a compliance monitoring program in the Lyre River to ensure effective implementation and enforcement of Forest Practice Rule and County Critical Areas Ordinances.

Lyre River Action 21 (LRRS#9, 10, 16): Inventory and prioritize sources of water quality impacts including sources of fine sediment and channel reaches with deficient riparian vegetation.

7.2.3 East and West Twin Rivers

7.2.3.1 Estuary and Nearshore Processes and Habitat Conditions

Process/Condition Status: Impaired – High

Twin Rivers Recovery Goal 1: Protect and restore estuary and nearshore processes and habitat conditions so that current limiting factors are no longer limiting and future limiting factors do not develop.

Twin Rivers Recovery Strategy 1: Protect estuarine processes and habitat conditions from degradation by employing environmental regulations and management plans. Where regulations are insufficient to protect estuarine processes and habitat conditions implement conservation easements or acquisitions with willing landowners.
Recovery strategy hierarchy: Tier 1

Twin Rivers Recovery Strategy 2: Restore degraded estuarine habitat conditions where they exist. Include road maintenance and abandonment plans. Restore floodplain forest in the lower reaches to increase bank stability and reduce sediment introduction and transport to the estuary.
Recovery strategy hierarchy: Tiers 2-4

Twin Rivers Recovery Strategy 3: For properties that provide particularly important estuarine processes and nearshore habitat, implement conservation easements or acquisitions with willing landowners.
Recovery strategy hierarchy: Tier 1

Twin Rivers Action 1 (TRRS#2): To the west of the mouth of the West Twin River remove the sheet pile and mole structure to restore physical habitat forming processes and sediment movement within the drift cell.

Twin Rivers Action 2 (TRRS#2): Assess historical estuarine and nearshore habitat that has been affected by SR 112 and the historical alterations that have disrupted floodplain connectivity between the Twin Rivers. Include an investigation into the potential impacts of macro-algae blooms on estuarine-nearshore water quality. Implement the recommendation from this assessment.

Twin Rivers Action 3 (TRRS#1, 3): Investigate the potential implementation of a conservation easement (or the direct acquisition) for the private property between the mouths of the Twin Rivers.

7.2.3.2 Habitat Connectivity

Process/Condition Status: Impaired – Medium

Twin Rivers Recovery Goal 2: Restore and protect habitat connectivity so that habitat connectivity does not limit VSP parameters.

Twin Rivers Recovery Strategy 4: Maintain and protect habitat connectivity where habitat connectivity is intact through the effective implementation of regulations.
Recovery strategy hierarchy: Tier 1

Twin Rivers Recovery Strategy 5: Restore habitat connectivity where habitat is currently disconnected.
Recovery strategy hierarchy: Tier 2

No comprehensive surveys of fish passage barriers has been conducted in the Twin River watersheds. In the last decade, known barriers have been corrected in Sadie Creek subbasin. Only one documented road related fish barrier exists in the Twin River watersheds.

Twin Rivers Action 4 (TRRS#5): Identify water-crossing and road inventories from basin landowners and combine into single basin-wide inventory. Where water-crossing information is lacking or missing, work with landowners to inventory and assess. Use a basin-wide approach to identify biological, physical, and process-based metrics for prioritizing future habitat connectivity projects.

Twin Rivers Action 5a (TRRS#5): Culvert on the USFS 3040 Road at RM 0.8 on the East Fork of the East Twin River is currently classified as a complete barrier to fish. Replace (or remove) the culvert with crossing structure that allows for better fish passage. Confirmation of upstream habitat, as well as existing barrier status should be confirmed before any project planning takes place.

Twin Rivers Action 5b (TRRS#5): Replace barrier culvert in unnamed tributary 19.0106 with stream crossing structure that allows for better fish passage.

Repair perched culvert (spur to 7000 Road) on an unnamed tributary to Johnson Creek (trib 19.0178). This culvert blocks access to 0.68 miles of low gradient (2-4%) stream habitat.

7.2.3.3 Biological Processes

Process/Condition Status: Impaired – Medium

Twin Rivers Recovery Goal 3: Maintain, protect, and/or restore salmonid population abundance, spatial distribution, productivity, and diversity.

Twin Rivers Recovery Strategy 6: Minimize or eliminate risks associated with hatchery origin salmonids to ensure that the genetic diversity of East and West Twin rivers salmonids is maintained.
Recovery strategy hierarchy: Tier 1/3

Twin Rivers Recovery Strategy 7: Evaluate in and out of basin fishing-related mortalities and influence fisheries regulations so that spawning escapement is sufficient to ensure VSP, as well as deliver adequate levels of marine nutrients from decaying salmon carcasses.
Recovery strategy hierarchy: Tier 1/3

Twin Rivers Action 6 (TRRS#6): Advocate for implementation of the Hatchery Scientific Review Group (HSRG) recommendations set for forth in the 2004 Hatchery Reform Report (HSRG 2004).

Twin Rivers Action 7 (TRRS#7): Advocate the adoption of harvest management regulations that ensure salmonid spawning escapement is sufficient to maintain, protect, and/or restore VSP parameters.

Twin Rivers Action 8 (TRRS#7): Implement and/or continue to implement population abundance monitoring.

7.2.3.4 Hydrologic Processes

Process/Condition Status: Impaired – Medium

Twin Rivers Recovery Goal 4: Restore hydrologic processes and natural hydrologic variability to the extent that hydrologic impacts no longer limit the Twin Rivers VSP parameters.

Twin Rivers Recovery Strategy 8: Restore hydrologic processes by addressing issues related to water withdrawals, stream piracy, impermeable surfaces, loss of wetlands and wetland function, and deforestation. Protect intact hydrologic processes where they exist.
Recovery strategy hierarchy: Tier 1/3

Twin Rivers Action 9 (TRRS#8): Reforestation of riparian forest and reconnection of wetland hydrology associated with floodplains to improve hydrologic processes related to flood capacity within the flood plain areas.

Twin Rivers Action 10 (TRRS#8): Reduce road related hydrologic impacts by reducing road densities and/or disconnecting road systems from the stream network.

Twin Rivers Action 11 (TRRS#8): Limit future water withdrawals from the Twin Rivers watershed through the implementation of the WRIA 19 Watershed Plan (WRIA 19 Planning Unit 2010).

7.2.3.5 Sediment Processes

Process/Condition Status: Impaired – High

Twin Rivers Recovery Goal 5: Maintain and restore sediment processes (production, routing, storage, and grain size frequency distribution) in the Twin Rivers to the extent that sediment processes do not limit VSP parameters.

Twin Rivers Recovery Strategy 9: Eliminate road/culvert and other land use related mass wasting events that deliver sediment to streams.
Recovery strategy hierarchy: Tier 3

Twin Rivers Recovery Strategy 10: Reduce surface runoff from existing road network to levels that meet or exceed existing Washington State Water Quality Standards.
Recovery strategy hierarchy: Tier 3

Twin Rivers Action 12 (TRRS#9, 10): Inventory roads for maintenance (use existing RMAP and other available data), side cast removal, and drainage structure improvements. Prioritize for project actions.

Twin Rivers Action 13 (TRRS#12): Reforest riparian and floodplain areas to increase stream bank integrity and reduce bank erosion (see Section 7.2.3.6).

7.2.3.6 Riparian and Floodplain Processes and Conditions

Process/Condition Status: Impaired – Medium

Twin Rivers Recovery Goal 6: Restore riparian and floodplain processes and conditions so that they are at levels necessary to attain VSP goals.

Twin Rivers Recovery Strategy 11: Hydrologically reconnect streams to their floodplains for the purposes of floodplain storage and reconnection of off-channel habitat.
Recovery strategy hierarchy: Tier 3

Twin Rivers Recovery Strategy 12: Protect, maintain, and or restore riparian habitat conditions by implementing riparian acquisitions, conservation easements, and riparian and in-stream restoration projects.
Recovery strategy hierarchy: Tier 1/3/4

Twin Rivers Recovery Strategy 13: Ensure that current and future regulatory mechanisms are in place to protect and provide sufficient riparian and floodplain conditions to maintain all necessary ecological functions.
Recovery strategy hierarchy: Tier 1/3

Twin Rivers Action 14 (TRRS#10, 11): Reduce road related hydrologic impacts by reducing road densities and/or disconnecting road systems from the stream network.

Twin Rivers Action 15 (TRRS#11, 12): Develop and implement restoration treatment that includes LWD placement and riparian planting/enhancement. This will help restore channel migration processes and reconnect portions of the floodplain with the mainstem.

Twin Rivers Action 16 (TRRS#12): Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.

Twin Rivers Action 17 (TRRS#12): Map and delineate channel migration zones within the East and West Twin Rivers watershed.

Twin Rivers Action 18 (TRRS#13): Advocate for and support a WRIA 19 representative of the NOPLE to participate in the Forest and Fish policy group. Individual would provide a conduit for information between the forest practices adaptive management program and the salmon recovery efforts of NOPLE.

7.2.3.7 Habitat and LWD Conditions

Process/Condition Status: Impaired – Medium (recovering in East Twin)

Twin Rivers Recovery Goal 7: Maintain and improve existing habitat conditions to levels necessary to attain VSP goals.

Twin Rivers Recovery Strategy 14: Continue the Intensively Monitored Watershed program including implementation of present project proposals. Identify and prioritize the West Twin for large woody debris introduction and riparian forest planting upon completion of or consistent with IMW.
Recovery strategy hierarchy: Tier 1/3/4

An extensive and ongoing set of recovery actions have been implemented as part of the Intensively Monitored Watershed process. It is anticipated that the lower flood plain channel segments of both Twins will benefit from riparian planting, large woody material introductions, and reconnection of wetlands. Throughout the Twin Rivers basins identification, prioritization and implementation of road and road related maintenance, drainage improvements and abandonment, would reduce the introduction of sediment, restore hydrology, and improve water quality.

7.2.3.8 Water Quality Conditions

Process/Condition Status: Unknown

Twin Rivers Recovery Goal 8: Protect and/or restore water quality conditions so that water quality impacts do not limit VSP parameters.

Twin Rivers Recovery Strategy 15: Develop water quality monitoring program for the Twin Rivers watershed.
Recovery strategy hierarchy: Tier 1

Twin Rivers Recovery Strategy 16: Protect and restore water quality through the implementation of riparian/floodplain recovery strategies and actions that protect and restore riparian and floodplain habitat.
Recovery strategy hierarchy: Tier 1/3/4

Twin Rivers Action 19 (TRRS#15): Implement long-term surface water quality monitoring program (e.g., temperature, dissolved oxygen, pH, conductivity, turbidity, BIBI).

Twin Rivers Action 20 (TRRS#16): Advocate for effective implementation and enforcement of Forest Practice Rules and County Critical Areas Ordinances.

Twin Rivers Action 21 (TRRS#9, 10, 16): Inventory and prioritize sources of water quality impacts including sources of fine sediment and channel reaches with deficient riparian vegetation.

7.2.4 Deep Creek

7.2.4.1 Estuary and Nearshore Processes and Habitat Conditions

Process/Condition Status: Functional

Deep Creek Recovery Goal 1: Protect estuary and nearshore processes and habitat conditions so that future limiting factors do not develop.

Deep Creek Recovery Strategy 1: Protect estuarine processes and habitat conditions from degradation by implementing environmental regulations and management plans.

Where regulations are insufficient to adequately protect estuarine processes and habitat conditions implement conservation easements or acquisitions with willing landowners.
Recovery strategy hierarchy: Tier 1

Deep Creek Recovery Strategy 2: For properties that provide particularly important estuarine processes and nearshore habitat, implement conservation easements or acquisitions with willing landowners.

No restoration or recovery actions have been identified for the Deep Creek estuary and nearshore habitat.

7.2.4.2 Habitat Connectivity

Process/Condition Status: Impaired – Medium

Deep Creek Recovery Goal 2: Restore and protect habitat connectivity so that habitat connectivity does not limit VSP parameters.

Deep Creek Recovery Strategy 3: Maintain and protect habitat connectivity where habitat connectivity is intact through the effective implementation of regulations.
Recovery strategy hierarchy: Tier 1

Deep Creek Recovery Strategy 4: Restore habitat connectivity where habitat is currently disconnected.
Recovery strategy hierarchy: Tier 2

No comprehensive survey of fish passage barriers has been conducted in the Deep Creek watershed. In the last decade, known barriers have been corrected in Gibson Creek (RM 0.2), Sampson Creek (RM 0.3), and E.F. Deep Creek (RM 1.5). Currently known road related barriers are included below.

Deep Creek Action 1a (DCRS#4): Two separate culverts (SR 112) on an unnamed tributary to Deep Creek block an unquantified amount of potential salmonid habitat. Replace culverts with crossing structures that allow for better fish passage.

Deep Creek Action 1b (DCRS#4): Replace the partial barrier culvert (M&R 3100 Road) on an unnamed tributary to the W.F. Deep Creek with stream crossing structure that allows for better fish passage.

Deep Creek Action 1c (DCRS#4): Compile existing RMAP data and conduct fish passage culvert inventory for uninventoried portions of the Deep Creek watershed. Prioritize and replace fish barriers within the Deep Creek watershed.

7.2.4.3 Biological Processes

Process/Condition Status: Impaired – Medium

Deep Creek Recovery Goal 3: Maintain, protect, and/or restore salmonid population abundance, spatial distribution, productivity, and diversity.

Deep Creek Recovery Strategy 5: Minimize or eliminate risks associated with hatchery origin salmonids to ensure that the genetic diversity of Deep Creek salmonids is maintained.
Recovery strategy hierarchy: Tier 1/3

Deep Creek Recovery Strategy 6: Evaluate in and out of basin fishing-related mortalities and influence fisheries regulations so that spawning escapement is sufficient to ensure VSP, as well as deliver adequate levels of marine nutrients from decaying salmon carcasses.
Recovery strategy hierarchy: Tier 1/3

Deep Creek Action 2 (DCRS#5): Advocate for implementation of the Hatchery Scientific Review Group (HSRG) recommendations set for forth in the 2004 Hatchery Reform Report (HSRG 2004).

Deep Creek Action 3 (DCRS#6): Advocate for the adoption of harvest management regulations that ensure salmonid spawning escapement is sufficient to maintain, protect, and/or restore VSP parameters.

Deep Creek Action 4 (DCRS#6): Implement and/or continue to implement population abundance monitoring.

7.2.4.4 Hydrologic Processes

Process/Condition Status: Impaired – Medium

Deep Creek Recovery Goal 4: Restore hydrologic processes and natural hydrologic variability to the extent that hydrologic impacts no longer limit Deep Creek VSP parameters.

Deep Creek Recovery Strategy 7: Restore hydrologic processes by addressing issues related to water withdrawals, stream piracy, impermeable surfaces, loss of wetlands and wetland function, and deforestation. Protect intact hydrologic processes where they exist.
Recovery strategy hierarchy: Tier 1/3

Deep Creek Action 5 (DCRS#7): Reforestation of riparian forest and wetlands associated with flood plains to improve hydrologic processes related to flood capacity within the flood plain areas.

Deep Creek Action 6 (DCRS#7): Reduce road related hydrologic impacts by reducing road densities and/or disconnecting road systems from the stream network.

Deep Creek Action 7 (DCRS#7): Limit future water withdrawals from the Deep Creek watershed through the implementation of the WRIA 19 Watershed Plan (WRIA 19 Planning Unit 2010).

7.2.4.5 Sediment Processes

Process/Condition Status: Impaired – Medium (recovering)

Deep Creek Recovery Goal 5: Maintain and restore sediment processes (production, routing, storage, and grain size frequency distribution) in Deep Creek to the extent that sediment processes do not limit VSP parameters.

Deep Creek Recovery Strategy 8: Eliminate road/culvert and other land use related mass wasting events that deliver sediment to streams.
Recovery strategy hierarchy: Tier 3

Deep Creek Recovery Strategy 9: Reduce surface runoff from existing road network to levels that meet or exceed existing Washington State Water Quality Standards.
Recovery strategy hierarchy: Tier 3

Deep Creek Recovery Strategy 10: Restore natural wood loading volume and density to the Deep Creek watershed to restore habitat forming processes and improve in-stream sediment routing (see also Section 7.2.4.7).
Recovery strategy hierarchy: Tier 4

Deep Creek Action 8 (DCRS#8, 9): Inventory roads for maintenance (use existing RMAP and other available data), side cast removal, and drainage structure improvements. Prioritize for project actions.

Deep Creek Action 9 (DCRS#12): Reforest riparian and floodplain areas to increase stream bank integrity and reduce bank erosion (see also Section 7.2.4.6).

7.2.4.6 Riparian and Floodplain Processes and Conditions

Process/Condition Status: Impaired – Medium

Deep Creek Recovery Goal 6: Restore riparian and floodplain processes and conditions so that they are at levels necessary to attain VSP goals.

Deep Creek Recovery Strategy 11: Hydrologically reconnect streams to their floodplains for the purposes of floodplain storage and reconnection of off-channel habitat.
Recovery strategy hierarchy: Tier 3

Deep Creek Recovery Strategy 12: Protect, maintain, and or restore riparian habitat conditions by implementing riparian acquisitions, conservation easements, and riparian and in-stream restoration projects.
Recovery strategy hierarchy: Tier 1/3/4

Deep Creek Recovery Strategy 13: Ensure that current and future regulatory mechanisms are in place to protect and provide sufficient riparian and floodplain conditions to maintain all necessary ecological function.
Recovery strategy hierarchy: Tier 1/3

Deep Creek Action 10 (DCRS#12): Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.

Deep Creek Action 11 (DCRS#12): Map and delineate channel migration zones within the Deep Creek watershed.

Deep Creek Action 12 (DCRS#13): Advocate for and support a WRIA 19 representative of the NOPLE to participate in the Forest and Fish policy group. Individual would provide a conduit for information between the forest practices adaptive management program and the salmon recovery efforts of NOPLE.

7.2.4.7 Habitat and LWD Conditions

Process/Condition Status: Impaired – Medium (recovering)

Deep Creek Recovery Goal 7: Maintain and improve existing habitat conditions to levels necessary to attain VSP goals.

Deep Creek Recovery Strategy 14: Continue the Intensively Monitored Watershed program including implementation of present project proposals. Identify and prioritize the Deep Creek watershed for large woody debris introduction and riparian forest planting upon completion of or consistent with IMW.
Recovery strategy hierarchy: Tier 1/4

An extensive and ongoing set of recovery actions have been implemented as part of the Intensively Monitored Watershed process. It is anticipated that the lower floodplain channel segments of Deep Creek will benefit from riparian planting, large woody material introductions, and reconnection of wetlands.

7.2.4.8 Water Quality Conditions

Process/Condition Status: Impaired – Medium

Deep Creek Recovery Goal 8: Protect and/or restore water quality conditions so that water quality impacts do not limit VSP parameters.

Deep Creek Recovery Strategy 15: Develop water quality monitoring program for the Deep Creek watershed.
Recovery strategy hierarchy: Tier 1

Deep Creek Recovery Strategy 16: Protect and restore water quality through the implementation of riparian/floodplain recovery strategies and actions that protect and restore riparian and floodplain habitat.
Recovery strategy hierarchy: Tier 1/3/4

Deep Creek Action 10 (DCRS#15): Implement long-term surface water quality monitoring program (e.g., temperature, dissolved oxygen, pH, conductivity, turbidity, BIBI).

Deep Creek Action 11 (DCRS#16): Advocate for effective implementation and enforcement of Forest Practice Rules and County Critical Areas Ordinances.

Deep Creek Action 12 (DCRS#8, 9, 10, 11, 12): Inventory and prioritize sources of water quality impacts including sources of fine sediment and channel reaches with deficient riparian vegetation.

7.2.5 Pysht River

7.2.5.1 Estuary and Nearshore Processes and Habitat Conditions

Process/Condition Status: Impaired – High

Pysht River Recovery Goal 1: Protect and restore estuary and nearshore processes and habitat conditions so that current limiting factors are no longer limiting and future limiting factors do not develop.

Pysht River Recovery Strategy 1: Protect estuarine processes and habitat conditions from degradation by employing environmental regulations and management plans. Where regulations are insufficient to protect estuarine processes and habitat conditions implement conservation easements or acquisitions with willing landowners.
Recovery strategy hierarchy: Tier 1

Pysht River Recovery Strategy 2: Restore degraded estuarine habitat conditions where they exist. Reconnect tidal and fish passage processes where possible.

Recovery strategy hierarchy: Tiers 2-4

Pysht River Recovery Strategy 3: For properties that provide particularly important estuarine processes and nearshore habitat, implement conservation easements or acquisitions with willing landowners.
Recovery strategy hierarchy: Tier 1

Pysht River Action 1 (PRRS#2): Currently there is a large scale engineering feasibility study being conducted in the Pysht River estuary. The feasibility study will evaluate four restoration scenarios, including:

- removal of clam shell dredge deposits lining both banks of the river (disconnection with historical tidal marsh),
- removal of suction dredge deposits cast across historical tidal marshes (filling and conversion of tidal marsh),
- removal of log sheet pile on the lower Pysht River (disconnection of floodplain and tidal marsh),
- removal of roads associated with log storage areas on estuary sand spits (conversion of sand spit).

Implementation of the feasibility study recommendations is expected to result in the potential restoration of 60 acres of salt marsh and tidal channels, 20 acres of sand spit, and over a mile of floodplain.

Pysht River Action 2 (PRRS#2): Reconnect tidal wetlands (specifically within the central portion of the Pysht River meander, these are the wetlands affected by the east side road system).

Pysht River Action 3a (PRRS#2): Replace Farm Road culvert on Indian Creek with crossing structure that allows for better fish passage, decreases erosion, and restores complete tidal connectivity.

Pysht River Action 3b (PRRS#2): Replace Farm Road culvert on Indian Slough with crossing structure that allows for better fish passage and complete tidal connectivity.

Pysht River Action 3c (PRRS#2): Replace Farm Road culvert on Section 9 Creek with crossing structure that allows for better fish passage and complete tidal connectivity.

7.2.5.2 Habitat Connectivity

Process/Condition Status: Impaired – High

Pysht River Recovery Goal 2: Restore and protect habitat connectivity so that habitat connectivity does not limit VSP parameters.

Pysht River Recovery Strategy 4: Maintain and protect habitat connectivity where habitat connectivity is intact through the effective implementation of regulations.
Recovery strategy hierarchy: Tier 1

Pysht River Recovery Strategy 5: Restore habitat connectivity where habitat is currently disconnected.
Recovery strategy hierarchy: Tier 2

The first set of actions within this subsection comes directly from the Pysht River Floodplain Habitat Inventory and Assessment (Haggerty et al. 2006). It does not include a complete inventory of all barriers in the watershed. A detailed inventory that includes the S.F. Pysht River (and tributaries), and Reed, Green, and Needham creeks is needed. Barriers included in the WRIA 19 LFA (Smith 1999) are also included below.

Pysht River Action 4a (PRRS#5): Replace SR-112 culverts on Indian Creek with crossing structure that allows for better fish passage and sediment transport capacity.

Pysht River Action 4b (PRRS#5): Replace the 2000 Road culvert on Ring Creek with crossing structure that allows for better fish passage.

Pysht River Action 4c (PRRS#5): Replace the 2000 Road culvert on Shop Creek crossing structure that allows for better fish passage. Evaluate feasibility of removing fill from wetland and/or constructing new channel around fill.

Pysht River Action 4d (PRRS#5): Investigate methods that could be used to improve habitat connectivity and minimize dewatering of the Andis Slough off-channel habitat. Continued monitoring of site is recommended.

Pysht River Action 4e (PRRS#5): Replace SR 112 culvert on Razz Creek T1 with crossing structure that allows for better fish passage and sediment transport (see Section 7.2.5.7).

Pysht River Action 4f (PRRS#5): Replace SR 112 culvert on Razz Creek T2 with crossing structure that allows for better fish passage (see Section 7.2.5.7).

Pysht River Action 4g (PRRS#5): Replace unnamed spur road culvert on Razz Creek T4_T3 with crossing structure that allows for better fish passage.

Pysht River Action 4h (PRRS#5): Replace the 4500 Road culvert on the mainstem Razz Creek with crossing structure that allows for better fish passage.

Pysht River Action 4i (PRRS#5): Monitor and continue to assess habitat connectivity in the 2100 Road Swamp off-channel habitat complex. Implement restoration project that may be developed from assessment. As of last field reports Lost Creek had been re-diverted back into the wetland complex, for more details see Haggerty et al. 2006.

Pysht River Action 4j (PRRS#5): Develop and implement a plan to reconnect the 4500 Road Swamp to the mainstem of the Pysht River. This will require at a minimum the replacement of the SR 112 culvert with a crossing structure that provides fish passage.

Pysht River Action 4k (PRRS#5): Develop and implement a plan to remove the old railroad grade that runs parallel to Lee Creek. This will provide much needed habitat connectivity to associated wetlands along the right bank of Lee Creek.

Pysht River Action 4l (PRRS#5): Replace SR 112 culvert on Michelena Creek with crossing structure that allows for better fish passage.

Pysht River Action 4m (PRRS#5): Replace SR 112 culvert on 25 Mile Creek with crossing structure that allows for better fish passage.

Pysht River Action 4n (PRRS#5): Replace SR 112 culvert on 4800 Road Swamp with crossing structure that allows for better fish passage.

Pysht River Action 4o (PRRS#5): Replace SR 112 culvert on Burnt Creek One with crossing structure that allows for better fish passage.

Pysht River Action 4p (PRRS#5): Replace 801 culvert on Burnt Creek One with crossing structure that allows for better fish passage.

Pysht River Action 4q (PRRS#5): Replace SR 112 culvert on Burnt Creek Two with crossing structure that allows for better fish passage.

Pysht River Action 4r (PRRS#5): Replace 801 Road culvert on Burnt Creek Two with crossing structure that allows for better fish passage.

Pysht River Action 4s (PRRS#5): Replace an impassable culvert near RM 0.3 in a tributary to Reed Creek (19.0014) with crossing structure that allows for fish passage. This potential barrier requires field verification of fish passage conditions above and below the culvert prior to restoration planning.

Pysht River Action 4t (PRRS#5): Replace SR 112 culvert on tributary 19.0121A (RM 0.3) to Green Creek with crossing structure that allows for better fish passage. This potential barrier requires field verification of fish passage conditions above and below the culvert prior to restoration planning.

Pysht River Action 4u (PRRS#5): Replace SR 112 culvert on tributary 19.0121 to Green Creek with crossing structure that allows for better fish passage. This potential barrier requires field verification of fish passage conditions above and below the culvert prior to restoration planning.

Pysht River Action 4v (PRRS#5): Identify water-crossing and road inventories from basin landowners and combine into single basin-wide inventory. Where water-crossing information is lacking or missing (S.F. Pysht River and tributaries, and Reed, Green, and Needham creeks), work with landowners to inventory and assess. Use assessment to identify biological, physical, and process-based metrics to use for prioritizing future habitat connectivity projects.

7.2.5.3 Biological Processes

Process/Condition Status: Impaired – High

Pysht River Recovery Goal 3: Maintain, protect, and/or restore salmonid population abundance, spatial distribution, productivity, and diversity.

Pysht River Recovery Strategy 6: Minimize or eliminate risks associated with hatchery origin salmonids to ensure that the genetic diversity of Pysht River salmonids is maintained.
Recovery strategy hierarchy: Tier 1/3

Pysht River Recovery Strategy 7: Evaluate in and out of basin fishing-related mortalities and influence fisheries regulations so that spawning escapement is sufficient to ensure VSP, as well as deliver adequate levels of marine nutrients from decaying salmon carcasses.
Recovery strategy hierarchy: Tier 1/3

Pysht River Recovery Strategy 8: Supplementation with hatchery origin salmonids.
Recovery strategy hierarchy: Tier 3-6

Pysht River Action 5 (PRRS#6): Develop and implement genetic sampling program for all salmonid species in order to better understand population structure and diversity.

Pysht River Action 6 (PRRS#6): For steelhead trout advocate for the implementation of the Hatchery Scientific Review Group (HSRG) recommendations set for forth in the 2004 Hatchery Reform Report (HSRG 2004), which recommend the discontinuation of out-of-basin steelhead outplanting.

Pysht River Action 7 (PRRS#6, 8): Evaluate the risks and benefits of Chinook salmon hatchery supplementation, also consider the habitats ability to support a viable Chinook salmon population.

Pysht River Action 8 (PRRS#7): Advocate for the adoption of harvest management regulations that ensure salmonid spawning escapement is sufficient to maintain, protect, and/or restore VSP parameters.

Pysht River Action 9 (PRRS#7): Implement and/or continue to implement population abundance monitoring.

7.2.5.4 Hydrologic Processes

Process/Condition Status: Impaired – High

Pysht River Recovery Goal 4: Protect, maintain, and/or restore hydrologic processes and natural hydrologic variability in the Pysht River watershed to the extent that hydrologic impacts do not limit VSP parameters.

Pysht River Recovery Strategy 9: Restore hydrologic processes by addressing issues related to water withdrawals, stream piracy, impermeable surfaces, loss of wetlands and wetland function, and deforestation. Protect intact hydrologic processes where they exist.
Recovery strategy hierarchy: Tier 1/3

Pysht River Recovery Strategy 10: Implement recommendations found in the WRIA 19 Watershed Plan (e.g., establish in-stream flows).
Recovery strategy hierarchy: Tier 1/3

Pysht River Action 10 (PRRS#9): Reduce road related hydrologic impacts by reducing road densities and/or disconnecting road systems from the stream network.

Pysht River Action 11 (PRRS#9): Implement projects that reconnect the mainstem and its tributaries to their floodplains and/or associated wetlands (see Section 7.2.5.6).

Pysht River Action 12 (PRCRS#9): Reforestation of unutilized pastures, degraded riparian/floodplain areas, and other open areas to improve hydrologic processes (see Section 7.2.5.6).

Pysht River Action 13 (PRRS#10): Limit future water withdrawals from the Pysht River watershed through the implementation of the WRIA 19 Watershed Plan (WRIA 19 Planning Unit 2010).

7.2.5.5 Sediment Processes

Process/Condition Status: Impaired – High

Pysht River Recovery Goal 5: Maintain and restore sediment processes (production, routing, storage, and grain size frequency distribution) in the Pysht River to the extent that sediment processes do not limit VSP parameters.

Pysht River Recovery Strategy 11: Eliminate road/culvert and other land use related mass wasting events that deliver sediment to streams.
Recovery strategy hierarchy: Tier 3

Pysht River Recovery Strategy 12: Reduce surface runoff from existing road network to levels that meet or exceed existing Washington State Water Quality Standards.
Recovery strategy hierarchy: Tier 3

Pysht River Recovery Strategy 13: Restore natural wood loading volume and density to the Pysht River watershed to restore habitat forming processes and improve in-stream sediment routing (see also Section 7.2.5.7).
Recovery strategy hierarchy: Tier 4

Pysht River Action 14 (PRRS#11, 12): Inventory roads for maintenance (use existing RMAP and other available data), side cast removal, and drainage structure improvements. Prioritize for project actions.

Pysht River Action 15 (PRRS#13): Reforest riparian and floodplain areas to increase stream bank integrity and reduce bank erosion (see also Section 7.2.5.6).

Pysht River Action 16 (PRRS#11, 12): Using existing core sample data for the Pysht watershed (McHenry et al. 1994), collect core samples in the next two years to compare conditions.

7.2.5.6 Riparian and Floodplain Processes and Conditions

Process/Condition Status: Impaired – High

Pysht River Recovery Goal 6: Restore riparian and floodplain processes and conditions so that they are at levels necessary to attain VSP goals.

Pysht River Recovery Strategy 14: Hydrologically reconnect streams to their floodplains for the purposes of floodplain storage and reconnection of off-channel habitat.
Recovery strategy hierarchy: Tier 3

Pysht River Recovery Strategy 15: Protect, maintain, and or restore riparian habitat conditions by implementing riparian acquisitions, conservation easements, and riparian and/or restoration projects.
Recovery strategy hierarchy: Tier 1/3/4

Pysht River Recovery Strategy 16: Ensure that current and future regulatory mechanisms are in place to protect and provide sufficient riparian and floodplain conditions to maintain all necessary ecological function.
Recovery strategy hierarchy: Tier 1/3

As described in Section 5.6.4 floodplain and riparian conditions are severely degraded within the Pysht River subbasin. Haggerty et al. (2006) recommended a broad-scale approach to the protection and restoration of the Pysht River floodplain and floodplain habitats. Their recommendations are outlined below.

Pysht River Action 17 (PRRS#14): Attempt to reconnect floodplain where feasible, through barrier correction, road relocation, or treatment of mainstem incision. The restructuring of the mainstem Pysht River with LWD, from both natural recruitment and restoration projects likely offers the best approach for treating incision problems.

Pysht River Action 18 (PRRS#14, 15): Work with WDOT regarding future Highway 112 planning to encourage alternative road locations that minimize encroachment of floodplain habitats.

- Considered relocation SR 112 from RM 5.5 to 4.8. Consider large scale channel and riparian restoration project in this stream reach that addresses shade and stream temperature impacts, as well as in-channel habitat conditions.
- Considered other locations where road relocation out of the active floodplain might be feasible and help address floodplain encroachment issues.

Pysht River Action 19 (PRRS#15): Convert unutilized fields and non-forested riparian areas back to functional riparian forests.

Pysht River Action 20 (PRRS#15): Advocate for effective implementation and enforcement of Forest Practice Rules and County Critical Areas Ordinances. Limit future land use encroachment along the Pysht River floodplain.

Pysht River Action 21 (PRRS#15): Assess possibilities for obtaining floodplain conservation easements along the Pysht River corridor. A nearly 1000 acre easement that includes significant portions of the estuary has recently been negotiated. Floodplain easements that connect to this core area are a logical strategy for conserving floodplain habitats over the long term.

Pysht River Action 22 (PRRS#15): Implement riparian restoration projects where degraded riparian forest conditions exist. Riparian conditions are degraded throughout many portions of the watershed. Many of these areas could benefit from riparian restoration. Young to medium aged deciduous riparian forests where conifers were historically the dominant species should be a high priority for restoration treatments. Treatments of these sites could involve conifer under planting with a long-term commitment to brush control (or other appropriate methods such as small patch cuts). Many of these sites could be combined with LWD placement projects designed to treat channel incision or improve stream habitat conditions.

Pysht River Action 23 (PRRS#14, 15): Replace the 3400 Road bridge on the South Fork Pysht River with a bridge that allows for optimal passage of LWD, sediment, and water at the 100-year flood flow.

Pysht River Action 24 (PRRS#15): Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.

Pysht River Action 25 (SCRS#15): Map and delineate channel migration zones within the Pysht River watershed.

Pysht River Action 26 (PRRS#16): Advocate for and support a WRIA 19 representative of the NOPLE to participate in the Forest and Fish policy group. Individual would provide a conduit for information between the forest practices adaptive management program and the salmon recovery efforts of NOPLE.

7.2.5.7 Habitat and LWD Conditions

Process/Condition Status: Impaired – High

Pysht River Recovery Goal 7: Maintain and improve existing habitat conditions to levels necessary to attain VSP goals.

Pysht River Recovery Strategy 17: Where data are lacking assess instream meso-habitat conditions in the Pysht River watershed.
Recovery strategy hierarchy: Tier 1

Pysht River Recovery Strategy 18: Implement wood supplementation in identified wood deficient zones and/or from future habitat monitoring results.
Recovery strategy hierarchy: Tier 1/3/4

No comprehensive list of projects to restore habitat and LWD conditions has been developed for the Pysht River. Significant restoration efforts have been conducted in the South Fork Pysht River but very little work has occurred in the mainstem Pysht River. Habitat and LWD conditions suggest that much of the mainstem and some of the tributaries could benefit from projects focused on restoring habitat conditions. It is important to consider that much of the current habitat and LWD conditions are a function of degraded riparian and floodplain habitat conditions and impaired habitat forming processes. Projects that focus on enhancing habitat conditions should also have a detailed strategy that addresses habitat forming processes, because the degraded habitat conditions are merely a symptom of the overall degraded habitat forming processes that exist along much of the mainstem Pysht River.

Pysht River Action 27 (PRRS#17, 18): Conduct detailed instream meso-habitat mapping inventory and assessment. Implement wood supplementation in identified wood deficient zones from the habitat mapping assessment.

Pysht River Action 28 (PRRS#18): Within the S.F. Pysht River implement LWD treatments identified to facilitate floodplain reconnection in channel reaches that have incised from historical land use practices and in the lower 0.5 miles which has had no restoration treatments to date. This project would involve the addition of key pieces of LWD (~200) using a heavy lift helicopter as well as the under-planting of conifers on terraces adjacent to the river.

Pysht River Action 29 (PRRS#18, 14, 5): Develop and implement a detailed stream restoration project in the Razz Creek sub-basin. Project scope should include an evaluation of re-routing the mainstem Razz Creek and reconnecting Razz T1 and T2. Plan should include LWD placement in new channel. Plan should include channel reconfiguration and LWD placement in the lower reach of Razz T1 to reduce cascade step elevations. Also include increasing habitat connectivity in Razz Creek T3_t1 (see Haggerty et al. 2006).

7.2.5.8 Water Quality Conditions

Process/Condition Status: Impaired – High

Pysht River Recovery Goal 8: Protect and/or restore water quality conditions so that water quality conditions do not limit VSP parameters.

Pysht River Recovery Strategy 19: Develop water quality monitoring program for the Pysht River watershed.
Recovery strategy hierarchy: Tier 1

Pysht River Recovery Strategy 20: Protect and restore water quality through the implementation of riparian/floodplain recovery strategies and actions that protect and restore riparian and floodplain habitat.
Recovery strategy hierarchy: Tier 1/3/4

Pysht River Action 30 (PRRS#19): Implement long-term surface water quality monitoring program (e.g., temperature, dissolved oxygen, pH, conductivity, turbidity, BIBI). Also include monitoring of hydrocarbons and other potential contaminants.

Pysht River Action 31 (PRRS#20): Advocate for effective implementation and enforcement of Forest Practice Rules and County Critical Areas Ordinances.

7.2.6 Clallam River

7.2.6.1 Estuary and Nearshore Processes and Habitat Conditions

Process/Condition Status: Impaired – High

Clallam River Recovery Goal 1: Protect and restore estuary and nearshore processes and habitat conditions so that current limiting factors are no longer limiting and future limiting factors do not develop.

Clallam River Recovery Strategy 1: Protect estuarine processes and habitat conditions from degradation by implementing environmental regulations and management plans. Where regulations are insufficient to adequately protect estuarine processes and habitat conditions implement conservation easements or acquisitions with willing landowners.
Recovery strategy hierarchy: Tier 1

Clallam River Recovery Strategy 2: Restore degraded estuarine habitat conditions where they exist. Reconnect tidal and fish passage processes where possible.
Recovery strategy hierarchy: Tiers 2/3/4

Clallam River Recovery Strategy 3: For properties that provide particularly important estuarine processes and nearshore habitat, implement conservation easements or acquisitions with willing landowners.
Recovery strategy hierarchy: Tier 1

Clallam River Action 1 (CRRS#2): As much as possible, remove infrastructure that encroaches on the Clallam River estuary and Clallam Bay/Sekiu nearshore, impeding its function.

Clallam River Action 2 (CRRS#2): Reconnect remaining tidal channels and restore wetlands behind the town to increase tidal prism.

Clallam River Action 3 (CRRS#2): Reconnect and restore forest wetlands along left bank of Swamp Creek by removing north-south trending grade off of Frontier Road. The road grade mentioned above is within the land parcel described in Clallam River Action 5.

Clallam River Action 4 (CRRS#1, 5, 6): Develop a plan and stakeholder approval for how to monitor the river mouth and how to open the river mouth when closures threaten fish passage. This plan should include the compilation of recent records of mouth closures and openings.

Clallam River Action 5 (CRRS#1): Protect the wetlands on the east side of town. Explore the possibility of acquiring the land parcel adjacent to the mainstem Clallam River to the south of Frontier Road and to the north of the school. This parcel includes 0.40 miles of mainstem Clallam River (both sides), 0.25 miles of estuarine channel in Swamp Creek and tributaries, 2 fish bearing forested wetlands, and several additional short channel segments that include off-channel rearing habitat.

Clallam River Action 6 (CRRS#1, 3): Explore possibility of habitat acquisition and/or easements to protect high quality riparian and floodplain estuarine habitats. Prioritize areas where the tidal prism can be protected and/or increased.

7.2.6.2 Habitat Connectivity

Process/Condition Status: Impaired – Medium

Clallam River Recovery Goal 2: Restore and protect habitat connectivity so that habitat connectivity does not limit VSP parameters.

Clallam River Recovery Strategy 4: Maintain and protect habitat connectivity where habitat connectivity is intact through the effective implementation of regulations.
Recovery strategy hierarchy: Tier 1

Clallam River Recovery Strategy 5: Restore habitat connectivity where habitat is currently disconnected.
Recovery strategy hierarchy: Tier 2

Clallam River Recovery Strategy 6: Where restoration of habitat connectivity is currently not possible develop mitigation plan that minimizes the impacts to salmonids.
Recovery strategy hierarchy: Tier 2-6

Clallam River Action 7a (CRRS#5): Replace two total barrier culverts located at RM 0.49 and RM 0.68 of Swamp Creek with fish passable stream crossings (see Section 5.7.2 for more details).

Clallam River Action 7b (CRRS#5): Within Spruce Creek a 0.47 m diameter, 2.7 percent slope, slightly perched culvert (0.25 m) at RM 0.01 completely blocks juvenile fish migration into a 0.4 acre forested wetland complex located directly upstream from the culvert. This culvert is located on Charley Creek Road. A short (13m) stream reach separates the culvert from the Clallam River. No adult salmonid habitat exists upstream of the culvert. Replace culvert with fish passable stream crossing.

Clallam River Action 7c (CRRS#5): Replace total fish barrier culvert (SR 112) in Unnamed Creek WP 203 (RBT to Clallam River RM 6.24) with fish passable structure. Note: this culvert is not included in the WDOT inventory.

Clallam River Action 7d (CRRS#5): Assess fish passage through the Hamilton Creek culvert (SR 112). This culvert is not included in the WDOT inventory.

Clallam River Action 7e (CRRS#5): Assess benefits of replacing current fish blockages in an unnamed tributary (Trib H) to Last Creek, unnamed tributary 19.0135, and in an unnamed tributary (Trib WP 450) to the Clallam River (see Section 5.7.2). None of these streams appear to have more than 100 meters of habitat upstream of the current barrier and below the natural barriers present.

7.2.6.3 Biological Processes

Process/Condition Status: Impaired – High

Clallam River Recovery Goal 3: Maintain, protect, and/or restore salmonid population abundance, spatial distribution, productivity, and diversity.

Clallam River Recovery Strategy 7: Minimize or eliminate risks associated with hatchery origin salmonids to ensure that the genetic diversity of Clallam River salmonids is maintained.
Recovery strategy hierarchy: Tier 1/3

Clallam River Recovery Strategy 8: Evaluate in and out of basin fishing-related mortalities and influence fisheries regulations so that spawning escapement is sufficient to ensure VSP, as well as deliver adequate levels of marine nutrients from decaying salmon carcasses.
Recovery strategy hierarchy: Tier 1/3

Clallam River Action 8 (CRRS#7): Advocate for implementation of the Hatchery Scientific Review Group (HSRG) recommendations set for forth in the 2004 Hatchery Reform Report (HSRG 2004) that call for the discontinuation of hatchery outplanting in the Clallam River watershed.

Clallam River Action 9 (CRRS#8): Advocate for the adoption of harvest management regulations that ensure salmonid spawning escapement is sufficient to maintain, protect, and/or restore VSP parameters.

Clallam River Action 10 (CRRS#8): Implement and/or continue to implement population abundance monitoring.

7.2.6.4 Hydrologic Processes

Process/Condition Status: Impaired – High

Clallam River Recovery Goal 4: Protect, maintain, and/or restore hydrologic processes and natural hydrologic variability in the Clallam River watershed to the extent that hydrologic impacts do not limit VSP parameters.

Clallam River Recovery Strategy 9: Restore hydrologic processes by addressing issues related to water withdrawals, stream piracy, impermeable surfaces, loss of wetlands and wetland function, and deforestation. Protect intact hydrologic processes where they exist.
Recovery strategy hierarchy: Tier 1/3

Clallam River Recovery Strategy 10: Implement recommendations found in the WRIA 19 Watershed Plan (e.g., establish in-stream flows).

Recovery strategy hierarchy: Tier 1/3

Clallam River Action 11 (CRRS#9): Reforestation of unutilized pastures, degraded riparian/floodplain areas, and other open areas to improve hydrologic processes (see also Section 7.2.6.6).

Clallam River Action 12 (CRRS#9): Reduce road related hydrologic impacts by reducing road densities and/or disconnecting road systems from the stream network.

Clallam River Action 13 (CRRS#10): Limit future water withdrawals from the Clallam River watershed through the implementation of the WRIA 19 Watershed Plan (WRIA 19 Planning Unit 2010).

7.2.6.5 Sediment Processes

Process/Condition Status: Impaired – Medium

Clallam River Recovery Goal 5: Maintain and restore sediment processes (production, routing, storage, and grain size frequency distribution) in the Clallam River to the extent that sediment processes do not limit VSP parameters.

Clallam River Recovery Strategy 11: Eliminate road/culvert and other land use related mass wasting events that deliver sediment to streams.
Recovery strategy hierarchy: Tier 3

Clallam River Recovery Strategy 12: Reduce surface runoff from existing road network to levels that meet or exceed existing Washington State Water Quality Standards.
Recovery strategy hierarchy: Tier 3

Clallam River Recovery Strategy 13: Restore natural wood loading volume and density to the Clallam River watershed to restore habitat forming processes and improve in-stream sediment routing (see also Section 7.2.6.7).
Recovery strategy hierarchy: Tier 4

Clallam River Action 14 (CRRS#11, 12): Inventory roads for maintenance (use existing RMAP and other available data), side cast removal, and drainage structure improvements. Prioritize for project actions.

Clallam River Action 15 (CRRS#13): Reforest riparian and floodplain areas to increase stream bank integrity and reduce bank erosion (see also Section 7.2.6.6).

Clallam River Action 16 (CRRS#11, 12): Using existing sediment core sample data for the Clallam watershed (McHenry et al. 1994), collect sediment core samples in the next two years to compare conditions.

7.2.6.6 Riparian and Floodplain Processes and Conditions

Process/Condition Status: Impaired – High

Clallam River Recovery Goal 6: Restore riparian and floodplain processes and conditions so that they are at levels necessary to attain VSP goals.

Clallam River Recovery Strategy 14: Hydrologically reconnect streams to their floodplains for the purposes of floodplain storage and reconnection of off-channel habitat.
Recovery strategy hierarchy: Tier 3

Clallam River Recovery Strategy 15: Protect, maintain, and or restore riparian habitat conditions by implementing riparian acquisitions, conservation easements, and riparian and/or restoration projects.
Recovery strategy hierarchy: Tier 3

Clallam River Recovery Strategy 16: Ensure that current and future regulatory mechanisms are in place to protect and provide sufficient riparian and floodplain conditions to maintain all necessary ecological function.
Recovery strategy hierarchy: Tier 3

As described in Section 5.7.4 floodplain and riparian conditions are severely degraded within portions of the Clallam River subbasin. Restoration of riparian and floodplain conditions and processes will help restore important habitat forming processes along the mainstem. In order to achieve recovery of floodplain and riparian conditions the following recommendations should be implemented.

Clallam River Action 17 (CRRS#15): Assess possibilities for acquisition or conservation easements along the lower mainstem (see Haggerty 2008 for sites). Priority should be given to the most intact habitats in order to protect areas that are currently properly functioning.

Clallam River Action 18 (CRRS#14, 15): Work with WDOT and Clallam County regarding future Highway 112 planning to encourage alternative road locations that minimize encroachment on the floodplain and floodplain habitats. Consider locations where road relocation out of the active floodplain might be feasible and help address floodplain encroachment issues.

Clallam River Action 19 (CRRS#15): Conversion of fields and non-forested riparian areas (mostly between RM 1.0 and 6.0) back to fully functional riparian forests.

Clallam River Action 20 (CRRS#14): Attempt to reconnect floodplain where it is viable, through barrier correction, road relocation, or treatment of mainstem incision.

The restructuring of the mainstem Clallam River with LWD, from both natural recruitment and restoration projects likely offers the best approach for treating incision problems.

Clallam River Action 21 (CRRS#15): Work with willing landowners and other restoration partners to remove knotweed and other noxious weeds followed by riparian replanting.

Clallam River Action 22 (CRRS#15, 16): Advocate for effective implementation and enforcement of Forest Practice Rules and County Critical Areas Ordinances. Limit future land use encroachment along the Clallam River floodplain.

Clallam River Action 23 (CRRS#14, 15): Replace undersized bridges with correctly sized bridges.

Clallam River Action 24 (CRRS#15): Reduce roads, road prisms, and impervious surfaces within the floodplain.

Clallam River Action 25 (CRRS#15): Relocate roads which negatively impact fish populations and habitat.

Clallam River Action 26 (CRRS#15): Implement projects that will enhance riparian conditions in tributaries where current conditions are poor (e.g. Last Creek segment 1). For other potential projects also see the riparian inventory in Haggerty (2008).

Clallam River Action 27 (CRRS#12): Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.

Clallam River Action 28 (CRRS#15, 16): Map and delineate channel migration zones within the Clallam River watershed.

Clallam River Action 29 (CRRS#16): Advocate for and support a WRIA 19 representative of the NOPLE to participate in the Forest and Fish policy group. Individual would provide a conduit for information between the forest practices adaptive management program and the salmon recovery efforts of NOPLE.

7.2.6.7 Habitat and LWD Conditions

Process/Condition Status: Impaired – Medium

Clallam River Recovery Goal 7: Maintain and improve existing habitat conditions to levels necessary to attain VSP goals.

Clallam River Recovery Strategy 17: Where data are lacking assess instream meso-habitat conditions in the Clallam River watershed.
Recovery strategy hierarchy: Tier 1

Clallam River Recovery Strategy 18: Implement wood supplementation in identified wood deficient zones and/or from future habitat monitoring results.
Recovery strategy hierarchy: Tier 1/3/4

Clallam River Action 30 (CRRS#17, 18): Mainstem Clallam River- most of segments 1 through 4 are low or deficient in LWD. LWD projects in any of these stream segments could significantly improve fish habitat conditions. Caution will be needed due to extensive private property holdings and infrastructure located close to the river's edge. Meso-habitat data are needed in stream segments 1 through 4.

Clallam River Action 31 (CRRS#18): Mainstem Clallam River- upper segment 5 and segment 6 could benefit from LWD introductions that help improve channel complexity, stability, and floodplain connectivity. Historically this stream reach contained abundant LWD, current LWD levels are low in this reach (see Section 5.7.3 and Table 36).

Clallam River Action 32 (CRRS#18): Upper Mainstem Clallam River- Segments 9 and 12 have the most potential to benefit from LWD introductions (segments 7, 8, 10, 11, and 14 are confined, high energy environments where LWD introduction may not be feasible). Projects in these stream reaches should attempt to add habitat complexity and restore floodplain connectivity where possible.

Clallam River Action 33 (CRRS#18): LWD wood supplementation in the Charley Creek subbasin. Areas to target include the mainstem Charley Creek, upper segment 2 and segment 3, unnamed tributary 19.0135 segment 1, Err Creek segment 1, unnamed tributary 19.0136 segment 1.

Clallam River Action 34 (CRRS#18): LWD wood supplementation in Simmons Creek segment 1.

Clallam River Action 35 (CRRS#18): LWD wood supplementation in Blowder Creek (upper segment 1 and portions of segment 2).

7.2.6.8 Water Quality Conditions

Process/Condition Status: Impaired – High

Clallam River Recovery Goal 8: Protect and/or restore water quality conditions so that water quality conditions do not limit VSP parameters.

Clallam River Recovery Strategy 19: Develop water quality monitoring program for the Clallam River watershed.

Recovery strategy hierarchy: Tier 1

Clallam River Recovery Strategy 20: Protect and restore water quality through the implementation of riparian/floodplain recovery strategies and actions that protect and restore riparian and floodplain habitat.
Recovery strategy hierarchy: Tier 1/3/4

Clallam River Action 36 (CRRS#19): Implement long-term surface water quality monitoring program (e.g., temperature, dissolved oxygen, pH, conductivity, turbidity, BIBI). Also include monitoring of hydrocarbons and other potential contaminants.

Clallam River Action 37 (CRRS#20): Advocate for effective implementation and enforcement of Forest Practice Rules and County Critical Areas Ordinances.

7.2.7 Hoko River

7.2.7.1 Estuary and Nearshore Processes and Habitat Conditions

Process/Condition Status: Impairment – High

Hoko River Recovery Goal 1: Protect and restore estuary and nearshore processes and habitat conditions so that current limiting factors are no longer limiting and future limiting factors do not develop.

Hoko River Recovery Strategy 1: Ensure that existing environmental regulations and management plans protect estuarine and nearshore processes.
Recovery strategy hierarchy: Tier 1 (form of an assessment)

Hoko River Recovery Strategy 2: Protect intact, continuous shoreline that is uninterrupted by man-made armoring.
Recovery strategy hierarchy: Tier 1

Hoko River Recovery Strategy 3: Remove existing "hard-point" armoring and/or replace with alternative design methods that avoid and minimize environmental impacts to the greatest extent possible.
Recovery strategy hierarchy: Tier 3

Hoko River Recovery Strategy 4: Support natural process recovery through wood supplementation.
Recovery strategy hierarchy: Tier 4

Hoko River Action 1 (HRRS#1): Assess the effectiveness of existing regulatory mechanisms in protecting natural resources. Identify actions taken under specific regulatory controls that can be assessed through effectiveness monitoring.

Hoko River Action 2 (HRRS#2, 3): Identify willing sellers of parcels with natural shoreline for either permanent conservation or acquisition for protection. Within conservation easements or areas acquired for protection, completely remove shoreline armoring and return to original shoreline geometry.

Hoko River Action 3 (HRRS#1): Water quality and fish use monitoring should be conducted in the Hoko River estuary to determine potential impacts to aquatic resources. Future monitoring should incorporate recent water quality data collected by Stream Keepers, local residents, and volunteers. Also include cross-section monitoring through and across the meander channel.

Hoko River Action 4 (HRRS#3): Work with landowners to replace existing "hard-point" armoring with alternative soft shore protection designs (ex. beach nourishment, grade control w/ LWD, wood revetment, and biotechnical slope support).

Hoko River Action 5 (HRRS#3): Assess the feasibility of moving 0.24mi of Hwy 112, that is currently armored to a higher elevation, landward location.

Hoko River Action 6 (HRRS#4): Introduce small-scale wood complex at outlet of historical meander to improve tidal exchange and maintain surface water connection.

Hoko River Action 7 (HRRS#4): Introduce large-scale, channel-spanning wood complexes below historical meander inlet to improve flood flow connection to meander.

7.2.7.2 Habitat Connectivity

Process/Condition Status: Impaired – Medium

Hoko River Recovery Goal 2: Restore and protect habitat connectivity so that habitat connectivity does not limit VSP parameters.

Hoko River Recovery Strategy 5: Maintain and protect habitat connectivity where habitat connectivity is intact through the effective implementation of regulations.
Recovery strategy hierarchy: Tier 1

Hoko River Recovery Strategy 6: Develop basin-wide inventory of existing water-crossings and incorporate current condition assessment. Restore habitat connectivity where habitat is currently disconnected.
Recovery strategy hierarchy: Tier 1/2

Hoko River Action 8a (HRRS#6): Identify water-crossing and road inventories from basin landowners and combine into single basin-wide inventory. Where water-crossing information is lacking or missing, work with landowners to inventory and assess.

Hoko River Action 8b (HRRS#6): Using a basin-wide approach, identify biological, physical, and process-based metrics to use for prioritizing future habitat connectivity projects.

The Hoko River actions listed below (9a-9i) were prioritized based on several factors including the quantity and quality of habitat upstream of the barrier(s). Confirmation of upstream habitat, as well as existing barrier status should be confirmed before any project planning takes place.

Hoko River Action 9a (HRRS#6): Remove undersized, perched culvert that acts as a partial barrier in Johnson Creek at the confluence with the Hoko River. Currently adult coho and steelhead appear to easily pass upstream through the culvert. The road fill is extremely deep and the culvert is partially collapsed and poses a significant risk of catastrophic failure.

Hoko River Action 9b (HRRS#6): Repair perched culvert (Hoko Ozette Road) on an unnamed tributary to Johnson Creek (tributary 19.0176) blocking access to 0.8 miles of low gradient (1-4%) habitat and 0.35 miles of 4-8 percent gradient habitat.

Hoko River Action 9c (HRRS#6): Repair perched culvert (spur to 7000 Road) on an unnamed tributary to Johnson Creek (tributary 19.0178). This culvert blocks access to 0.68 miles of low gradient (2-4%) stream habitat.

Hoko River Action 9d (HRRS#6): Repair perched culvert on an unnamed tributary (19.0189; RM 0.18) to the Hoko River. This culvert blocks access to 0.41 miles of 3-6% gradient spawning habitat (field verified by Makah Fisheries 1998).

Hoko River Action 9e (HRRS#6): Two perched culverts on the 9000 Road block access to a 4 acre fish bearing wetland complex. No spawning habitat has been identified upstream of the barrier culverts. Replace with fish passable structure.

Hoko River Action 9f (HRRS#6): Replace Hoko-Ozette Road partial barrier culvert on Wrights Creek with crossing structure that allows for better fish passage. Ensure structure is adequately sized to pass flood flows, debris, and sediment. Coordinate actions with Hoko River hatchery facility to ensure that fish passage does not present health risk from adult spawners above hatchery.

Hoko River Action 9g (HRRS#6): Repair partial barrier associated with SR 112 near MP 12.3. This culvert blocks access to a 1.6 acre wetland complex and 0.15 miles of 2-4 percent gradient spawning and rearing habitat. An additional 0.3 miles of 4-8 percent gradient habitat is also upstream of the barrier culvert.

Hoko River Action 9h (HRRS#6): Repair partial barrier culvert on Hoko Ozette Road blocking 0.25 miles of 2-8 percent gradient spawning and rearing habitat in Hoko Gage Creek (near Hoko RM 5.0).

Hoko River Action 9i (HRRS#6): An unmapped right bank tributary to unnamed tributary 19.0199 (RM 0.45) contains a barrier culvert at RM 0.06 that blocks access to about 0.1 miles of spawning habitat. Replace with fish passable culvert or bridge.

7.2.7.3 Biological Processes

Process/Condition Status: Impairment – High

Hoko River Recovery Goal 3: Maintain, protect, and/or restore salmonid population abundance, productivity, and diversity to conditions needed to achieve VSP.

Hoko River Recovery Strategy 7: Maintain genetic diversity within natural origin Hoko populations.
Recovery strategy hierarchy: Tier 1/3

Hoko River Recovery Strategy 8: Evaluate in and out of basin fishing-related mortalities and influence fisheries regulations so that spawning escapement is sufficient to ensure VSP, as well as deliver adequate levels of marine nutrients from decaying salmon carcasses.
Recovery strategy hierarchy: Tier 1/3

Hoko River Recovery Strategy 9: Improve spatial distribution and retention of salmon carcasses in the Hoko River drainage to maintain critical marine-derived nutrient cycles.
Recovery strategy hierarchy: Tier 3-6

Hoko River Action 10 (HRRS#7): Develop and implement genetic sampling program for all salmonid species in order to better understand population structure and diversity.

Hoko River Action 11 (HRRS#8): Advocate for the adoption of harvest management regulations that ensure salmonid spawning escapement is sufficient to maintain, protect, and/or restore VSP parameters.

Hoko River Action 12 (HRRS#8): Implement and/or continue to implement population abundance monitoring.

Hoko River Action 13 (HRRS#9): Specify locations to introduce salmon carcass analogs to the Hoko River drainage to improve N, P, and C cycling in areas deficient of natural salmon spawners.

7.2.7.4 Hydrologic Processes

Process/Condition Status: Impairment – High

Hoko River Recovery Goal 4: Restore natural flow regime (magnitude, frequency, duration, timing, and rate-of-change) to conditions that maintain self-sustaining ecological processes and patterns.

Hoko River Recovery Strategy 10: Restore hydrologic processes by addressing issues related to water withdrawals, stream piracy, impermeable surfaces, loss of wetlands and wetland function, and deforestation. Protect intact hydrologic processes where they exist.
Recovery strategy hierarchy: Tier 1/3

Hoko River Recovery Strategy 11: Maintain existing USGS Hoko River gaging station.
Recovery strategy hierarchy: Tier 1

Hoko River Recovery Strategy 12: Evaluate existing road network and determine appropriate road density necessary to achieve Hoko River Recovery Goal 4.
Recovery strategy hierarchy: Tier 1

Hoko River Action 14 (HRRS#10): Collaborate with Washington Department of Fish and Wildlife, private landowners, and tribes to provide access and develop field methodology for evaluating flood flow passage through existing instream structures. This effort should focus on assessing existing in-stream structures on 3rd order or greater tributaries for flood water passage, flood water access to off-channel floodplain habitat, and capacity to transport flood associated debris and sediment.

Hoko River Action 15 (HRRS#10, 11): Obtain funding for necessary equipment to collect high flow data.

Hoko River Action 16 (HRRS#12): Obtain necessary information (RMAPs, RMAP Annual Reports, current and historical road inventory) from Washington Department of Natural Resources (WDNR).

Hoko River Action 17 (HRRS#12): Review published literature on impacts to natural basin hydrology due to changes in road density (including work completed in WDNR Hoko Watershed Analysis).

Hoko River Action 18 (HRRS#12): In coordination with WDNR, WDFW, WDOE, and landowners, develop road density goals for the Hoko River drainage based on “best available science” that will achieve Hoko River Recovery Goal 4.

Hoko River Action 19 (HRRS#10): Limit future water withdrawals from the Hoko River watershed through the implementation of the WRIA 19 Watershed Plan (WRIA 19 Planning Unit 2010).

7.2.7.5 Sediment Processes

Process/Condition Status: Impairment – Medium

Hoko River Recovery Goal 5: Minimize sediment inputs to the Hoko River drainage to those that occur naturally. Restore and protect natural in-stream sediment transport processes. Where sediment levels are impaired, reduce fine sediment (< 0.85mm) volume within the hyporheic zone to improve survival to emergence.

Hoko River Recovery Strategy 13: Eliminate road/culvert related mass wasting events to fish-bearing water.
Recovery strategy hierarchy: Tier 3

Hoko River Recovery Strategy 14: Reduce surface runoff from existing road network to levels that meet or exceed existing Washington State Water Quality Standards.
Recovery strategy hierarchy: Tier 3

Hoko River Recovery Strategy 15: Restore natural wood loading volume and density to the Hoko watershed to restore habitat forming processes and improve in-stream sediment routing.
Recovery strategy hierarchy: Tier 4

Hoko River Action 20 (HRRS#13): Evaluate rate of road/culvert related failure (mass wasting events) over time using aerial photo interpretation. Compare existing rates of mass wasting events to historical.

Hoko River Action 21 (HRRS#13): Using existing RMAP information, quantify remaining orphaned and abandoned roads to determine potential for resource damage and likelihood of failure.

Hoko River Action 22 (HRRS#14): Install continuous, long-term turbidity monitoring station coupled with storm-related suspended sediment collection. Use data for long-term trend analysis and measures of state water quality standards.

Hoko River Action 23 (HRRS#15): Using existing sediment core sample data for the Clallam watershed (McHenry et al. 1994), collect sediment core samples to compare conditions.

Hoko River Action 24 (HRS#15): Review published literature on recommended levels of fine sediment volume within the hyporheic zone for a range of STE, and establish benchmarks for the next 10-100 years.

7.2.7.6 Riparian and Floodplain Processes and Conditions

Process/Condition Status: Impairment – High

Hoko River Recovery Goal 6: Protect existing intact and high functioning riparian and floodplain processes and conditions to ensure “no net loss”. Restore degraded riparian and floodplain processes and conditions so that they are at levels necessary to attain VSP goals.

Hoko River Recovery Strategy 16: Ensure that current and future regulatory mechanisms are in place to protect and provide sufficient riparian and floodplain conditions to maintain all necessary ecological function.
Recovery strategy hierarchy: Tier 1/3

Hoko River Recovery Strategy 17: Protect, maintain, and or restore riparian habitat conditions by implementing riparian acquisitions, conservation easements, and riparian and/or restoration projects.
Recovery strategy hierarchy: Tier 1/3/4

Hoko River Recovery Strategy 18: Reduce riparian and floodplain road network that causes compaction and disconnection of subsurface flow pathways.
Recovery Strategy hierarchy: Tier 3

Hoko River Action 25 (HRRS#16): Advocate for and support a WRIA 19 representative of the NOPLE to participate in the Forest and Fish policy group. Individual would provide a conduit for information between the forest practices adaptive management program and the salmon recovery efforts of NOPLE.

Hoko River Action 26 (HRRS#16, 17): Limit future land use encroachment on the Hoko River floodplain.

Hoko River Action 27 (HRRS#17): Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011) to further refine prioritization of floodplain and riparian habitat. Assess possibilities for obtaining floodplain conservation easements along the Hoko River corridor. A large tract of land is currently owned by Washington State Parks and it includes significant portions of the estuary and Little Hoko River. Floodplain easements that connect to this core area are a logical strategy for conserving floodplain habitats over the long term.

Hoko River Action 28 (HRRS#17): Conversion of fields and non-forested riparian areas (mostly between RM 0.75 and 4.0) back to fully functional riparian forests.

Hoko River Action 29 (HRRS#18): Evaluate and prioritize the need to remove or abandon road segments that occupy floodplain habitat throughout the Hoko River drainage.

Hoko River Action 30 (HRRS#18): Work with WDOT and Clallam County regarding future Highway 112 and Hoko-Ozette Road planning to encourage alternative road locations that minimize encroachment on the floodplain and floodplain habitats. Considered locations where road relocation out of the active floodplain might be feasible and help address floodplain encroachment issues.

Hoko River Action 31 (HRRS#16-18): Map and delineate channel migration zones within the Hoko River watershed.

7.2.7.7 Habitat and LWD Conditions

Process/Condition Status: Impairment – High

Hoko River Recovery Goal 7: Maintain and improve existing habitat to conditions necessary to attain VSP goals.

Hoko River Recovery Strategy 19: Assess instream meso-habitat in the Hoko watershed.
Recovery strategy hierarchy: Tier 1

Hoko River Recovery Strategy 20: Based on LWD volume and density, develop a strategic implementation plan to achieve conditions that support VSP goals. Implement wood supplementation in high priority, wood deficient zones.
Recovery strategy hierarchy: Tier 1/3/4

No comprehensive list of projects to restore habitat and LWD conditions has been developed for the Hoko River. Significant work has been conducted in the Little Hoko River but very little work has occurred in the mainstem Hoko River. Habitat and LWD conditions suggest that much of the mainstem and some of the tributaries could benefit from projects focused on restoring habitat conditions. The NOPLE has identified a few habitat restoration and enhancement projects; they are included in the list below.

Hoko River Action 32 (HRS#19, 20): Conduct detailed instream meso-habitat mapping inventory and assessment. Implement wood supplementation in identified wood deficient zones from the habitat mapping assessment.

Hoko River Action 33 (HRS#20): Mainstem Hoko River - Emerson Flats LWD restoration. The first phase of the project will restore spawning and rearing habitat from RM 5.0 to 6.0. Adding LWD to this reach will create habitat complexity, providing sheltering areas for spawning adults and rearing fingerlings. It will also reduce scour and assist in gravel bed creation and maintenance. This project will benefit Chinook as well as coho, chum, steelhead and cutthroat trout.

Hoko River Action 34 (HRS#20): Mainstem Hoko River – LWD Restoration. Almost the entire low gradient reaches of the Hoko River have insufficient LWD loading as a result of historical land uses. These reaches should be delineated and prioritized for future projects.

Hoko River Action 35 (HRS#20): Little Hoko River LWD restoration – The Little Hoko River received extensive habitat restoration between 1994 and 1998. Monitoring has shown that the project has been partially successful in restoring channel and riparian habitat features. Additional LWD treatments have been identified to facilitate floodplain reconnection particularly in channel reaches that have heavily incised. This project would involve the addition of key pieces (~200) using a heavy lift helicopter. The Little Hoko River provides habitat for Chinook, coho, steelhead, chum and cutthroat trout.

Hoko River Action 36 (HRS#20): Herman Creek LWD restoration – This project will restore formerly productive spawning and rearing habitat to Herman Creek. Adding LWD to this tributary will create habitat complexity, providing sheltering areas for spawning adults and rearing fingerlings. It will also reduce scour and assist in gravel bed creation and maintenance. Herman Creek provides high quality habitat for Chinook as well as coho, steelhead and cutthroat trout.

Hoko River Action 37 (HRS#20): Bear/Cub Creek LWD Restoration - This project will restore formerly productive spawning and rearing habitat to two upper Hoko tributaries. Adding LWD to these tributaries will create habitat complexity, providing sheltering areas for spawning adults and rearing fingerlings. It will also reduce scour and assist in gravel bed creation and maintenance. Bear and Cub Creeks provide high quality habitat for Chinook as well as coho, steelhead and cutthroat trout.

7.2.7.8 Water Quality Conditions

Process/Condition Status: Impairment – High

Hoko River Recovery Goal 8: Establish water quality conditions that do not inhibit or prolong recovery to VSP goals.

Hoko River Recovery Strategy 21: Develop water quality monitoring program for the Hoko watershed.
Recovery strategy hierarchy: Tier 1

Hoko River Action 38 (HRRS#21): Implement long-term surface water quality monitoring program (e.g., temperature, dissolved oxygen, pH, conductivity, turbidity, BIBI). Also include monitoring of hydrocarbons and other potential contaminants.

Hoko River Action 39 (HRRS#21): Maintain and expand long-term surface water temperature monitoring program.

7.2.8 Sekiu River

7.2.8.1 Estuary and Nearshore Processes and Habitat Conditions

Process/Condition Status: Impaired – Medium (see Section 5.9.1)

Sekiu River Recovery Goal 1: Protect and restore estuary and nearshore processes and habitat conditions so that current limiting factors are no longer limiting and future limiting factors do not develop.

Sekiu River Recovery Strategy 1: Ensure that existing environmental regulations and management plans protect estuarine and nearshore processes.
Recovery strategy hierarchy: Tier 1

Sekiu River Recovery Strategy 2: Protect intact, continuous shoreline that is uninterrupted by man-made armoring.
Recovery strategy hierarchy: Tier 1

Sekiu River Recovery Strategy 3: Remove existing “hard-point” armoring and/or replace with alternative design methods that avoid and minimize environmental impacts to the greatest extent possible.
Recovery strategy hierarchy: Tier 3

Sekiu River Action 1 (SRRS#1): Assess the effectiveness of existing regulatory mechanisms in protecting natural resources. Identify actions taken under specific regulatory controls that can be assessed using effectiveness monitoring.

Sekiu River Action 2 (SRRS#2): Identify willing sellers of parcels with natural shoreline for either permanent conservation or acquisition for protection.

Sekiu River Action 3 (SRRS#3): Within conservation easements or areas acquired for protection, completely remove shoreline armoring and return to original shoreline geometry.

Sekiu River Action 4 (SRRS#3): Work with landowners to replace existing “hard-point” armoring with alternative soft shore protection designs (ex. beach nourishment, grade control w/ LWD, wood revetment, and biotechnical slope support).

7.2.8.2 Habitat Connectivity

Process/Condition Status: Impairment – Medium

Sekiu River Recovery Goal 2: Restore habitat connectivity so that access to physical habitat is no longer limiting the spatial structure and habitat diversity necessary to achieve VSP.

Hoko River Recovery Strategy 4: Maintain and protect habitat connectivity where habitat connectivity is intact through the effective implementation of regulations.
Recovery strategy hierarchy: Tier 1

Sekiu River Recovery Strategy 5: Develop updated basin-wide inventory of existing water-crossings and incorporate current condition assessment. Restore habitat connectivity where habitat is currently disconnected.
Recovery strategy hierarchy: Tier 1/2

Sekiu River Action 5a (SRRS#5): Identify water-crossing and road inventories from basin landowners and combine into single basin-wide inventory. Where water-crossing information is lacking or missing, work with landowners to inventory and assess.

Sekiu River Action 5b (SRRS#5): Using a basin-wide approach, identify biological, physical, and process-based metrics to use for prioritizing future habitat connectivity projects.

Sekiu River Action 6a (SRRS#5): Replace barrier culvert in unnamed tributary to No Name Creek (near RM 0.6) with structure that allows for better fish passage.

Sekiu River Action 6b (SRRS#5): When the CZ 1000 Road was constructed it cut off a major meander of the Sekiu River leaving a large ponded channel segment. This habitat is now partially blocked by an improperly placed culvert. Restoring fish access to this pond would substantially increase the off-channel habitat available to juvenile salmonids in this subbasin.

Sekiu River Action 6c (SRRS#5): A barrier culvert on the CZ-1000 Road blocks approximately 0.25 miles of spawning and rearing habitat in an unnamed right bank tributary to the Sekiu River (section 13). Replace culvert with crossing structure that allows for better fish passage.

Sekiu River Action 6d (SRRS#5): Near RM 0.18 in a left bank tributary to 19.0218 (RM 0.44), a culvert blocks an unquantified amount of coho, steelhead and cutthroat habitat. Upstream habitat quantification needs to occur prior to restoration planning. Replace (or remove) culvert with structure that allows for better fish passage.

7.2.8.3 Biological Processes

Process/Condition Status: Impaired – High

Sekiu River Recovery Goal 3: Maintain, protect, and/or restore salmonid population abundance, productivity, and diversity to conditions needed to achieve VSP.

Sekiu River Recovery Strategy 6: Maintain genetic diversity within natural origin Sekiu populations.
Recovery strategy hierarchy: Tier 1/3

Sekiu River Recovery Strategy 7: Supplementation with hatchery origin salmonids.
Recovery strategy hierarchy: Tier 3/6

Sekiu River Recovery Strategy 8: Evaluate in and out of basin fishing-related mortalities and influence fisheries regulations so that spawning escapement is sufficient to ensure VSP, as well as deliver adequate levels of marine nutrients from decaying salmon carcasses.
Recovery strategy hierarchy: Tier 3

Sekiu River Recovery Strategy 9: Improve spatial distribution and retention of salmon carcasses in the Sekiu River drainage to maintain critical marine-derived nutrient cycles.
Recovery strategy hierarchy: Tier 3

Sekiu River Action 7 (SRRS#6): Develop and implement genetic sampling program for all salmonid species in order to better understand population structure and diversity.

Sekiu River Action 8 (SRRS#7): Evaluate the necessity of hatchery supplementation once higher tiered recovery actions have been completed in the watershed (through future survey/smolt trapping results).

Sekiu River Action 9 (SRRS#8): Advocate for the adoption of harvest management regulations that ensure salmonid spawning escapement is sufficient to maintain, protect, and/or restore VSP parameters.

Sekiu River Action 10 (SRRS#8): Implement and/or continue to implement population abundance monitoring.

Sekiu River Action 11 (SRRS#9): Introduce salmon carcass analogs to the Sekiu river drainage to improve N, P, and C cycling in areas deficient of natural salmon spawners.

7.2.8.4 Hydrologic Processes

Process/Condition Status: Impairment - Unknown

Sekiu River Recovery Goal 4: Restore natural flow regime (magnitude, frequency, duration, timing, and rate-of-change) to conditions that maintain self-sustaining ecological processes and patterns.

Sekiu River Recovery Strategy 10: Restore hydrologic processes by addressing issues related to water withdrawals, stream piracy, impermeable surfaces, loss of wetlands and wetland function, and deforestation. Protect intact hydrologic processes where they exist.
Recovery strategy hierarchy: Tier 1/3

Sekiu River Recovery Strategy 11: Maintain existing Washington Department of Ecology Sekiu River stream gaging station.
Recovery strategy hierarchy: Tier 1

Sekiu River Recovery Strategy 12: Evaluate existing road network and determine appropriate road density necessary to achieve Sekiu Recovery Goal 4.
Recovery strategy hierarchy: Tier 1

Sekiu River Action 12 (SRRS#10): Collaborate with Washington Department of Fish and Wildlife, private landowners, and tribes to provide access and develop field methodology for evaluating flood flow passage through existing instream structures. This effort should focus on assessing existing in-stream structures on 3rd order or greater tributaries for flood water passage, flood water access to off-channel floodplain habitat, and capacity to transport flood associated debris and sediment.

Sekiu River Action 13 (SRRS#11): Seek additional funding for maintenance and calibration of WDOE Sekiu River gaging station. Obtain funding for necessary equipment for high flow data collection.

Sekiu River Action 14 (SRRS#12): Obtain necessary information (RMAPs, RMAP Annual Reports, current and historical road inventory) from Washington Department of Natural Resources (WDNR).

Sekiu River Action 15 (SRRS#12): Review published literature on impacts to natural basin hydrology due to changes in road density (including work completed in WDNR Sekiu Watershed Analysis).

Sekiu River Action 16 (SRRS#12): In coordination with WDNR, WDFW, and WDOE, and landowners, develop road density goals for the Sekiu River drainage based on “best available science” that will achieve Sekiu River Recovery Goal 4.

Sekiu River Action 17 (SRRS#10): Limit future water withdrawals from the Sekiu River watershed through the implementation of the WRIA 19 Watershed Plan (WRIA 19 Planning Unit 2010).

7.2.8.5 Sediment Processes

Process/Condition Status: Impairment – Medium

Sekiu River Recovery Goal 5: Minimize sediment inputs to the Sekiu River drainage to those that occur naturally through space and time. Restore and protect natural in-stream sediment transport processes. Where sediment levels are impaired reduce fine sediment (< 0.85mm) volume within the hyporheic zone to improve survival to emergence.

Sekiu River Recovery Strategy 13: Eliminate road/culvert related mass wasting events to fish-bearing water.
Recovery strategy hierarchy: Tier 3

Sekiu River Recovery Strategy 14: Reduce surface runoff from existing road network to levels that meet or exceed existing Washington State Water Quality Standards.
Recovery strategy hierarchy: Tier 3

Sekiu River Recovery Strategy 15: Restore natural wood loading volume and density to the Sekiu watershed to restore habitat forming processes and improve in-stream sediment routing.
Recovery strategy hierarchy: Tier 3/4

Sekiu River Action 18 (SRRS#13): Evaluate rate of road/culvert related failure (mass wasting events) over time using aerial photo history. Compare existing rates of mass wasting events to historical.

Sekiu River Action 19 (SRRS#13): Using existing RMAP information, quantify remaining orphan and abandoned roads to determine potential for resource damage and likelihood of failure.

Sekiu River Action 20 (SRRS#14): Install continuous, long-term turbidity monitoring station coupled with storm-related suspended sediment collection. Use data for long-term trend analysis and measures of state water quality standards.

Sekiu River Action 21 (SRRS#15): Using existing sediment core sample data for the Clallam watershed (McHenry et al. 1994), collect sediment core samples to compare conditions.

Sekiu River Action 22 (SRRS#15): Review published literature on recommended levels of fine sediment volume within the hyporheic zone for a range of STE, and establish benchmarks for the next 10-100 years.

7.2.8.6 Riparian and Floodplain Processes and Conditions

Process/Condition Status: Impairment – High

Sekiu River Recovery Goal 6: Protect existing intact and high functioning riparian and floodplain processes and conditions to ensure “no net loss”. Restore degraded riparian and floodplain processes and conditions so that they are at levels necessary to attain VSP goals.

Sekiu River Recovery Strategy 16: Ensure that current and future regulatory mechanisms are in place to protect and provide sufficient riparian zones that maintain all necessary ecological function.
Recovery strategy hierarchy: Tier 1/3

Sekiu River Recovery Strategy 17: Protect, maintain, and or restore riparian habitat conditions by implementing riparian acquisitions, conservation easements, and riparian and/or restoration projects.
Recovery strategy hierarchy: Tier 1/3/4

Sekiu River Recovery Strategy 18: Reduce riparian and floodplain road network that causes compaction and disconnection of subsurface flow pathways.
Recovery Strategy hierarchy: Tier 3

Sekiu River Action 23 (SRRS#16): Advocate for and support a WRIA 19 representative of the NOPLE to participate in the Forest and Fish policy group. Individual would provide a conduit for information between the forest practices adaptive management program and the salmon recovery efforts of NOPLE.

Sekiu River Action 24 (SRRS#18): Evaluate and prioritize the need to remove or abandon the following road segments:

- 3.19 miles within 250ft of Sekiu mainstem
- 2.35 miles between 250-500ft of Sekiu mainstem
- 2.62 miles between 500-750ft of Sekiu mainstem
- 2.98 miles between 750-1000ft of Sekiu mainstem

Sekiu River Action 25 (SRRS#17): Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.

Sekiu River Action 26 (SCRS#16, 17): Map and delineate channel migration zones within the Sekiu River watershed.

7.2.8.7 Habitat and LWD Conditions

Process/Condition Status: Impairment – High

Sekiu River Recovery Goal 7: Maintain and improve existing habitat to conditions necessary to attain VSP goals.

Sekiu River Recovery Strategy 19: Assess instream meso-habitat in the Sekiu watershed.
Recovery strategy hierarchy: Tier 1

Sekiu River Recovery Strategy 20: Based on LWD volume and density develop a strategic implementation plan to achieve conditions that support VSP goals. Implement wood supplementation in high priority, wood deficient zones.
Recovery strategy hierarchy: Tier 1/3/4

Sekiu River Action 27 (SRRS#19, 20): Conduct detailed instream meso-habitat mapping inventory and assessment. Implement wood supplementation in identified wood deficient zones from the habitat mapping assessment.

Long-term restoration of habitat and LWD conditions within the Sekiu River watershed will only occur with significant improvements to habitat forming processes. Within the mainstem the most impaired habitat forming processes are associated with riparian and floodplain conditions affected by the Sekiu River mainline. Habitat and LWD conditions identified in the Sekiu-Coastal Watershed Analysis (Currence *in* WDNR 2001) suggest that much of the mainstem and some of the tributaries could benefit from projects focused on restoring habitat conditions (pool structure and LWD volume). A list of potential projects is included below.

- Mainstem Sekiu River- Most of mainstem is low or deficient in LWD. LWD projects in the mainstem should significantly improve fish habitat conditions. Caution will be needed due to infrastructure located close to the river's edge.
- North Fork Sekiu- portions of the North Fork could benefit from LWD introductions that help improve channel complexity, stability, and floodplain connectivity.
- South Fork Sekiu River- the steep, confined nature of the South Fork likely naturally limited the quantity of LWD in the South Fork. However, current LWD levels are extremely low. Opportunities to improve LWD and habitat conditions should be evaluated. Where feasible, LWD introductions should be attempted but these efforts should include a detailed monitoring plan to help determine the effectiveness of LWD placement given the high energy nature of the South Fork Sekiu River.

Several tributaries currently contain low levels of LWD, these streams would benefit from LWD additions. Natural processes should eventually restore LWD conditions in most small streams.

7.2.8.8 Water Quality Conditions

Process/Condition Status: Impairment – Unknown

Sekiu River Recovery Goal 8: Establish water quality conditions that do not inhibit or prolong recovery to VSP goals.

Sekiu River Recovery Strategy 21: Develop water quality monitoring program for the Sekiu watershed.
Recovery strategy hierarchy: Tier 1

Sekiu River Action 28 (SRRS#18): Implement long-term surface water quality monitoring program (e.g., temperature, dissolved oxygen, pH, conductivity, turbidity, BIBI).

Sekiu River Action 29 (SRRS#18): Maintain and expand long-term surface water temperature monitoring program.

7.2.9 Western Strait Independents

7.2.9.1 Estuary and Nearshore Processes and Habitat Conditions

Process/Condition Status: Impaired – Low

WSI Recovery Goal 1: Protect and restore estuary and nearshore processes and habitat conditions so that current limiting factors are no longer limiting and future limiting factors do not develop.

WSI Recovery Strategy 1: Protect estuarine processes and habitat conditions from degradation by employing environmental regulations and management plans. Where regulations are insufficient to protect estuarine processes and habitat conditions implement conservation easements or acquisitions with willing landowners.
Recovery strategy hierarchy: Tier 1

WSI Recovery Strategy 2: Restore degraded estuarine habitat conditions where they exist. Include road maintenance and abandonment plans.
Recovery strategy hierarchy: Tier 2-4

WSI Recovery Strategy 3: For properties that provide particularly important estuarine processes and nearshore habitat, implement conservation easements or acquisitions with willing landowners.
Recovery strategy hierarchy: Tier 1

WSI Action 1 (WSIRS#1): Develop plan to protect eelgrass and kelp beds where they occur. Plan should focus on sediment reduction where needed.

WSI Action 2 (WSIRS#2): Evaluate impacts of bulkheads constructed near Whiskey Creek, reduce or eliminate potential negative impacts.

WSI Action 3 (WSIRS#1, 2): Restore the mouths of Jim and Joe Creeks by reducing sediment transport to estuary. Remove or reduce impacts of breakwaters near the mouth of Jim Creek. Discontinue dredging in this area.

WSI Action 4 (WSIRS#1, 2): Develop and implement plan to restore habitat conditions in the Sail River estuary.

WSI Action 5 (WSIRS#3): Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.

7.2.9.2 Habitat Connectivity

Process/Condition Status: Impaired – Medium

WSI Recovery Goal 2: Restore habitat connectivity so that habitat connectivity no longer limits VSP parameters.

WSI Recovery Strategy 4: Maintain and protect habitat connectivity where habitat connectivity is intact through the effective implementation of regulations.
Recovery strategy hierarchy: Tier 1

WSI Recovery Strategy 5: Restore habitat connectivity where habitat is currently disconnected.
Recovery strategy hierarchy: Tier 2

No comprehensive surveys of fish passage barriers have been conducted in the WSI subbasins. Barriers identified in Clallam County, WDNR, and private landowner road maintenance plans should be incorporated into a comprehensive list of barriers for the WSI subbasin. Repairing fish passage at road related barriers will improve habitat connectivity in the WSI subbasin and should be considered a high priority. Currently known road related barriers are included below.

WSI Action 6a (WSIRS#5): Within the Colville Creek subbasin a perched culvert (SR112 MP 56.5) in tributary 19.0003 potentially blocks 2.0 miles of coho, steelhead, and cutthroat habitat. Upon confirmation of barrier and upstream habitat, replace culvert with stream crossing structure that allows for better fish passage and sediment transport capacity.

WSI Action 6b (WSIRS#5): Within the Colville Creek subbasin a culvert (Oxenford Road) in tributary 19.0001a potentially blocks 0.7 miles of coho, steelhead, and cutthroat habitat. Upon confirmation of barrier and upstream habitat, replace culvert with stream crossing structure that allows for better fish passage and sediment transport capacity.

WSI Action 6c (WSIRS#5): In Whiskey Creek (RM 1.5), a 40 percent barrier at box culvert SR 112 MP 49.5 blocks 1.2 miles of coho steelhead, and cutthroat habitat. This documented blockage requires field verification of fish passage conditions above and below the culvert prior to restoration planning. Upon confirmation of barrier and upstream habitat, replace culvert with stream crossing structure that allows for better fish passage and sediment transport capacity.

WSI Action 6d (WSIRS#5): At the mouth of an unnamed stream located between Deep Creek and West Twin River, a recently installed corrugated metal pipe associated with SR 112 near MP 34.8, blocks about 0.5 miles of coho, steelhead, and cutthroat habitat. Upon confirmation of barrier and upstream habitat, replace culvert with stream crossing structure that allows for better fish passage and sediment transport capacity.

WSI Action 6e (WSIRS#5): In Jim Creek at RM 0.1 a partial barrier culvert on a private road blocks several miles of habitat in Jim Creek (source: DOT culvert database). Replace with structure that allows for better fish passage.

WSI Action 6f (WSIRS#5): In Joe Creek at RM 0.5, a 60 percent passable box culvert on SR 112 MP 32.8 blocks about one mile of coho, steelhead, and cutthroat habitat, based upon database documentation. Upon confirmation of barrier and upstream habitat, replace culvert with stream crossing structure that allows for better fish passage and sediment transport capacity.

WSI Action 6g (WSIRS#5): A barrier culvert at the Pillar Point access road blocks about 0.8 miles of coho, steelhead, and cutthroat habitat at the mouth of Butler Creek. Upon confirmation of barrier and upstream habitat, replace culvert with stream crossing structure that allows for better fish passage and sediment transport capacity.

WSI Action 6h (WSIRS#5): Double 30" culverts (SR 112 MP 29.7) form an 80 percent barrier partially blocking about 0.5 miles of coho, steelhead, and cutthroat habitat in Butler Creek (19.0112 RM 0.3). Upon confirmation of barrier and upstream habitat, replace culvert with stream crossing structure that allows for better fish passage and sediment transport capacity.

WSI Action 5i (WSIRS#5): In a left bank tributary to the Sail River (near RM 0.1), a culvert blocks at least 0.4 (2-4% gradient) miles of coho, steelhead, and cutthroat habitat. Replace culvert with stream crossing structure that allows for better fish passage and sediment transport capacity.

WSI Action 6j (WSIRS#5): On Village Creek (19.0240) near RM 0.25, a 185' long perched culvert blocks 0.32 miles of coho, steelhead, and cutthroat habitat (0.23 miles of 2-4 percent gradient, moderately confined and 0.09 miles of 4-8 percent gradient, confined channel. Replace culvert with stream crossing structure that allows for better fish passage and sediment transport capacity.

7.2.9.3 Biological Processes

Process/Condition Status: Impaired – High

WSI Recovery Goal 3: Maintain, protect, and/or restore salmonid population abundance, spatial distribution, productivity, and diversity.

WSI Recovery Strategy 6: Minimize or eliminate risks associated with hatchery origin salmonids to ensure that the genetic diversity of salmonids is maintained.
Recovery strategy hierarchy: Tier 1/3

WSI Recovery Strategy 7: Evaluate in and out of basin fishing-related mortalities and influence fisheries regulations so that spawning escapement is sufficient to ensure VSP, as well as deliver adequate levels of marine nutrients from decaying salmon carcasses. **Recovery strategy hierarchy:** Tier 1/3

WSI Action 7 (WSIRS #6): Advocate for implementation of the Hatchery Scientific Review Group (HSRG) recommendations set for forth in the 2004 Hatchery Reform Report (HSRG 2004).

WSI Action 8 (WSIRS #7): Advocate for the adoption of harvest management regulations that ensure salmonid spawning escapement is sufficient to maintain, protect, and/or restore VSP parameters.

WSI Action 9 (WSIRS#7): Implement and/or continue to implement population abundance monitoring.

7.2.9.4 Hydrologic Processes

Process/Condition Status: Unknown

WSI Recovery Goal 4: Restore and protect hydrologic processes and natural hydrologic variability to the extent that hydrologic impacts do not limit WSI VSP parameters.

WSI Recovery Strategy 8: Restore hydrologic processes by addressing issues related to water withdrawals, stream piracy, impermeable surfaces, loss of wetlands and wetland function, and deforestation. Protect intact hydrologic processes where they exist. **Recovery strategy hierarchy:** Tier 1/3

WSI Action 10 (WSIRS#8): Reforestation of riparian forest and wetlands associated with flood plains to improve hydrologic processes related to flood capacity within the flood plain areas.

WSI Action 11 (WSIRS#8): Reduce road related hydrologic impacts by reducing road densities and/or disconnecting road systems from the stream network.

WSI Action 12 (WSIRS#8): Limit future water withdrawals from WSI tributaries through the implementation of the WRIA 19 Watershed Plan (WRIA 19 Planning Unit 2010).

7.2.9.5 Sediment Processes

Process/Condition Status: Unknown

WSI Recovery Goal 5: Maintain and restore sediment processes (production, routing, storage, and grain size frequency distribution) to the extent that sediment processes do not limit VSP parameters.

WSI Recovery Strategy 9: Eliminate road/culvert and other land use related mass wasting events that deliver to streams.
Recovery strategy hierarchy: Tier 3

WSI Recovery Strategy 10: Reduce surface runoff from existing road network to levels that meet or exceed existing Washington State Water Quality Standards.
Recovery strategy hierarchy: Tier 3

WSI Recovery Strategy 11: Restore natural wood loading volume and density to the WSI subbasins to restore habitat forming processes and improve in-stream sediment routing.
Recovery strategy hierarchy: Tier 4

The high level of fine sediment documented in Bullman Creek strongly suggests that reducing fine sediment inputs from roads and mass wasting could increase spawning gravel quality. Removing or improving stream adjacent or problematic roads where they exist could help improve water quality conditions.

WSI Action 13 (WSIRS#9, 10): Inventory roads for maintenance (use existing RMAP and other available data), side cast removal, and drainage structure improvements. Prioritize for project actions.

WSI Action 14 (WSIRS#13): Reforest riparian and floodplain areas to increase stream bank integrity and reduce bank erosion.

7.2.9.6 Riparian and Floodplain Processes and Conditions

Process/Condition Status: Impaired – Medium

WSI Recovery Goal 6: Restore riparian and floodplain processes and conditions so that they are at levels necessary to attain VSP goals.

WSI Recovery Strategy 12: Hydrologically reconnect streams to their floodplains for the purposes of floodplain storage and reconnection of off-channel habitat.
Recovery strategy hierarchy: Tier 3

WSI Recovery Strategy 13: Protect, maintain, and or restore riparian habitat conditions by implementing riparian acquisitions, conservation easements, and riparian and in-stream restoration projects.
Recovery strategy hierarchy: Tier 1/3/4

WSI Recovery Strategy 14: Ensure that current and future regulatory mechanisms are in place to protect and provide sufficient riparian and floodplain conditions to maintain all necessary ecological function.
Recovery strategy hierarchy: Tier 1/3

WSI Action 15 (WSIRS#12, 13): Few riparian and floodplain habitat data are available for WSI subbasin streams. Collecting additional data where data are lacking could help identify areas in need of riparian restoration.

WSI Action 16 (WSIRS#12, 13): Conversion of fields and non-forested riparian areas back to fully functional riparian forests. Target streams should include Colville, Whiskey, and Field creeks.

WSI Action 17 (WSIRS#13): Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.

WSI Action 18 (WSIRS#13, 14): Map and delineate channel migration zones within the WSI sub-basins.

WSI Action 19 (WSIRS#14): Advocate for and support a WRIA 19 representative of the NOPLE to participate in the Forest and Fish policy group. Individual would provide a conduit for information between the forest practices adaptive management program and the salmon recovery efforts of NOPLE.

7.2.9.7 Habitat and LWD Conditions

Process/Condition Status: Impaired – Medium

WSI Recovery Goal 7: Maintain and improve existing habitat conditions to levels necessary to attain VSP goals.

WSI Recovery Strategy 15: Assess instream meso-habitat in the WSI sub-basins
Recovery strategy hierarchy: Tier 1

WSI Recovery Strategy 16: Based on LWD volume and density develop a strategic implementation plan to achieve conditions that support VSP goals. Implement wood supplementation in high priority, wood deficient zones.
Recovery strategy hierarchy: Tier 1/3/4

No comprehensive list of projects to restore habitat and LWD conditions has been developed for the WSI subbasin. Few if any significant restoration projects have occurred within the subbasin. Habitat and LWD conditions suggest that many of the streams within the subbasin could benefit from projects focused on restoring habitat conditions. Currence (2001 *in* WDNR 2001) suggested that increasing key pieces and other very large conifer LWD would help to scour pools and create plunge pools improving fish habitat. Additions of large LWD could also help improve sediment storage and the quantity of suitable spawning habitat available for salmonids.

WSI Action 20 (WSIRS#15, 16): Conduct detailed instream meso-habitat mapping inventory and assessment. Implement wood supplementation in identified wood deficient zones from the habitat mapping assessment.

7.2.9.8 Water Quality Conditions

Process/Condition Status: Unknown

WSI Recovery Goal 8: Protect and/or restore water quality conditions so that water quality conditions do not limit VSP parameters.

WSI River Recovery Strategy 17: Develop water quality monitoring program for the WSI tributaries.
Recovery strategy hierarchy: Tier 1

WSI River Recovery Strategy 18: Protect and restore water quality through the implementation of riparian/floodplain recovery strategies and actions that protect and restore riparian and floodplain habitat.
Recovery strategy hierarchy: Tier 1/3/4

WSI Action 21 (WSI RS#17): Implement long-term surface water quality monitoring program (e.g., temperature, dissolved oxygen, pH, conductivity, turbidity, BIBI). Also include monitoring of hydrocarbons and other potential contaminants.

WSI Action 22 (WSI RS#18): Advocate for effective implementation and enforcement of Forest Practice Rules and County Critical Areas Ordinances.

8 IMPLEMENTATION, RESEARCH, MONITORING, AND EVALUATION

8.1 PLAN IMPLEMENTATION

Upon completion and adoption of a recovery plan for an ESA-listed species the responsible agency is required to complete an implementation plan or schedule. The purpose of the implementation plan is to provide guidance for taking actions to help recover the listed species, as well as to monitor recovery of the listed species. An implementation plan also provides an organized and structured system for tracking and reporting recovery performance. Since there are no ESA-listed species within WRIA 19 there is no formal requirement to develop an implementation plan.

The successful implementation of this Plan's list of recommended recovery goals, strategies, and actions will require substantial funding, as well as a focused and coordinated effort from implementing agencies, governments, and citizens. The NOPLE group will be responsible for coordinating the implementation of the plan. It is assumed that Clallam County, the Tribes, WDFW, WDNR, WDOE, WDOT, private forest land managers, local residents, citizen groups, numerous other agencies, and individuals will develop and implement the recovery actions described within the Plan.

Our long-term implementation plan/schedule is currently in the format of two tables: recovery goals and strategies, and recovery actions. These tables are described in detail in Section 7.1 and are included in Appendix E and F. In addition, the recovery actions listed in Appendix F have been added to the NOPLE 3-year work plan.

8.2 RESEARCH, MONITORING, AND EVALUATION ACTIONS

The development of a detailed Research, Monitoring, and Evaluation (RM&E) program is beyond the scope of this Plan. However, RM&E are critically important components of any restoration/recovery plan, and are needed in order to effectively integrate adaptive management. NMFS (2007) provided detailed guidance for developing adaptive management framework and RM&E programs. The following text is a summary of their adaptive management guidance.

Adaptive management in salmon recovery planning is a method of decision making in the face of uncertainty and/or new information. To do this, it is essential to incorporate a plan that includes monitoring, evaluation, and feedback. Results of actions can become feedback on design and implementation of future actions. Adaptive management works by coupling the decision-making process with a collection of performance data and its evaluation. Most importantly, it works by offering an explicit process through which alternative strategies to achieve the same ends are proposed, prioritized, and implemented when necessary. Due to the length and complexity of the salmonid life cycle, there are many uncertainties involved in improving their survival. Simply identifying cause-and-effect relationships between any given management action and characteristics of salmon populations can be a scientific challenge. It is essential to design a monitoring and evaluation program that will answer these basic questions:

- How will we know we are making progress?
- How will we get the information we need?
- How will we use the information in decision making?

This basic approach can be used by NOPLE in the future if a more formal approach to RM&E and adaptive management is requested by the Puget Sound Partnership for WRIA 19. In the absence of a detailed RM&E and adaptive management plan it is assumed that NOPLE will coordinate and advocate for the implementation of the RM&E actions outlined in Chapter 7. Adaptive management will occur through future updates to this Plan, as well as updates to the NOPLE 3-year work plan.

Chapter 7 indentified 81 watershed-specific RM&E actions that will help promote salmonid restoration and recovery within the planning area. These RM&E actions are included in Appendix F. It should be recognized that this list of RM&E actions is not an all inclusive list of RM&E projects, as it primarily focuses on three types of monitoring:

- implementation and compliance monitoring;
- status and trend monitoring;
- effectiveness monitoring

Additional critical uncertainties research may also be required in order to fully understand and recover habitat and habitat forming processes.

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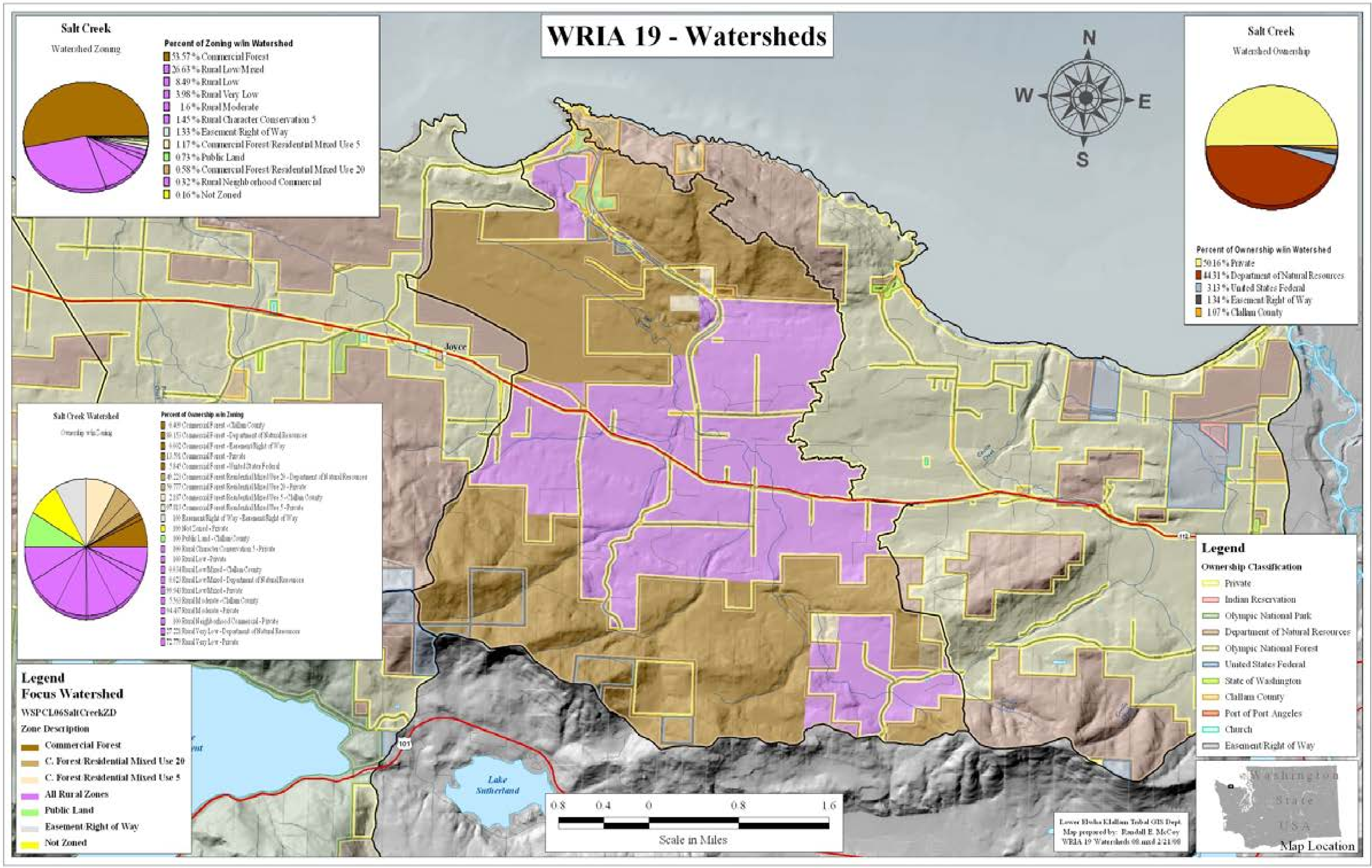
APPENDIX A: Subbasin zoning and land ownership maps



WRIA 19 - Watersheds
Salt Creek
Watershed Zoning
Percent of Zoning w/in Watershed
53.57 % Commercial Forest
26.63 % Rural Low/Mixed
8.49 % Rural Low
3.98 % Rural Very Low
1.6 % Rural Moderate
1.45 % Rural Character Conservation 5
1.33 % Easement/Right of Way
1.17 % Commercial Forest/Residential Mixed Use 5
0.73 % Public Land
0.58 % Commercial Forest/Residential Mixed Use 20
0.32 % Rural Neighborhood Commercial
0.16 % Not Zoned
Salt Creek Watershed
Percent of Ownership w/in Zoning
Salt Creek
Watershed Ownership
Percent of Ownership w/in Watershed
50.16 % Private
44.31 % Department of Natural Resources
3.13 % United States Federal
1.34 % Easement/Right of Way
1.07 % Clallam County
N
W
E
S
Joyce
Lake Sutherland
101
112
Legend
Focus Watershed
WSPCL06SaltCreekZD
Zone Description
Commercial Forest
C. Forest/Residential Mixed Use 20
C. Forest/Residential Mixed Use 5
All Rural Zones
Public Land
Easement/Right of Way
Not Zoned
Legend
Ownership Classification
Private
Indian Reservation
Olympic National Park
Department of Natural Resources
Olympic National Forest
United States Federal
State of Washington
Clallam County
Port of Port Angeles
Church
Easement/Right of Way
0.8 0.4 0 0.8 1.6
Scale in Miles
Washington
State
USA
Map Location

Figure A-1. Salt Creek subbasin zoning and landownership map.

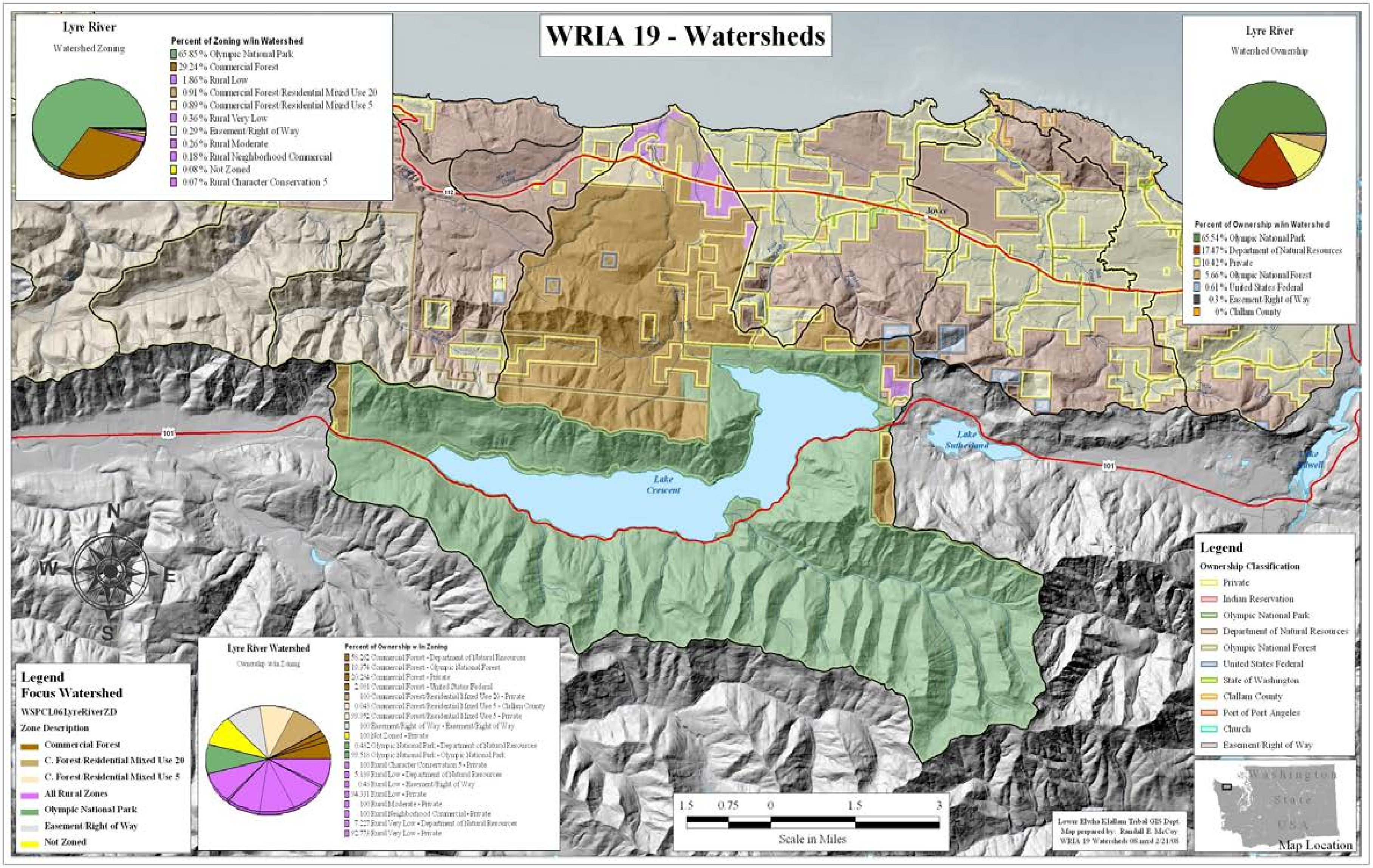
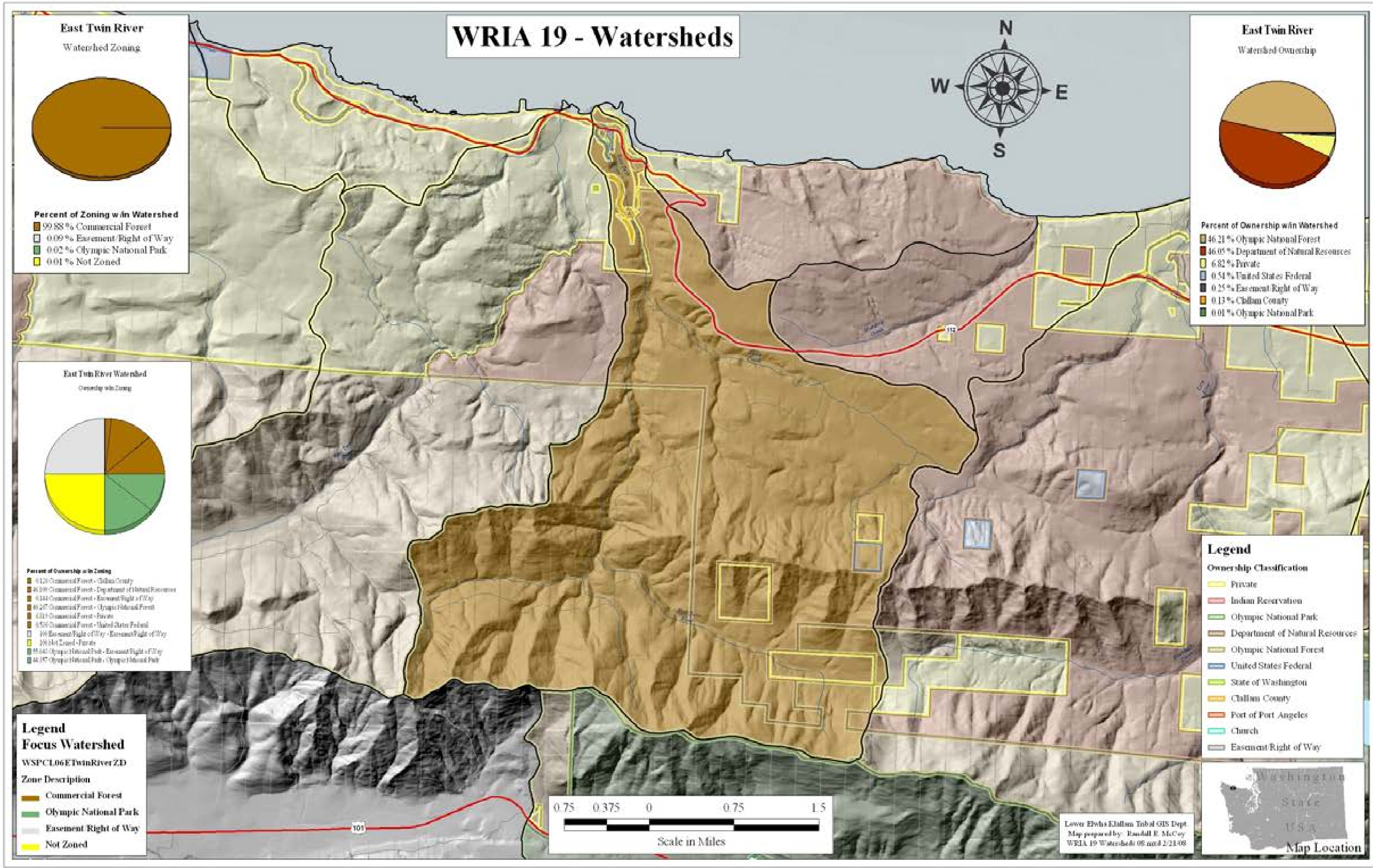
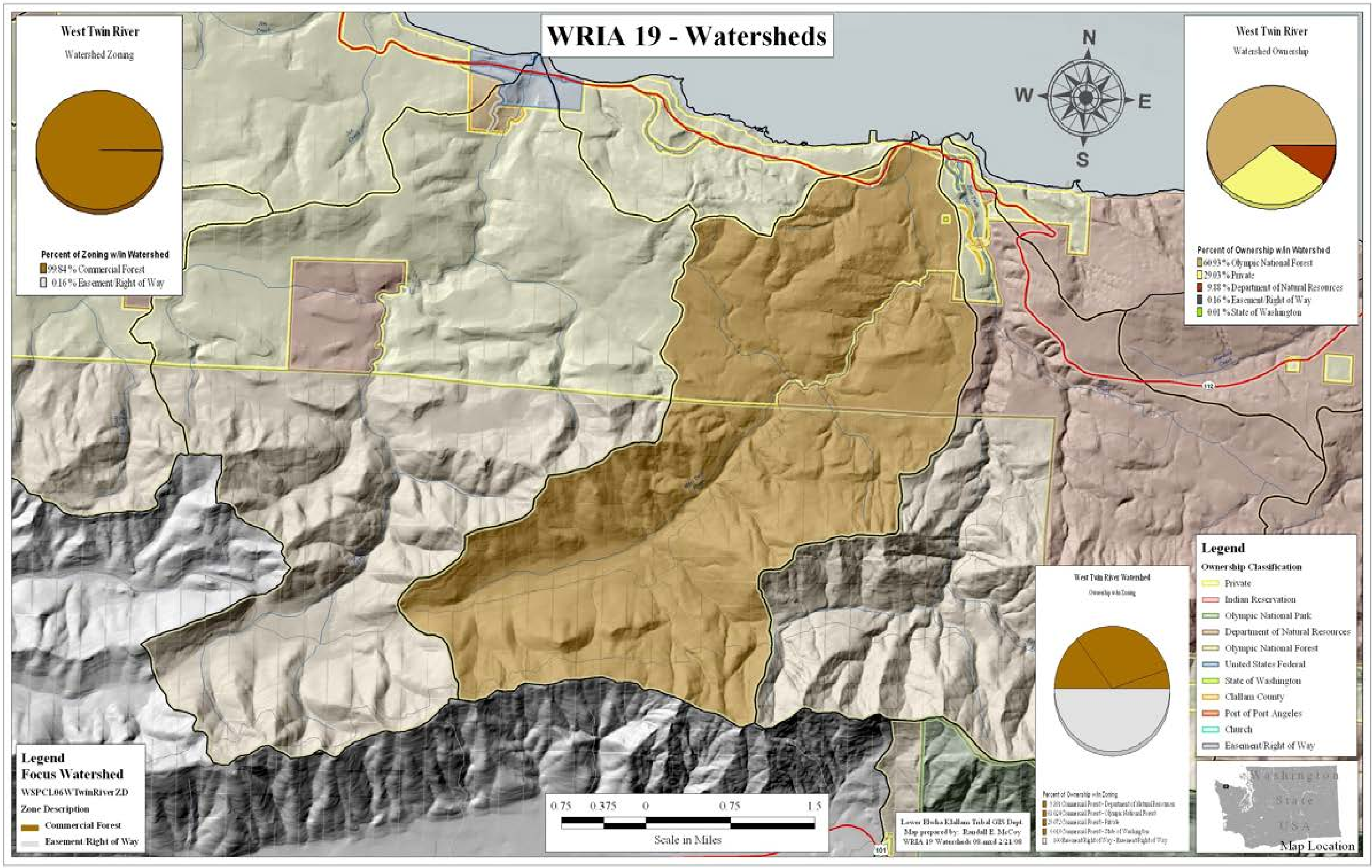


Figure A-2. Lyre River subbasin zoning and landownership map.



WRIA 19 - Watersheds
N
W
E
S
East Twin River
Watershed Zoning
Percent of Zoning w/in Watershed
99.88 % Commercial Forest
0.09 % Easement/Right of Way
0.02 % Olympic National Park
0.01 % Not Zoned
East Twin River
Watershed Ownership
Percent of Ownership w/in Watershed
46.21 % Olympic National Forest
46.05 % Department of Natural Resources
6.82 % Private
0.54 % United States Federal
0.25 % Easement Right of Way
0.13 % Clallam County
0.01 % Olympic National Park
East Twin River Watershed
Legend
Ownership Classification
Private
Indian Reservation
Olympic National Park
Department of Natural Resources
Olympic National Forest
United States Federal
State of Washington
Clallam County
Port of Port Angeles
Church
Easement/Right of Way
Legend
Focus Watershed
WSPCL06ETwinRiverZD
Zone Description
Commercial Forest
Olympic National Park
Easement/Right of Way
Not Zoned
0.75 0.375 0 0.75 1.5
Scale in Miles
Lower Elwha Klallam Tribal GIS Dept.
Map prepared by: Randall E. McCoy
WRIA 19 Watersheds 08.mxd 2/21/08
Washington
State
USA
Map Location

Figure A-3. East Twin River subbasin zoning and landownership map.



WRIA 19 - Watersheds
West Twin River
Watershed Zoning
Percent of Zoning w/in Watershed
99.84 % Commercial Forest
0.16 % Easement/Right of Way
West Twin River
Watershed Ownership
Percent of Ownership w/in Watershed
60.93 % Olympic National Forest
29.03 % Private
9.88 % Department of Natural Resources
0.16 % Easement/Right of Way
0.01 % State of Washington
N
W
E
S
Legend
Ownership Classification
Private
Indian Reservation
Olympic National Park
Department of Natural Resources
Olympic National Forest
United States Federal
State of Washington
Clallam County
Port of Port Angeles
Church
Easement/Right of Way
West Twin River Watershed
Legend
Focus Watershed
WSPCL06WTwinRiverZD
Zone Description
Commercial Forest
Easement/Right of Way
0.75 0.375 0 0.75 1.5
Scale in Miles
Lower Elwha Klallam Tribal GIS Dept.
Map prepared by: Randall E. McCoy
Washington
State
USA
Map Location

Figure A-4. West Twin River subbasin zoning and land ownership map.

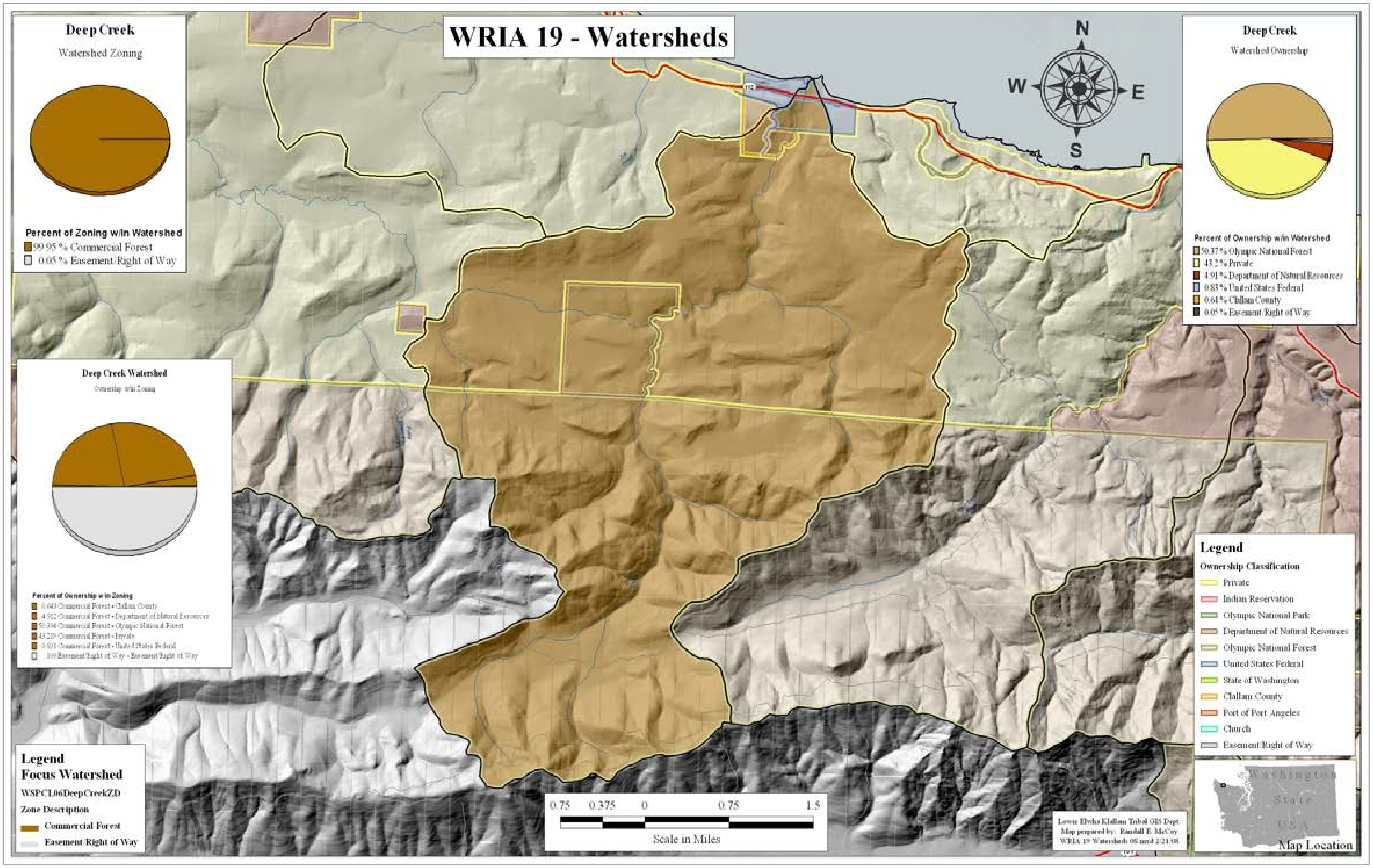
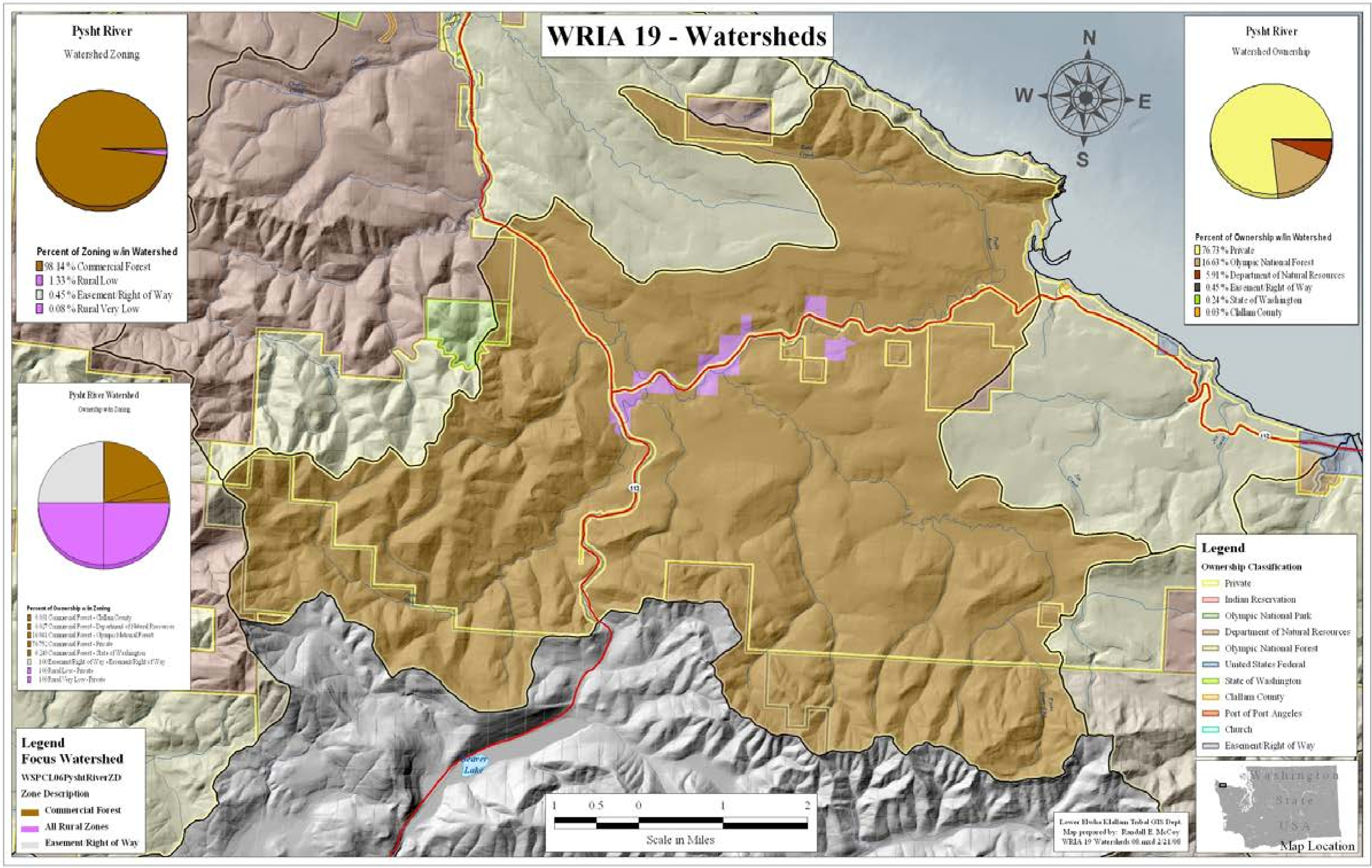


Figure A-5. Deep Creek subbasin zoning and land ownership map.


WRIA 19 - Watersheds
N
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E
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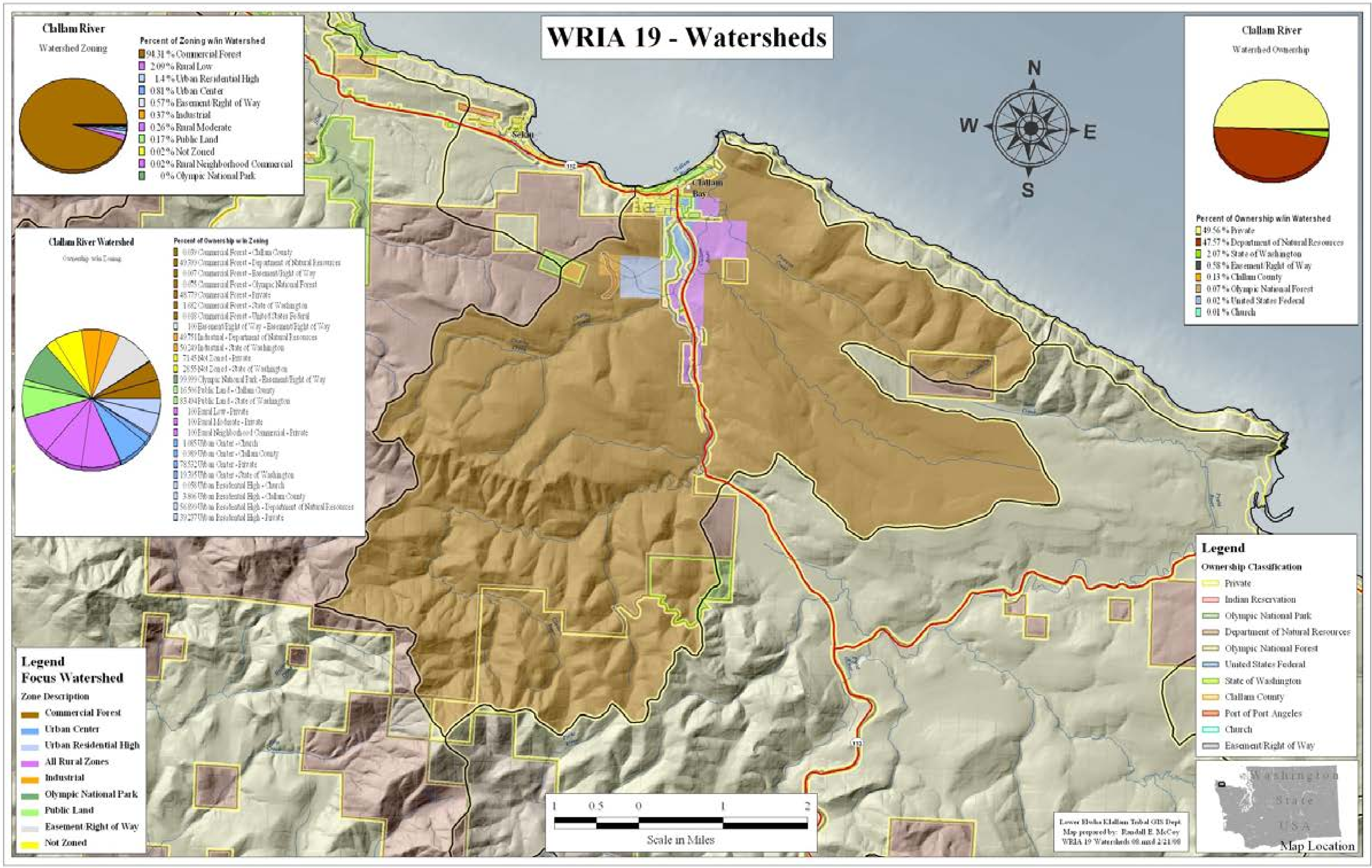
Pysht River
Watershed Zoning
Percent of Zoning w/in Watershed
98.14 % Commercial Forest
1.33 % Rural Low
0.45 % Easement/Right of Way
0.08 % Rural Very Low
Pysht River Watershed
Pysht River
Watershed Ownership
Percent of Ownership w/in Watershed
76.73 % Private
16.63 % Olympic National Forest
5.91 % Department of Natural Resources
0.45 % Easement/Right of Way
0.24 % State of Washington
0.03 % Clallam County
Legend
Ownership Classification
Private
Indian Reservation
Olympic National Park
Department of Natural Resources
Olympic National Forest
United States Federal
State of Washington
Clallam County
Port of Port Angeles
Church
Easement/Right of Way
Legend
Focus Watershed
WSPCL06PyshtRiverZD
Zone Description
Commercial Forest
All Rural Zones
Easement/Right of Way
1 0.5 0 1 2
Scale in Miles
Map Location
Washington
State
USA

Figure A-6. Pysht River subbasin zoning and land ownership map.



WRIA 19 - Watersheds
Clallam River
Watershed Zoning
Percent of Zoning w/in Watershed
94.31 % Commercial Forest
2.09 % Rural Low
1.4 % Urban Residential High
0.81 % Urban Center
0.57 % Easement Right of Way
0.37 % Industrial
0.26 % Rural Moderate
0.17 % Public Land
0.02 % Not Zoned
0.02 % Rural Neighborhood Commercial
0 % Olympic National Park
Clallam River Watershed
Percent of Ownership w/in Zoning
Clallam River
Watershed Ownership
Percent of Ownership w/in Watershed
49.56 % Private
47.57 % Department of Natural Resources
2.07 % State of Washington
0.58 % Easement Right of Way
0.13 % Clallam County
0.07 % Olympic National Forest
0.02 % United States Federal
0.01 % Church
N
W
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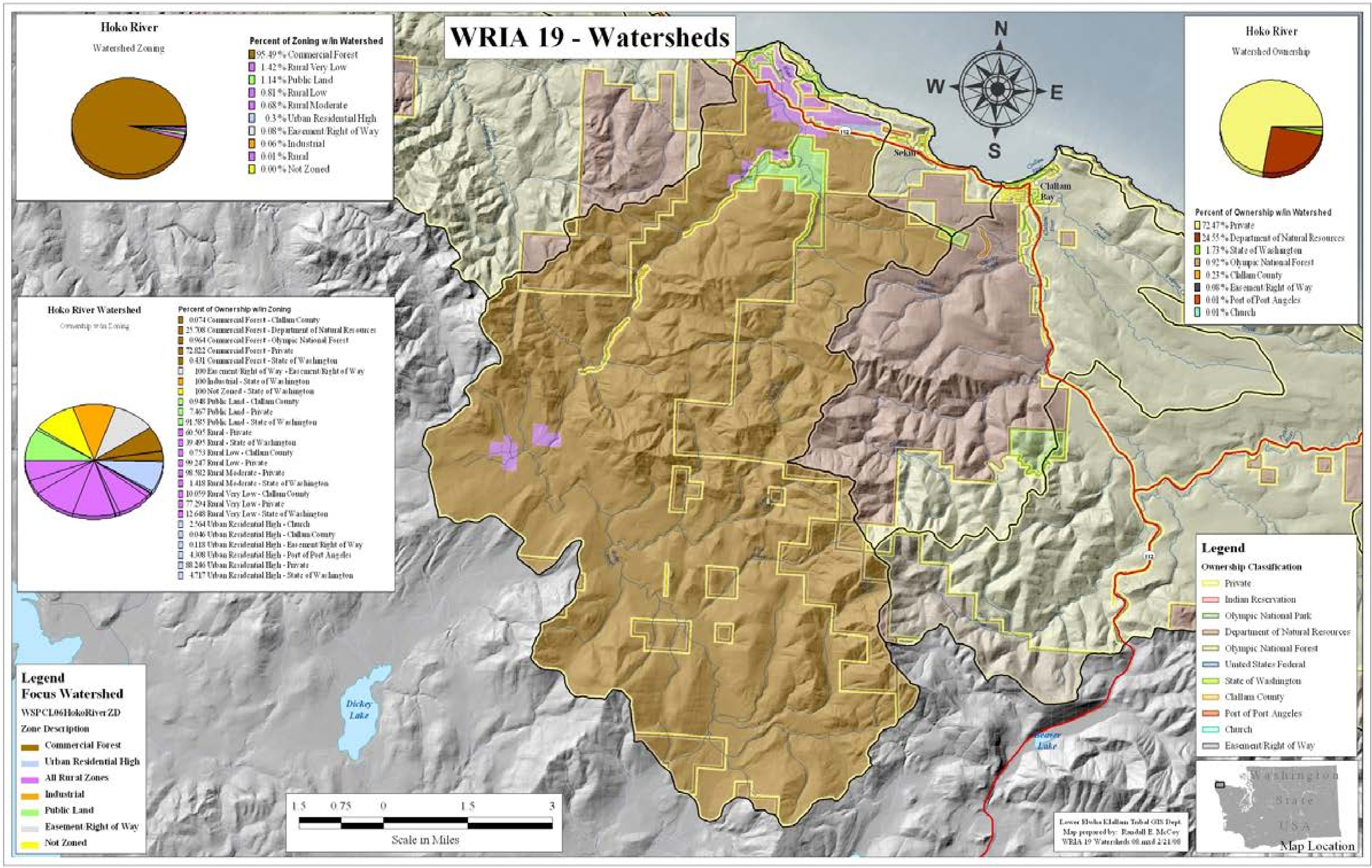
Sekiu
Clallam Bay
Legend
Focus Watershed
Zone Description
Commercial Forest
Urban Center
Urban Residential High
All Rural Zones
Industrial
Olympic National Park
Public Land
Easement/Right of Way
Not Zoned
Legend
Ownership Classification
Private
Indian Reservation
Olympic National Park
Department of Natural Resources
Olympic National Forest
United States Federal
State of Washington
Clallam County
Port of Port Angeles
Church
Easement/Right of Way
1 0.5 0 1 2
Scale in Miles
Lower Elwha Klallam Tribal GIS Dept
Map prepared by: Randall E. McCoy
Washington
State
USA
Map Location

Figure A-7. Clallam River subbasin zoning and land ownership map.



WRIA 19 - Watersheds
Hoko River
Watershed Zoning
Percent of Zoning w/in Watershed
95.49 % Commercial Forest
1.42 % Rural Very Low
1.14 % Public Land
0.81 % Rural Low
0.68 % Rural Moderate
0.3 % Urban Residential High
0.08 % Easement/Right of Way
0.06 % Industrial
0.01 % Rural
0.00 % Not Zoned
Hoko River Watershed
Ownership w/in Zoning
Percent of Ownership w/in Zoning
0.074 Commercial Forest - Clallam County
25.708 Commercial Forest - Department of Natural Resources
0.964 Commercial Forest - Olympic National Forest
72.822 Commercial Forest - Private
0.431 Commercial Forest - State of Washington
100 Easement/Right of Way - Easement/Right of Way
100 Industrial - State of Washington
100 Not Zoned - State of Washington
0.948 Public Land - Clallam County
7.467 Public Land - Private
91.585 Public Land - State of Washington
60.505 Rural - Private
39.495 Rural - State of Washington
0.753 Rural Low - Clallam County
99.247 Rural Low - Private
98.582 Rural Moderate - Private
1.418 Rural Moderate - State of Washington
10.059 Rural Very Low - Clallam County
77.294 Rural Very Low - Private
12.648 Rural Very Low - State of Washington
2.564 Urban Residential High - Church
0.046 Urban Residential High - Clallam County
0.118 Urban Residential High - Easement/Right of Way
4.308 Urban Residential High - Port of Port Angeles
88.246 Urban Residential High - Private
4.717 Urban Residential High - State of Washington
Legend
Focus Watershed
WSPCL06HokoRiverZD
Zone Description
Commercial Forest
Urban Residential High
All Rural Zones
Industrial
Public Land
Easement/Right of Way
Not Zoned
Dickey Lake
Sekiu
Clallam Bay
Beaver Lake
N
W
E
S
1.5 0.75 0 1.5 3
Scale in Miles
Hoko River
Watershed Ownership
Percent of Ownership w/in Watershed
72.47 % Private
24.55 % Department of Natural Resources
1.73 % State of Washington
0.92 % Olympic National Forest
0.23 % Clallam County
0.08 % Easement/Right of Way
0.01 % Port of Port Angeles
0.01 % Church
Legend
Ownership Classification
Private
Indian Reservation
Olympic National Park
Department of Natural Resources
Olympic National Forest
United States Federal
State of Washington
Clallam County
Port of Port Angeles
Church
Easement/Right of Way
Washington
State
USA
Map Location

Figure A-8. Hoko River subbasin zoning and land ownership map.

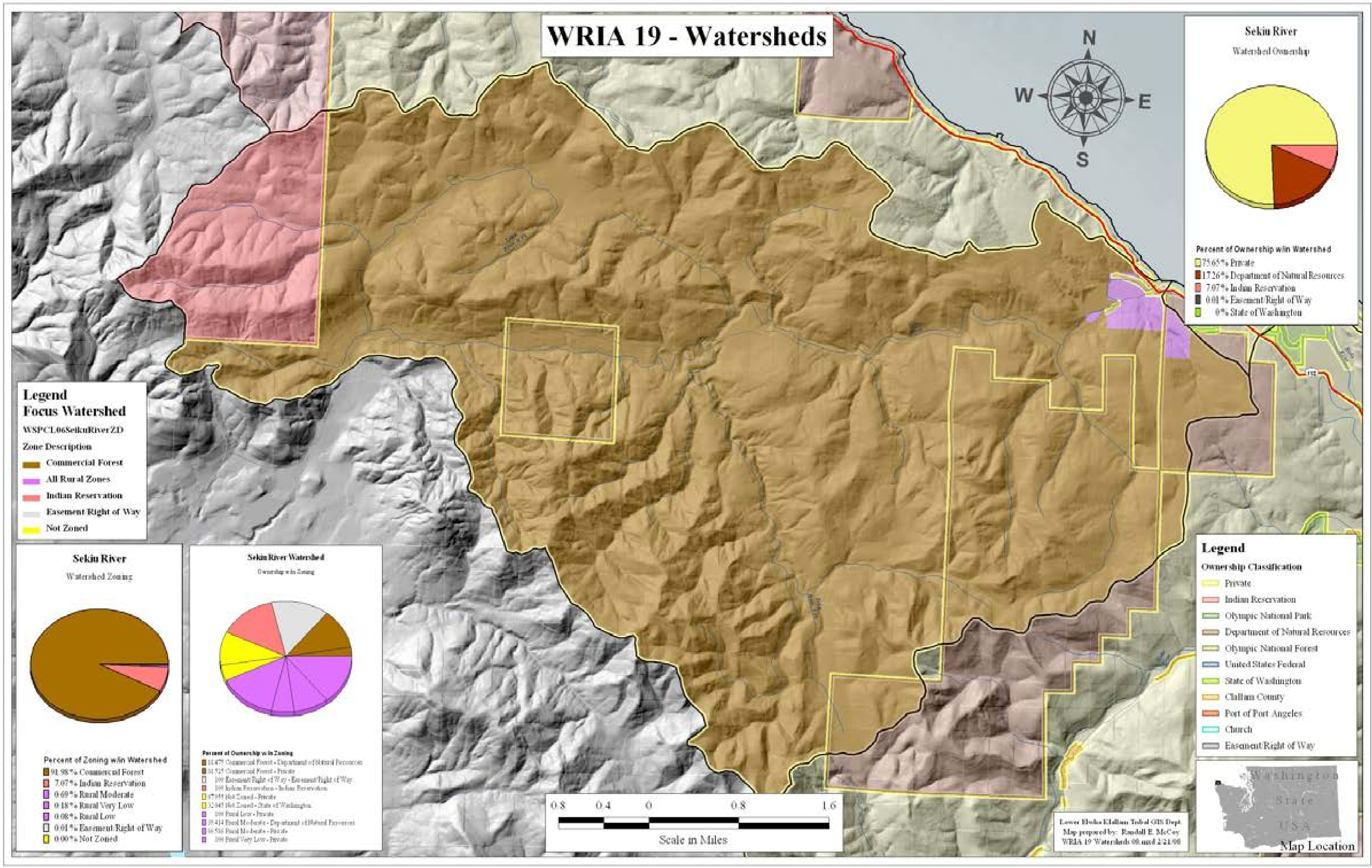

WRIA 19 - Watersheds
N
W
E
S
Sekiu River
Watershed Ownership
Percent of Ownership w/in Watershed
75.65% Private
17.26% Department of Natural Resources
7.07% Indian Reservation
0.01% Easement/Right of Way
0% State of Washington
Legend
Focus Watershed
WSPCL06SeikuRiverZD
Zone Description
Commercial Forest
All Rural Zones
Indian Reservation
Easement Right of Way
Not Zoned
Sekiu River
Watershed Zoning
Percent of Zoning w/in Watershed
91.98% Commercial Forest
7.07% Indian Reservation
0.69% Rural Moderate
0.18% Rural Very Low
0.08% Rural Low
0.01% Easement/Right of Way
0.00% Not Zoned
Sekiu River Watershed
Ownership w/in Zoning
Percent of Ownership w/in Zoning
0.8 0.4 0 0.8 1.6
Scale in Miles
Lower Elwha Klallam Tribal GIS Dept.
Map prepared by: Randall E. McCoy
Legend
Ownership Classification
Private
Indian Reservation
Olympic National Park
Department of Natural Resources
Olympic National Forest
United States Federal
State of Washington
Clallam County
Port of Port Angeles
Church
Easement/Right of Way
Washington
State
USA
Map Location

Figure A-9. Sekiu River subbasin zoning and land ownership map.

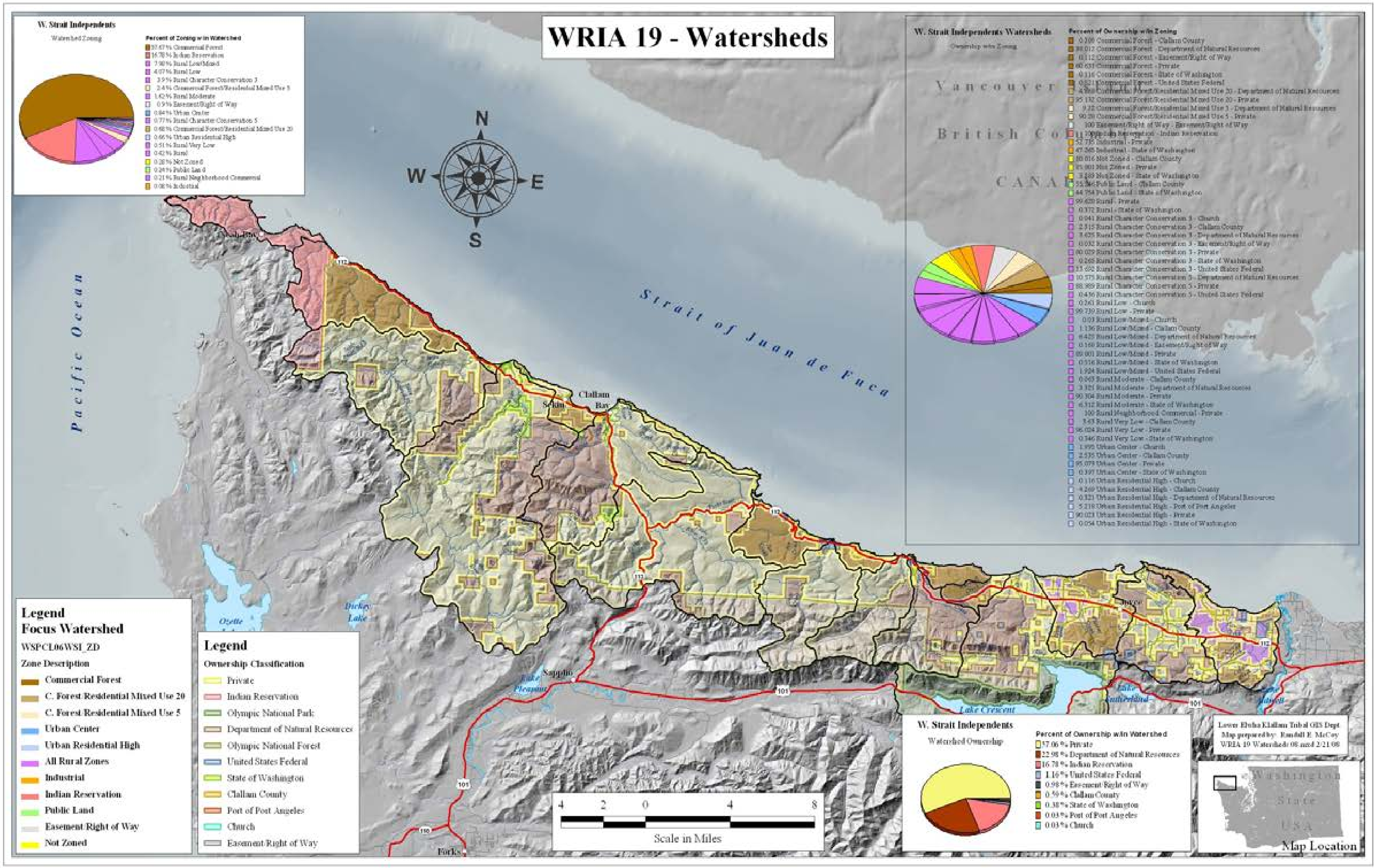

WRIA 19 - Watersheds
N
S
W
E
Pacific Ocean
Strait of Juan de Fuca
Vancouver
British Co
CANA
Clallam Bay
Sekiu
Neah Bay
Ozette
Dickey Lake
Lake Pleasant
Sappho
Lake Crescent
Forks
W. Strait Independents
Watershed Zoning
W. Strait Independents Watersheds
Ownership w/in Zoning
Legend
Focus Watershed
WSPCL06WSI_ZD
Zone Description
Commercial Forest
C. Forest/Residential Mixed Use 20
C. Forest/Residential Mixed Use 5
Urban Center
Urban Residential High
All Rural Zones
Industrial
Indian Reservation
Public Land
Easement/Right of Way
Not Zoned
Legend
Ownership Classification
Private
Indian Reservation
Olympic National Park
Department of Natural Resources
Olympic National Forest
United States Federal
State of Washington
Clallam County
Port of Port Angeles
Church
Easement/Right of Way
4 2 0 4 8
Scale in Miles
W. Strait Independents
Watershed Ownership
Percent of Ownership w/in Watershed
57.06 % Private
22.98 % Department of Natural Resources
16.78 % Indian Reservation
1.16 % United States Federal
0.98 % Easement/Right of Way
0.59 % Clallam County
0.38 % State of Washington
0.03 % Port of Port Angeles
0.03 % Church
Lower Elwha Klallam Tribal GIS Dept
Map prepared by: Randall E. McCoy
Washington State
USA
Map Location

Figure A-10. Western Strait Independents subbasin zoning and land ownership map.

APPENDIX B: Chinook Salmon Hatchery Releases

WRIA 19 Chinook salmon hatchery releases.

Brood Year	Year of Release	Avg. Weight (grams)	Release Stage	Release Location	Number Released	Broodstock Origin
1958	1958	0.97	Fingerling	Salt Creek	42,120	Elwha
1970	1971	5.4-6.2	Smolt	Salt Creek	304,900	Finch
1971	1972	5.34-10.08	Smolt	Salt Creek	387,833	Issaquah xWhite, Hood Canal x Elwha
1972	1973	4.83-6.05	Smolt	Salt Creek	138,990	Finch
1972	1974	45.36	Smolt	Salt Creek	35,700	Hood Canal x White
1973	1974	7.20	Smolt	Salt Creek	72,450	Hood Canal x Sol Duc
1973	1975	64.8-82.47	Smolt	Salt Creek	32,380	Hood Canal x Sol Duc
1974	1975	5.40	Smolt	Salt Creek	100,800	Deschutes
n=7	**n=7**		**-**	**Total=**	**1,115,173**	**n=8**
1957	1958	1.4-1.62	Fingerling	Lyre River	101,012	Big Coos
1958	1959	1.45	Fingerling	Lyre River	70,425	Deschutes
1962	1963	1.70	Fingerling	Lyre River	112,348	Finch
n=3	**n=3**	**-**	**-**	**Total=**	**283,785**	**n=3**
1973	1975	64.80	Smolt	Deep Creek	25,774	Hood Canal x Sol Duc
1974	1975	5.40	Smolt	Deep Creek	100,800	Deschutes
n=2	**n=1**	**-**	**-**	**Total**	**126,574**	**n=3**
1952	1953	2.19	Fingerling	Pysht River	33,120	Elwha
1953	1954	3.54	Smolt	Pysht River	16,640	Elwha
1954	1955	2.27	Fingerling	Pysht River	30,000	Elwha
1955	1956	2.27	Fingerling	Pysht River	30,000	Elwha
1957	1958	1.81	Fingerling	Pysht River	30,000	Big Soos
1958	1959	1.07-1.45	Fingerling	Pysht River	156,432	Deschutes
1959	1960	1.10	Fingerling	Pysht River	249,056	Big Soos
1962	1963	1.70	Fingerling	Pysht River	160,200	Finch
1964	1965	1.40	Fingerling	Pysht River	165,775	Big Soos
1971	1972	5.27-9.86	Smolt	Pysht River	386,901	Hood Canal x White, Hood Canal x Sol Duc
1972	1973	4.54-6.05	Smolt	Pysht River	248,750	Finch
1973	1974	5.89	Smolt	Pysht River	115,500	Hood Canal x Sol Duc

Brood Year	Year of Release	Avg. Weight (grams)	Release Stage	Release Location	Number Released	Broodstock Origin
1973	1975	75.60	Smolt	Pysht River	23,400	Hood Canal x Sol Duc
n=12	**n=13**	**-**	**-**	**Total=**	**1,645,774**	**n=7**
1960	1961	0.60	Fed fry	Clallam River	109,185	Deschutes River
1961	1962	0.69	Fingerling	Clallam River	254,760	Finch Creek
1962	1963	0.65	Fingerling	Clallam River	246,400	Finch Creek
1963	1964	0.60	Fed fry	Clallam River	302,000	Minter Creek
1964	1965	0.54	Fingerling	Clallam River	1,438,330	Big Soos Creek
1965	1966	2.27	Fingerling	Clallam River	4,600	Big Soos Creek
1967	1968	0.70	Fingerling	Clallam River	208,000	Finch Creek
1968	1969	0.53	Fed fry	Clallam River	249,900	Finch Creek
1969	1970	0.65	Fingerling	Clallam River	161,000	Finch Creek
1970	1971	5.15	Smolt	Clallam River	803,937	Finch Creek
1971	1972	5.74	Smolt	Clallam River	98,987	Hood Cannel/Elwha
1972	1973	5.76	Smolt	Clallam River	172,100	Finch Creek
1972/73	1974	17.31	Smolt	Clallam River	133,684	Sol Duc River, Hood Canal x White
1974	1975	5.18	Smolt	Clallam River	212,250	Sol Duc/Deschutes Rivers
n=15	**n=14**	**3.31**	**-**	**Total=**	**4,395,133**	**n=7**
1952	1953	2.19	Fingerling	Hoko River	49,706	Elwha River
1954	1955	1.81	Fingerling	Hoko River	34,750	Elwha River
1957	1958	1.47	Fingerling	Hoko River	100,116	Big Soos Creek
1958	1959	1.07	Fingerling	Hoko River	84,400	Deschutes River
1959	1960	1.08	Fingerling	Hoko River	126,300	Big Soos Creek
1962	1963	4.01	Smolt	Hoko River	24,182	Finch Creek
1970	1971	5.00	Smolt	Hoko River	1,518,100	Finch Creek
1971	1972	8.05	Smolt	Hoko River	387,904	Issaquah x White, Hood Canal x Elwha
1972	1973	4.60	Smolt	Hoko River	308,300	Finch Creek
1973/1974	1974	na	Smolt/Fing	Hoko River	195,650	Hood Canal x White, Hood Canal x Sol Duc
1974/1975	1975	na	Smolt/Fing	Hoko River	270,348	Deschutes, Hood Canal x Sol Duc
1982	1983	3.47	Fingerling	Hoko River	13,464	Hoko River
1983	1984	5.09	Fingerling	Hoko River	71,250	Hoko River
1984	1985	6.10	Fingerling	Hoko River	45,600	Hoko River
1985	1986	3.77	Fingerling	Hoko River	138,120	Hoko River
1986	1987	6.49	Fingerling	Hoko River	162,500	Hoko River

Brood Year	Year of Release	Avg. Weight (grams)	Release Stage	Release Location	Number Released	Broodstock Origin
1987	1988	7.62	Fingerling	Hoko River	239,158	Hoko River
1989	1990	7.37	Fingerling	Hoko River	115,300	Hoko River
1990	1991	8.73	Fingerling	Hoko River	193,977	Hoko River
1991	1992	8.73	Fingerling	Hoko River	223,267	Hoko River
1992	1993	7.63	Fingerling	Hoko River	190,588	Hoko River
1993	1994	7.72	Fingerling	Hoko River	234,767	Hoko River
1994	1995	5.46	Fingerling	Hoko River	163,228	Hoko River
1995	1996	na	Fingerling	Hoko River	319,352	Hoko River
1996	1997	8.47	Fingerling	Hoko River	82,736	Hoko River
1997	1998	7.50	Fingerling	Hoko River	239,800	Hoko River
1998	1999	7.09	Fingerling	Hoko River	186,390	Hoko River
1999	2000	na	Fingerling	Hoko River	279,281	Hoko River
2000	2001	6.05	Fingerling	Hoko River	149,634	Hoko River
2001	2002	7.32	Fingerling	Hoko River	181,789	Hoko River
2002	2003	na	Fingerling	Hoko River	377,684	Hoko River
2003	2004	na	Fingerling	Hoko River	489,303	Hoko River
2004	2005	na	Fingerling	Hoko River	452,523	Hoko River
2005	2006	na	Fingerling	Hoko River	82,851	Hoko River
2006	2007	9.2	Fingerling	Hoko River	91,449	Hoko River
2007	2008	4.9	Fingerling	Hoko River	248,127	Hoko River
2008	2009	8.8	Fingerling	Hoko River	68,340	Hoko River
2009	2010	3.4-6.2	Fingerling	Hoko River	179,113	Hoko River
2010	2011	7.2	Fingerling	Hoko River	241,907	Hoko River
n=39	**n=39**	**-**	**-**	**Total Released**	**7,732,318**	**Percent out of basin=31%**
1970	1971	0.51-6.21	Smolt/Fed Fry	Sekiu River	1,057,471	Finch, Minter
1972	1973	4.45-6.13	Smolt	Sekiu River	225,200	Finch
1974	1975	5.40	Smolt	Sekiu River	184,800	Deschutes
n=3	**n=3**	**-**	**-**	**Sekiu River**	**1,467,471**	**n=3**
1979	1980	0.56	Emergent Fry	Sail River	2,000	Portage Bay UW
n=3	**n=3**	**-**	**-**	**Sail River**	**2,000**	**n=3**
WRIA 19 TOTALS						
n=48	**n=49**				**17,596,314**	**n=11; 71.2% out of basin plants**

APPENDIX C: Coho Salmon Hatchery Releases

WRIA 19 coho salmon hatchery releases.

Brood Year	Year of Release	Avg. Weight (grams)	Release Stage	Release Location	Number Released	Broodstock Origin
1983	1984	0.78	Fingerling	Agency Creek	60,528	Sooes River; Big Quilcene
1985	1986	1.32	Fingerling	Agency Creek	17,134	Sooes River
1987	1988	1.15	Fingerling	Agency Creek	24,095	Sooes River
n=3	**n=3**		**-**	**Total=**	**101,757**	**n=2**
1952	1953	0.32	Emergent Fry	Clallam River	19,600	Dungeness River
1956	1958	2.25	Fingerling	Clallam River	24,038	Dungeness River
1957	1959	4.46	Fingerling	Clallam River	37,130	Dungeness River
1960	1962	4.83	Fingerling	Clallam River	75,576	Dungeness River
1961	1963	11.34	Pre-smolt	Clallam River	12,000	Dungeness River
1962	1964	6.30	Fingerling	Clallam River	30,024	Dungeness River
1963	1965	11.94	Pre-smolt	Clallam River	15,000	Dungeness River
1964	1966	10.44	Fingerling	Clallam River	75,010	Big Soos Creek
1965	1967	12.60	Pre-smolt	Clallam River	60,012	Dungeness River
1968	1970	8.90	Fingerling	Clallam River	25,182	Dungeness River
1969	1971	13.97	Pre-smolt	Clallam River	34,100	Dungeness River
1970	1972	28.35	Smolt	Clallam River	32,000	Lake Creek (Sol Duc)
1972	1974	33.59	Smolt	Clallam River	328,007	Washougal River
1973	1975	30.24	Smolt	Clallam River	48,495	Sol Duc River
1975	1976	0.91	Fingerling	Clallam River	148,000	Sol Duc River
1976	1977	0.36	Emergent Fry	Clallam River	200,000	George Adams
1976	1978	21.59	Smolt	Clallam River	50,100	Washington General
1977	1979	18.90	Smolt	Clallam River	243,600	Washington General
1981	1982	0.35	Emergent Fry	Clallam River	84,500	Elwha River
1981	1983	0.56	Fingerling	Clallam River	12,900	Elwha River
1983	1984	0.76	Emergent Fry	Clallam River	94,800	Dungeness River
1985	1987	17.51	Pre-smolt	Clallam River	5,000	Dungeness River
n=20	**n=22**	**-**	**-**	**Total Released=**	**1,655,074**	**n=8**
1981	1982	0.78	Fingerling	Colville Creek	30,900	Elwha River
1982	1983	0.90	Fingerling	Colville Creek	32,000	Elwha River

Brood Year	Year of Release	Avg. Weight (grams)	Release Stage	Release Location	Number Released	Broodstock Origin
1983	1984	0.75	Emergent Fry	Colville Creek	19,900	Dungeness River
1984	1985	0.62	Fingerling	Colville Creek	21,600	Elwha River
1985	1986	1.12	Fingerling	Colville Creek	20,000	Elwha River
n=5	**n=5**	**-**	**-**	**Total=**	**124,400**	**n=2**
1954	1955	5.67	Fingerling	Deep Creek	4,000	Big Soos Creek
1956	1957	2.27	Fingerling	Deep Creek	36,000	Dungeness River
1957	1958	5.04	Fingerling	Deep Creek	9,000	Dungeness River
1958	1959	8.10	Fingerling	Deep Creek	17,920	Dungeness River
1959	1960	11.06	Fingerling	Deep Creek	3,280	Skagit River
1960	1961	6.30	Fingerling	Deep Creek	22,320	Dungeness River
1961	1962	3.49	Fingerling	Deep Creek	17,550	Lake Creek (Sol Duc)
1962	1964	15.12	Pre-smolt	Deep Creek	24,000	Dungeness River
1963	1965	14.39	Pre-smolt	Deep Creek	21,580	Dungeness River
1964	1966	13.34	Pre-smolt	Deep Creek	34,000	Dungeness River
1965	1967	12.60	Pre-smolt	Deep Creek	30,168	Dungeness River
1967	1969	9.45	Fingerling	Deep Creek	26,400	Dungeness River
1970	1971	0.34	Emergent Fry	Deep Creek	119,160	Dungeness River
1971	1972	4.73	Fingerling	Deep Creek	71,421	Dungeness River
1982	1983	0.76	Fingerling	Deep Creek	85,800	Elwha River
1983	1984	0.60	Fed Fry	Deep Creek	147,700	Dungeness River
1984	1985	0.59	Fingerling	Deep Creek	101,200	Elwha River
n=17	**n=17**	**-**	**-**	**Total Released=**	**771,499**	**n=5**
1952	1953/54	na	Fingerling/Emergent Fry	East Twin River	26,980	Dungeness River
1954	1956	5.04	Fingerling	East Twin River	18,000	Big Soos Creek
1956	1958	2.27	Fingerling	East Twin River	20,000	Dungeness River
1957	1959	5.04	Fingerling	East Twin River	9,000	Dungeness River
1958	1960	6.57	Fingerling	East Twin River	20,700	Dungeness River
1959	1961	11.06	Fingerling	East Twin River	3,280	Skagit River
1960	1962	6.30	Fingerling	East Twin River	24,912	Dungeness River
1961	1963	3.49	Fingerling	East Twin River	18,200	Lake Creek (Sol Duc)
1962	1964	15.12	Pre-smolt	East Twin River	25,500	Dungeness River
1963	1965	14.75	Pre-smolt	East Twin River	21,192	Dungeness River

Brood Year	Year of Release	Avg. Weight (grams)	Release Stage	Release Location	Number Released	Broodstock Origin
1964	1966	11.34	Pre-smolt	East Twin River	40,000	Dungeness River
1965	1967	11.94	Pre-smolt	East Twin River	38,000	Dungeness River
1967	1969	11.06	Fingerling	East Twin River	22,550	Dungeness River
1968	1970	8.89	Fingerling	East Twin River	20,400	Dungeness River
1969	1971	13.34	Pre-smolt	East Twin River	33,500	Dungeness River
1970	1971	0.34	Emergent Fry	East Twin River	133,724	Dungeness River
1971	1972	4.73	Fingerling	East Twin River	100,000	Elwha River
1981	1982	0.78	Fingerling	East Twin River	139,200	Elwha River
1982	1983	0.76	Fingerling	East Twin River	81,000	Elwha River
1983	1984	0.60	Fingerling	East Twin River	77,300	Dungeness River
1984	1985	0.62	Fingerling	East Twin River	52,600	Elwha River
1985	1986	1.10	Fingerling	East Twin River	50,100	Elwha River
n=22	**n=23**	**-**	**-**	**Total Released=**	**976,138**	**n=5**
1970	1971	0.36	Emergent Fry	Field Creek	15,000	Dungeness River
1981	1982	0.78	Fingerling	Field Creek	60,800	Elwha River
1982	1983	0.90	Fingerling	Field Creek	30,500	Elwha River
1983	1984	0.75	Emergent Fry	Field Creek	20,500	Dungeness River
1984	1985	0.62	Fingerling	Field Creek	21,600	Elwha River
1985	1986	1.12	Fingerling	Field Creek	20,000	Elwha River
1986	1987	0.98	Fingerling	Field Creek	20,000	Elwha River
n=7	**n=7**	**-**	**-**	**Total=**	**188,400**	**n=2**
1985	1986	1.32	Fingerling	Halfway Creek	17,134	Sooes River
n=1	**n=1**	**-**	**-**	**Total=**	**17,134**	**n=1**
1951	1952	1.42	Fingerling	Hoko River	25,000	Dungeness River
1952	1953/54	na	Fingerling/Emergent Fry	Hoko River	62,610	Dungeness River
1953	1955	8.25	Fingerling	Hoko River	9,020	Dungeness River
1956	1958	4.70	Fingerling	Hoko River	29,675	Dungeness River
1957	1959	4.70	Fingerling	Hoko River	69,640	Dungeness River
1958	1960	6.05	Fingerling	Hoko River	24,000	Dungeness River
1964	1966	10.25	Fingerling	Hoko River	105,856	Dungeness River
1965	1967	11.94	Pre-smolt	Hoko River	89,984	Dungeness River
1968	1970	8.89	Fingerling	Hoko River	60,078	Dungeness River

Brood Year	Year of Release	Avg. Weight (grams)	Release Stage	Release Location	Number Released	Broodstock Origin
1970	1971/72	na	Emergent Fry/Smolt	Hoko River	135,550	Lake Creek (Sol Duc), Dungeness River
1974	1975	1.10	Fingerling	Hoko River	108,356	Sol Duc River
1975	1976	0.30	Emergent Fry	Hoko River	201,000	Dungeness River
1976	1977	0.36	Emergent Fry	Hoko River	190,000	George Adams
1978	1978	0.32	Emergent Fry	Hoko River	4,200	Sol Duc River
1981	1982	0.50	Fed Fry/Emergent Fry	Hoko River	701,600	Elwha River
1983	1984	0.60	Emergent Fry	Hoko River	231,800	Dungeness River
1984	1985/86	0.47-22.7	Smolt/Fingerling	Hoko River	372,700	Elwha River
1985	1986/87	0.5 -30.26	Smolt/Fingerling	Hoko River	349,700	Elwha River
1986	1987	1.25	Fingerling	Hoko River	145,800	Elwha River
1987	1988	1.83	Fingerling	Hoko River	131,564	Elwha River
n=20	**n=22**	**-**	**-**	**Total Released=**	**3,048,133**	**n=5**
1981	1982	0.56	Fingerling	Jim Creek	4,800	Elwha River
1982	1983	0.76	Fingerling	Jim Creek	21,000	Elwha River
1983	1984	0.75	Emergent Fry	Jim Creek	11,400	Dungeness River
1984	1985	0.62	Fingerling	Jim Creek	10,100	Elwha River
1985	1986	0.62	Fingerling	Jim Creek	10,800	Elwha River
n=5	**n=5**	**-**	**-**	**Total=**	**58,100**	**n=2**
1952	1954	9.07-11.06	Fingerling	Lyre River	20,930	Dungeness River
1953	1955	8.25	Fingerling	Lyre River	10,340	Dungeness River
1954	1956	4.77	Fingerling	Lyre River	10,450	Big Soos Creek
1955	1957	2.11	Fingerling	Lyre River	30,100	Dungeness River
1956	1958	4.16	Fingerling	Lyre River	25,070	Dungeness River
1957	1959	2.52-4.16	Fingerling	Lyre River	93,440	Dungeness River
1958	1959/1960	0.62-9.07	Fingerling/Fed Fry	Lyre River	137,824	Dungeness River
1959	1961	9.26	Fingerling	Lyre River	12,593	Skagit River
1960	1962	5.53	Fingerling	Lyre River	37,556	Dungeness River
1961	1963	7.44	Fingerling	Lyre River	18,300	Dungeness River
1962	1964	15.12	Pre-smolt	Lyre River	30,330	Dungeness River
1963	1965	11.63	Pre-smolt	Lyre River	20,124	Dungeness River
1964	1966	11.34	Pre-smolt	Lyre River	40,000	Dungeness River
1965	1967	12.60	Pre-smolt	Lyre River	30,924	Dungeness River
1967	1969	9.07	Fingerling	Lyre River	51,550	Dungeness River

Brood Year	Year of Release	Avg. Weight (grams)	Release Stage	Release Location	Number Released	Broodstock Origin
1968	1970	8.95	Fingerling	Lyre River	68,712	Dungeness River
1969	1971	11.06-14.17	Fingerling	Lyre River	36,564	Dungeness River
1981	1982	0.78	Fingerling	Lyre River	31,500	Elwha River
1982	1983	0.90	Fingerling	Lyre River	30,000	Elwha River
1983	1984	0.60	Emergent Fry	Lyre River	21,000	Dungeness River
1984	1985	0.62	Fingerling	Lyre River	21,600	Elwha River
1985	1986	1.10	Fingerling	Lyre River	20,200	Elwha River
n=22	**n=23**	**-**	**-**	**Total Released=**	**799,107**	**n=5**
1951	1952	1.42	Fingerling	Pysht River	27,200	Dungeness River
1952	1953/54	0.32-9.07	Fingerling/Emergent Fry	Pysht River	64,725	Dungeness River
1953	1955	8.25	Fingerling	Pysht River	10,010	Dungeness River
1954	1956	5.70	Fingerling	Pysht River	18,000	Big Soos Creek
1955	1957	2.26	Fingerling	Pysht River	30,002	Dungeness River
1956	1958	1.91-6.05	Fingerling	Pysht River	50,100	Dungeness River, Big Soos Creek
1957	1959	3.11-3.6	Fingerling	Pysht River	52,540	Dungeness River
1958	1959/60	0.78-5.27	Fingerling/Fed Fry	Pysht River	141,258	Dungeness River
1959	1961	11.06	Fingerling	Pysht River	5,330	Skagit River
1960	1962	5.67	Fingerling	Pysht River	37,120	Dungeness River
1961	1963	2.18	Fingerling	Pysht River	39,520	Lake Creek (Sol Duc)
1962	1964	5.67	Fingerling	Pysht River	30,000	Dungeness River
1963	1965	11.94	Pre-smolt	Pysht River	30,030	Dungeness River
1964	1966	10.08	Fingerling	Pysht River	75,558	Big Soos Creek
1965	1967	12.60	Pre-smolt	Pysht River	60,012	Dungeness River
1967	1969	9.07	Fingerling	Pysht River	27,250	Dungeness River
1968	1970	8.89	Fingerling	Pysht River	22,950	Dungeness River
1969	1971	14.17-15.12	Pre-smolt	Pysht River	27,832	Dungeness River
1976	1977	0.36	Emergent Fry	Pysht River	190,000	George Adams
1978	1979	0.70	Fed Fry	Pysht River	150,150	Elwha River
1981	1982	0.35-0.56	Emergent Fry/ Fed Fry	Pysht River	223,500	Elwha River
1982	1983	0.76	Fed Fry	Pysht River	75,600	Elwha River
1983	1984	0.6-0.76	Fed Fry	Pysht River	182,300	Dungeness River
1984	1985	0.47-0.62	Fed Fry	Pysht River	257,400	Elwha River
1985	1986	0.64	Fed Fry	Pysht River	81,900	Elwha River

Brood Year	Year of Release	Avg. Weight (grams)	Release Stage	Release Location	Number Released	Broodstock Origin
n=25	**n=26**	**-**	**-**	**Total Released=**	**1,910,287**	**n=6**
1983	1984	0.78	Fed Fry	Sail River	195,572	Sooes River, Big Quilcene River
1984	1985	1.21	Fed Fry	Sail River	200,000	Sooes River
1985	1986	1.32	Fed Fry	Sail River	17,134	Sooes River
1987	1988	0.80	Fed Fry	Sail River	154,661	Sooes River
n=4	**n=4**	**-**	**-**	**Total=**	**567,367**	**n=2**
1957	1959	3.6-7.32	Fingerling	Salt Creek	102,618	Dungeness River
1958	1959/60	0.62-9.07	Fingerling/Fed Fry	Salt Creek	279,344	Dungeness River
1959	1961	9.26-11.06	Fingerling	Salt Creek	17,980	Skagit River
1960	1962	5.67	Fingerling	Salt Creek	36,240	Dungeness River
1962	1964	6.48	Fingerling	Salt Creek	25,060	Dungeness River
1963	1965	11.94	Pre-smolt	Salt Creek	19,760	Dungeness River
1964	1966	6.62-12.96	Fingerling/Pre-smolt	Salt Creek	57,420	Big Soos Creek
1965	1967	12.60	Pre-smolt	Salt Creek	30,096	Dungeness River
1967	1969	8.56	Fingerling	Salt Creek	29,945	Dungeness River
1968	1970	9.23	Fingerling	Salt Creek	59,011	Dungeness River
1969	1971	14.17	Pre-smolt	Salt Creek	16,000	Dungeness River
1972	1974	26.68	Smolt	Salt Creek	121,550	Washougal River
1976	1977	0.36	Emergent Fry	Salt Creek	190,000	George Adams
1981	1982	0.60	Fed Fry	Salt Creek	60,000	Elwha River
n=14	**n=14**	**-**	**-**	**Total Released=**	**1,045,024**	**n=6**
1956	1958	2.25	Fingerling	Sekiu River	20,200	Dungeness River
1968	1970	8.89	Fingerling	Sekiu River	33,150	Dungeness River
1970	1971/72	0.34-28.35	Emergent Fry/Smolt	Sekiu River	254,656	Dungeness River, Sol Duc River
1971	1972	4.73	Fingerling	Sekiu River	100,000	Dungeness River
1976	1977	0.36	Emergent Fry	Sekiu River	180,000	George Adams
1978	1979	1.59	Fingerling	Sekiu River	109,155	Dungeness River
1981	1982	0.35-0.47	Emergent Fry/Fed Fry	Sekiu River	701,720	Elwha River
1983	1984	0.45	Fed Fry	Sekiu River	118,000	Elwha River
1985	1986	2.16	Fingerling	Sekiu River	127,300	Elwha River
n=9	**n=9**	**-**	**-**	**Total=**	**1,644,181**	**n=4**
1983	1984	0.78	Fingerling	Village Creek	60,528	Sooes River, Big Quilcene River

Brood Year	Year of Release	Avg. Weight (grams)	Release Stage	Release Location	Number Released	Broodstock Origin
1984	1985	1.21	Fingerling	Village Creek	40,000	Sooes River, Big Quilcene River
1985	1986	1.32	Fingerling	Village Creek	17,134	Sooes River
1987	1988	1.15	Fingerling	Village Creek	25,280	Sooes River
n=4	**n=4**	**-**	**-**	**Total=**	**142,942**	**n=2**
1954	1956	4.88	Fingerling	West Twin River	9,300	Big Soos Creek
1956	1958	2.27	Fingerling	West Twin River	14,000	Dungeness River
1958	1960	8.10	Fingerling	West Twin River	17,472	Dungeness River
1960	1962	6.30	Fingerling	West Twin River	20,880	Dungeness River
1962	1964	15.12	Pre-smolt	West Twin River	24,000	Dungeness River
1963	1965	12.6-16.2	Pre-smolt	West Twin River	18,144	Dungeness River, Unknown
1964	1966	11.34	Pre-smolt	West Twin River	12,000	Dungeness River
1965	1967	12.60	Pre-smolt	West Twin River	25,020	Dungeness River
1967	1969	9.45	Fingerling	West Twin River	12,000	Dungeness River
1970	1971	0.34	Emergent Fry	West Twin River	139,020	Dungeness River
1971	1972	4.72	Fingerling	West Twin River	50,000	Dungeness River
1982	1983	0.76	Fingerling	West Twin River	53,400	Elwha River
1983	1984	0.74	Emergent Fry	West Twin River	54,900	Dungeness River
n=13	**n=13**	**-**	**-**	**Total Released=**	**450,136**	**n=6**
1970	1971	0.34	Emergent Fry	Whiskey Creek	51,200	Dungeness River
1981	1982	0.35	Emergent Fry	Whiskey Creek	59,800	Elwha River
1982	1983	0.90	Fingerling	Whiskey Creek	29,000	Elwha River
1983	1984	0.75	Emergent Fry	Whiskey Creek	19,900	Dungeness River
1984	1985	0.62	Fingerling	Whiskey Creek	21,600	Elwha River
1985	1986	1.12	Fingerling	Whiskey Creek	20,000	Elwha River
n=6	**n=6**	**-**	**-**	**Total=**	**201,500**	**n=2**
WRIA 19 TOTALS						
n=34	**n=33**				**13,701,179**	**n=10; 100% out of basin plants**

APPENDIX D: Steelhead Trout Hatchery Releases

WRIA 19 steelhead trout hatchery releases.

Brood Year	Year of Release	Avg. Weight (Grams)	Release Stage	Release Location	Number Released	Broodstock Origin
1983	1984	0.78	Fingerling	Agency Creek	60,528	Sooes River; Big Quilcene
1985	1986	1.32	Fingerling	Agency Creek	17,134	Sooes River
1988	1989	64.85	Smolt	Agency Creek	1,777	Hoko River
1989	1990	73.22	Smolt	Agency Creek	2,027	Bogachiel River
1990	1991	61.34	Smolt	Agency Creek	2,186	Hoko River
1991	1992	62.19	Smolt	Agency Creek	3,113	Hoko River
1992	1993	59.73	Smolt	Agency Creek	4,724	Hoko River
1993	1994	51.01	Smolt	Agency Creek	2,614	Hoko River
1994	1995	41.27	Smolt	Agency Creek	5,688	Hoko River
1995	1995/96	na	Smolt/Fingerling	Agency Creek	10,079	Hoko River
1996	1997	59.74	Smolt	Agency Creek	5,625	Hoko River
1997	1998	87.31	Smolt	Agency Creek	5,804	Hoko River
1998	1998/1999	na	Smolt/Fingerling	Agency Creek	24,382	Hoko River
1999	1999	0.37	Fed Fry	Agency Creek	19,200	Hoko River
2000	2000/01	na	Smolt/Fingerling	Agency Creek	16,305	Hoko River
2001	2001	na	Emergent Fry/Fed Fry	Agency Creek	76,552	Hoko River
2003	2004	90.72	Smolt	Agency Creek	948	Hoko River
2004	2004/05	na	Smolt/Fingerling	Agency Creek	77,625	Hoko River
2005	2005/06	na	Fed Fry	Agency Creek	30,531	Hoko River
2006	2006	1.80	Fed Fry	Agency Creek	16,855	Hoko River
2007	2008	53.7	Smolt	Agency Creek	2,768	Hoko River
2008	2008	0.5	Fed Fry	Agency Creek	10.908	Hoko River
n=23	**n=20**	**na**	**-**	**Total Released=**	**421,468**	**n=2**
1977	1978	na	Smolt	Clallam River	10,200	Unknown
1978	1979	na	Smolt	Clallam River	5,500	Unknown
1979	1980	na	Smolt	Clallam River	5,200	Unknown
1980	1981	na	Smolt	Clallam River	10,100	Unknown
1981	1982	100.82	Smolt	Clallam River	8,571	Bogachiel River
1982	1983	128.34	Smolt	Clallam River	10,019	Bogachiel River

Brood Year	Year of Release	Avg. Weight (Grams)	Release Stage	Release Location	Number Released	Broodstock Origin
1983	1984	87.23	Smolt	Clallam River	10,322	Bogachiel River
1984	1985	92.62	Smolt	Clallam River	10,383	Bogachiel River
1985	1986	91.77	Smolt	Clallam River	10,059	Bogachiel River
1986	1987	81.00	Smolt	Clallam River	5,208	Quinault River
1987	1988	92.57	Smolt	Clallam River	5,145	Bogachiel River
1988	1989	81.00	Smolt	Clallam River	5,068	Bogachiel River
1991	1991	56.05	Smolt	Clallam River	5,927	Hoko River
1992	1992	58.20	Smolt	Clallam River	4,013	Hoko River
1993	1993	56.05	Smolt	Clallam River	6,390	Hoko River
1994	1994	85.58	Smolt	Clallam River	5,247	Bogachiel River
1995	1995	41.27	Smolt	Clallam River	4,300	Hoko River
1996	1996	80.99	Smolt	Clallam River	5,152	Bogachiel River
1997	1997	59.74	Smolt	Clallam River	5,000	Hoko River
1997	1998	75.59	Smolt	Clallam River	5,010	Bogachiel River
1998	1999	75.59	Smolt	Clallam River	5,010	Bogachiel River
1999	2000	82.47	Smolt	Clallam River	5,000	Bogachiel River
2000	2001	87.22	Smolt	Clallam River	5,000	Bogachiel River
2001	2002	68.72	Smolt	Clallam River	5,000	Bogachiel River
2002	2003	82.47	Smolt	Clallam River	5,000	Bogachiel River
2003	2004	75.59	Smolt	Clallam River	5,000	Bogachiel River
2004	2005	83.22	Smolt	Clallam River	10,000	Bogachiel River
2005	2006	74.50	Smolt	Clallam River	14,838	Dungeness River, Elwha River
2006	2007	75.6	Smolt	Clallam River	9,802	Dungeness River, Elwha River
2007	2008	84.0	Smolt	Clallam River	6,372	Dungeness River, Elwha River
2008	2009	98.6	Smolt	Clallam River	10,037	Dungeness River, Elwha River
n=31	**n=31**	**79.3**	**Smolt**	**Total Released**	**217,873**	**n=5**
1964	1965	na	Smolt	Deep Creek	7,600	na
n=1	**n=1**	**na**	**Smolt**	**Total Released**	**7,600**	**n=1**
1977	1978	na	Smolt	Hoko River	15,000	Unknown
1978	1979	na	Smolt	Hoko River	10,200	Unknown
1979	1980	na	Smolt	Hoko River	12,800	Unknown
1980	1981	na	Smolt	Hoko River	5,500	Unknown

Brood Year	Year of Release	Avg. Weight (Grams)	Release Stage	Release Location	Number Released	Broodstock Origin
1981	1982	98.10	Smolt	Hoko River	8,619	Bogachiel River
1982	1983	125.60	Smolt	Hoko River	14,992	Bogachiel River
1983	1984	88.90	Smolt	Hoko River	10,532	Bogachiel River
1984	1985	85.90	Smolt	Hoko River	15,620	Bogachiel River
1985	1986	92.60	Smolt	Hoko River	15,059	Bogachiel River
1986	1987	32.42	Fingerling	Hoko River	24,700	Sooes River
1987	1988	77.90	Smolt	Hoko River	15,089	Bogachiel River
1988	1989	62.20	Smolt	Hoko River	15,600	Hoko River
1989	1990	73.20	Smolt	Hoko River	15,600	Bogachiel River
1990	1991	56.80	Smolt	Hoko River	16,046	Hoko River
1991	1992	62.20	Smolt	Hoko River	15,906	Hoko River
1992	1993	56.05	Smolt	Hoko River	23,546	Hoko River
1993	1994	52.79	Smolt	Hoko River	21,000	Hoko River
1994	1995	41.27	Smolt	Hoko River	20,855	Hoko River
1995	1996	63.06	Smolt	Hoko River	20,463	Hoko River
1996	1997	59.74	Smolt	Hoko River	20,156	Hoko River
1997	1998	85.66	Smolt	Hoko River	21,065	Hoko River
1998	1999	50.40	Smolt	Hoko River	21,717	Hoko River
1999	2000	64.80	Smolt	Hoko River	13,971	Hoko River
2000	2001	58.15	Smolt	Hoko River	20,786	Hoko River
2001	2002	52.14	Smolt	Hoko River	19,972	Hoko River
2002	2003	41.24	Smolt	Hoko River	18,978	Hoko River
2003	2004	90.72	Smolt	Hoko River	9,658	Hoko River
2004	2005	57.42	Smolt	Hoko River	26,169	Hoko River
2005	2006	50.40	Smolt	Hoko River	29,564	Hoko River
2006	2007	39.9	Smolt	Hoko River	34,336	Hoko River
2007	2008	50.9	Smolt	Hoko River	23,086	Hoko River
2008	2009	67.9	Smolt	Hoko River	16,251	Hoko River
2009	2010	67.7	Smolt	Hoko River	18,310	Hoko River
n=33	**n=33**	**65.7**	**Smolt**	**Total Released**	**591,146**	**n=3**
1977	1978	na	Smolt	Lyre River	30,400	Bogachiel River
1978	1979	na	Smolt	Lyre River	30,000	Bogachiel River

Brood Year	Year of Release	Avg. Weight (Grams)	Release Stage	Release Location	Number Released	Broodstock Origin
1979	1980	na	Smolt	Lyre River	26,500	Bogachiel River
1980	1981	na	Smolt	Lyre River	30,100	Bogachiel River
1981	1982	102.60	Smolt	Lyre River	26,010	Bogachiel River
1982	1983	123.11	Smolt	Lyre River	22,131	Bogachiel River
1983	1984	90.02	Smolt	Lyre River	25,900	Bogachiel River
1984	1985	90.71	Smolt	Lyre River	15,550	Bogachiel River
1985	1986	93.56	Smolt	Lyre River	23,587	Bogachiel River
1986	1987	84.89	Smolt	Lyre River	20,677	Bogachiel River
1987	1988	91.92	Smolt	Lyre River	25,189	Bogachiel River
1988	1989	83.63	Smolt	Lyre River	30,152	Bogachiel River
1989	1990	96.50	Smolt	Lyre River	24,088	Bogachiel River
1990	1991	45.39	Smolt	Lyre River	25,000	Bogachiel River
1991	1992	94.49	Smolt	Lyre River	25,524	Bogachiel River
1992	1993	75.60	Smolt	Lyre River	25,080	Bogachiel River
1993	1994	87.95	Smolt	Lyre River	26,094	Bogachiel River
1994	1995	87.67	Smolt	Lyre River	25,169	Bogachiel River
1995	1996	79.37	Smolt	Lyre River	25,159	Bogachiel River
1996	1997	88.55	Smolt	Lyre River	25,013	Bogachiel River
1997	1998	77.46	Smolt	Lyre River	25,061	Bogachiel River
1998	1999	77.97	Smolt	Lyre River	25,012	Bogachiel River
1999	2000	82.47	Smolt	Lyre River	25,000	Bogachiel River
2000	2001	87.22	Smolt	Lyre River	25,000	Bogachiel River
2001	2002	68.72	Smolt	Lyre River	25,000	Bogachiel River
2002	2003	75.59	Smolt	Lyre River	25,000	Bogachiel River
2003	2004	82.47	Smolt	Lyre River	25,000	Bogachiel River
2004	2005	83.22	Smolt	Lyre River	25,000	Bogachiel River
2005	2006	80.15	Smolt	Lyre River	40,130	Dungeness River, Elwha River
2006	2007	73.1	Smolt	Lyre River	25,722	Dungeness River, Elwha River
2007	2008	84.0	Smolt	Lyre River	24,661	Dungeness River, Elwha River
2008	2009	98.6	Smolt	Lyre River	26,933	Dungeness River, Elwha River
n=32	**n=32**	**85.2**	**Smolt**	**Total Released**	**824,842**	**n=3**
1977	1978	na	Smolt	Pysht River	15,300	Unknown

Brood Year	Year of Release	Avg. Weight (Grams)	Release Stage	Release Location	Number Released	Broodstock Origin
1978	1979	na	Smolt	Pysht River	11,800	Unknown
1979	1980	na	Smolt	Pysht River	9,000	Unknown
1980	1981	na	Smolt	Pysht River	15,100	Unknown
1981	1982	104.26	Smolt	Pysht River	13,052	Bogachiel River
1982	1983	120.69	Smolt	Pysht River	14,138	Bogachiel River
1983	1984	88.71	Smolt	Pysht River	9,050	Bogachiel River
1984	1985	90.71	Smolt	Pysht River	10,625	Bogachiel River
1985	1986	92.56	Smolt	Pysht River	10,119	Bogachiel River
1986	1987	89.82	Smolt	Pysht River	10,302	Bogachiel River
1987	1988	90.71	Smolt	Pysht River	10,125	Bogachiel River
1988	1989	82.46	Smolt	Pysht River	10,450	Bogachiel River
1989	1990	96.50	Smolt	Pysht River	10,058	Bogachiel River
1990	1991	56.05	Smolt	Pysht River	13,521	Bogachiel River
1991	1992	58.20	Smolt	Pysht River	11,362	Bogachiel River
1992	1993	54.70	Smolt	Pysht River	21,466	Bogachiel River
1993	1994	88.93	Smolt	Pysht River	15,351	Bogachiel River
1994	1995	92.56	Smolt	Pysht River	15,215	Bogachiel River
1995	1996	85.58	Smolt	Pysht River	10,070	Bogachiel River
1996	1997	88.13	Smolt	Pysht River	10,010	Bogachiel River
1997	1998	83.99	Smolt	Pysht River	10,017	Bogachiel River
1998	1999	77.58	Smolt	Pysht River	10,003	Bogachiel River
1999	2000	82.47	Smolt	Pysht River	10,000	Bogachiel River
2000	2001	87.22	Smolt	Pysht River	10,000	Bogachiel River
2001	2002	68.72	Smolt	Pysht River	10,000	Bogachiel River
2002	2003	82.47	Smolt	Pysht River	10,000	Bogachiel River
2003	2004	75.59	Smolt	Pysht River	10,000	Bogachiel River
2004	2005	83.22	Smolt	Pysht River	10,000	Bogachiel River
2005	2006	79.64	Smolt	Pysht River	20,400	Dungeness River, Elwha River
2006	2007	75.6	Smolt	Pysht River	9,780	Dungeness River, Elwha River
2007	2008	84.0	Smolt	Pysht River	10,076	Dungeness River, Elwha River
2008	2009	98.6	Smolt	Pysht River	10,014	Dungeness River, Elwha River
n=32	**n=32**	**84.1**	**Smolt**	**Total Released**	**376,404**	**n=3**

Brood Year	Year of Release	Avg. Weight (Grams)	Release Stage	Release Location	Number Released	Broodstock Origin
1986/87	1987	3.60	Fingerling	Sail River	74,000	Sooes River
1988	1988/89	na	Fed Fry/Smolt	Sail River	41,221	Sooes River, Hoko River
1989	1990	73.22	Smolt	Sail River	3,317	Bogachiel River
1990	1991	60.53	Smolt	Sail River	4,772	Hoko River
1991	1992	62.19	Smolt	Sail River	5,138	Hoko River
1992	1993	55.36	Smolt	Sail River	5,025	Hoko River
1993	1994	51.01	Smolt	Sail River	4,967	Hoko River
1994	1994/1995	na	Smolt/Fingerling	Sail River	32,040	Hoko River
1995	1995/96	na	Smolt/Fingerling	Sail River	21,836	Hoko River
1996	1997	60.53	Smolt	Sail River	10,581	Hoko River
1997	1998	87.31	Smolt	Sail River	9,286	Hoko River
1998	1999	50.40	Smolt	Sail River	7,620	Hoko River
1999	2000	65.74	Smolt	Sail River	6,466	Hoko River
2000	2001	58.15	Smolt	Sail River	7,838	Hoko River
2001	2002	46.76	Smolt	Sail River	5,412	Hoko River
2003	2004	90.72	Smolt	Sail River	2,844	Hoko River
2004	2005	57.42	Smolt	Sail River	6,222	Hoko River
2005	2006	50.4	Smolt	Sail River	8,387	Hoko River
2006	2007	57.4	Smolt	Sail River	5,510	Hoko River
2007	2008	52.1	Smolt	Sail River	7,890	Hoko River
2008	2009	67.9	Smolt	Sail River	2,919	Hoko River
2009	2010	59.7	Smolt	Sail River	7,670	Hoko River
n=22	**n=23**	**na**	**-**	**Total Released**	**280,961**	**n=3**
na	1962	na	na	Salt Creek	9,700	na
na	1965	na	na	Salt Creek	400	na
na	1966	na	na	Salt Creek	2,500	na
na	1967	na	na	Salt Creek	4,800	na
na	1968	na	na	Salt Creek	4,000	na
na	1969	na	na	Salt Creek	7,900	na
na	1970	na	na	Salt Creek	10,200	na
na	1978	na	na	Salt Creek	10,111	na
1993	1993	9.46	Fingerling	Salt Creek	1,000	Hoko River

Brood Year	Year of Release	Avg. Weight (Grams)	Release Stage	Release Location	Number Released	Broodstock Origin
-	**n=9+**	**na**	**-**	**Total Released**	**50,611**	**n=2+**
1988	1989	59.73	Smolt	Sekiu River	5,077	Hoko River
1989	1990	73.22	Smolt	Sekiu River	5,016	Bogachiel River
1990	1991	60.53	Smolt	Sekiu River	4,773	Hoko River
1991	1992	62.19	Smolt	Sekiu River	4,951	Hoko River
1992	1993	55.36	Smolt	Sekiu River	12,129	Hoko River
1993	1994	52.18	Smolt	Sekiu River	8,528	Hoko River
1994	1995	41.27	Smolt	Sekiu River	10,104	Hoko River
1995	1996	64.86	Smolt	Sekiu River	9,605	Hoko River
1996	1997	60.53	Smolt	Sekiu River	9,602	Hoko River
1997	1998	87.31	Smolt	Sekiu River	10,447	Hoko River
1998	1999	50.40	Smolt	Sekiu River	9,906	Hoko River
1999	2000	65.74	Smolt	Sekiu River	9,515	Hoko River
2000	2001	63.00	Smolt	Sekiu River	10,058	Hoko River
2001	2002	52.14	Smolt	Sekiu River	10,741	Hoko River
2002	2003	41.24	Smolt	Sekiu River	5,546	Hoko River
2004	2005	50.40	Smolt	Sekiu River	14,457	Hoko River
2005	2006	50.4	Smolt	Sekiu River	10,675	Hoko River
2006	2007	57.4	Smolt	Sekiu River	9,815	Hoko River
2007	2008	53.7	Smolt	Sekiu River	10,380	Hoko River
2008	2009	67.9	Smolt	Sekiu River	5,838	Hoko River
2009	2010	59.7	Smolt	Sekiu River	10,620	Hoko River
n=21	**n=21**	**58.9**	**Smolt**	**Total Released**	**187,783**	**n=2**
1988	1989	64.85	Smolt	Village Creek	2,829	Hoko River
1989	1990	73.22	Smolt	Village Creek	1,897	Bogachiel River
1990	1991	61.34	Smolt	Village Creek	2,125	Hoko River
1991	1992	62.19	Smolt	Village Creek	1,920	Hoko River
1992	1993	56.05	Smolt	Village Creek	3,216	Hoko River
1993	1994	54.05	Smolt	Village Creek	3,880	Hoko River
1994	1995	41.27	Smolt	Village Creek	3,792	Hoko River
1995	1996	69.84	Smolt	Village Creek	3,051	Hoko River
1996	1997	59.74	Smolt	Village Creek	5,625	Hoko River

Brood Year	Year of Release	Avg. Weight (Grams)	Release Stage	Release Location	Number Released	Broodstock Origin
1999	2000	64.80	Smolt	Village Creek	2,430	Hoko River
2005	2006	50.40	Smolt	Village Creek	2,287	Hoko River
2007	2008	46.8	Smolt	Village Creek	2,307	Hoko River
2008	2008	0.9	Fed Fry	Village Creek	15,367	Hoko River
n=13	**n=13**	**54.3**	**Smolt/Fed Fry**	**Total Released**	**50,726**	**n=2**
SUMMER-RUN STEELHEAD						
1980	1981	na	Smolt	Lyre River	11,332	Unknown
1981	1982	75.60	Smolt	Lyre River	7,800	Washington General
1982	1983	90.72	Smolt	Lyre River	4,000	Sol Duc River
1983	1984	84.98	Smolt	Lyre River	8,060	Chehalis River
1984	1985	90.72	Smolt	Lyre River	7,525	Chehalis River
1985	1986	83.43	Smolt	Lyre River	5,029	Chehalis River
1986	1987	98.45	Smolt	Lyre River	9,145	W.F. Washougal River
1987	1988	95.62	Smolt	Lyre River	10,008	Quillayute River
1988	1989	84.00	Smolt	Lyre River	10,026	Quillayute River
1989	1990	84.00	Smolt	Lyre River	8,235	Bogachiel River
1991	1992	84.71	Smolt	Lyre River	9,877	Quillayute River
1992	1993	80.51	Smolt	Lyre River	16,194	Quillayute River
1993	1994	88.93	Smolt	Lyre River	20,579	Quillayute River
1994	1995	77.53	Smolt	Lyre River	21,422	Quillayute River
1995	1996	84.96	Smolt	Lyre River	15,241	Quillayute River
1996	1997	88.93	Smolt	Lyre River	5,100	Quillayute River
1997	1998	78.05	Smolt	Lyre River	10,001	Quillayute River
1998	1999	81.86	Smolt	Lyre River	10,056	Quillayute River
1999	2000	83.99	Smolt	Lyre River	10,000	Quillayute River
2000	2001	78.20	Smolt	Lyre River	10,000	Quillayute River
2001	2002	67.70	Smolt	Lyre River	10,000	Bogachiel River
2002	2003	75.59	Smolt	Lyre River	5,000	Quillayute River
2004	2005	82.62	Smolt	Lyre River	10,000	Quillayute River
2005	2006	78.20	Smolt	Lyre River	10,000	Quillayute River
2006	2007	85.7	Smolt	Lyre River	8,000	Quillayute River
2007	2008	73.7	Smolt	Lyre River	10,000	Quillayute River

Brood Year	Year of Release	Avg. Weight (Grams)	Release Stage	Release Location	Number Released	Broodstock Origin
2008	2009	75.6	Smolt	Lyre River	10,000	Quillayute River
n=27	**n=27**	**82.9**	**Smolt**	**Total Released**	**272,630**	**n=6**

APPENDIX E: Subbasin recovery goals and strategies

Watershed	Primary Watershed Process Addressed	Process Impairment Rating	Recovery Goal ID	Recovery Goal Narrative	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier
Salt Creek	Estuary and Nearshore Processes and Habitat Conditions	High	Salt Creek Recovery Goal 1	Protect and restore estuary and nearshore processes and habitat conditions so that current limiting factors are no longer limiting and future limiting factors do not develop.	Salt Creek Recovery Strategy 1	Protect estuarine processes and habitat conditions from degradation by employing environmental regulations and management plans. Where regulations are insufficient to protect estuarine processes and habitat conditions implement conservation easements or acquisitions with willing landowners.	1	Salt Creek Recovery Strategy 2	Restore degraded estuarine habitat conditions where they exist.	2-4	Salt Creek Recovery Strategy 3	For properties that provide particularly important estuarine processes and nearshore habitat, implement conservation easements or acquisitions with willing landowners.	1
Salt Creek	Habitat Connectivity	Medium	Salt Creek Recovery Goal 2	Restore and protect habitat connectivity so that habitat connectivity does not limit VSP parameters.	Salt Creek Recovery Strategy 4	Maintain and protect habitat connectivity where habitat connectivity is intact through the effective implementation of regulations.	1	Salt Creek Recovery Strategy 5	Restore habitat connectivity where habitat is currently disconnected.	2	-	-	-
Salt Creek	Biological Processes	Medium	Salt Creek Recovery Goal 3	Maintain, protect, and/or restore salmonid population abundance, spatial distribution, productivity, and diversity.	Salt Creek Recovery Strategy 6	Minimize or eliminate risks associated with hatchery origin salmonids to ensure that the genetic diversity of Salt Creek salmonids is maintained.	1/3	Salt Creek Recovery Strategy 7	Evaluate in and out of basin fishing-related mortalities and influence fisheries regulations so that spawning escapement is sufficient to ensure VSP, as well as deliver adequate levels of marine nutrients from decaying salmon carcasses.	1/3	-	-	-
Salt Creek	Hydrologic Processes	Medium	Salt Creek Recovery Goal 4	Restore hydrologic processes and natural hydrologic variability to the extent that hydrologic impacts no longer limit Salt Creek VSP parameters.	Salt Creek Recovery Strategy 8	Restore hydrologic processes by addressing issues related to water withdrawals, stream piracy, impermeable surfaces, loss of wetlands and wetland function, and deforestation. Protect intact hydrologic processes where they exist.	1/3	-	-		-	-	-
Salt Creek	Sediment Processes	Low	Salt Creek Recovery Goal 5	Maintain and restore sediment processes (production, routing, storage, and grain size frequency distribution) in Salt Creek to the extent that sediment processes do not limit VSP parameters.	Salt Creek Recovery Strategy 9	Eliminate road/culvert and other landuse related mass wasting events that deliver to streams.	3	Salt Creek Recovery Strategy 10	Reduce surface runoff from existing road network to levels that meet or exceed existing Washington State Water Quality Standards.	3	Salt Creek Recovery Strategy 11	Restore natural wood loading volume and density to the Salt Creek watershed to restore habitat forming processes and improve in-stream sediment routing (see also Section 7.1.1.7).	4
Salt Creek	Riparian and Floodplain Processes and Conditions	High	Salt Creek Recovery Goal 6	Restore riparian and floodplain processes and conditions so that they are at levels necessary to attain VSP goals.	Salt Creek Recovery Strategy 12	Hydrologically reconnect streams to their floodplains for the purposes of floodplain storage and reconnection of off-channel habitat.	3/4	Salt Creek Recovery Strategy 13	Protect, maintain, and or restore riparian habitat conditions by implementing riparian acquisitions, conservation easements, and riparian and in-stream restoration projects.	1/3/4	Salt Creek Recovery Strategy 14	Ensure that current and future regulatory mechanisms are in place to protect and provide sufficient riparian and floodplain conditions to maintain all necessary ecological function.	3

Watershed	Primary Watershed Process Addressed	Process Impairment Rating	Recovery Goal ID	Recovery Goal Narrative	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier
Salt Creek	Habitat and LWD Conditions	Medium	Salt Creek Recovery Goal 7	Maintain and improve existing habitat conditions to levels necessary to attain VSP goals.	Salt Creek Recovery Strategy 15	Where data are lacking assess instream meso-habitat conditions in the Salt Creek watershed.	1	Salt Creek Recovery Strategy 16	Implement wood supplementation in identified wood deficient zones outlined in McHenry et al. (2004) and/or from future habitat monitoring results.	4	-	-	-
Salt Creek	Water Quality Conditions	Low	Salt Creek Recovery Goal 8	Protect and/or restore water quality conditions so that water quality conditions do not limit VSP parameters.	Salt Creek Recovery Strategy 17	Develop water quality monitoring program for the Salt Creek watershed.		Salt Creek Recovery Strategy 18	Protect and restore water quality through the implementation of riparian/floodplain recovery strategies and actions that protect and restore riparian and floodplain habitat.	1/3/4	-	-	-
Lyre River	Estuary and Nearshore Processes and Habitat Conditions	Medium	Lyre River Recovery Goal 1	Protect and restore estuary and nearshore processes and habitat conditions so that current limiting factors are no longer limiting and future limiting factors do not develop.	Lyre River Recovery Strategy 1	Protect estuarine processes and habitat conditions from degradation by employing environmental regulations and management plans. Where regulations are insufficient to protect estuarine processes and habitat conditions implement conservation easements or acquisitions with willing landowners.	1	Lyre River Recovery Strategy 2	Restore degraded estuarine habitat conditions where they exist. Include road maintenance and abandonment plans. Restore floodplain forest in the lower reaches to increase bank stability and reduce sediment introduction and transport to the estuary.	3	Lyre River Recovery Strategy 3	For properties that provide particularly important estuarine processes and nearshore habitat, implement conservation easements or acquisitions with willing landowners.	1
Lyre River	Habitat Connectivity	Low	Lyre River Recovery Goal 2	Restore and protect habitat connectivity so that habitat connectivity does not limit VSP parameters.	Lyre River Recovery Strategy 4	Maintain and protect habitat connectivity where habitat connectivity is intact through the effective implementation of regulations.	1	Lyre River Recovery Strategy 5	Restore habitat connectivity where habitat is currently disconnected.	2	-	-	-
Lyre River	Biological Processes	Medium	Lyre River Recovery Goal 3	Maintain, protect, and/or restore salmonid population abundance, spatial distribution, productivity, and diversity.	Lyre River Recovery Strategy 6	Minimize or eliminate risks associated with hatchery origin salmonids to ensure that the genetic diversity of Lyre River salmonids is maintained.	1/3	Lyre River Recovery Strategy 7	Evaluate in and out of basin fishing-related mortalities and influence fisheries regulations so that spawning escapement is sufficient to ensure VSP, as well as deliver adequate levels of marine nutrients from decaying salmon carcasses.	1/3	-	-	-
Lyre River	Hydrologic Processes	Low	Lyre River Recovery Goal 4	Restore hydrologic processes and natural hydrologic variability to the extent that hydrologic impacts no longer limit the Lyre River VSP parameters.	Lyre River Recovery Strategy 8	Restore hydrologic processes by addressing issues related to water withdrawals, stream piracy, impermeable surfaces, loss of wetlands and wetland function, and deforestation. Protect intact hydrologic processes where they exist.	1/3	-	-	-	-	-	-

Watershed	Primary Watershed Process Addressed	Process Impairment Rating	Recovery Goal ID	Recovery Goal Narrative	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier
Lyre River	Sediment Processes	Medium	Lyre River Recovery Goal 5	Maintain and restore sediment processes (production, routing, storage, and grain size frequency distribution) to the extent that sediment processes do not limit VSP parameters.	Lyre River Recovery Strategy 9	Eliminate road/culvert and other landuse related mass wasting events that deliver to streams.	3	Lyre River Recovery Strategy 10	Reduce road and other landuse related surface erosion to levels that achieve Lyre River Recovery Goal 5.	3	-	-	-
Lyre River	Riparian and Floodplain Processes and Conditions	Medium	Lyre River Recovery Goal 6	Restore riparian and floodplain processes and conditions so that they are at levels necessary to attain VSP goals .	Lyre River Recovery Strategy 11	Hydrologically reconnect streams to their floodplains for the purposes of floodplain storage and reconnection of off-channel habitat.	3	Lyre River Recovery Strategy 12	Protect, maintain, and or restore riparian habitat conditions by implementing riparian acquisitions, conservation easements, and riparian and in-stream restoration projects.	1/3/4	Lyre River Recovery Strategy 13	Ensure that current and future regulatory mechanisms are in place to protect and provide sufficient riparian and floodplain conditions to maintain all necessary ecological function.	1/3
Lyre River	Habitat and LWD Conditions	Unknown	Lyre River Recovery Goal 7	Maintain and improve existing habitat conditions to levels necessary to attain VSP goals.	Lyre River Recovery Strategy 14	Protect, maintain, and or restore large woody debris (LWD) loading and physical habitat conditions through implementing riparian acquisitions, conservation easements, and riparian and habitat restoration projects.	1/3/4	-	-	-	-	-	-
Lyre River	Water Quality Conditions	Unknown	Lyre River Recovery Goal 8	Protect and/or restore water quality conditions so that water quality conditions do not limit VSP parameters.	Lyre River Recovery Strategy 15	Develop water quality monitoring program for the Lyre River watershed.	1	Lyre River Recovery Strategy 16	Protect and restore water quality through the implementation of riparian/floodplain recovery strategies and actions that protect and restore riparian and floodplain habitat.	1/3/4	-	-	-
Twin Rivers	Estuary and Nearshore Processes and Habitat Conditions	High	Twin Rivers Recovery Goal 1	Protect and restore estuary and nearshore processes and habitat conditions so that current limiting factors are no longer limiting and future limiting factors do not develop.	Twin Rivers Recovery Strategy 1	Protect estuarine processes and habitat conditions from degradation by employing environmental regulations and management plans. Where regulations are insufficient to protect estuarine processes and habitat conditions implement conservation easements or acquisitions with willing landowners.	1	Twin Rivers Recovery Strategy 2	Restore degraded estuarine habitat conditions where they exist. Include road maintenance and abandonment plans. Restore floodplain forest in the lower reaches to increase bank stability and reduce sediment introduction and transport to the estuary.	2-4	Twin Rivers Recovery Strategy 3	For properties that provide particularly important estuarine processes and nearshore habitat, implement conservation easements or acquisitions with willing landowners.	1
Twin Rivers	Habitat Connectivity	Low	Twin Rivers Recovery Goal 2	Restore and protect habitat connectivity so that habitat connectivity does not limit VSP parameters.	Twin Rivers Recovery Strategy 4	Maintain and protect habitat connectivity where habitat connectivity is intact through the effective implementation of regulations.	1	Twin Rivers Recovery Strategy 5	Restore habitat connectivity where habitat is currently disconnected.	2	-	-	-

Watershed	Primary Watershed Process Addressed	Process Impairment Rating	Recovery Goal ID	Recovery Goal Narrative	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier
Twin Rivers	Biological Processes	Medium	Twin Rivers Recovery Goal 3	Maintain, protect, and/or restore salmonid population abundance, spatial distribution, productivity, and diversity.	Twin Rivers Recovery Strategy 6	Minimize or eliminate risks associated with hatchery origin salmonids to ensure that the genetic diversity of East and West Twin rivers salmonids is maintained.	1/3	Twin Rivers Recovery Strategy 7	Evaluate in and out of basin fishing-related mortalities and influence fisheries regulations so that spawning escapement is sufficient to ensure VSP, as well as deliver adequate levels of marine nutrients from decaying salmon carcasses.	1/3	-	-	-
Twin Rivers	Hydrologic Processes	Medium	Twin Rivers Recovery Goal 4	Restore hydrologic processes and natural hydrologic variability to the extent that hydrologic impacts no longer limit the Twin Rivers VSP parameters.	Twin Rivers Recovery Strategy 8	Restore hydrologic processes by addressing issues related to water withdrawals, stream piracy, impermeable surfaces, loss of wetlands and wetland function, and deforestation. Protect intact hydrologic processes where they exist.	1/3	-	-	-	-	-	-
Twin Rivers	Sediment Processes	Medium	Twin Rivers Recovery Goal 5	Maintain and restore sediment processes (production, routing, storage, and grain size frequency distribution) in the Twin Rivers to the extent that sediment processes do not limit VSP parameters.	Twin Rivers Recovery Strategy 9	Eliminate road/culvert and other landuse related mass wasting events that deliver to streams.	3	Twin Rivers Recovery Strategy 10	Reduce surface runoff from existing road network to levels that meet or exceed existing Washington State Water Quality Standards.	3	-	-	-
Twin Rivers	Riparian and Floodplain Processes and Conditions	Medium	Twin Rivers Recovery Goal 6	Restore riparian and floodplain processes and conditions so that they are at levels necessary to attain VSP goals.	Twin Rivers Recovery Strategy 11	Hydrologically reconnect streams to their floodplains for the purposes of floodplain storage and reconnection of off-channel habitat.	3	Twin Rivers Recovery Strategy 12	Protect, maintain, and or restore riparian habitat conditions by implementing riparian acquisitions, conservation easements, and riparian and in-stream restoration projects.	1/3/4	Twin Rivers Recovery Strategy 13	Ensure that current and future regulatory mechanisms are in place to protect and provide sufficient riparian and floodplain conditions to maintain all necessary ecological function.	1/3
Twin Rivers	Habitat and LWD Conditions	Medium	Twin Rivers Recovery Goal 7	Maintain and improve existing habitat conditions to levels necessary to attain VSP goals.	Twin Rivers Recovery Strategy 14	Continue the Intensively Monitored Watershed program including implementation of present project proposals. Identify and prioritize the West Twin for large woody debris introduction and riparian forest planting upon completion of or consistent with IMW.	1/3/4	-	-	-	-	-	-
Twin Rivers	Water Quality Conditions	Unknown	Twin Rivers Recovery Goal 8	Protect and/or restore water quality conditions so that water quality conditions do not limit VSP parameters.	Twin Rivers Recovery Strategy 15	Develop water quality monitoring program for the Twin Rivers watershed.	1	Twin Rivers Recovery Strategy 16	Protect and restore water quality through the implementation of riparian/floodplain recovery strategies and actions that protect and restore riparian and floodplain habitat.	1/3/4	-	-	-

Watershed	Primary Watershed Process Addressed	Process Impairment Rating	Recovery Goal ID	Recovery Goal Narrative	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier
Deep Creek	Estuary and Nearshore Processes and Habitat Conditions	Functional	Deep Creek Recovery Goal 1	Protect estuary and nearshore processes and habitat conditions so that future limiting factors do not develop.	Deep Creek Recovery Strategy 1	Protect estuarine processes and habitat conditions from degradation by employing environmental regulations and management plans. Where regulations are insufficient to protect estuarine processes and habitat conditions implement conservation easements or acquisitions with willing landowners.	1	Deep Creek Recovery Strategy 2	For properties that provide particularly important estuarine processes and nearshore habitat, implement conservation easements or acquisitions with willing landowners.	1	-	-	-
Deep Creek	Habitat Connectivity	Low	Deep Creek Recovery Goal 2	Restore and protect habitat connectivity so that habitat connectivity does not limit VSP parameters.	Deep Creek Recovery Strategy 3	Maintain and protect habitat connectivity where habitat connectivity is intact through the effective implementation of regulations.	1	Deep Creek Recovery Strategy 4	Restore habitat connectivity where habitat is currently disconnected.	2	-	-	-
Deep Creek	Biological Processes	Medium	Deep Creek Recovery Goal 3	Maintain, protect, and/or restore salmonid population abundance, spatial distribution, productivity, and diversity.	Deep Creek Recovery Strategy 5	Minimize or eliminate risks associated with hatchery origin salmonids to ensure that the genetic diversity of Deep Creek salmonids is maintained.	1/3	Deep Creek Recovery Strategy 6	Evaluate in and out of basin fishing-related mortalities and influence fisheries regulations so that spawning escapement is sufficient to ensure VSP, as well as deliver adequate levels of marine nutrients from decaying salmon carcasses.	1/3	-	-	-
Deep Creek	Hydrologic Processes	Medium	Deep Creek Recovery Goal 4	Restore hydrologic processes and natural hydrologic variability to the extent that hydrologic impacts no longer limit the Deep Creek VSP parameters.	Deep Creek Recovery Strategy 7	Restore hydrologic processes by addressing issues related to water withdrawals, stream piracy, impermeable surfaces, loss of wetlands and wetland function, and deforestation. Protect intact hydrologic processes where they exist.	1/3	-	-	-	-	-	-
Deep Creek	Sediment Processes	Medium	Deep Creek Recovery Goal 5	Maintain and restore sediment processes (production, routing, storage, and grain size frequency distribution) in Deep Creek to the extent that sediment processes do not limit VSP parameters.	Deep Creek Recovery Strategy 8	Eliminate road/culvert and other landuse related mass wasting events that deliver to streams.	3	Deep Creek Recovery Strategy 9	Reduce surface runoff from existing road network to levels that meet or exceed existing Washington State Water Quality Standards.	3	Deep Creek Recovery Strategy 10	Restore natural wood loading volume and density to the Deep Creek watershed to restore habitat forming processes and improve in-stream sediment routing.	4
Deep Creek	Riparian and Floodplain Processes and Conditions	Medium	Deep Creek Recovery Goal 6	Restore riparian and floodplain processes and conditions so that they are at levels necessary to attain VSP goals.	Deep Creek Recovery Strategy 11	Hydrologically reconnect streams to their floodplains for the purposes of floodplain storage and reconnection of off-channel habitat.	3	Deep Creek Recovery Strategy 12	Protect, maintain, and or restore riparian habitat conditions by implementing riparian acquisitions, conservation easements, and riparian and in-stream restoration projects.	1/3/4	Deep Creek Recovery Strategy 13	Ensure that current and future regulatory mechanisms are in place to protect and provide sufficient riparian and floodplain conditions to maintain all necessary ecological function.	1/3

Watershed	Primary Watershed Process Addressed	Process Impairment Rating	Recovery Goal ID	Recovery Goal Narrative	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier
Deep Creek	Habitat and LWD Conditions	Medium	Deep Creek Recovery Goal 7	Maintain and improve existing habitat conditions to levels necessary to attain VSP goals.	Deep Creek Recovery Strategy 14	Continue the Intensively Monitored Watershed program including implementation of present project proposals. Identify and prioritize the West Twin for large woody debris introduction and riparian forest planting upon completion of or consistent with IMW.	1/3/4	-	-	-	-	-	-
Deep Creek	Water Quality Conditions	Medium	Deep Creek Recovery Goal 8	Protect and/or restore water quality conditions so that water quality impacts do not limit VSP parameters.	Deep Creek Recovery Strategy 15	Develop water quality monitoring program for the Deep Creek watershed.	1	Deep Creek Recovery Strategy 16	Protect and restore water quality through the implementation of riparian/floodplain recovery strategies and actions that protect and restore riparian and floodplain habitat.	1/3/4	-	-	-
Pysht River	Estuary and Nearshore Processes and Habitat Conditions	High	Pysht River Recovery Goal 1	Protect and restore estuary and nearshore processes and habitat conditions so that current limiting factors are no longer limiting and future limiting factors do not develop.	Pysht River Recovery Strategy 1	Protect estuarine processes and habitat conditions from degradation by employing environmental regulations and management plans. Where regulations are insufficient to protect estuarine processes and habitat conditions implement conservation easements or acquisitions with willing landowners.	1	Pysht River Recovery Strategy 2	Restore degraded estuarine habitat conditions where they exist. Reconnect tidal and fish passage processes where possible.	2-4	Pysht River Recovery Strategy 3	For properties that provide particularly important estuarine processes and nearshore habitat, implement conservation easements or acquisitions with willing landowners.	1
Pysht River	Habitat Connectivity	High	Pysht River Recovery Goal 2	Restore and protect habitat connectivity so that habitat connectivity does not limit VSP parameters.	Pysht River Recovery Strategy 4	Maintain and protect habitat connectivity where habitat connectivity is intact through the effective implementation of regulations.	1	Pysht River Recovery Strategy 5	Restore habitat connectivity where habitat is currently disconnected.	2	-	-	-
Pysht River	Biological Processes	High	Pysht River Recovery Goal 3	Maintain, protect, and/or restore salmonid population abundance, spatial distribution, productivity, and diversity.	Pysht River Recovery Strategy 6	Minimize or eliminate risks associated with hatchery origin salmonids to ensure that the genetic diversity of Pysht River salmonids is maintained.	1/3	Pysht River Recovery Strategy 7	Evaluate in and out of basin fishing-related mortalities and influence fisheries regulations so that spawning escapement is sufficient to ensure VSP, as well as deliver adequate levels of marine nutrients from decaying salmon carcasses.	1/3	Pysht River Recovery Strategy 8	Supplementation with hatchery origin salmonids.	3-6
Pysht River	Hydrologic Processes	High	Pysht River Recovery Goal 4	Protect, maintain, and/or restore hydrologic processes and natural hydrologic variability in the Pysht River watershed to the extent that hydrologic impacts do not limit VSP parameters.	Pysht River Recovery Strategy 9	Restore hydrologic processes by addressing issues related to water withdrawals, stream piracy, impermeable surfaces, loss of wetlands and wetland function, and deforestation. Protect intact hydrologic processes where they exist.	1/3	Pysht River Recovery Strategy 10	Implement recommendations found in the WRIA 19 Watershed Plan (e.g., establish in-stream flows).	1/3	-	-	-

Watershed	Primary Watershed Process Addressed	Process Impairment Rating	Recovery Goal ID	Recovery Goal Narrative	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier
Pysht River	Sediment Processes	High	Pysht River Recovery Goal 5	Maintain and restore sediment processes (production, routing, storage, and grain size frequency distribution) in the Pysht River to the extent that sediment processes do not limit VSP parameters.	Pysht River Recovery Strategy 11	Eliminate road/culvert and other landuse related mass wasting events that deliver to streams.	3	Pysht River Recovery Strategy 12	Reduce surface runoff from existing road network to levels that meet or exceed existing Washington State Water Quality Standards.	3	Pysht River Recovery Strategy 13	Restore natural wood loading volume and density to the Pysht River watershed to restore habitat forming processes and improve in-stream sediment routing.	4
Pysht River	Riparian and Floodplain Processes and Conditions	High	Pysht River Recovery Goal 6	Restore riparian and floodplain processes and conditions so that they are at levels necessary to attain VSP goals.	Pysht River Recovery Strategy 14	Hydrologically reconnect streams to their floodplains for the purposes of floodplain storage and reconnection of off-channel habitat.	3	Pysht River Recovery Strategy 15	Protect, maintain, and or restore riparian habitat conditions by implementing riparian acquisitions, conservation easements, and riparian and in-stream restoration projects.	1/3/4	Pysht River Recovery Strategy 16	Ensure that current and future regulatory mechanisms are in place to protect and provide sufficient riparian and floodplain conditions to maintain all necessary ecological function.	1/3
Pysht River	Habitat and LWD Conditions	High	Pysht River Recovery Goal 7	Maintain and improve existing habitat conditions to levels necessary to attain VSP goals.	Pysht River Recovery Strategy 17	Where data are lacking assess instream meso-habitat conditions in the Pysht River watershed.	1	Pysht River Recovery Strategy 18	Implement wood supplementation in identified wood deficient zones and/or from future habitat monitoring results.	1/3/4	-	-	-
Pysht River	Water Quality Conditions	High	Pysht River Recovery Goal 8	Protect and/or restore water quality conditions so that water quality impacts do not limit VSP parameters.	Pysht River Recovery Strategy 19	Develop water quality monitoring program for the Pysht River watershed.	1	Pysht River Recovery Strategy 20	Protect and restore water quality through the implementation of riparian/floodplain recovery strategies and actions that protect and restore riparian and floodplain habitat.	1/3/4	-	-	-
Clallam River	Estuary and Nearshore Processes and Habitat Conditions	High	Clallam River Recovery Goal 1	Protect and restore estuary and nearshore processes and habitat conditions so that current limiting factors are no longer limiting and future limiting factors do not develop.	Clallam River Recovery Strategy 1	Protect estuarine processes and habitat conditions from degradation by employing environmental regulations and management plans. Where regulations are insufficient to protect estuarine processes and habitat conditions implement conservation easements or acquisitions with willing landowners.	1	Clallam River Recovery Strategy 2	Restore degraded estuarine habitat conditions where they exist. Reconnect tidal and fish passage processes where possible.	2-4	3	For properties that provide particularly important estuarine processes and nearshore habitat, implement conservation easements or acquisitions with willing landowners.	1
Clallam River	Habitat Connectivity	Medium	Clallam River Recovery Goal 2	Restore habitat connectivity so that habitat connectivity no longer limits VSP parameters.	Clallam River Recovery Strategy 4	Maintain and protect habitat connectivity where habitat connectivity is intact through the effective implementation of regulations.	1	Clallam River Recovery Strategy 5	Restore habitat connectivity where habitat is currently disconnected.	2	Clallam River Recovery Strategy 6	Where restoration of habitat connectivity is currently not possible develop mitigation plan that minimizes the impacts to salmonids.	2-6

Watershed	Primary Watershed Process Addressed	Process Impairment Rating	Recovery Goal ID	Recovery Goal Narrative	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier
Clallam River	Biological Processes	High	Clallam River Recovery Goal 3	Maintain, protect, and/or restore salmonid population abundance, spatial distribution, productivity, and diversity.	Clallam River Recovery Strategy 7	Minimize or eliminate risks associated with hatchery origin salmonids to ensure that the genetic diversity of Clallam River salmonids is maintained.	1/3	Clallam River Recovery Strategy 8	Evaluate in and out of basin fishing-related mortalities and influence fisheries regulations so that spawning escapement is sufficient to ensure VSP, as well as deliver adequate levels of marine nutrients from decaying salmon carcasses.	1/3	-	-	-
Clallam River	Hydrologic Processes	High	Clallam River Recovery Goal 4	Protect, maintain, and/or restore hydrologic processes and natural hydrologic variability in the Clallam River watershed to the extent that hydrologic impacts do not limit VSP parameters.	Clallam River Recovery Strategy 9	Restore hydrologic processes by addressing issues related to water withdrawals, stream piracy, impermeable surfaces, loss of wetlands and wetland function, and deforestation. Protect intact hydrologic processes where they exist.	1/3	Clallam River Recovery Strategy 10	Implement recommendations found in the WRIA 19 Watershed Plan (e.g., establish in-stream flows).	1/3	-	-	-
Clallam River	Sediment Processes	Medium	Clallam River Recovery Goal 5	Maintain and restore sediment processes (production, routing, storage, and grain size frequency distribution) in the Clallam River to the extent that sediment processes do not limit VSP parameters.	Clallam River Recovery Strategy 11	Eliminate road/culvert and other landuse related mass wasting events that deliver to streams.	3	Clallam River Recovery Strategy 12	Reduce surface runoff from existing road network to levels that meet or exceed existing Washington State Water Quality Standards.	3	Clallam River Recovery Strategy 13	Restore natural wood loading volume and density to the Clallam River watershed to restore habitat forming processes and improve in-stream sediment routing.	4
Clallam River	Riparian and Floodplain Processes and Conditions	High	Clallam River Recovery Goal 6	Restore riparian and floodplain processes and conditions so that they are at levels necessary to attain VSP goals.	Clallam River Recovery Strategy 14	Hydrologically reconnect streams to their floodplains for the purposes of floodplain storage and reconnection of off-channel habitat.	3	Clallam River Recovery Strategy 15	Protect, maintain, and or restore riparian habitat conditions by implementing riparian acquisitions, conservation easements, and riparian and in-stream restoration projects.	1/3/4	Clallam River Recovery Strategy 16	Ensure that current and future regulatory mechanisms are in place to protect and provide sufficient riparian and floodplain conditions to maintain all necessary ecological function.	1/3
Clallam River	Habitat and LWD Conditions	Medium	Clallam River Recovery Goal 7	Maintain and improve existing habitat conditions to levels necessary to attain VSP goals.	Clallam River Recovery Strategy 17	Where data are lacking assess instream meso-habitat conditions in the Clallam River watershed.	1	Clallam River Recovery Strategy 18	Implement wood supplementation in identified wood deficient zones and/or from future habitat monitoring results.	1/3/4	-	-	-
Clallam River	Water Quality Conditions	High	Clallam River Recovery Goal 8	Protect and/or restore water quality conditions so that water quality impacts do not limit VSP parameters.	Clallam River Recovery Strategy 19	Develop water quality monitoring program for the Clallam River watershed.	1	Clallam River Recovery Strategy 20	Protect and restore water quality through the implementation of riparian/floodplain recovery strategies and actions that protect and restore riparian and floodplain habitat.	1/3/4	-	-	-
Hoko River	Estuary and Nearshore Processes and Habitat Conditions	High	Hoko River Recovery Goal 1	Protect and restore estuary and nearshore processes and habitat conditions so that current limiting factors are no longer limiting and future limiting factors do not develop.	Hoko River Recovery Strategy 1	Ensure that existing environmental regulations and management plans protect estuarine and nearshore processes.	1	Hoko River Recovery Strategy 2	Protect intact, continuous shoreline that is uninterrupted by man-made armoring.	1	Hoko River Recovery Strategy 3	Remove existing “hard-point” armoring and/or replace with alternative design methods that avoid and minimize environmental impacts to the greatest extent possible.	3

Watershed	Primary Watershed Process Addressed	Process Impairment Rating	Recovery Goal ID	Recovery Goal Narrative	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier
Hoko River	Estuary and Nearshore Processes and Habitat Conditions	High	Hoko River Recovery Goal 1	Protect and restore estuary and nearshore processes and habitat conditions so that current limiting factors are no longer limiting and future limiting factors do not develop.	Hoko River Recovery Strategy 4	Support natural process recovery through wood supplementation.	4	-	-	-	-	-	-
Hoko River	Habitat Connectivity	Medium	Hoko River Recovery Goal 2	Restore and protect habitat connectivity so that habitat connectivity does not limit VSP parameters.	Hoko River Recovery Strategy 5	Maintain and protect habitat connectivity where habitat connectivity is intact through the effective implementation of regulations.	1	Hoko River Recovery Strategy 6	Develop basin-wide inventory of existing water-crossings and incorporate current condition assessment. Restore habitat connectivity where habitat is currently disconnected.	1/2	-	-	-
Hoko River	Biological Processes	High	Hoko River Recovery Goal 3	Maintain, protect, and/or restore salmonid population abundance, productivity, and diversity to conditions needed to achieve VSP.	Hoko River Recovery Strategy 7	Maintain genetic diversity within natural origin Hoko populations.	1/3	Hoko River Recovery Strategy 8	Evaluate in and out of basin fishing-related mortalities and influence fisheries regulations so that spawning escapement is sufficient to ensure VSP, as well as deliver adequate levels of marine nutrients from decaying salmon carcasses.	1/3	Hoko River Recovery Strategy 9	Improve spatial distribution and retention of salmon carcasses in the Hoko River drainage to maintain critical marine-derived nutrient cycles.	3-6
Hoko River	Hydrologic Processes	High	Hoko River Recovery Goal 4	Restore natural flow regime (magnitude, frequency, duration, timing, and rate-of-change) to conditions that maintain self-sustaining ecological processes and patterns.	Hoko River Recovery Strategy 10	Restore hydrologic processes by addressing issues related to water withdrawals, stream piracy, impermeable surfaces, loss of wetlands and wetland function, and deforestation. Protect intact hydrologic processes where they exist.	1/3	Hoko River Recovery Strategy 11	Maintain existing USGS Hoko River gaging station.	1	Hoko River Recovery Strategy 12	Evaluate existing road network and determine appropriate road density necessary to achieve Hoko River Recovery Goal 4.	1
Hoko River	Sediment Processes	Medium	Hoko River Recovery Goal 5	Minimize sediment inputs to the Hoko River drainage to those that occur naturally through space and time. Restore and protect natural in-stream sediment transport processes. Where sediment levels are impaired reduce fine sediment (< 0.85mm) volume within the hyporheic zone to improve survival to emergence (STE).	Hoko River Recovery Strategy 13	Eliminate road/culvert related mass wasting events to fish-bearing water.	3	Hoko River Recovery Strategy 14	Reduce surface runoff from existing road network to levels that meet or exceed existing Washington State Water Quality Standards.	3	Hoko River Recovery Strategy 15	Restore natural wood loading volume and density to the Hoko watershed to restore habitat forming processes and improve in-stream sediment routing.	4

Watershed	Primary Watershed Process Addressed	Process Impairment Rating	Recovery Goal ID	Recovery Goal Narrative	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier
Hoko River	Riparian and Floodplain Processes and Conditions	High	Hoko River Recovery Goal 6	Protect existing intact and high functioning riparian and floodplain processes and conditions to ensure "no net loss". Restore degraded riparian and floodplain processes and conditions so that they are at levels necessary to attain VSP goals .	Hoko River Recovery Strategy 16	Ensure that current and future regulatory mechanisms are in place to protect and provide sufficient riparian and floodplain conditions to maintain all necessary ecological function.	1/3	Hoko River Recovery Strategy 17	Protect, maintain, and or restore riparian habitat conditions by implementing riparian acquisitions, conservation easements, and riparian and/or restoration projects.	1/3/4	Hoko River Recovery Strategy 18	Reduce riparian and floodplain road network that causes compaction and disconnection of subsurface flow pathways.	3
Hoko River	Habitat and LWD Conditions	High	Hoko River Recovery Goal 7	Maintain and improve existing habitat to the conditions necessary to attain VSP goals.	Hoko River Recovery Strategy 19	Assess instream meso-habitat in the Hoko watershed.	1	Hoko River Recovery Strategy 20	Based on LWD volume and density develop a strategic implementation plan to achieve conditions that support VSP goals. Implement wood supplementation in high priority, wood deficient zones.	1/3/4	-	-	-
Hoko River	Water Quality Conditions	High	Hoko River Recovery Goal 8	Establish water quality conditions that do not inhibit or prolong recovery to VSP goals.	Hoko River Recovery Strategy 21	Develop water quality monitoring program for the Hoko watershed.	1	-	-	-	-	-	-
Sekiu River	Estuary and Nearshore Processes and Habitat Conditions	Medium	Sekiu River Recovery Goal 1	Protect and restore estuary and nearshore processes and habitat conditions so that current limiting factors are no longer limiting and future limiting factors do not develop.	Sekiu River Recovery Strategy 1	Ensure that existing environmental regulations and management plans protect estuarine and nearshore processes.	1	Sekiu River Recovery Strategy 2	Protect intact, continuous shoreline that is uninterrupted by man-made armoring.	1	Sekiu River Recovery Strategy 3	Remove existing "hard-point" armoring and/or replace with alternative design methods that avoid and minimize environmental impacts to the greatest extent possible.	3
Sekiu River	Habitat Connectivity	Medium	Sekiu River Recovery Goal 2	Restore and protect habitat connectivity so that habitat connectivity does not limit VSP parameters.	Sekiu River Recovery Strategy 4	Maintain and protect habitat connectivity where habitat connectivity is intact through the effective implementation of regulations.	1	Sekiu River Recovery Strategy 5	Develop basin-wide inventory of existing water-crossings and incorporate current condition assessment. Restore habitat connectivity where habitat is currently disconnected.	1/2	-	-	-
Sekiu River	Biological Processes	High	Sekiu River Recovery Goal 3	Maintain, protect, and/or restore salmonid population abundance, productivity, and diversity to conditions needed to achieve VSP.	Sekiu River Recovery Strategy 6	Maintain genetic diversity within natural origin Sekiu populations.	1/3	Sekiu River Recovery Strategy 7	Supplementation with hatchery origin salmonids.	3-6	Sekiu River Recovery Strategy 8	Evaluate in and out of basin fishing-related mortalities and influence fisheries regulations so that spawning escapement is sufficient to ensure VSP, as well as deliver adequate levels of marine nutrients from decaying salmon carcasses.	1/3
Sekiu River	Biological Processes	High	Sekiu River Recovery Goal 3	Maintain, protect, and/or restore salmonid population abundance, productivity, and diversity to conditions needed to achieve VSP.	Sekiu River Recovery Strategy 9	Improve spatial distribution and retention of salmon carcasses in the Sekiu River drainage to maintain critical marine-derived nutrient cycles.	3-6	-	-	-	-	-	-

Watershed	Primary Watershed Process Addressed	Process Impairment Rating	Recovery Goal ID	Recovery Goal Narrative	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier
Sekiu River	Hydrologic Processes	Unknown	Sekiu River Recovery Goal 4	Restore natural flow regime (magnitude, frequency, duration, timing, and rate-of-change) to conditions that maintain self-sustaining ecological processes and patterns.	Sekiu River Recovery Strategy 10	Restore hydrologic processes by addressing issues related to water withdrawals, stream piracy, impermeable surfaces, loss of wetlands and wetland function, and deforestation. Protect intact hydrologic processes where they exist.	1/3	Sekiu River Recovery Strategy 11	Maintain existing Washington Department of Ecology Sekiu River stream gaging station.	1	Sekiu River Recovery Strategy 12	Evaluate existing road network and determine appropriate road density necessary to achieve Sekiu Recovery Goal 4.	1
Sekiu River	Sediment Processes	Medium	Sekiu River Recovery Goal 5	Minimize sediment inputs to the Sekiu River drainage to those that occur naturally through space and time. Restore and protect natural in-stream sediment transport processes. Where sediment levels are impaired reduce fine sediment (< 0.85mm) volume within the hyporheic zone to improve survival to emergence (STE).	Sekiu River Recovery Strategy 13	Eliminate road/culvert related mass wasting events to fish-bearing water.	3	Sekiu River Recovery Strategy 14	Reduce surface runoff from existing road network to levels that meet or exceed existing Washington State Water Quality Standards.	3	Sekiu River Recovery Strategy 15	Restore natural wood loading volume and density to the Sekiu watershed to restore habitat forming processes and improve in-stream sediment routing.	3/4
Sekiu River	Riparian and Floodplain Processes and Conditions	High	Sekiu River Recovery Goal 6	Protect existing intact and high functioning riparian and floodplain processes and conditions to ensure "no net loss". Restore degraded riparian and floodplain processes and conditions so that they are at levels necessary to attain VSP goals.	Sekiu River Recovery Strategy 16	Ensure that current and future regulatory mechanisms are in place to protect and provide sufficient riparian zones that maintain all necessary ecological function.	1/3	Sekiu River Recovery Strategy 17	Protect, maintain, and or restore riparian habitat conditions by implementing riparian acquisitions, conservation easements, and riparian and/or restoration projects.	1/3/4	Sekiu River Recovery Strategy 18	Reduce riparian and floodplain road network that causes compaction and disconnection of subsurface flow pathways.	3
Sekiu River	Habitat and LWD Conditions	High	Sekiu River Recovery Goal 7	Maintain and improve existing habitat to the conditions necessary to attain VSP goals.	Sekiu River Recovery Strategy 19	Assess instream meso-habitat in the Sekiu watershed.	1	Sekiu River Recovery Strategy 10	Based on LWD volume and density develop a strategic implementation plan to achieve conditions that support VSP goals. Implement wood supplementation in high priority, wood deficient zones.	1/3/4	-	-	-
Sekiu River	Water Quality Conditions	Unknown	Sekiu River Recovery Goal 8	Establish water quality conditions that do not inhibit or prolong recovery to VSP goals.	Sekiu River Recovery Strategy 21	Develop water quality monitoring program for the Sekiu watershed.	1	-	-	-	-	-	-

Watershed	Primary Watershed Process Addressed	Process Impairment Rating	Recovery Goal ID	Recovery Goal Narrative	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier
WSI	Estuary and Nearshore Processes and Habitat Conditions	Low	WSI Recovery Goal 1	Protect and restore estuary and nearshore processes and habitat conditions so that current limiting factors are no longer limiting and future limiting factors do not develop.	WSI Recovery Strategy 1	Protect estuarine processes and habitat conditions from degradation by employing environmental regulations and management plans. Where regulations are insufficient to protect estuarine processes and habitat conditions implement conservation easements or acquisitions with willing landowners.	1	WSI Recovery Strategy 2	Restore degraded estuarine habitat conditions where they exist. Reconnect tidal and fish passage processes where possible.	2-4	3	For properties that provide particularly important estuarine processes and nearshore habitat, implement conservation easements or acquisitions with willing landowners.	1
WSI	Habitat Connectivity	Medium	WSI Recovery Goal 2	Restore and protect habitat connectivity so that habitat connectivity does not limit VSP parameters.	WSI Recovery Strategy 4	Maintain and protect habitat connectivity where habitat connectivity is intact through the effective implementation of regulations.	1	WSI Recovery Strategy 5	Restore habitat connectivity where habitat is currently disconnected.	2	-	-	-
WSI	Biological Processes	High	WSI Recovery Goal 3	Maintain, protect, and/or restore salmonid population abundance, spatial distribution, productivity, and diversity.	WSI Recovery Strategy 6	Minimize or eliminate risks associated with hatchery origin salmonids to ensure that the genetic diversity of WSI salmonids is maintained.	1/3	WSI Recovery Strategy 7	Evaluate in and out of basin fishing-related mortalities and influence fisheries regulations so that spawning escapement is sufficient to ensure VSP, as well as deliver adequate levels of marine nutrients from decaying salmon carcasses.	1/3	-	-	-
WSI	Hydrologic Processes	Unknown	WSI Recovery Goal 4	Restore and protect hydrologic processes and natural hydrologic variability to the extent that hydrologic impacts do not limit the WSI VSP parameters.	WSI Recovery Strategy 8	Restore hydrologic processes by addressing issues related to water withdrawals, stream piracy, impermeable surfaces, loss of wetlands and wetland function, and deforestation. Protect intact hydrologic processes where they exist.	1/3	-	-	-	-	-	-
WSI	Sediment Processes	Unknown	WSI Recovery Goal 5	Maintain and restore sediment processes (production, routing, storage, and grain size frequency distribution) in WSI to the extent that sediment processes do not limit VSP parameters.	WSI Recovery Strategy 9	Eliminate road/culvert and other landuse related mass wasting events that deliver to streams.	3	WSI Recovery Strategy 10	Reduce surface runoff from existing road network to levels that meet or exceed existing Washington State Water Quality Standards.	3	WSI Recovery Strategy 11	Restore natural wood loading volume and density to the WSI watershed to restore habitat forming processes and improve in-stream sediment routing.	4
WSI	Riparian and Floodplain Processes and Conditions	Medium	WSI Recovery Goal 6	Restore riparian and floodplain processes and conditions so that they are at levels necessary to attain VSP goals.	WSI Recovery Strategy 12	Hydrologically reconnect streams to their floodplains for the purposes of floodplain storage and reconnection of off-channel habitat.	3	WSI Recovery Strategy 13	Protect, maintain, and or restore riparian habitat conditions by implementing riparian acquisitions, conservation easements, and riparian and in-stream restoration projects.	1/3/4	WSI Recovery Strategy 14	Ensure that current and future regulatory mechanisms are in place to protect and provide sufficient riparian and floodplain conditions to maintain all necessary ecological function.	1/3

Watershed	Primary Watershed Process Addressed	Process Impairment Rating	Recovery Goal ID	Recovery Goal Narrative	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier	Recovery Strategy ID	Recovery Strategy Narrative	Recovery Strategy Tier
WSI	Habitat and LWD Conditions	Medium	WSI Recovery Goal 7	Maintain and improve existing habitat conditions to levels necessary to attain VSP goals.	WSI Recovery Strategy 15	Where data are lacking assess instream meso-habitat conditions in the WSI watershed.	1	WSI Recovery Strategy 16	Based on LWD volume and density develop a strategic implementation plan to achieve conditions that support VSP goals. Implement wood supplementation in high priority, wood deficient zones.	1/3/4	-	-	-
WSI	Water Quality Conditions	Unknown	WSI Recovery Goal 8	Protect and/or restore water quality conditions so that water quality impacts do not limit VSP parameters.	WSI Recovery Strategy 17	Develop water quality monitoring program for the WSI watershed.	1	WSI Recovery Strategy 18	Protect and restore water quality through the implementation of riparian/floodplain recovery strategies and actions that protect and restore riparian and floodplain habitat.	1/3/4	-	-	-

APPENDIX F: Subbasin restoration actions

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Salt Creek	SCA#1	HRA	The Salt Creek estuary and salt marsh is partially disconnected from the mainstem of Salt Creek by a 1,000 foot long, 10 foot high road which was installed in the early 1920's (Shaffer et al. 2006). WDFW and the landowner of the road are working together to restore the function of the Salt Creek estuary with the specific collective goals of: 1) Improving fish access; 2) Decreasing mosquito populations, and; 3) Possibly provide additional water storage during high flows, while maintaining the current level of access (Shaffer et al. 2006). Based upon these goals WDFW and the land owner have proposed at a minimum, replacing the two failed box culverts with a minimum of 6 foot diameter round concrete culverts (Shaffer et al. 2006).	Estuary and Nearshore Processes and Habitat Conditions	High	Salt Creek Recovery Strategy 2	2/3	Salt Creek Recovery Goal 1	WDFW		
Salt Creek	SCA#2	HRA	Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.	Estuary and Nearshore Processes and Habitat Conditions	High	Salt Creek Recovery Strategy 3	1	Salt Creek Recovery Goal 1	Not Defined		
Salt Creek	SCA#3a	HRA	Install fish passable culvert on Hart Creek (Camp Hayden Road). A fish passable culvert will provide access to approximately 0.1 miles of low gradient (<4%) fish habitat.	Habitat Connectivity	Medium	Salt Creek Recovery Strategy 5	2	Salt Creek Recovery Goal 2	Clallam County		
Salt Creek	SCA#3b	HRA	Implement comprehensive fish passage program directed at Kreaman Creek and tributaries. Currently 5 culverts partially or totally block access to 0.37, 1.08, 0.38, 0.50, and 0.40 miles of <1%, 1-2%, 2-4%, 4-8%, and 8-20% gradient habitat respectively.	Habitat Connectivity	Medium	Salt Creek Recovery Strategy 5	2	Salt Creek Recovery Goal 2	Not Defined		
Salt Creek	SCA#3c	HRA	The Nordstrom Creek SR 112 culvert is a partial fish barrier, replacing this structure with a fully passable stream crossing structure will enhance fish passage to 0.78, 1.27, 0.81, and 0.48 miles of 1-2%, 2-4%, 4-8% and 8-20% gradient habitat respectively.	Habitat Connectivity	Medium	Salt Creek Recovery Strategy 5	2	Salt Creek Recovery Goal 2	WDOT		
Salt Creek	SCA#3d	HRA	The Falls Creek (tributary to Nordstrom Creek) SR 112 culvert is a partial barrier. Replacement of this stream crossing will provide passage to 1.15, 0.45, and 0.49 miles of 1-2%, 2-4%, and 4-8% gradient habitat respectively	Habitat Connectivity	Medium	Salt Creek Recovery Strategy 5	2	Salt Creek Recovery Goal 2	WDOT		
Salt Creek	SCA#3e	HRA	Conduct fish passage culvert inventory in upper Nordstrom, Wasankari, and Lijendahl creeks. Prioritize and replace fish barriers within this portion of the watershed.	Habitat Connectivity	Medium	Salt Creek Recovery Strategy 5	1/2	Salt Creek Recovery Goal 2	Various		
Salt Creek	SCA#4	RM&E and HRA	Assess series of constructed private ponds throughout the watershed for fish passage issues affecting habitat connectivity. Prioritize streams/ponds for fish passage improvements and implement fish passage restoration program.	Habitat Connectivity	Medium	Salt Creek Recovery Strategy 5	2	Salt Creek Recovery Goal 2	Not Defined		
Salt Creek	SCA#5	PA	Advocate for the enforcement of existing regulations that protect and provide for fish passage.	Habitat Connectivity	Medium	Salt Creek Recovery Strategy 4	1	Salt Creek Recovery Goal 2	Various		
Salt Creek	SCA#6	PA	Advocate for implementation of the Hatchery Scientific Review Group (HSRG) recommendations set for forth in the 2004 Hatchery Reform Report (HSRG 2004), which recommend no hatchery fish outplanting into the Salt Creek watershed.	Biological Processes	Medium	Salt Creek Recovery Strategy 6	1	Salt Creek Recovery Goal 3	WDFW and Tribes		
Salt Creek	SCA#7	PA	Advocate for the adoption of harvest management regulations that ensure salmonid spawning escapement is sufficient to maintain, protect, and/or restore VSP parameters.	Biological Processes	Medium	Salt Creek Recovery Strategy 7	1	Salt Creek Recovery Goal 3	WDFW and Tribes		
Salt Creek	SCA#8	RM&E and PA	Implement and/or continue to implement population abundance monitoring.	Biological Processes	Medium	Salt Creek Recovery Strategy 7	1	Salt Creek Recovery Goal 3	WDFW and Tribes		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Salt Creek	SCA#9	HRA and PA	Reintroduction and management of beaver (*Castor canadensis)* in portions of the Salt Creek watershed could help restore wetland functions. Potential areas for consideration should include low gradient streams without significant human infrastructure (e.g., the mainstem below river mile 5.0, Kreaman Creek, Oien Creek, unnamed tributaries 19.0009 and 19.0010).	Hydrologic Processes	Medium	Salt Creek Recovery Strategy 8	3	Salt Creek Recovery Goal 4	Not Defined		
Salt Creek	SCA#10	HRA	Reforestation of unutilized pastures and other open areas could help improve hydrologic processes.	Hydrologic Processes	Medium	Salt Creek Recovery Strategy 8	3	Salt Creek Recovery Goal 4	Various		
Salt Creek	SCA#11	HRA	Reduce road related hydrologic impacts by reducing road densities and/or disconnecting road systems from the stream network.	Hydrologic Processes	Medium	Salt Creek Recovery Strategy 8	3	Salt Creek Recovery Goal 4	Various		
Salt Creek	SCA#12	PA	Limit future water withdrawals from the Salt Creek watershed through the implementation of the WRIA 19 Watershed Plan (WRIA 19 Planning Unit 2010).	Hydrologic Processes	Medium	Salt Creek Recovery Strategy 8	1	Salt Creek Recovery Goal 4	DOE		
Salt Creek	SCA#13	HRA	Inventory roads for maintenance (use existing RMAP and other available data), side cast removal, and drainage structure improvements. Prioritize for project actions.	Sediment Processes	Low	Salt Creek Recovery Strategy 9 & 10	3	Salt Creek Recovery Goal 5	Various		
Salt Creek	SCA#14	HRA	Reforest riparian and floodplain areas to increase stream bank integrity and reduce bank erosion (see also Section 7.1.1.6).	Sediment Processes	Low	Salt Creek Recovery Strategy 11	3	Salt Creek Recovery Goal 5	Various		
Salt Creek	SCA#15	HRA	Treatment of channel incision in the mainstem of Salt Creek from RM 0.5 to 6.0 (note RM 2.5 to 3.5 were treated with LWD placement in 2006.	Riparian and Floodplain Processes and Conditions	High	Salt Creek Recovery Strategy 12	3/4	Salt Creek Recovery Goal 6	Elwha Tribe, private landowners		
Salt Creek	SCA#16	HRA	Develop and implement a treatment plan for channel incision from RM 0 to RM 1.0 in Nordstrom Creek.	Riparian and Floodplain Processes and Conditions	High	Salt Creek Recovery Strategy 12	3/4	Salt Creek Recovery Goal 6	Elwha Tribe, private landowners		
Salt Creek	SCA#17	HRA	Develop and implement restoration treatment that includes the abandonment of the Camp Hayden spur road, LWD placement, and riparian planting. This will help restore channel migration processes and reconnect portions of the floodplain with the mainstem.	Riparian and Floodplain Processes and Conditions	High	Salt Creek Recovery Strategy 12	3/4	Salt Creek Recovery Goal 6	Elwha Tribe, private landowners		
Salt Creek	SCA#18	RM&E and HRA	Evaluate the Thompson Road Bridge across mainstem Salt Creek for impacts to flood flow and floodplain	Riparian and Floodplain Processes and Conditions	High	Salt Creek Recovery Strategy 12	1/3	Salt Creek Recovery Goal 6	Not Defined		
Salt Creek	SCA#19	HRA	Replace undersized Oien Road Bridge across mainstem Salt Creek	Riparian and Floodplain Processes and Conditions	High	Salt Creek Recovery Strategy 12	3	Salt Creek Recovery Goal 6	Not Defined		
Salt Creek	SCA#20	HRA	Implement riparian restoration projects within the 54 degraded riparian stream segments identified by McHenry et al. (2004). A total of 18.2 linear miles of riparian habitat could benefit from riparian restoration treatments. In addition, they identified 4.3 miles of stream adjacent roads within these 54 riparian segments that are affecting riparian conditions. For detailed riparian segment level data please refer to Table 20 in McHenry et al. (2004).	Riparian and Floodplain Processes and Conditions	High	Salt Creek Recovery Strategy 13	3	Salt Creek Recovery Goal 6	Various		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Salt Creek	SCA#21	HRA	Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.	Riparian and Floodplain Processes and Conditions	High	Salt Creek Recovery Strategy 13	1	Salt Creek Recovery Goal 6	Not Defined		
Salt Creek	SCA#22	RM&E and PA	Map and delineate channel migration zones within the Salt Creek watershed.	Riparian and Floodplain Processes and Conditions	High	Salt Creek Recovery Strategy 13	1	Salt Creek Recovery Goal 6	Clallam County and others		
Salt Creek	SCA#23	PA	Advocate for and support a WRIA 19 representative of the North Olympic Peninsula Lead Entity (NOPLE) to participate in the Forest and Fish policy group. Individual would provide a conduit for information between the forest practices AM program and the salmon recovery efforts of NOPLE.	Riparian and Floodplain Processes and Conditions	High	Salt Creek Recovery Strategy 14	na	Salt Creek Recovery Goal 6	NOPLE		
Salt Creek	SCA#24	HRA	Work with landowners to develop comprehensive stream restoration and habitat access program for Barr Creek (Falls Creek tributary)	Habitat and LWD Conditions	Medium	Salt Creek Recovery Strategies 5, 13, 15, 16	1-4	Salt Creek Recovery Goal 7	Not Defined		
Salt Creek	SCA#25	HRA	Work with landowner(s) to develop comprehensive stream restoration program on lower Salt, Kreaman, and Hart creeks. The project area is located on lower Salt Creek and includes unconstrained portions of the floodplain channel, as well as lower Kreaman Creek, which enters Salt Creek across its floodplain. An unnamed tributary, Hart Creek drains into Salt Creek after crossing Camp Hayden Road.	Habitat and LWD Conditions	Medium	Salt Creek Recovery Strategies 5, 13, 15, 16	1-4	Salt Creek Recovery Goal 7	Not Defined		
Salt Creek	SCA#26	HRA	Work with landowner to develop comprehensive stream restoration program on Bear Cree. The project area includes approximately 0.5 miles of Bear Creek south of Liljedahl Road.	Habitat and LWD Conditions	Medium	Salt Creek Recovery Strategies 13 and 16	3/4	Salt Creek Recovery Goal 7	Not Defined		
Salt Creek	SCA#27	RM&E	Implement long-term surface water quality monitoring program (e.g., temperature, dissolved oxygen, pH, conductivity, turbidity, BIBI). Also include monitoring of hydrocarbons and other potential contaminants.	Water Quality Conditions	Low	Salt Creek Recovery Strategy 17	1	Salt Creek Recovery Goal 8	Not Defined		
Salt Creek	SCA#28	PA	Advocate for effective implementation and enforcement of Forest Practice Rules and County Critical Areas Ordinances.	Water Quality Conditions	Low	Salt Creek Recovery Strategy 18	na	Salt Creek Recovery Goal 8	Not Defined		
Lyre River	LRA#1	RM&E and HRA	To the west of the mouth of the Lyre River investigate impacts of bulkhead structure to physical habitat forming processes and sediment movement within the drift cell.	Estuary and Nearshore Processes and Habitat Conditions	Medium	Lyre River Recovery Strategy 2	1/3	Lyre River Recovery Goal 1	Not Defined		
Lyre River	LRA#2	HRA	Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.	Estuary and Nearshore Processes and Habitat Conditions	Medium	Lyre River Recovery Strategy 3	1	Lyre River Recovery Goal 1	Not Defined		
Lyre River	LRA#3a	HRA	Work with Clallam County PUD, WDOT, WDNR, and private landowners to assess, prioritize, and correct potential fish barriers in the Nelson Creek subbasin.	Habitat Connectivity	Low	Lyre River Recovery Strategy 5	2	Lyre River Recovery Goal 2	Various		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Lyre River	LRA#3b	HRA	The mainstem of Susie Creek is free of fish barriers, however, the status of barriers in tributaries to Susie Creek is undocumented. Work with WDNR and private landowners to assess, prioritize, and correct potential fish barriers in tributaries to the Susie Creek subbasin.	Habitat Connectivity	Low	Lyre River Recovery Strategy 5	1/2	Lyre River Recovery Goal 2	Various		
Lyre River	LRA#4	PA	Advocate for implementation of the Hatchery Scientific Review Group (HSRG) recommendations set for forth in the 2004 Hatchery Reform Report (HSRG 2004), which recommend the discontinuation of hatchery outplanting in the Lyre River watershed.	Biological Processes	Medium	Lyre River Recovery Strategy 6	1	Lyre River Recovery Goal 3	WDFW and Tribes		
Lyre River	LRA#5	PA	Advocate for the adoption of harvest management regulations that ensure salmonid spawning escapement is sufficient to maintain, protect, and/or restore VSP parameters.	Biological Processes	Medium	Lyre River Recovery Strategy 7	1	Lyre River Recovery Goal 3	WDFW and Tribes		
Lyre River	LRA#6	RM&E and PA	Implement and/or continue to implement population abundance monitoring.	Biological Processes	Medium	Lyre River Recovery Strategy 7	1	Lyre River Recovery Goal 3	WDFW and Tribes		
Lyre River	LRA#7	HRA	Reforestation of riparian forest and wetlands associated with floodplains to improve hydrologic processes related to flood capacity within the flood plain areas.	Hydrologic Processes	Low	Lyre River Recovery Strategy 8	3	Lyre River Recovery Goal 4	Not Defined		
Lyre River	LRA#8	HRA	Reduce road related hydrologic impacts by reducing road densities and/or disconnecting road systems from the stream network.	Hydrologic Processes	Low	Lyre River Recovery Strategy 8	3	Lyre River Recovery Goal 4	Various		
Lyre River	LRA#9	PA	Limit future water withdrawals from the Lyre River watershed through the implementation of the WRIA 19 Watershed Plan (WRIA 19 Planning Unit 2010).	Hydrologic Processes	Low	Lyre River Recovery Strategy 8	1	Lyre River Recovery Goal 4	DOE		
Lyre River	LRA#10	HRA	Inventory roads for maintenance (use existing RMAP and other available data), side cast removal, and drainage structure improvements. Prioritize for project actions.	Sediment Processes	Medium	Lyre River Recovery Strategy 9	3	Lyre River Recovery Goal 5	Various		
Lyre River	LRA#11	HRA	Inventory roads for decommissioning, drainage structure removal and restoration of stream segments within the crossing structure.	Sediment Processes	Medium	Lyre River Recovery Strategy 10	3	Lyre River Recovery Goal 5	Various		
Lyre River	LRA#12	HRA	Reduce road related hydrologic impacts by reducing road densities and/or disconnecting road systems from the stream network.	Riparian and Floodplain Processes and Conditions	Medium	Lyre River Recovery Strategy 11	3	Lyre River Recovery Goal 6	Various		
Lyre River	LRA#13	HRA	Treatment and restoration of the lower 2.0 miles of the mainstem Lyre River including LWD placement, and riparian planting. This will help restore channel migration processes and reconnect portions of the floodplain with the Lyre mainstem.	Riparian and Floodplain Processes and Conditions	Medium	Lyre River Recovery Strategy 12	3/4	Lyre River Recovery Goal 6	Not Defined		
Lyre River	LRA#14	HRA	Based on results of a watershed assessment, implement riparian restoration projects within degraded riparian stream segments. Identify stream adjacent roads within these riparian segments that are affecting riparian conditions.	Riparian and Floodplain Processes and Conditions	Medium	Lyre River Recovery Strategy 11, 12	3	Lyre River Recovery Goal 6	Not Defined		
Lyre River	LRA#15	HRA	Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.	Riparian and Floodplain Processes and Conditions	Medium	Lyre River Recovery Strategy 12	1	Lyre River Recovery Goal 6	Not Defined		
Lyre River	LRA#16	PA	Map and delineate channel migration zones within the Salt Creek watershed.	Riparian and Floodplain Processes and Conditions	Medium	Lyre River Recovery Strategy 12	1	Lyre River Recovery Goal 6	Clallam County and others		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Lyre River	LRA#17	PA	Advocate for and support a WRIA 19 representative of the North Olympic Peninsula Lead Entity (NOPLE) to participate in the Forest and Fish policy group. Individual would provide a conduit for information between the forest practices AM program and the salmon recovery efforts of NOPLE.	Riparian and Floodplain Processes and Conditions	Medium	Lyre River Recovery Strategy 13	na	Lyre River Recovery Goal 6	NOPLE		
Lyre River	LRA#18	RM&E and HRA	Conduct a comprehensive watershed assessment to investigate current habitat conditions and better identify limiting factors affecting salmonids. Upon completion of a Lyre River watershed assessment develop a detailed list of projects to improve instream habitat and LWD conditions in the Lyre river sub basin. Implement a systematic enhancement of habitat by introducing LWD.	Habitat and LWD Conditions	Unknown	Lyre River Recovery Strategy 1, 5, 13, and 14	1/3/4	Lyre River Goal 1, 2, and 7	Not Defined		
Lyre River	LRA#19	RM&E	Implement long-term surface water quality monitoring program (e.g., temperature, dissolved oxygen, pH, conductivity, turbidity, BIBI).	Water Quality Conditions	Unknown	Lyre River Recovery Strategy 15	1	Lyre River Recovery Goal 8	Not Defined		
Lyre River	LRA#20	PA	Develop and implement a compliance monitoring program in the Lyre River to ensure effective implementation and enforcement of Forest Practice Rule and County Critical areas Ordinances.	Water Quality Conditions	Unknown	Lyre River Recovery Strategy 16	na	Lyre River Recovery Goal 8	DNR and Clallam County		
Lyre River	LRA#21	RM&E	Inventory and prioritize sources of water quality impacts including sources of fine sediment and channel reaches with deficient riparian vegetation.	Water Quality Conditions	Unknown	Lyre River Recovery Strategy 9, 10, and 16	1	Lyre River Recovery Goal 8	Not Defined		
Twin Rivers	TRA#1	HRA	To the west of the mouth of the West Twin River remove the sheet pile and mole structure to restore physical habitat forming processes and sediment movement within the drift cell.	Estuary and Nearshore Processes and Habitat Conditions	High	Twin Rivers Recovery Strategy 2	3	Twin Rivers Recovery Goal 1	Not Defined		
Twin Rivers	TRA#2	RM&E	Assess historical estuarine and nearshore habitat that has been affected by SR 112 and the historical alterations that have disrupted floodplain connectivity between the Twin Rivers. Include an investigation into the potential impacts of macro-algae blooms on estuarine-nearshore water quality. Implement the recommendation from this assessment.	Estuary and Nearshore Processes and Habitat Conditions	High	Twin Rivers Recovery Strategy 2	1	Twin Rivers Recovery Goal 1	Not Defined		
Twin Rivers	TRA#3	HRA	Investigate the potential implementation of a conservation easement (or the direct acquisition) for the private property between the mouths of the Twin Rivers.	Estuary and Nearshore Processes and Habitat Conditions	High	Twin Rivers Recovery Strategy 1, 3	1	Twin Rivers Recovery Goal 1	Not Defined		
Twin Rivers	TRA#4	RM&E and HRA	Identify water-crossing and road inventories from basin landowners and combine into single basin-wide inventory. Where water-crossing information is lacking or missing, work with landowners to inventory and assess. Use a basin-wide approach to identify biological, physical, and process-based metrics for prioritizing future habitat connectivity projects.	Habitat Connectivity	Low	Twin Rivers Recovery Strategy 5	1/2	Twin Rivers Recovery Goal 2	Not Defined		
Twin Rivers	TRA#5a	HRA	Culvert on the USFS 3040 Road at RM 0.8 on the East Fork of the East Twin River is currently classified as a complete barrier to fish. Replace (or remove) the culvert with crossing structure that allows for better fish passage.	Habitat Connectivity	Low	Twin Rivers Recovery Strategy 5	2	Twin Rivers Recovery Goal 2	USFS		
Twin Rivers	TRA#5b	HRA	Replace barrier culvert in unnamed tributary 19.0106 with stream crossing structure that allows for better fish passage.	Habitat Connectivity	Low	Twin Rivers Recovery Strategy 5	2	Twin Rivers Recovery Goal 2	Not Defined		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Twin Rivers	TRA#6	PA	Advocate for implementation of the Hatchery Scientific Review Group (HSRG) recommendations set for forth in the 2004 Hatchery Reform Report (HSRG 2004).	Biological Processes	Medium	Twin Rivers Recovery Strategy 6	1	Twin Rivers Recovery Goal 3	WDFW and Tribes		
Twin Rivers	TRA#7	PA	Advocate for the adoption of harvest management regulations that ensure salmonid spawning escapement is sufficient to maintain, protect, and/or restore VSP parameters.	Biological Processes	Medium	Twin Rivers Recovery Strategy 7	1	Twin Rivers Recovery Goal 3	WDFW and Tribes		
Twin Rivers	TRA#8	RM&E and PA	Implement and/or continue to implement population abundance monitoring.	Biological Processes	Medium	Twin Rivers Recovery Strategy 7	1	Twin Rivers Recovery Goal 3	WDFW and Tribes		
Twin Rivers	TRA#9	HRA	Reforestation of riparian forest and reconnection of wetland hydrology associated with floodplains to improve hydrologic processes related to flood capacity within the flood plain areas.	Hydrologic Processes	Medium	Twin Rivers Recovery Strategy 8	3	Twin Rivers Recovery Goal 4	Not Defined		
Twin Rivers	TRA#10	HRA	Reduce road related hydrologic impacts by reducing road densities and/or disconnecting road systems from the stream network.	Hydrologic Processes	Medium	Twin Rivers Recovery Strategy 8	3	Twin Rivers Recovery Goal 4	Not Defined		
Twin Rivers	TRA#11	PA	Limit future water withdrawals from the Twin Rivers watershed through the implementation of the WRIA 19 Watershed Plan (WRIA 19 Planning Unit 2010).	Hydrologic Processes	Medium	Twin Rivers Recovery Strategy 8	1	Twin Rivers Recovery Goal 4	DOE		
Twin Rivers	TRA#12	HRA	Inventory roads for maintenance (use existing RMAP and other available data), side cast removal, and drainage structure improvements. Prioritize for project actions.	Sediment Processes	High	Twin Rivers Recovery Strategy 9, 10	3	Twin Rivers Recovery Goal 5	Various		
Twin Rivers	TRA#13	HRA	Reforest riparian and floodplain areas to increase stream bank integrity and reduce bank erosion.	Sediment Processes	High	Twin Rivers Recovery Strategy 12	3	Twin Rivers Recovery Goal 5	Not Defined		
Twin Rivers	TRA#14	HRA	Reduce road related hydrologic impacts by reducing road densities and/or disconnecting road systems from the stream network.	Riparian and Floodplain Processes and Conditions	Medium	Twin Rivers Recovery Strategy 10, 11	3	Twin Rivers Recovery Goal 4 and 6	Not Defined		
Twin Rivers	TRA#15	HRA	Develop and implement restoration treatment that includes LWD placement and riparian planting/enhancement. This will help restore channel migration processes and reconnect portions of the floodplain with the mainstem.	Riparian and Floodplain Processes and Conditions	Medium	Twin Rivers Recovery Strategy 11, 12	3/4	Twin Rivers Recovery Goal 6 and 7	Elwha Tribe		
Twin Rivers	TRA#16	HRA	Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.	Riparian and Floodplain Processes and Conditions	Medium	Twin Rivers Recovery Strategy 12	1	Twin Rivers Recovery Goal 6	Not Defined		
Twin Rivers	TRA#17	RM&E and PA	Map and delineate channel migration zones within the East and West Twin Rivers watershed.	Riparian and Floodplain Processes and Conditions	Medium	Twin Rivers Recovery Strategy 12	1	Twin Rivers Recovery Goal 6	Clallam County and others		
Twin Rivers	TRA#18	PA	Advocate for and support a WRIA 19 representative of the North Olympic Peninsula Lead Entity (NOPLE) to participate in the Forest and Fish policy group. Individual would provide a conduit for information between the forest practices AM program and the salmon recovery efforts of NOPLE.	Riparian and Floodplain Processes and Conditions	Medium	Twin Rivers Recovery Strategy 13	na	Twin Rivers Recovery Goal 6	NOPLE		
Twin Rivers	TRA#19	RM&E	Implement long-term surface water quality monitoring program (e.g., temperature, dissolved oxygen, pH, conductivity, turbidity, BIBI).	Water Quality Conditions	Unknown	Twin Rivers Recovery Strategy 15	1	Twin Rivers Recovery Goal 8	Not Defined		
Twin Rivers	TRA#20	PA	Advocate for effective implementation and enforcement of Forest Practice Rules and County Critical Areas Ordinances.	Water Quality Conditions	Unknown	Twin Rivers Recovery Strategy 16	na	Twin Rivers Recovery Goal 8	DNR and Clallam County		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Twin Rivers	TRA#21	RM&E	Inventory and prioritize sources of water quality impacts including sources of fine sediment and channel reaches with deficient riparian vegetation.	Water Quality Conditions	Unknown	Twin Rivers Recovery Strategy 9, 10, 16	1	Twin Rivers Recovery Goal 8	Not Defined		
Deep Creek	DCA#1a	HRA	Two separate culverts (SR 112) on an unnamed tributary to Deep Creek block an unquantified amount of potential salmonid habitat. Replace culverts with crossing structures that allow for better fish passage.	Habitat Connectivity	Low	Deep Creek Recovery Strategy 4	2	Deep Creek Recovery Goal 2	WDOT		
Deep Creek	DCA#1b	HRA	Replace the partial barrier culvert (M&R 3100 Road) on an unnamed tributary to the W.F. Deep Creek with stream crossing structure that allows for better fish passage.	Habitat Connectivity	Low	Deep Creek Recovery Strategy 4	2	Deep Creek Recovery Goal 2	?		
Deep Creek	DCA#1c	HRA	Compile existing RMAP data and conduct fish passage culvert inventory for uninventoried portions of the Deep Creek watershed. Prioritize and replace fish barriers within the Deep Creek watershed.	Habitat Connectivity	Low	Deep Creek Recovery Strategy 4	1/2	Deep Creek Recovery Goal 2	?		
Deep Creek	DCA#2	PA	Advocate for implementation of the Hatchery Scientific Review Group (HSRG) recommendations set for forth in the 2004 Hatchery Reform Report (HSRG 2004).	Biological Processes	Medium	Deep Creek Recovery Strategy 5	1	Deep Creek Recovery Goal 3	WDFW and Tribes		
Deep Creek	DCA#3	PA	Advocate for the adoption of harvest management regulations that ensure salmonid spawning escapement is sufficient to maintain, protect, and/or restore VSP parameters.	Biological Processes	Medium	Deep Creek Recovery Strategy 6	1	Deep Creek Recovery Goal 3	WDFW and Tribes		
Deep Creek	DCA#4	RM&E and PA	Implement and/or continue to implement population abundance monitoring.	Biological Processes	Medium	Deep Creek Recovery Strategy 6	1	Deep Creek Recovery Goal 3	WDFW and Tribes		
Deep Creek	DCA#5	HRA	Reforestation of riparian forest and wetlands associated with flood plains to improve hydrologic processes related to flood capacity within the flood plain areas.	Hydrologic Processes	Medium	Deep Creek Recovery Strategy 7	3	Deep Creek Recovery Goal 4	Not Defined		
Deep Creek	DCA#6	HRA	Reduce road related hydrologic impacts by reducing road densities and/or disconnecting road systems from the stream network.	Hydrologic Processes	Medium	Deep Creek Recovery Strategy 7	3	Deep Creek Recovery Goal 4	Not Defined		
Deep Creek	DCA#7	PA	Limit future water withdrawals from the Deep Creek watershed through the implementation of the WRIA 19 Watershed Plan (WRIA 19 Planning Unit 2010).	Hydrologic Processes	Medium	Deep Creek Recovery Strategy 7	1	Deep Creek Recovery Goal 4	DOE		
Deep Creek	DCA#8	HRA	Inventory roads for maintenance (use existing RMAP and other available data), side cast removal, and drainage structure improvements. Prioritize for project actions.	Sediment Processes	Medium	Deep Creek Recovery Strategy 8, 9	3	Deep Creek Recovery Goal 5	Various		
Deep Creek	DCA#9	HRA	Reforest riparian and floodplain areas to increase stream bank integrity and reduce bank erosion.	Sediment Processes	Medium	Deep Creek Recovery Strategy 12	3	Deep Creek Recovery Goal 5	Not Defined		
Deep Creek	DCA#10	HRA	Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.	Riparian and Floodplain Processes and Conditions	Medium	Deep Creek Recovery Strategy 12	1	Deep Creek Recovery Goal 6	Not Defined		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Deep Creek	DCA#11	RM&E and PA	Map and delineate channel migration zones within the Deep Creek watershed.	Riparian and Floodplain Processes and Conditions	Medium	Deep Creek Recovery Strategy 12	1	Twin Rivers Recovery Goal 6	Clallam County and others		
Deep Creek	DCA#12	PA	Advocate for and support a WRIA 19 representative of the North Olympic Peninsula Lead Entity (NOPLE) to participate in the Forest and Fish policy group. Individual would provide a conduit for information between the forest practices AM program and the salmon recovery efforts of NOPLE.	Riparian and Floodplain Processes and Conditions	Medium	Deep Creek Recovery Strategy 13	na	Twin Rivers Recovery Goal 6	NOPLE		
Deep Creek	DCA#13	RM&E	Implement long-term surface water quality monitoring program (e.g., temperature, dissolved oxygen, pH, conductivity, turbidity, BIBI).	Water Quality Conditions	Medium	Deep Creek Recovery Strategy 15	1	Twin Rivers Recovery Goal 8	Not Defined		
Deep Creek	DCA#14	PA	Advocate for effective implementation and enforcement of Forest Practice Rules and County Critical Areas Ordinances.	Water Quality Conditions	Medium	Deep Creek Recovery Strategy 16	na	Twin Rivers Recovery Goal 8	DNR and Clallam County		
Deep Creek	DCA#15	RM&E	Inventory and prioritize sources of water quality impacts including sources of fine sediment and channel reaches with deficient riparian vegetation.	Water Quality Conditions	Medium	Deep Creek Recovery Strategy 8-12	1	Twin Rivers Recovery Goal 8	Not Defined		
Pysht River	PRA#1	HRA	Implement recommendations from estuary restoration feasibility study. Project actions may include dredge spoil removal, restoring tidal connectivity to isolated channels, removal of sheet pile, removal of roads associated with log storage facilities, etc.	Estuary and nearshore processes and habitat conditions	High	Pysht River Recovery Strategy 2	2-4	Pysht River Recovery Goal 1	M&R/Elwha Tribe		
Pysht River	PRA#2	HRA	Reconnect tidal wetlands (specifically within the central portion of the Pysht River meander, these are the wetlands affected by the east side road system).	Estuary and nearshore processes and habitat conditions	High	Pysht River Recovery Strategy 2	2	Pysht River Recovery Goal 1	M&R/Elwha Tribe		
Pysht River	PRA#3a	HRA	Replace Farm Road culvert on Indian Creek with crossing structure that allows for better fish passage, decreases erosion, and restores complete tidal connectivity.	Estuary and nearshore processes and habitat conditions	High	Pysht River Recovery Strategy 2	2	Pysht River Recovery Goal 1	M&R/Elwha Tribe		
Pysht River	PRA#3b	HRA	Replace Farm Road culvert on Indian Slough with crossing structure that allows for better fish passage and complete tidal connectivity.	Estuary and nearshore processes and habitat conditions	High	Pysht River Recovery Strategy 2	2	Pysht River Recovery Goal 1	M&R/Elwha Tribe		
Pysht River	PRA#3c	HRA	Replace Farm Road culvert on Section 9 Creek with crossing structure that allows for better fish passage and complete tidal connectivity.	Estuary and nearshore processes and habitat conditions	High	Pysht River Recovery Strategy 2	2	Pysht River Recovery Goal 1	M&R/Elwha Tribe		
Pysht River	PRA#3d	HRA	Replace Farm Road culvert on Cabin Creek with crossing structure that allows for better fish passage and complete tidal connectivity. This project is currently funded and planned for replacement during the summer of 2010.	Estuary and nearshore processes and habitat conditions	High	Pysht River Recovery Strategy 2	2	Pysht River Recovery Goal 1	M&R/Elwha Tribe		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Pysht River	PRA#4a	HRA	Replace SR-112 culverts on Indian Creek with crossing structure that allows for better fish passage and sediment transport capacity.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	WDOT		
Pysht River	PRA#4b	HRA	Replace the 2000 Road culvert on Ring Creek with crossing structure that allows for better fish passage.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	M&R		
Pysht River	PRA#4c	HRA	Replace the 2000 Road culvert on Shop Creek crossing structure that allows for better fish passage. Evaluate feasibility of removing fill from wetland and/or constructing new channel around fill.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	M&R/Elwha Tribe		
Pysht River	PRA#4d	HRA	Replace the 3000 Road culvert on Cabin Creek with crossing structure that allows for better fish passage.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	M&R/Elwha Tribe		
Pysht River	PRA#4e	HRA	Investigate methods that could be used to improve habitat connectivity and minimize dewatering of the Andis Slough off-channel habitat. Continued monitoring of site is recommended.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	M&R/Elwha Tribe		
Pysht River	PRA#4f	HRA	Replace SR 112 culvert on Razz Creek T1 with crossing structure that allows for better fish passage and sediment transport.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	WDOT		
Pysht River	PRA#4g	HRA	Replace SR 112 culvert on Razz Creek T2 with crossing structure that allows for better fish passage.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	WDOT		
Pysht River	PRA#4h	HRA	Replace unnamed spur road culvert on Razz Creek T4_T3 with crossing structure that allows for better fish passage.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	WDOT		
Pysht River	PRA#4i	HRA	Replace the 4500 Road culvert on the mainstem Razz Creek with crossing structure that allows for better fish passage.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	M&R		
Pysht River	PRA#4j	RM&E and HRA	Monitor and continue to assess habitat connectivity in the 2100 Road Swamp off-channel habitat complex. Implement restoration project that may be developed from assessment.	Habitat connectivity	High	Pysht River Recovery Strategy 5	1-2	Pysht River Recovery Goal 2	Elwha Tribe		
Pysht River	PRA#4k	HRA	Develop and implement a plan to reconnect the 4500 Road Swamp to the mainstem of the Pysht River. This will require at a minimum the replacement of the SR 112 culvert with a crossing structure that provides fish passage.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	WDOT		
Pysht River	PRA#4l	RM&E and HRA	Develop and implement a plan to remove the old railroad grade that runs parallel to Lee Creek. This will provide much needed habitat connectivity to associated wetlands along the right bank of Lee Creek.	Habitat connectivity	High	Pysht River Recovery Strategy 5	1-2	Pysht River Recovery Goal 2	M&R		
Pysht River	PRA#4m	HRA	Replace SR 112 culvert on Michelena Creek with crossing structure that allows for better fish passage.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	WDOT		
Pysht River	PRA#4n	HRA	Replace SR 112 culvert on 25 Mile Creek with crossing structure that allows for better fish passage.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	WDOT		
Pysht River	PRA#4o	HRA	Replace SR 112 culvert on 4800 Road Swamp with crossing structure that allows for better fish passage.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	WDOT		
Pysht River	PRA#4p	HRA	Replace SR 112 culvert on Burnt Creek One with crossing structure that allows for better fish passage.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	WDOT		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Pysht River	PRA#4q	HRA	Replace SR 801 culvert on Burnt Creek One with crossing structure that allows for better fish passage.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	M&R		
Pysht River	PRA#4r	HRA	Replace SR 112 culvert on Burnt Creek Two with crossing structure that allows for better fish passage.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	WDOT		
Pysht River	PRA#4s	HRA	Replace 801 Road culvert on Burnt Creek Two with crossing structure that allows for better fish passage.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	M&R		
Pysht River	PRA#4t	HRA	Replace an impassable culvert near RM 0.3 in a tributary to Reed Creek (19.0014) with crossing structure that allows for fish passage. This potential barrier requires field verification of fish passage conditions above and below the culvert prior to restoration planning.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	Not Defined		
Pysht River	PRA#4u	HRA	Replace SR 112 culvert on tributary 19.0121A (RM 0.3) to Green Creek with crossing structure that allows for better fish passage. This potential barrier requires field verification of fish passage conditions above and below the culvert prior to restoration planning.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	WDOT		
Pysht River	PRA#4v	HRA	Replace SR 112 culvert on tributary 19.0121 to Green Creek with crossing structure that allows for better fish passage. This potential barrier requires field verification of fish passage conditions above and below the culvert prior to restoration planning.	Habitat connectivity	High	Pysht River Recovery Strategy 5	2	Pysht River Recovery Goal 2	WDOT		
Pysht River	PRA#4w	RM&E and HRA	Identify water-crossing and road inventories from basin landowners and combine into single basin-wide inventory. Where water-crossing information is lacking or missing (S.F. Pysht River and tributaries, and Reed, Green, and Needham creeks), work with landowners to inventory and assess. Use assessment to identify biological, physical, and process-based metrics to use for prioritizing future habitat connectivity projects.	Habitat connectivity	High	Pysht River Recovery Strategy 5	1-2	Pysht River Recovery Goal 2	Not Defined		
Pysht River	PRA#5	RM&E	Develop and implement genetic sampling program for all salmonid species in order to better understand population structure and diversity.	Biological Processes	High	Pysht River Recovery Strategy 6	1	Pysht River Recovery Goal 3	WDFW and Tribes		
Pysht River	PRA#6	PA	For steelhead trout advocate the implementation of the Hatchery Scientific Review Group (HSRG) recommendations set for forth in the 2004 Hatchery Reform Report (HSRG 2004), which recommend the discontinuation of out-of-basin steelhead outplanting.	Biological Processes	High	Pysht River Recovery Strategy 6	1	Pysht River Recovery Goal 3	WDFW and Tribes		
Pysht River	PRA#7	PA	Evaluate the risks and benefits of Chinook salmon hatchery supplementation, also consider the habitats ability to support a viable Chinook salmon population.	Biological Processes	High	Pysht River Recovery Strategy 6, 8	3-6	Pysht River Recovery Goal 3	WDFW and Tribes		
Pysht River	PRA#8	PA	Advocate for the adoption of harvest management regulations that ensure salmonid spawning escapement is sufficient to maintain, protect, and/or restore VSP parameters.	Biological Processes	High	Pysht River Recovery Strategy 7	1	Pysht River Recovery Goal 3	WDFW and Tribes		
Pysht River	PRA#9	PA	Implement and/or continue to implement population abundance monitoring.	Biological Processes	High	Pysht River Recovery Strategy 7	1	Pysht River Recovery Goal 3	WDFW and Tribes		
Pysht River	PRA#10	HRA	Reduce road related hydrologic impacts by reducing road densities and/or disconnecting road systems from the stream network.	Hydrologic Processes	High	Pysht River Recovery Strategy 9	3	Pysht River Recovery Goal 4	Various		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Pysht River	PRA#11	HRA	Implement projects that reconnect the mainstem and its tributaries to their floodplains and/or associated wetlands.	Hydrologic Processes	High	Pysht River Recovery Strategy 9	3	Pysht River Recovery Goal 4	Not Defined		
Pysht River	PRA#12	HRA	Reforestation of unutilized pastures, degraded riparian/floodplain areas, and other open areas to improve hydrologic processes.	Hydrologic Processes	High	Pysht River Recovery Strategy 9	3	Pysht River Recovery Goal 4	Various		
Pysht River	PRA#13	PA	Limit future water withdrawals from the Pysht River watershed through the implementation of the WRIA 19 Watershed Plan (WRIA 19 Planning Unit 2010).	Hydrologic Processes	High	Pysht River Recovery Strategy 10	1	Pysht River Recovery Goal 4	DOE		
Pysht River	PRA#14	RM&E and HRA	Inventory roads for maintenance (use existing RMAP and other available data), side cast removal, and drainage structure improvements. Prioritize for project actions.	Sediment Processes	High	Pysht River Recovery Strategy 11, 12	1/3	Pysht River Recovery Goal 5	Not Defined		
Pysht River	PRA#15	HRA	Reforest riparian and floodplain areas to increase stream bank integrity and reduce bank erosion.	Sediment Processes	High	Pysht River Recovery Strategy 13	3	Pysht River Recovery Goal 5	Not Defined		
Pysht River	PRA#16	RM&E	Using existing core sample data for the Pysht watershed (McHenry et al. 1994), collect core samples in the next two years to compare conditions.	Sediment Processes	High	Pysht River Recovery Strategy 11, 12	1	Pysht River Recovery Goal 5	Not Defined		
Pysht River	PRA#17	HRA	Attempt to reconnect floodplain where it is viable, through barrier correction, road relocation, or treatment of mainstem incision. The restructuring of the mainstem Pysht River with LWD, from both natural recruitment and restoration projects likely offers the best approach for treating incision problems.	Riparian and Floodplain Processes and Conditions	High	Pysht River Recovery Strategy 14	1-4	Pysht River Recovery Goal 6	Various		
Pysht River	PRA#18	HRA	Work with WDOT regarding future Highway 112 planning to encourage alternative road locations that minimize encroachment of floodplain habitats.	Riparian and Floodplain Processes and Conditions	High	Pysht River Recovery Strategy 14, 15	1-4	Pysht River Recovery Goal 6	WDOT		
Pysht River	PRA#19	HRA	Convert unutilized fields and non-forested riparian areas back to functional riparian forests	Riparian and Floodplain Processes and Conditions	High	Pysht River Recovery Strategy 15	3	Pysht River Recovery Goal 6	Various		
Pysht River	PRA#20	PA	Advocate for effective implementation and enforcement of Forest Practice Rules and County Critical Areas Ordinances. Limit future land use encroachment along the Pysht River floodplain.	Riparian and Floodplain Processes and Conditions	High	Pysht River Recovery Strategy 15	na	Pysht River Recovery Goal 6	DNR and Clallam County		
Pysht River	PRA#21	HRA	Assess possibilities for obtaining floodplain conservation easements along the Pysht River corridor. A nearly 1000 acre easement that includes significant portions of the estuary has recently been negotiated. Floodplain easements that connect to this core area are a logical strategy for conserving floodplain habitats over the long term.	Riparian and Floodplain Processes and Conditions	High	Pysht River Recovery Strategy 15	1	Pysht River Recovery Goal 6	Various		
Pysht River	PRA#22	HRA	Implement riparian restoration projects where degraded riparian forest conditions exist. Riparian conditions are degraded throughout many portions of the watershed. Many of these areas could benefit from riparian restoration.	Riparian and Floodplain Processes and Conditions	High	Pysht River Recovery Strategy 15	3	Pysht River Recovery Goal 6	Various		
Pysht River	PRA#23	HRA	Replace the 3400 Road bridge on the South Fork Pysht River with a bridge that allows for optimal passage of LWD, sediment, and water at the 100-year flood flow.	Riparian and Floodplain Processes and Conditions	High	Pysht River Recovery Strategy 14, 15	3	Pysht River Recovery Goal 6	M&R		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Pysht River	PRA#24	HRA	Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.	Riparian and Floodplain Processes and Conditions	High	Pysht River Recovery Strategy 15	1	Pysht River Recovery Goal 6	Not Defined		
Pysht River	PRA#25	RM&E and PA	Map and delineate channel migration zones within the Pysht River watershed.	Riparian and Floodplain Processes and Conditions	High	Pysht River Recovery Strategy 15	1	Pysht River Recovery Goal 6	Clallam County		
Pysht River	PRA#26	PA	Advocate for and support a WRIA 19 representative of the North Olympic Peninsula Lead Entity (NOPLE) to participate in the Forest and Fish policy group. Individual would provide a conduit for information between the forest practices AM program and the salmon recovery efforts of NOPLE.	Riparian and Floodplain Processes and Conditions	High	Pysht River Recovery Strategy 16	na	Pysht River Recovery Goal 6	NOPLE		
Pysht River	PRA#27	RM&E and HRA	Conduct detailed instream meso-habitat mapping inventory and assessment. Implement wood supplementation in identified wood deficient zones from the habitat mapping assessment.	Habitat and LWD Conditions	High	Pysht River Recovery Strategy 17, 18	1/4	Pysht River Recovery Goal 7	Not Defined		
Pysht River	PRA#28	HRA	Within the S.F. Pysht River implement LWD treatments identified to facilitate floodplain reconnection in channel reaches that have incised from historic land use practices and in the lower 0.5 miles which has had no restoration treatments to date. This project would involve the addition of key pieces of LWD (~200) using a heavy lift helicopter as well as the under-planting of conifers on terraces adjacent to the river.	Habitat and LWD Conditions	High	Pysht River Recovery Strategy 18	4	Pysht River Recovery Goal 7	M&R/Elwha Tribe		
Pysht River	PRA#29	HRA	Develop and implement a detailed stream restoration project in the Razz Creek sub-basin. Project scope should include an evaluation of re-routing the mainstem Razz Creek and reconnecting Razz T1 and T2. Plan should include LWD placement in new channel. Plan should include channel reconfiguration and LWD placement in the lower reach of Razz T1 to reduce cascade step elevations. Also include increasing habitat connectivity in Razz Creek T3_t1 (see Haggerty et al. 2006).	Habitat and LWD Conditions	High	Pysht River Recovery Strategy 18	1-4	Pysht River Recovery Goal 7	M&R/Elwha Tribe		
Pysht River	PRA#30	RM&E	Implement long-term surface water quality monitoring program (e.g., temperature, dissolved oxygen, pH, conductivity, turbidity, BIBI). Also include monitoring of hydrocarbons and other potential contaminants.	Water Quality Conditions	High	Pysht River Recovery Strategy 19	1	Pysht River Recovery Goal 8	Not Defined		
Pysht River	PRA#31	PA	Advocate for effective implementation and enforcement of Forest Practice Rules and County Critical Areas Ordinances.	Water Quality Conditions	High	Pysht River Recovery Strategy 20	na	Pysht River Recovery Goal 8	DNR and Clallam County		
Clallam River	CRA#1	HRA	As much as possible, remove infrastructure that encroaches on the Clallam River estuary and Clallam Bay/Sekiu nearshore, impeding its function.	Estuary and nearshore processes and habitat conditions	High	Clallam River Recovery Strategy 2	3	Clallam River Recovery Goal 1	Various		
Clallam River	CRA#2	HRA	Reconnect remaining tidal channels and restore wetlands behind the town to increase tidal prism.	Estuary and nearshore processes and habitat conditions	High	Clallam River Recovery Strategy 2	3	Clallam River Recovery Goal 1	Not Defined		
Clallam River	CRA#3	HRA	Reconnect and restore forest wetlands along left bank of Swamp Creek by removing north-south trending grade off of Frontier Road. The road grade mentioned above is within the land parcel described in Clallam River Action 5.	Estuary and nearshore processes and habitat conditions	High	Clallam River Recovery Strategy 2	2/3	Clallam River Recovery Goal 1	Not Defined		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Clallam River	CRA#4	RM&E and HRA	Develop a plan and stakeholder approval for how to monitor the river mouth and how to open the river mouth when closures threaten fish passage. This plan should include the compilation of recent records of mouth closures and openings.	Estuary and nearshore processes and habitat conditions	High	Clallam River Recovery Strategy 1,5,6	1/2/5	Clallam River Recovery Goal 1	Not Defined		
Clallam River	CRA#5	HRA	Protect the wetlands on the east side of town. Explore the possibility of acquiring the land parcel adjacent to the mainstem Clallam River to the south of Frontier Road and to the north of the school. This parcel includes 0.40 miles of mainstem Clallam River (both sides), 0.25 miles of estuarine channel in Swamp Creek and tributaries, 2 fish bearing forested wetlands, and several additional short channel segments that include off-channel rearing habitat.	Estuary and nearshore processes and habitat conditions	High	Clallam River Recovery Strategy 1, 3	1	Clallam River Recovery Goal 1	Not Defined		
Clallam River	CRA#6	HRA	Explore possibility of habitat acquisition and/or easements to protect high quality riparian and floodplain estuarine habitats. Prioritize areas where the tidal prism can be protected and/or increased.	Habitat connectivity	Medium	Clallam River Recovery Strategy 1, 3	1	Clallam River Recovery Goal 1	Not Defined		
Clallam River	CRA#7a	HRA	Replace two total barrier culverts located at RM 0.49 and RM 0.68 of Swamp Creek with fish passable stream crossings	Habitat connectivity	Medium	Clallam River Recovery Strategy 5	2	Clallam River Recovery Goal 2	WDOT, others?		
Clallam River	CRA#7b	HRA	Within Spruce Creek a 0.47 m diameter, 2.7 percent slope, slightly perched culvert (0.25 m) at RM 0.01 completely blocks juvenile fish migration into a 0.4 acre forested wetland complex located directly upstream from the culvert. This culvert is located on Charley Creek Road. A short (13m) stream reach separates the culvert from the Clallam River. No adult salmonid habitat exists upstream of the culvert. Replace culvert with fish passable stream crossing.	Habitat connectivity	Medium	Clallam River Recovery Strategy 5	2	Clallam River Recovery Goal 2	Clallam County		
Clallam River	CRA#7c	HRA	Replace total fish barrier culvert (SR 112) in Unnamed Creek WP 203 (RBT to Clallam River RM 6.24) with fish passable structure.	Habitat connectivity	Medium	Clallam River Recovery Strategy 5	2	Clallam River Recovery Goal 2	WDOT		
Clallam River	CRA#7d	RM&E and HRA	Assess fish passage through the Hamilton Creek culvert (SR 112). This culvert is not included in the WDOT inventory.	Habitat connectivity	Medium	Clallam River Recovery Strategy 5	1/2	Clallam River Recovery Goal 2	WDOT		
Clallam River	CRA#7e	RM&E	Assess benefits of replacing current fish blockages in an unnamed tributary (Trib H) to Last Creek, unnamed tributary 19.0135, and in an unnamed tributary (Trib WP 450) to the Clallam River (see Section 5.7.2). None of these streams appear to have more than 100 meters of habitat upstream of the current barrier and below the natural barriers present.	Habitat connectivity	Medium	Clallam River Recovery Strategy 5, 6	1	Clallam River Recovery Goal 2	Not Defined		
Clallam River	CRA#8	PA	Advocate for implementation of the Hatchery Scientific Review Group (HSRG) recommendations set for forth in the 2004 Hatchery Reform Report (HSRG 2004) that call for the discontinuation of hatchery outplanting in the Clallam River watershed.	Biological Processes	High	Clallam River Recovery Strategy 7	1	Clallam River Recovery Goal 3	WDFW and Tribes		
Clallam River	CRA#9	PA	Advocate for the adoption of harvest management regulations that ensure salmonid spawning escapement is sufficient to maintain, protect, and/or restore VSP parameters.	Biological Processes	High	Clallam River Recovery Strategy 8	1	Clallam River Recovery Goal 3	WDFW and Tribes		
Clallam River	CRA#10	PA	Implement and/or continue to implement population abundance monitoring.	Biological Processes	High	Clallam River Recovery Strategy 8	1	Clallam River Recovery Goal 3	WDFW and Tribes		
Clallam River	CRA#11	HRA	Reforestation of unutilized pastures, degraded riparian/floodplain areas, and other open areas to improve hydrologic processes	Hydrologic Processes	High	Clallam River Recovery Strategy 9	3	Clallam River Recovery Goal 4	Various		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Clallam River	CRA#12	HRA	Reduce road related hydrologic impacts by reducing road densities and/or disconnecting road systems from the stream network.	Hydrologic Processes	High	Clallam River Recovery Strategy 9	3	Clallam River Recovery Goal 4	Various		
Clallam River	CRA#13	PA	Limit future water withdrawals from the Salt Creek watershed through the implementation of the WRIA 19 Watershed Plan (WRIA 19 Planning Unit 2010).	Hydrologic Processes	High	Clallam River Recovery Strategy 10	1	Clallam River Recovery Goal 4	DOE		
Clallam River	CRA#14	HRA	Inventory roads for maintenance (use existing RMAP and other available data), side cast removal, and drainage structure improvements. Prioritize for project actions.	Sediment Processes	Medium	Clallam River Recovery Strategy 11, 12	1/3	Clallam River Recovery Goal 5	Various		
Clallam River	CRA#15	HRA	Reforest riparian and floodplain areas to increase stream bank integrity and reduce bank erosion	Sediment Processes	Medium	Clallam River Recovery Strategy 13	3	Clallam River Recovery Goal 5	Various		
Clallam River	CRA#16	RM&E	Using existing sediment core sample data for the Clallam watershed (McHenry et al. 1994), collect sediment core samples in the next two years to compare conditions.	Sediment Processes	Medium	Clallam River Recovery Strategy 11, 12	1	Clallam River Recovery Goal 5	Not Defined		
Clallam River	CRA#17	HRA	Assess possibilities for acquisition or conservation easements along the lower mainstem (see Haggerty 2008 Draft for sites). Priority should be given to the most intact habitats in order to protect areas that are currently properly functioning.	Riparian and Floodplain Processes and Conditions	High	Clallam River Recovery Strategy 15	1	Clallam River Recovery Goal 6	Not Defined		
Clallam River	CRA#18	HRA	Work with WDOT and Clallam County regarding future Highway 112 planning to encourage alternative road locations that minimize encroachment on the floodplain and floodplain habitats. Consider locations where road relocation out of the active floodplain might be feasible and help address floodplain encroachment issues.	Riparian and Floodplain Processes and Conditions	High	Clallam River Recovery Strategy 14, 15	1/3	Clallam River Recovery Goal 6	WDOT and Clallam County		
Clallam River	CRA#19	HRA	Conversion of fields and non-forested riparian areas (mostly between RM 1.0 and 6) back to fully functional riparian forests.	Riparian and Floodplain Processes and Conditions	High	Clallam River Recovery Strategy 15	3	Clallam River Recovery Goal 6	Various		
Clallam River	CRA#20	HRA	Attempt to reconnect floodplain where it is viable, through barrier correction, road relocation, or treatment of mainstem incision. The restructuring of the mainstem Clallam River with LWD, from both natural recruitment and restoration projects likely offers the best approach for treating incision problems.	Riparian and Floodplain Processes and Conditions	High	Clallam River Recovery Strategy 14	3/4	Clallam River Recovery Goal 6	Not Defined		
Clallam River	CRA#21	HRA	Work with willing landowners and other restoration partners to remove knotweed and other noxious weeds followed by riparian replanting.	Riparian and Floodplain Processes and Conditions	High	Clallam River Recovery Strategy 15	3	Clallam River Recovery Goal 6	Clallam County Noxious Weed Workgroup		
Clallam River	CRA#22	PA	Advocate for effective implementation and enforcement of Forest Practice Rules and County Critical Areas Ordinances. Limit future land use encroachment along the Clallam River floodplain.	Riparian and Floodplain Processes and Conditions	High	Clallam River Recovery Strategy 15	na	Clallam River Recovery Goal 6	Clallam County and DNR		
Clallam River	CRA#23	HRA	Replace undersized bridges with correctly sized bridges.	Riparian and Floodplain Processes and Conditions	High	Clallam River Recovery Strategy 14, 15	3	Clallam River Recovery Goal 6	WDOT		
Clallam River	CRA#24	HRA	Reduce roads, road prisms, and impervious surfaces cover within the floodplain.	Riparian and Floodplain Processes and Conditions	High	Clallam River Recovery Strategy 14, 15	3	Clallam River Recovery Goal 6	Various		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Clallam River	CRA#25	HRA	Relocate roads which negatively impact fish populations and habitat.	Riparian and Floodplain Processes and Conditions	High	Clallam River Recovery Strategy 14, 15	3	Clallam River Recovery Goal 6	Various		
Clallam River	CRA#26	HRA	Implement projects that will enhance riparian conditions in tributaries where current conditions are poor (e.g. Last Creek segment 1). For other potential projects also see the riparian inventory in Haggerty (2008 Draft).	Riparian and Floodplain Processes and Conditions	High	Clallam River Recovery Strategy 15	3	Clallam River Recovery Goal 6	Various		
Clallam River	CRA#27	HRA	Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.	Riparian and Floodplain Processes and Conditions	High	Clallam River Recovery Strategy 15	1	Clallam River Recovery Goal 6	Various		
Clallam River	CRA#28	RM&E and PA	Map and delineate channel migration zones within the Clallam River watershed.	Riparian and Floodplain Processes and Conditions	High	Clallam River Recovery Strategy 15	1	Clallam River Recovery Goal 6	Clallam County		
Clallam River	CRA#29	PA	Advocate for and support a WRIA 19 representative of the North Olympic Peninsula Lead Entity (NOPLE) to participate in the Forest and Fish policy group. Individual would provide a conduit for information between the forest practices AM program and the salmon recovery efforts of NOPLE.	Riparian and Floodplain Processes and Conditions	High	Clallam River Recovery Strategy 16	na	Clallam River Recovery Goal 6	NOPLE		
Clallam River	CRA#30	HRA and RM&E	Mainstem Clallam River- Most of segments 1 through 4 are low or deficient in LWD. LWD projects in any of these stream segments could significantly improve fish habitat conditions. Caution will be needed due to extensive private property holdings and infrastructure located close to the rivers edge. Meso-habitat data are need in stream segments 1 through 4.	Habitat and LWD Conditions	Medium	Clallam River Recovery Strategy 17, 18	1/4	Clallam River Recovery Goal 7	Not Defined		
Clallam River	CRA#31	HRA	Mainstem Clallam River- Upper segment 5 and segment 6 could benefit from LWD introductions that help improve channel complexity, stability, and floodplain connectivity. Historically this stream reach contained abundant LWD, current LWD levels are low in this reach.	Habitat and LWD Conditions	Medium	Clallam River Recovery Strategy 18	4	Clallam River Recovery Goal 7	Not Defined		
Clallam River	CRA#32	HRA	Upper Mainstem Clallam River- Segments 9 and 12 have the most potential to benefit from LWD introductions (segments 7, 8, 10, 11, and 14 are confined, high energy environments where LWD introduction may not be feasible). Projects in these stream reaches should attempt to add habitat complexity and restore floodplain connectivity where possible.	Habitat and LWD Conditions	Medium	Clallam River Recovery Strategy 18	4	Clallam River Recovery Goal 7	Not Defined		
Clallam River	CRA#33	HRA	LWD wood supplementation in the Charley Creek subbasin. Areas to target include the mainstem Charley Creek, upper segment 2 and segment 3, unnamed tributary 19.0135 segment 1, Err Creek segment 1, unnamed tributary 19.0136 segment 1.	Habitat and LWD Conditions	Medium	Clallam River Recovery Strategy 18	4	Clallam River Recovery Goal 7	Not Defined		
Clallam River	CRA#34	HRA	LWD wood supplementation in Simmons Creek segment 1.	Habitat and LWD Conditions	Medium	Clallam River Recovery Strategy 18	4	Clallam River Recovery Goal 7	Not Defined		
Clallam River	CRA#35	HRA	LWD wood supplementation in Blowder Creek (upper segment 1 and portions of segment 2).	Habitat and LWD Conditions	Medium	Clallam River Recovery Strategy 18	4	Clallam River Recovery Goal 7	Not Defined		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Clallam River	CRA#36	RM&E	Implement long-term surface water quality monitoring program (e.g., temperature, dissolved oxygen, pH, conductivity, turbidity, BIBI). Also include monitoring of hydrocarbons and other potential contaminants.	Water Quality Conditions	Medium	Clallam River Recovery Strategy 19	1	Clallam River Recovery Goal 8	Not Defined		
Clallam River	CRA#37	PA	Advocate for effective implementation and enforcement of Forest Practice Rules and County Critical Areas Ordinances.	Water Quality Conditions	Medium	Clallam River Recovery Strategy 20	na	Clallam River Recovery Goal 8	DNR and Clallam County		
Hoko River	HRA#1	RM&E	Assess the effectiveness of existing regulatory mechanisms in protecting natural resources. Identify actions taken under specific regulatory controls that can be assessed through effectiveness monitoring.	Estuary and Nearshore Processes and Habitat Conditions	High	Hoko River Recovery Strategy 1	1	Hoko River Recovery Goal 1	Not Defined		
Hoko River	HRA#2	HRA	Identify willing sellers of parcels with natural shoreline for either permanent conservation or acquisition for protection. Within conservation easements or areas acquired for protection, completely remove shoreline armoring and return to original shoreline geometry.	Estuary and Nearshore Processes and Habitat Conditions	High	Hoko River Recovery Strategy 2, 3	1	Hoko River Recovery Goal 1	Not Defined		
Hoko River	HRA#3	RM&E	Water quality and fish use monitoring should be conducted in the Hoko River estuary to determine potential impacts to aquatic resources. Future monitoring should incorporate recent water quality data collected by Stream Keepers, local residents, and volunteers. Also include cross-section monitoring through and across the meander channel.	Estuary and Nearshore Processes and Habitat Conditions	High	?	1	Hoko River Recovery Goal 1	Not Defined		Does not have a strategy relationship
Hoko River	HRA#4	HRA	Work with landowners to replace existing “hard-point” armoring with alternative soft shore protection designs (ex. beach nourishment, grade control w/ LWD, wood revetment, and biotechnical slope support).	Estuary and Nearshore Processes and Habitat Conditions	High	Hoko River Recovery Strategy 3	3	Hoko River Recovery Goal 1	Various		
Hoko River	HRA#5	RM&E	Assess the feasibility of moving 0.24mi of Hwy 112, that is currently, armored to a higher elevation, landward location.	Riparian and Floodplain Processes and Conditions	High	Hoko River Recovery Strategy 3	1	Hoko River Recovery Goal 1	WDOT		
Hoko River	HRA#6	HRA	Introduce small-scale wood complex at outlet of historic meander to improve tidal exchange and maintain surface water connection.	Riparian and Floodplain Processes and Conditions	High	Hoko River Recovery Strategy 4	4	Hoko River Recovery Goal 1	Not Defined		
Hoko River	HRA#7	HRA	Introduce large-scale, channel spanning wood complexes below historic meander inlet to improve flood flow connection to meander.	Riparian and Floodplain Processes and Conditions	High	Hoko River Recovery Strategy 4	4	Hoko River Recovery Goal 1	Not Defined		
Hoko River	HRA#8a	RM&E	Identify water-crossing and road inventories from basin landowners and combine into single basin-wide inventory. Where water-crossing information is lacking or missing, work with landowners to inventory and assess.	Habitat connectivity	Medium	Hoko River Recovery Strategy 6	1	Hoko River Recovery Goal 2	Not Defined		
Hoko River	HRA#8b	RM&E and HRA	Using a basin-wide approach to identify biological, physical, and process-based metrics to use for prioritizing future habitat connectivity projects.	Habitat connectivity	Medium	Hoko River Recovery Strategy 6	1/2	Hoko River Recovery Goal 2	Not Defined		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Hoko River	HRA#9a	HRA	Remove undersized, perched culvert that acts as a partial barrier in Johnson Creek at the confluence with the Hoko River. Currently adult coho and steelhead appear to easily pass upstream through the culvert. The road fill is extremely deep and the culvert is partially collapsed and poses a significant risk of catastrophic failure.	Habitat connectivity	Medium	Hoko River Recovery Strategy 6	2	Hoko River Recovery Goal 2	Private Landowner?		
Hoko River	HRA#9b	HRA	Repair perched culvert (Hoko Ozette Road) on an unnamed tributary to Johnson Creek (trib 19.0176) blocks access to 0.8 miles of low gradient (1-4%) habitat and 0.35 miles of 4-8% gradient habitat.	Habitat connectivity	Medium	Hoko River Recovery Strategy 6	2	Hoko River Recovery Goal 2	Clallam County		
Hoko River	HRA#9c	HRA	Repair perched culvert (spur to 7000 Road) on an unnamed tributary to Johnson Creek (trib 19.0178). This culvert blocks access to 0.68 miles of low gradient (2-4%) stream habitat.	Habitat connectivity	Medium	Hoko River Recovery Strategy 6	2	Hoko River Recovery Goal 2	Private Landowner?		
Hoko River	HRA#9d	HRA	Repair perched culvert on an unnamed tributary (19.0189; RM 0.18) to the Hoko River. This culvert blocks access to 0.41 miles of 3-6% gradient spawning habitat.	Habitat connectivity	Medium	Hoko River Recovery Strategy 6	2	Hoko River Recovery Goal 2	Private Landowner?		
Hoko River	HRA#9e	HRA	Two perched culverts on the 9000 Road block access to a 4 acre fish bearing wetland complex. No spawning habitat has been identified upstream of the barrier culverts. Replace with fish passable structure.	Habitat connectivity	Medium	Hoko River Recovery Strategy 6	2	Hoko River Recovery Goal 2	Private Landowner?		
Hoko River	HRA#9f	HRA	Replace Hoko-Ozette Road partial barrier culvert on Wrights Creek with crossing structure that allows for better fish passage. Ensure structure is adequately sized to pass flood flows, debris, and sediment.	Habitat connectivity	Medium	Hoko River Recovery Strategy 6	2	Hoko River Recovery Goal 2	Clallam County		
Hoko River	HRA#9g	HRA	Repair partial barrier associated with SR 112 near MP 12.3. This culvert blocks access to a 1.6 acre wetland complex and 0.15 miles of 2-4% gradient spawning and rearing habitat. An additional 0.3 miles of 4-8% gradient habitat is also upstream of the barrier culvert.	Habitat connectivity	Medium	Hoko River Recovery Strategy 6	2	Hoko River Recovery Goal 2	WDOT		
Hoko River	HRA#9h	HRA	Repair partial barrier culvert on Hoko Ozette Road blocks 0.25 miles of 2-8% gradient spawning and rearing habitat in Hoko Gage Creek (near Hoko RM 5.0).	Habitat connectivity	Medium	Hoko River Recovery Strategy 6	2	Hoko River Recovery Goal 2	Clallam County		
Hoko River	HRA#9i	HRA	An unmapped right bank tributary to unnamed tributary 19.0199 (RM 0.45) contains a barrier culvert at RM 0.06 that blocks access to about 0.1 miles of spawning habitat. Replace with fish passable culvert or bridge.	Habitat connectivity	Medium	Hoko River Recovery Strategy 6	2	Hoko River Recovery Goal 2	Rayonier		
Hoko River	HRA#10	RM&E	Develop and implement genetic sampling program for all salmonid species in order to better understand population structure and diversity.	Biological Processes	High	Hoko River Recovery Strategy 7	1	Hoko River Recovery Goal 3	WDFW and Tribes		
Hoko River	HRA#11	PA	Advocate for the adoption of harvest management regulations that ensure salmonid spawning escapement is sufficient to maintain, protect, and/or restore VSP parameters.	Biological Processes	High	Hoko River Recovery Strategy 8	1	Hoko River Recovery Goal 3	WDFW and Tribes		
Hoko River	HRA#12	PA	Implement and/or continue to implement population abundance monitoring.	Biological Processes	High	Hoko River Recovery Strategy 8	1	Hoko River Recovery Goal 3	WDFW and Tribes		
Hoko River	HRA#13	PA and RM&E	Specify locations to introduce salmon carcass analogs to the Hoko River drainage to improve N, P, and C cycling in areas deficient of natural salmon spawners.	Biological Processes	High	Hoko River Recovery Strategy 9	3-6	Hoko River Recovery Goal 3	WDFW and Tribes		
Hoko River	HRA#14	RM&E	Collaborate with Washington Department of Fish and Wildlife, private landowners, and tribes to provide access and develop field methodology for evaluating flood flow passage through existing instream structures.	Hydrologic Processes	High	Hoko River Recovery Strategy 10	1	Hoko River Recovery Goal 4	Various		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Hoko River	HRA#15	RM&E	Obtain funding for necessary equipment to collect high flow data.	Hydrologic Processes	High	Hoko River Recovery Strategy 10, 11	1	Hoko River Recovery Goal 4	USGS		
Hoko River	HRA#16	RM&E, PA	Obtain necessary information (RMAPs, RMAP Annual Reports, current and historical road inventory) from Washington Department of Natural Resources (WDNR).	Hydrologic Processes	High	Hoko River Recovery Strategy 12	1	Hoko River Recovery Goal 4	Various		
Hoko River	HRA#17	RM&E	Review published literature on impacts to natural basin hydrology due to changes in road density (including work completed in WDNR Hoko Watershed Analysis).	Hydrologic Processes	High	Hoko River Recovery Strategy 12	1	Hoko River Recovery Goal 4	Not Defined		
Hoko River	HRA#18	HRA	In coordination with WDNR, WDFW, and WDOE, and landowners, develop road density goals for the Hoko River drainage based on “best available science” that will achieve Hoko River Recovery Goal 4.	Hydrologic Processes	High	Hoko River Recovery Strategy 12	3	Hoko River Recovery Goal 4	Various		
Hoko River	HRA#19	PA	Limit future water withdrawals from the Hoko River watershed through the implementation of the WRIA 19 Watershed Plan (WRIA 19 Planning Unit 2010).	Hydrologic Processes	High	Hoko River Recovery Strategy 10	1	Hoko River Recovery Goal 4	DOE		
Hoko River	HRA#20	RM&E	Evaluate rate of road/culvert related failure (mass wasting events) over time using aerial photo interpretation. Compare existing rates of mass wasting events to those historically.	Sediment Processes	Medium	Hoko River Recovery Strategy 13	1	Hoko River Recovery Goal 5	Not Defined		
Hoko River	HRA#21	RM&E and HRA	Using existing RMAP information, quantify remaining orphaned and abandoned roads to determine potential for resource damage and likelihood of failure.	Sediment Processes	Medium	Hoko River Recovery Strategy 13	1/3	Hoko River Recovery Goal 5	Not Defined		
Hoko River	HRA#22	RM&E	Install continuous, long-term turbidity monitoring station coupled with storm-related suspended sediment collection. Use data for long-term trend analysis and measures of state water quality standards.	Sediment Processes	Medium	Hoko River Recovery Strategy 14	1	Hoko River Recovery Goal 5	Not Defined		
Hoko River	HRA#23	RM&E	Using existing sediment core sample data for the Clallam watershed (McHenry et al. 1994), collect sediment core samples in the next two years to compare conditions.	Sediment Processes	Medium	Hoko River Recovery Strategy 15	1	Hoko River Recovery Goal 5	Not Defined		
Hoko River	HRA#24	RM&E	Review published literature on recommended levels of fine sediment volume within the hyporheic zone for a range of STE, and establish benchmarks for the next 10-100 years.	Sediment Processes	Medium	Hoko River Recovery Strategy 15	1	Hoko River Recovery Goal 5	Not Defined		
Hoko River	HRA#25	PA	Advocate for and support a WRIA 19 representative of the North Olympic Peninsula Lead Entity (NOPLE) to participate in the Forest and Fish policy group. Individual would provide a conduit for information between the forest practices AM program and the salmon recovery efforts of NOPLE.	Riparian and Floodplain Processes and Conditions	High	Hoko River Recovery Strategy 16	na	Hoko River Recovery Goal 6	NOPLE		
Hoko River	HRA#26	PA and HRA	Limit future land use encroachment on the Hoko River floodplain.	Riparian and Floodplain Processes and Conditions	High	Hoko River Recovery Strategy 16, 17	1	Hoko River Recovery Goal 6	Various		
Hoko River	HRA#27	HRA	Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011)to further refine prioritization of floodplain and riparian habitat. Assess possibilities for obtaining floodplain conservation easements along the Hoko River corridor.	Riparian and Floodplain Processes and Conditions	High	Hoko River Recovery Strategy 17	1	Hoko River Recovery Goal 6	Various		
Hoko River	HRA#28	HRA	Conversion of fields and non-forested riparian areas (mostly between RM 0.75 and 4.0) back to fully functional riparian forests.	Riparian and Floodplain Processes and Conditions	High	Hoko River Recovery Strategy 17	3	Hoko River Recovery Goal 6	Various		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Hoko River	HRA#29	RM&E and HRA	Evaluate and prioritize the need to remove or abandon road segments that occupy floodplain habitat throughout the Hoko River drainage.	Riparian and Floodplain Processes and Conditions	High	Hoko River Recovery Strategy 18	1/3	Hoko River Recovery Goal 6	Various		
Hoko River	HRA#30	PA and HRA	Work with WDOT and Clallam County regarding future Highway 112 and Hoko-Ozette Road planning to encourage alternative road locations that minimize encroachment on the floodplain and floodplain habitats. Considered locations where road relocation out of the active floodplain might be feasible and help address floodplain encroachment issues.	Riparian and Floodplain Processes and Conditions	High	Hoko River Recovery Strategy 18	1/3	Hoko River Recovery Goal 6	WDOT and Clallam County		
Hoko River	HRA#31	RM&E and PA	Map and delineate channel migration zones within the Hoko River watershed.	Riparian and Floodplain Processes and Conditions	High	Hoko River Recovery Strategy 16-18	1	Hoko River Recovery Goal 6	Clallam County		
Hoko River	HRA#32	RM&E and HRA	Conduct detailed instream meso-habitat mapping inventory and assessment. Implement wood supplementation in identified wood deficient zones from the habitat mapping assessment.	Habitat and LWD Conditions	High	Hoko River Recovery Strategy 19, 20	1/4	Hoko River Recovery Goal 7	Not Defined		
Hoko River	HRA#33	HRA	Mainstem Hoko River - Emerson Flats LWD restoration. The first phase of the project will restore spawning and rearing habitat from RM 5.0 to 6. Adding LWD to this reach will create habitat complexity, providing sheltering areas for spawning adults and rearing fingerlings. It will also reduce scour and assist in gravel bed creation and maintenance. This project will benefit Chinook as well as coho, chum, steelhead and cutthroat trout.	Habitat and LWD Conditions	High	Hoko River Recovery Strategy 20	4	Hoko River Recovery Goal 7	Not Defined		
Hoko River	HRA#34	HRA	Mainstem Hoko River – LWD Restoration. Almost the entire low gradient reaches of the Hoko River have insufficient LWD loading as a result of historic land uses. These reaches should be delineated and prioritized for future projects.	Habitat and LWD Conditions	High	Hoko River Recovery Strategy 19	4	Hoko River Recovery Goal 7	Not Defined		
Hoko River	HRA#35	HRA	Little Hoko River LWD restoration – The Little Hoko River received extensive habitat restoration between 1994 and 1998. Monitoring has shown that the project has been partially successful in restoring channel and riparian habitat features. Additional LWD treatments have been identified to facilitate floodplain reconnection particularly in channel reaches that have heavily incised. This project would involve the addition of key pieces (~200) using a heavy lift helicopter.	Habitat and LWD Conditions	High	Hoko River Recovery Strategy 20	4	Hoko River Recovery Goal 7	Not Defined		
Hoko River	HRA#36	HRA	Herman Creek LWD restoration – This project will restore formerly productive spawning and rearing habitat to Herman Creek. Adding LWD to this tributary will create habitat complexity, providing sheltering areas for spawning adults and rearing fingerlings. It will also reduce scour and assist in gravel bed creation and maintenance.	Habitat and LWD Conditions	High	Hoko River Recovery Strategy 20	4	Hoko River Recovery Goal 7	Not Defined		
Hoko River	HRA#37	HRA	Bear/Cub Creek LWD Restoration - This project will restore formerly productive spawning and rearing habitat to two upper Hoko tributaries. Adding LWD to these tributaries will create habitat complexity, providing sheltering areas for spawning adults and rearing fingerlings. It will also reduce scour and assist in gravel bed creation and maintenance	Habitat and LWD Conditions	High	Hoko River Recovery Strategy 20	4	Hoko River Recovery Goal 7	Not Defined		
Hoko River	HRA#38	RM&E	Implement long-term surface water quality monitoring program (e.g., temperature, dissolved oxygen, pH, conductivity, turbidity, BIBI). Also include monitoring of hydrocarbons and other potential contaminants.	Water Quality Conditions	High	Hoko River Recovery Strategy 21	1	Hoko River Recovery Goal 8	Not Defined		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Hoko River	HRA#39	PA	Maintain and expand long-term surface water temperature monitoring program.	Water Quality Conditions	High	Hoko River Recovery Strategy 21	1	Hoko River Recovery Goal 8	Tribes		
Sekiu River	SRA#1	RM&E	Assess the effectiveness of existing regulatory mechanisms in protecting natural resources. Identify actions taken under specific regulatory controls that can be assessed through effectiveness monitoring.	Estuary and Nearshore Processes and Habitat Conditions	Medium	Sekiu River Recovery Strategy 1	1	Sekiu River Recovery Goal 1	Not Defined		
Sekiu River	SRA#2	HRA	Identify willing sellers of parcels with natural shoreline for either permanent conservation or acquisition for protection.	Estuary and Nearshore Processes and Habitat Conditions	Medium	Sekiu River Recovery Strategy 2	1	Sekiu River Recovery Goal 1	Various		
Sekiu River	SRA#3	HRA	Within conservation easements or areas acquired for protection, completely remove shoreline armoring and return to original shoreline geometry.	Estuary and Nearshore Processes and Habitat Conditions	Medium	Sekiu River Recovery Strategy 3	3	Sekiu River Recovery Goal 1	Not Defined		
Sekiu River	SRA#4	HRA	Work with landowners to replace existing “hard-point” armoring with alternative soft shore protection designs (ex. beach nourishment, grade control w/ LWD, wood revetment, and biotechnical slope support).	Estuary and Nearshore Processes and Habitat Conditions	Medium	Sekiu River Recovery Strategy 3	4/5	Sekiu River Recovery Goal 1	Not Defined		
Sekiu River	SRA#5a	RM&E	Identify water-crossing and road inventories from basin landowners and combine into single basin-wide inventory. Where water-crossing information is lacking or missing, work with landowners to inventory and assess.	Habitat connectivity	Medium	Sekiu River Recovery Strategy 5	1	Sekiu River Recovery Goal 2	Not Defined		
Sekiu River	SRA#5b	RM&E and HRA	Using a basin-wide approach to identify biological, physical, and process-based metrics to use for prioritizing future habitat connectivity projects.	Habitat connectivity	Medium	Sekiu River Recovery Strategy 5	1/2	Sekiu River Recovery Goal 2	Not Defined		
Sekiu River	SRA#6a	HRA	Replace barrier culvert in unnamed tributary to No Name Creek (near RM 0.6) with structure that allows for better fish passage.	Habitat connectivity	Medium	Sekiu River Recovery Strategy 5	2	Sekiu River Recovery Goal 2	Not Defined		
Sekiu River	SRA#6b	HRA	When the CZ 1000 Road was constructed it cut off a major meander of the Sekiu River leaving a large ponded channel segment. This habitat is now partially blocked by an improperly placed culvert. Restoring fish access to this pond would substantially increase the off-channel habitat available to juvenile salmonids in this subbasin.	Habitat connectivity	Medium	Sekiu River Recovery Strategy 5	2	Sekiu River Recovery Goal 2	Not Defined		
Sekiu River	SRA#6c	HRA	A barrier culvert on the CZ-1000 Road blocks approximately 0.25 miles of spawning and rearing habitat in an unnamed right bank tributary to the Sekiu River (section 13). Replace culvert with crossing structure that allows for better fish passage.	Habitat connectivity	Medium	Sekiu River Recovery Strategy 5	2	Sekiu River Recovery Goal 2	Not Defined		
Sekiu River	SRA#6d	HRA	Near RM 0.18 in a left bank tributary to 19.0218 (RM 0.44), a culvert blocks an unquantified amount of coho, steelhead and cutthroat habitat. Upstream habitat quantification needs to occur prior to restoration planning. Replace (or remove) culvert with structure that allows for better fish passage.	Habitat connectivity	Medium	Sekiu River Recovery Strategy 5	2	Sekiu River Recovery Goal 2	Not Defined		
Sekiu River	SRA#7	RM&E	Develop and implement genetic sampling program for all salmonid species in order to better understand population structure and diversity.	Biological Processes	High	Sekiu River Recovery Strategy 6	1	Sekiu River Recovery Goal 3	WDFW and Tribes		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Sekiu River	SRA#8	PA	Evaluate the necessity of hatchery supplementation once higher tiered recovery actions have been completed in the watershed (through future survey/smolt trapping results).	Biological Processes	High	Sekiu River Recovery Strategy 7	3-6	Sekiu River Recovery Goal 3	WDFW and Tribes		
Sekiu River	SRA#9	PA	Advocate for the adoption of harvest management regulations that ensure salmonid spawning escapement is sufficient to maintain, protect, and/or restore salmonid VSP parameters.	Biological Processes	High	Sekiu River Recovery Strategy 8	1	Sekiu River Recovery Goal 3	WDFW and Tribes		
Sekiu River	SRA#10	RM&E and PA	Implement and/or continue to implement population abundance monitoring.	Biological Processes	High	Sekiu River Recovery Strategy 8	1	Sekiu River Recovery Goal 3	WDFW and Tribes		
Sekiu River	SRA#11	PA and RM&E	Introduce salmon carcass analogs to the Sekiu river drainage to improve N, P, and C cycling in areas deficient of natural salmon spawners.	Biological Processes	High	Sekiu River Recovery Strategy 9	3-6	Sekiu River Recovery Goal 3	WDFW and Tribes		
Sekiu River	SRA#12	RM&E	Collaborate with Washington Department of Fish and Wildlife, private landowners, and tribes to provide access and develop field methodology for evaluating flood flow passage through existing instream structures.	Hydrologic Processes	Unknown	Sekiu River Recovery Strategy 10	1	Sekiu River Recovery Goal 4	Various		
Sekiu River	SRA#13	RM&E	Seek additional funding for maintenance and calibration of WDOE Sekiu River gaging station. Obtain funding for necessary equipment for high flow data collection.	Hydrologic Processes	Unknown	Sekiu River Recovery Strategy 11	1	Sekiu River Recovery Goal 4	DOE		
Sekiu River	SRA#14	RM&E, PA	Obtain necessary information (RMAPs, RMAP Annual Reports, current and historical road inventory) from Washington Department of Natural Resources (WDNR).	Hydrologic Processes	Unknown	Sekiu River Recovery Strategy 12	1	Sekiu River Recovery Goal 4	Various		
Sekiu River	SRA#15	RM&E	Review published literature on impacts to natural basin hydrology due to changes in road density (including work completed in WDNR Sekiu Watershed Analysis).	Hydrologic Processes	Unknown	Sekiu River Recovery Strategy 12	1	Sekiu River Recovery Goal 4	Not Defined		
Sekiu River	SRA#16	HRA	In coordination with WDNR, WDFW, and WDOE, and landowners, develop road density goals for the Sekiu River drainage based on "best available science" that will achieve Sekiu River Recovery Goal 4.	Hydrologic Processes	Unknown	Sekiu River Recovery Strategy 12	3	Sekiu River Recovery Goal 4	Various		
Sekiu River	SRA#17	PA	Limit future water withdrawals from the Sekiu River watershed through the implementation of the WRIA 19 Watershed Plan (WRIA 19 Planning Unit 2010).	Hydrologic Processes	Unknown	Sekiu River Recovery Strategy 10	1	Sekiu River Recovery Goal 4	DOE		
Sekiu River	SRA#18	RM&E	Evaluate rate of road/culvert related failure (mass wasting events) over time using aerial photo history. Compare existing rates of mass wasting events to those historically.	Sediment Processes	Medium	Sekiu River Recovery Strategy 13	1	Sekiu River Recovery Goal 5	Not Defined		
Sekiu River	SRA#19	RM&E and HRA	Using existing RMAP information, quantify remaining orphan and abandoned roads to determine potential for resource damage and likelihood of failure.	Sediment Processes	Medium	Sekiu River Recovery Strategy 13	1/3	Sekiu River Recovery Goal 5	Not Defined		
Sekiu River	SRA#20	RM&E	Install continuous, long-term turbidity monitoring station coupled with storm-related suspended sediment collection. Use data for long-term trend analysis and measures of state water quality standards.	Sediment Processes	Medium	Sekiu River Recovery Strategy 14	1	Sekiu River Recovery Goal 5	Not Defined		
Sekiu River	SRA#21	RM&E	Using existing sediment core sample data for the Clallam watershed (McHenry et al. 1994), collect sediment core samples in the next two years to compare conditions.	Sediment Processes	Medium	Sekiu River Recovery Strategy 15	1	Sekiu River Recovery Goal 5	Not Defined		
Sekiu River	SRA#22	RM&E	Review published literature on recommended levels of fine sediment volume within the hyporheic zone for a range of STE, and establish benchmarks for the next 10-100 years.	Sediment Processes	Medium	Sekiu River Recovery Strategy 15	1	Sekiu River Recovery Goal 5	Not Defined		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
Sekiu River	SRA#23	HRA	Advocate for and support a WRIA 19 representative of the North Olympic Peninsula Lead Entity (NOPLE) to participate in the Forest and Fish policy group. Individual would provide a conduit for information between the forest practices AM program and the salmon recovery efforts of NOPLE.	Riparian and Floodplain Processes and Conditions	High	Sekiu River Recovery Strategy 16	na	Sekiu River Recovery Goal 6	NOPLE		
Sekiu River	SRA#24	RM&E and HRA	Evaluate and prioritize the need to remove or abandon the following road segments: (1) 3.19 miles within 250ft of Sekiu mainstem, (2) 2.35 miles between 250-500ft of Sekiu mainstem, (3) 2.62 miles between 500-750ft of Sekiu mainstem, and (4) 2.98 miles between 750-1000ft of Sekiu mainstem.	Riparian and Floodplain Processes and Conditions	High	Sekiu River Recovery Strategy 18	1/3	Sekiu River Recovery Goal 6	Not Defined		
Sekiu River	SRA#25	HRA	Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.	Riparian and Floodplain Processes and Conditions	High	Sekiu River Recovery Strategy 17	1	Sekiu River Recovery Goal 6	Various		
Sekiu River	SRA#26	RM&E and PA	Map and delineate channel migration zones within the Sekiu River watershed.	Riparian and Floodplain Processes and Conditions	High	Sekiu River Recovery Strategy 16, 17	1	Sekiu River Recovery Goal 6	Clallam County		
Sekiu River	SRA#27	RM&E and HRA	Conduct detailed instream meso-habitat mapping inventory and assessment. Implement wood supplementation in identified wood deficient zones from the habitat mapping assessment.	Riparian and Floodplain Processes and Conditions	High	Sekiu River Recovery Strategy 20	1/3/4	Sekiu River Recovery Goal 7	Not Defined		
Sekiu River	SRA#28	RM&E	Implement long-term surface water quality monitoring program (e.g., temperature, dissolved oxygen, pH, conductivity, turbidity, BIBI).	Water Quality Conditions	Unknown	Sekiu River Recovery Strategy 21	1	Sekiu River Recovery Goal 8	Not Defined		
Sekiu River	SRA#29	PA	Maintain and expand long-term surface water temperature monitoring program.	Water Quality Conditions	Unknown	Sekiu River Recovery Strategy 21	1	Sekiu River Recovery Goal 8	Tribes		
WSI	WSIRA#1	RM&E	Develop plan to protect eelgrass and kelp beds where they occur. Plan should focus on sediment reduction where needed.	Estuary and Nearshore Processes and Habitat Conditions	Low	WSI Recovery Strategy 1	1	WSI Recovery Goal 1	Not Defined		
WSI	WSIRA#2	RM&E and HRA	Evaluate impacts bulkheads constructed near Whiskey Creek, reduce or eliminate potential negative impacts.	Estuary and Nearshore Processes and Habitat Conditions	Low	WSI Recovery Strategy 2	1/3/4	WSI Recovery Goal 1	Not Defined		
WSI	WSIRA#3	HRA	Restore the mouths of Jim and Joe Creeks by reducing sediment transport to estuary. Remove or reduce impacts of breakwaters near the mouth of Jim Creek. Discontinue dredging in this area.	Estuary and Nearshore Processes and Habitat Conditions	Low	WSI Recovery Strategy 1, 2	1/3	WSI Recovery Goal 1	Not Defined		
WSI	WSIRA#4	HRA	Develop and implement plan to restore habitat conditions in the Sail River estuary.	Estuary and Nearshore Processes and Habitat Conditions	Low	WSI Recovery Strategy 1, 2	1/3/4	WSI Recovery Goal 1	Makah Tribe		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
WSI	WSIRA#5	HRA	Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.	Estuary and Nearshore Processes and Habitat Conditions	Low	WSI Recovery Strategy 3	1	WSI Recovery Goal 1	Not Defined		
WSI	WSIRA#6a	HRA	Within the Colville Creek subbasin a perched culvert (SR112 MP 56.5) in tributary 19.0003 potentially blocks 2.0 miles of coho, steelhead, and cutthroat habitat. Upon confirmation of barrier and upstream habitat, replace culvert with stream crossing structure that allows for better fish passage and sediment transport capacity.	Habitat connectivity	Medium	WSI Recovery Strategy 5	2	WSI Recovery Goal 2	WDOT		
WSI	WSIRA#6b	HRA	Within the Colville Creek subbasin a culvert (Oxenford Road) in tributary 19.0001a potentially blocks 0.7 miles of coho, steelhead, and cutthroat habitat. Upon confirmation of barrier and upstream habitat, replace culvert with stream crossing structure that allows for better fish passage and sediment transport capacity.	Habitat connectivity	Medium	WSI Recovery Strategy 5	2	WSI Recovery Goal 2	Clallam County		
WSI	WSIRA#6c	HRA	Whiskey Creek (RM 1.5), a 40% barrier at box culvert SR 112 MP 49.5 blocks 1.2 miles of coho steelhead, and cutthroat habitat. This documented blockage requires field verification of fish passage conditions above and below the culvert prior to restoration planning. Upon confirmation of barrier and upstream habitat, replace culvert with stream crossing structure that allows for better fish passage and sediment transport capacity.	Habitat connectivity	Medium	WSI Recovery Strategy 5	2	WSI Recovery Goal 2	WDOT		
WSI	WSIRA#6d	HRA	At the mouth of an unnamed stream located between Deep Creek and West Twin River, a recently installed corrugated metal pipe associated with SR 112 near MP 34.8, blocks about 0.5 miles of coho, steelhead, and cutthroat habitat. Upon confirmation of barrier and upstream habitat, replace culvert with stream crossing structure that allows for better fish passage and sediment transport capacity.	Habitat connectivity	Medium	WSI Recovery Strategy 5	2	WSI Recovery Goal 2	WDOT		
WSI	WSIRA#6e	HRA	In Jim Creek at RM 0.1. a partial barrier culvert on a private road blocks several miles of habitat in Jim Creek (source: DOT culvert database). Replace with structure that allows for better fish passage.	Habitat connectivity	Medium	WSI Recovery Strategy 5	2	WSI Recovery Goal 2	Private Landowner?		
WSI	WSIRA#6f	HRA	In Joe Creek at RM 0.5, a 60% passable box culvert on SR 112 MP 32.8 blocks about one mile of coho, steelhead, and cutthroat habitat, based upon database documentation. Upon confirmation of barrier and upstream habitat, replace culvert with stream crossing structure that allows for better fish passage and sediment transport capacity.	Habitat connectivity	Medium	WSI Recovery Strategy 5	2	WSI Recovery Goal 2	WDOT		
WSI	WSIRA#6g	HRA	A barrier at the Pillar Point access road culvert blocks about 0.8 miles of coho, steelhead, and cutthroat habitat at the mouth of Butler Creek. Upon confirmation of barrier and upstream habitat, replace culvert with stream crossing structure that allows for better fish passage and sediment transport capacity.	Habitat connectivity	Medium	WSI Recovery Strategy 5	2	WSI Recovery Goal 2	DNR		
WSI	WSIRA#6h	HRA	Double 30" culverts (SR 112 MP 29.7)form an 80% barrier partially blocking about 0.5 miles of coho, steelhead, and cutthroat habitat in Butler Creek (19.0112 RM 0.3). Upon confirmation of barrier and upstream habitat, replace culvert with stream crossing structure that allows for better fish passage and sediment transport capacity.	Habitat connectivity	Medium	WSI Recovery Strategy 5	2	WSI Recovery Goal 2	WDOT		
WSI	WSIRA#6i	HRA	In a left bank tributary to the Sail River (near RM 0.1), a culvert blocks at least 0.4 (2-4% gradient) miles of coho, steelhead, and cutthroat habitat. Replace culvert with stream crossing structure that allows for better fish passage and sediment transport capacity.	Habitat connectivity	Medium	WSI Recovery Strategy 5	2	WSI Recovery Goal 2	Makah Tribe		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
WSI	WSIRA#6j	HRA	On Village Creek (19.0240) near RM 0.25, a 185' long perched culvert blocks 0.32 miles of coho, steelhead, and cutthroat habitat (0.23 miles of 2-4% gradient, moderately confined and 0.09 miles of 4-8% gradient, confined channel. Replace culvert with stream crossing structure that allows for better fish passage and sediment transport capacity.	Habitat connectivity	Medium	WSI Recovery Strategy 5	2	WSI Recovery Goal 2	Makah Tribe		
WSI	WSIRA#7	PA	Advocate for implementation of the Hatchery Scientific Review Group (HSRG) recommendations set for forth in the 2004 Hatchery Reform Report (HSRG 2004).	Biological Processes	High	WSI Recovery Strategy 6	1	WSI Recovery Goal 3	WDFW and Tribes		
WSI	WSIRA#8	PA	Advocate for the adoption of harvest management regulations that ensure salmonid spawning escapement is sufficient to maintain, protect, and/or restore VSP parameters.	Biological Processes	High	WSI Recovery Strategy 7	1	WSI Recovery Goal 3	WDFW and Tribes		
WSI	WSIRA#9	PA	Implement and/or continue to implement population abundance monitoring.	Biological Processes	High	WSI Recovery Strategy 7	1	WSI Recovery Goal 3	WDFW and Tribes		
WSI	WSIRA#10	HRA	Reforestation of riparian forest and wetlands associated with flood plains to improve hydrologic processes related to flood capacity within the flood plain areas.	Hydrologic Processes	Unknown	WSI Recovery Strategy 8	3	WSI Recovery Goal 4	Various		
WSI	WSIRA#11	HRA	Reduce road related hydrologic impacts by reducing road densities and/or disconnecting road systems from the stream network.	Hydrologic Processes	Unknown	WSI Recovery Strategy 8	3	WSI Recovery Goal 4	Various		
WSI	WSIRA#12	PA	Limit future water withdrawals from WSI tributaries through the implementation of the WRIA 19 Watershed Plan (WRIA 19 Planning Unit 2010).	Hydrologic Processes	Unknown	WSI Recovery Strategy 8	1	WSI Recovery Goal 4	DOE		
WSI	WSIRA#13	RM&E and HRA	Inventory roads for maintenance (use existing RMAP and other available data), side cast removal, and drainage structure improvements. Prioritize for project actions.	Sediment Processes	Unknown	WSI Recovery Strategy 9, 10	3	WSI Recovery Goal 5	Various		
WSI	WSIRA#14	HRA	Reforest riparian and floodplain areas to increase stream bank integrity and reduce bank erosion.	Sediment Processes	Unknown	WSI Recovery Strategy 13	3	WSI Recovery Goal 5	Various		
WSI	WSIRA#15	RM&E	Few riparian and floodplain habitat data are available for WSI subbasin streams. Collecting additional data where data are lacking could help identify areas in need of riparian restoration.	Riparian and Floodplain Processes and Conditions	Medium	WSI Recovery Strategy 12, 13	1	WSI Recovery Goal 6	Not Defined		
WSI	WSIRA#16	HRA	Conversion of fields and non-forested riparian areas back to fully functional riparian forests. Target streams should include Colville, Whiskey, and Field creeks.	Riparian and Floodplain Processes and Conditions	Medium	WSI Recovery Strategy 12, 13	3	WSI Recovery Goal 6	Various		
WSI	WSIRA#17	HRA	Implement recommendations from the Western Strait Habitat Conservation Plan (Haggerty and NOLT 2011), which prioritizes important habitats that could benefit from conservation easements or acquisition.	Riparian and Floodplain Processes and Conditions	Medium	WSI Recovery Strategy 13	1	WSI Recovery Goal 6	Not Defined		
WSI	WSIRA#18	RM&E and PA	Map and delineate channel migration zones within the WSI sub-basins.	Riparian and Floodplain Processes and Conditions	Medium	WSI Recovery Strategy 13, 14	1	WSI Recovery Goal 6	Clallam County		
WSI	WSIRA#19	PA	Advocate for and support a WRIA 19 representative of the North Olympic Peninsula Lead Entity (NOPLE) to participate in the Forest and Fish policy group. Individual would provide a conduit for information between the forest practices AM program and the salmon recovery efforts of NOPLE.	Riparian and Floodplain Processes and Conditions	Medium	WSI Recovery Strategy 14	na	WSI Recovery Goal 6	NOPLE		
WSI	WSIRA#20	RM&E and HRA	Conduct detailed instream meso-habitat mapping inventory and assessment. Implement wood supplementation in identified wood deficient zones from the habitat mapping assessment.	Habitat and LWD Conditions	Medium	WSI Recovery Strategy 15, 16	1/3/4	WSI Recovery Goal 7	Not Defined		

Watershed	Action ID	Action Type	Action Description	Primary Watershed Process Addressed	Process-Input-Condition Impairment Rating	Primary Recovery Strategy Addressed	Recovery Action Hierarchy	Recovery Goal	Lead Agency	Action Priority	Comments
WSI	WSIRA#21	RM&E	Implement long-term surface water quality monitoring program (e.g., temperature, dissolved oxygen, pH, conductivity, turbidity, BIBI). Also include monitoring of hydrocarbons and other potential contaminants.	Water Quality Conditions	Unknown	WSI Recovery Strategy 17	1	WSI Recovery Goal 8	Not Defined		
WSI	WSIRA#22	PA	Advocate for effective implementation and enforcement of Forest Practice Rules and County Critical Areas Ordinances.	Water Quality Conditions	Unknown	WSI Recovery Strategy 18	na	WSI Recovery Goal 8	DNR and Clallam County		