A photograph of a stream flowing through a forest. The water is white and foamy as it flows over numerous moss-covered rocks. The surrounding forest is dense with green foliage and ferns. The top of the image has a green horizontal band.

State of the Waters of Clallam County: 2004

*A Report on the Health
of
Our Streams & Watersheds*

*Clallam County
Department of Community Development*

June 2004



State of the Waters of Clallam County, 2004

A Report on the Health of Our Streams & Watersheds

*Clallam County
Department of Community Development*

June 2004

*Major funding provided by a Centennial Clean Water Fund Grant
from the Washington State Department of Ecology*

ACKNOWLEDGEMENTS

- Text, editing, layout, design, and analysis for habitat integrity**—————Linda Newberry, *Newberry Environmental*, Pagosa Springs, CO
- Project management, editing, data analysis**—————Ann Soule, Clallam County Environmental Health Services
- Digital printing**—————Printery.com, Port Townsend, WA
- Photos and drawings**—————*Streamkeepers of Clallam County's* library, except the following: *Cover*—Josey Paul; *Back Cover*—Lower Elwha Klallam Tribe; *Chapter 3 Cover*—Jamestown S'Klallam Tribe
- Maps**—————Tom Shindler, Clallam County Dept. of Community Development
- Design of CCWQI Rating Methods and Uncertainty Analysis**—————Ann Soule, Pat Crain, Valerie Streeter & Ed Chadd of Clallam County; *with input from:* Debby Sargeant, WA Dept. of Ecology; James Karr, University of Washington; Brad Shae, Westech Co.
- Database reporting**—————Walter Johnson
- Data and/or technical review**—————*Streamkeepers of Clallam County*; Mike McHenry & David Corpuz, Lower Elwha Klallam Tribe; Katie Krueger, Quileute Tribe; Lori DeLorm, Hansi Hals & Lyn Muench, Jamestown S'Klallam Tribe; Phillip DeCillis, Olympic National Forest; David Lawes & Jeff Shellberg, Makah Indian Tribe; Ed Chadd, Pat Crain, Cathy Lear, Valerie Streeter & Andy Brastad, Clallam County
- The authors gratefully acknowledge these individuals for sharing their science in the spirit of bringing the richness of environmental science to everyone, in his or her home watershed.*

Major grant funding for this project was from the Centennial Clean Water Fund, administered by the WA Dept. of Ecology, with a 25% match from Clallam County.

Please cite this report as: Clallam County. 2004. State of the Waters of Clallam County, 2004: A Report on the Health of Our Streams & Watersheds. Clallam County Department of Community Development. Port Angeles, Washington.

This report is not copyrighted, and parts or all of it may be used with proper credit and citation.

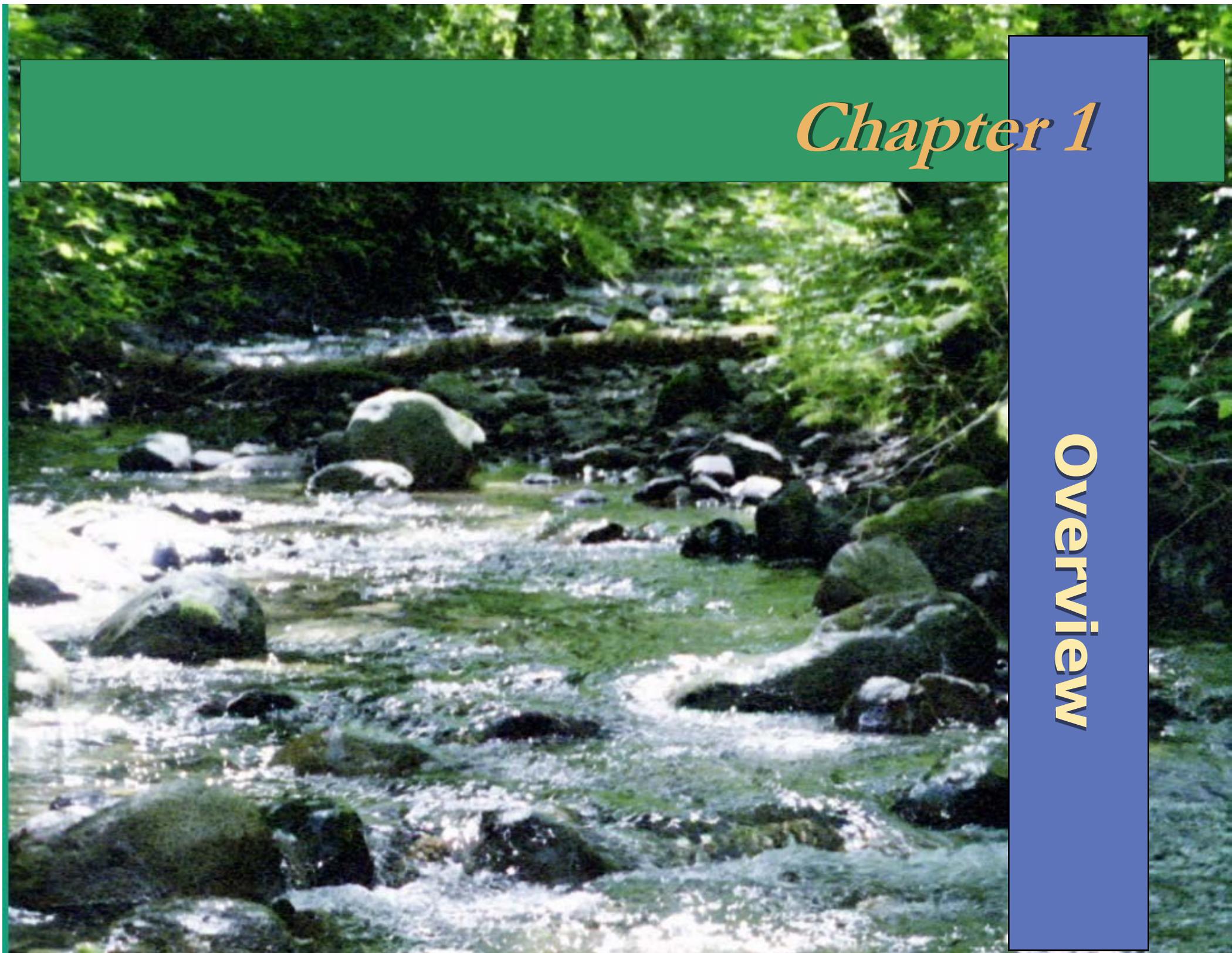
Cover Photos: *Front cover*—Confluence of Sadie Creek with East Twin River; *left of Table of Contents*—the mouth of Bell Creek; *Chapter 1 Title page*—Ennis Creek; *Chapter 2 Title page*—Jimmycomelately Creek restoration/revegetation 7/21/03; *Chapter 3 Title page*—Lake Creek, *Back cover*—Elwha River chinook.

Table of Contents

Chapter 1 <i>Overview</i>	1
Chapter 2 <i>Health Assessments</i>	9
Chapter 3 <i>Streams & Rivers by Watershed</i>	17
<i>Map:</i> Pacific Coast Drainages	18
<i>Map:</i> Western Strait Drainages.....	30
<i>Map:</i> Central Strait Drainages	42
<i>Map:</i> Elwha River Watersheds & Port Angeles Area Streams	54
<i>Map:</i> Greater Dungeness River Watershed	74
<i>Map:</i> Sequim Bay Drainages	100
Appendices	A1
A. Glossary & Acronyms	A2
B1. Clallam County Water Quality Index.....	A4
B2. Clallam County Water Quality Index Report for Streamkeepers Data.....	A8
C1. 10-Metric B-IBI Stream Health Scoring Method.....	A18
C2. B-IBI Report for Streamkeepers Data.....	A20
D. Habitat Integrity Ratings	A25
E. Uncertainty Analysis for Health Ratings	A26
F. Washington State Freshwater Surface Water Quality Standards.....	A30
G. 1998 303(d) List for Water Quality-Impaired Streams in Clallam County	A31
H. References.....	A32

Chapter 1

Overview



State of the Waters ~ Overview

Background & Purpose



The waters of Clallam County are varied, in some cases provide abundant resources for fish, wildlife and humans. In others, their quality has been diminished by human activities. They provide recreational, aesthetic, economic and ecological benefits for citizens and visitors. A recent study in Washington found that one-third of all outdoor recreational activities involved fresh or salt water resources. In Clallam County, recreational as well as commercial uses of these waters have always been important, including boating, fishing, and shellfish harvesting. The County's rivers, creeks, lakes, wetlands and estuaries provide habitat for a diversity of fish and wildlife species, including many different stocks of salmonids. Its groundwater aquifers supply drinking water as well as baseflow to most streams and wetlands.

The purpose of this ground-breaking report is to serve as a preliminary evaluation or "report card" to enable citizens in Clallam County to understand and evaluate the health of their individual watersheds. It is the first of its kind to report the current status of water quality and habitat conditions in a non-technical report, from the west end of the County to the east end. This synopsis of most of the County's freshwater resources enables watershed citizens to comprehend the causes and sources of any problems, and decision-makers and managers to develop effective management strategies and to support future monitoring efforts.

Organization of the Report

This document is divided into three chapters:

Chapter One: Overview is a summary of the purpose and content of the report, with a brief description of the County's watersheds, an explanation of water quality standards, and methods used for assessing watershed health, descriptions of probable contaminants and sources, as well as what the ratings mean to individual watershed citizens.

Chapter Two: Health Assessments describes the monitoring, measures and rating methods used to assess the condition of each river basin in Clallam County. This includes the physical, chemical and biological measures of a watershed's health, what these are, and why they are important to watershed residents. It introduces criteria and ratings of the Clallam County Water Quality Index (CCWQI) and the Benthic Index of Biological Integrity (B-IBI) used to measure stream health, as well as the sources and methods used to estimate habi-

tat integrity.

Chapter Three: Watershed Summaries includes brief watershed descriptions of each river, creek or basin, lists known water quality, biological and habitat integrity by stream (when available), provides a "rating" for each measure, and an "overall rating" for the entire watershed. It also describes what these ratings mean for both fish resources and for humans, and lists particular concerns and recommendations.

The **Appendix** includes a Glossary, the Clallam County Water Quality Index Method and Report, the B-IBI Stream Health Scoring Method and Report, the Habitat Integrity Rating Method, the Uncertainty Analysis Method, the State Water Quality Standards, the 1998 303(d) List for Water Quality-Impaired Streams in Clallam County, and References.

Clallam County Watersheds

The rivers and drainage basins are presented in this report geographically, starting in the southwest corner of the County on the Pacific Ocean, moving north up to the Strait of Juan de Fuca, and east across the Strait to the eastern edge of the County. The watersheds are grouped as follows:

- *Pacific Coast Drainages*
- *Western Strait Drainages*
- *Central Strait Drainages*
- *Elwha River System & Port Angeles Area Streams*
- *Greater Dungeness River Watershed*
- *Sequim Bay Drainages*

All of these rivers, streams and creeks flow from the Olympic Mountains that form the core of Washington's Olympic Peninsula. The heart of the peninsula has been preserved as Olympic National Park, and has been described as "more than 1,400 square miles of rugged mountains, richly forested river valleys, and pristine wilderness coast." For more than a century, the forests of the Olympics were prized by lumbermen and other residents for their record-size trees. Because of the richness of these forests, logging and other development have left a legacy of impacts on both habitat and water quality across the peninsula. While each stream has its own distinctive characteristics, some qualities are common on the streams described here. Unless in the rainshadow of the Olympics, the watersheds generally have abundant rainfall in the winter that can result in hydrologic stress, especially if the stream is in a disturbed condition. Those streams originating high in the mountains often descend rapidly, then flow across a lower elevation floodplain, before entering salt water in the ocean or strait. Geologic conditions provide for sediment-rich streams, with natural landslides regularly occurring on many peninsula rivers. When these streams were heavily forested, erosion usually proceeded at a more periodic rate. Once logged, especially in the steep upper watersheds, the amount of sediment entering the streams accelerated, often causing severe downcutting, failing banks,

blockages, and excessive fine sediments instream, causing problems for aquatic wildlife, including spawning and rearing salmon.

Two major types of human impacts have occurred to floodplain functions on peninsula streams. **First**, many channels have been disconnected from their floodplains. **Second**, many of the peninsula streams have lost their rich, deep riparian streamside corridors, which in the past provided shading, instream habitat, filtering, and aquatic food resources. Once removed, these benefits were no longer provided for fish, wildlife and water quality; many streams now have either minimal or no forest cover, and limited or poor-quality large woody debris instream, resulting in poor channel habitat, increased summer water temperatures, low dissolved oxygen and excessive turbidity. Other floodplain impacts on some of these streams include dams, diking, channelization, riparian roads, animal access and other effects of development. While some of the streams on the peninsula still maintain healthy ecosystems, the majority of them have been compromised by human activities.

These directly impact the quality of the water, which, in turn, impacts both fish and wildlife resources as well as human uses in the watershed.

Measuring and Reporting Watershed Health

All organisms that occupy the waters in the Pacific Northwest—fishes, invertebrates, algae and microorganisms—evolved life histories allowing them to survive, grow and reproduce. They adapted to the natural range of river conditions (for example, water temperature, pH, nutrient levels, seasonal flow patterns, water depth, streambed composition and other habitat features). When any major alteration or degradation of the river environment occurs, the abundance and distribution of many native species may be altered, as has occurred in most Clallam County streams with various stocks of salmonids. Measuring biological degradation helps us understand more about the ability of a stream to protect and sustain native wildlife such as salmon.

In order to gather information on the health of the area waters and ecosystems in a consistent way, and to use that data to understand natural and human-induced changes and develop protective strategies, various standards or methods are being used by the County, Tribes, the State and other organizations across the peninsula. For example, water quality standards exist and it is fairly easy to compare monitoring results from a stream against already-established criteria to see how the stream “measures up.” This would give us part of the answer—how clean the water is on a state or federal yardstick. We would know whether the water is drinkable or swimmable for people, whether there is a contamination problem, and if it is usable for fish and wildlife. In 1972 the U.S. Congress passed the Clean Water Act (CWA), with the objective to “restore and maintain the chemical, physical, and biological integrity of the Nation’s waters.” The goals of the CWA are that people can safely swim in the water and that the water does not threaten the health of fish, shellfish, or wildlife. These are known as the “swimmable and fishable” goals. The swimmable goal is not met when bacteria levels in the water are too high. The fishable goal is not met when toxic metals or chemicals violate state and federal levels

The Federal Clean Water Act of 1972: (33 U.S.C. § 1362)

The CWA requires each state to develop water quality standards that include “designated uses” for specified waters, water quality “criteria” that are sufficient to protect those uses, and an “antidegradation” policy to prevent future contamination. The Washington Department of Ecology (Ecology) recently proposed final standards and submitted them to the U.S. Environmental Protection Agency (EPA) for approval in August, 2003.

Salmon, trout and char spawning, rearing and migration are principal designated uses of Washington waters, including Clallam County streams.

303(d) Lists: The CWA, under Section 303(d), requires states to identify and list polluted waterbodies every two years. Ecology’s most recent “303(d) List” was released in draft form for public review in January 2004.

TMDLs: The EPA requires each state to set priorities and establish plans for cleaning up polluted waters. Water Cleanup Plans, also called Total Maximum Daily Loads or TMDLs, identify pollution problems, allocate maximum allowable pollution from various sources, develop strategies to achieve these limits, and require a monitoring plan to assess effectiveness. The plan’s purpose is to ensure that the impaired water will again meet its intended uses. In Clallam County, a study and plan was completed for the Lower Dungeness River Watershed, and one is now underway for Dungeness Bay.

for protection of aquatic life, or if fish or shellfish habitat has been significantly altered (including streamflow alteration, or the introduction of invasive plants). These goals established the standards for the specific chemical criteria set by the State of Washington, including: fecal coliform bacteria, dissolved oxygen, temperature, turbidity, and pH (see Appendix).

But gathering water quality samples doesn't tell us the full story because we want to know how *healthy* the stream is in the context of its drainage basin or watershed. Just like a blood test cannot indicate every human ailment, a water quality test cannot be used to interpret the overall health of the ecosystem. New methods for assessing biological and physical aspects of watershed health are quickly gaining acceptance. The Benthic Index of Biological Integrity (B-IBI) has emerged as the primary approach to biological monitoring and assessment in the United States, and is used locally by the *Streamkeepers of Clallam County*. This method involves counting the numbers and kinds of bugs ("benthic macroinvertebrates") present at a monitoring site. The idea behind this measurement is that if conditions are healthy, a wide variety of bugs will be present and lots of them! And, since bugs = fish food, we can predict whether the food web is adequate for fish to survive at that site.

Finally, having clean water and plenty of interesting bugs does not guarantee that we have a healthy system (but if the bugs are there, we probably do). Another important aspect of watershed health is its physical habitat. Habitat quality is much harder to measure and compare against objective standards; however, methods are being developed to accomplish this, and soon we will have much better tools with which to objectively evaluate habitat integrity.

This report on the *State of the Waters of Clallam County* tries to capture, in a reader-friendly format, overall watershed health by presenting as much recent information as could be obtained on water quality, biological integrity and habitat integrity. The difficulties in doing this are great: when detail ARE available, they have to be blurred and generalized, and when there ARE NOT many data, assumptions have to be made in order to say anything at all. Indeed, there were not enough data or information to accurately rate many of the watersheds described in *Chapter 3*. Even so, it was believed that it is important to start compiling this information, and present it to the public in this report. In many cases, ratings were developed based on very limited data, with the intent being to disclose what is currently known about the status of the region's surface water. This is meant as a first stage, a preliminary look at how the watersheds are faring, with the promise of ongoing, and hopefully increased monitoring and reporting in the future. These data will be updated periodically in an attempt to develop a clearer picture of the health of the County's watersheds. In the meantime, these ratings will help focus and lead future monitoring efforts, and provide information to develop and support water quality and habitat protection strategies.

Because biological conditions are influenced and determined by many chemical, physical, and biological factors, a strategy emphasizing more than just habitat and the chemical make-up of water is needed in order to support viable fish populations and their prey.

Some areas where current data do not exist or were not accessible at the time of production include: estuaries and marine waters, groundwater, invasive plant problems, and (as seen in Chapter 3), biological and water quality data for several rivers and streams.

Pollutants and Their Probable Sources

Pollutants are defined as specific substances added to waters by human activities as well as the alteration of the chemical, physical, biological and radiological integrity of the water. Such alterations can be caused by pollutants, as well as human impacts such as the alteration of natural flows, loss of riparian habitat, physical habitat alterations such as clear cutting, gravel removal and other in-channel excavation, as well as the introduction of alien and invasive plants or animals (e.g., reed canary grass).

Sources of pollution in the watershed are numerous, varied and sometimes difficult to detect. Surface water runoff can contain a mixture of nutrients, bacteria, sediments, petroleum products, metals and other toxic ingredients. The cumulative effect of these “nonpoint source pollutants” on water quality and aquatic life can be significant. Human alterations to water quality and salmonid habitat can be expected to have different consequences for different fish and wildlife species. Across Clallam County, land use activities associated with forest practices, agriculture, rural and industrial development have had negative impacts on water quality and salmonid habitat.



Streamkeeper volunteers measure streamflow conditions

1. **Excessive sediment** is one of the most common “pollutants” and a major limiting factor for salmonid production across the peninsula. It can cause channel instability, and degrade water quality and salmon habitat. Excess silt in stream gravels can make it difficult for fish to spawn and bugs to survive. Causes of excessive sediment include increased input from landslides, removal of vegetation and other ground-disturbance associated with logging and roads (particularly when built on steep slopes), agricultural practices, and construction activities. On the other hand, **decreased** amounts of gravels (medium-sized “sediment”) suitable for fish spawning is also sometimes a problem, and has been caused by dams, dikes and other floodplain constrictions.

2. **Excessive nutrients** and **bacteria contamination** are relatively common pollutants in peninsula streams, estuaries and groundwater. Food (e.g., shellfish) gathered where fecal coliform bacteria levels are high can be harmful if eaten by humans. It is not known if fecal coliform bacteria is specifically harmful to salmonids, although its presence may indicate that other pollutants are present that are known to be harmful to fish. Excessive nutrients often result in the rapid growth of algae in streams, causing problems for fish (including levels of dissolved oxygen and increased temperatures), and often “aesthetic” problems for humans. This contamination is caused by trampling and unrestricted animal access into riparian corridors or into the stream itself, leaking septic and sewer systems, excessive fertilizers and chemicals applied to the land, as well as general stormwater runoff.
3. **Low flows** cause some salmon to spawn in less stable areas of the stream, possibly increasing the likelihood that fish redds will be washed out during high flow events. Low flows also cause higher water temperatures and lower dissolved oxygen conditions than those needed by many fish and the “high-quality bugs” that salmon need to sustain their populations. Causes of low flows include water withdrawals, the operation of dams and diversions, alteration of floodplains and wetlands, and changes in vegetation patterns.
4. **Flooding** (high water where it wouldn’t have been under normal conditions) can seriously degrade stream channel conditions and bring pollutants into the stream, and eventually out into estuaries and bays. These pollutants are harmful to many species, including humans if they eat shellfish or other food gathered from these waters. Flooding is often due to channelization, routing of stormwater through irrigation systems, the presence of roads and impervious surfaces and increased stormwater from lands where native vegetation has been removed.

What Do the Health Ratings Mean to People & to Fish?

Besides being important for aesthetics and wildlife resources, good water quality and healthy ecosystems are critical for **our** quality of life. Not only do **we** need clean water to drink, safe food to consume, and the lack of bacteria and contaminated water in our communities, salmon on the Olympic Peninsula also need clean, cold, abundant water resources in order to thrive. For the aquatic environment in Clallam County to be considered healthy for both humans and fish, each of the water quality and habitat integrity criteria described in this report needs to be met on a regular and long-term basis. The protection of these resources not only provides people with good food and water, but it is also essential to maintain, and/or restore viable and abundant populations of salmon throughout Olympic Peninsula streams.

Chapter 2

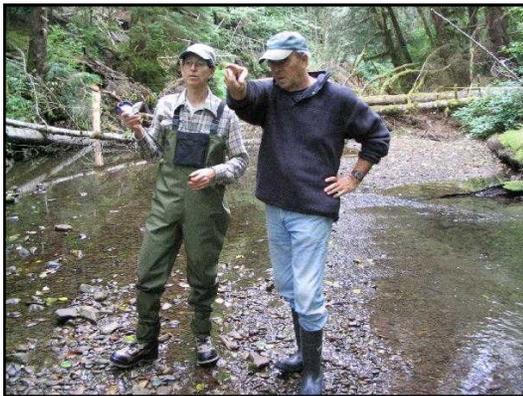
Health Assessments



Monitoring, Measures and Rating Methods

Monitoring

Water quality monitoring, macroinvertebrate sampling and characterizations of habitat conditions are critical to the understanding of watershed health in Clallam County. While governments such as Clallam County and area Tribes, and the Washington Department of Ecology hold the primary responsibility for data collection and analysis, and for meeting required goals, volunteer groups such as the *Streamkeepers of Clallam County* are vital to the effort of collecting information that can help us determine the health of the aquatic ecosystems across the peninsula. The sources of data used in the *water quality* ratings include:



- Clallam County, which maintains the Natural Resources Database with data from *Streamkeepers of Clallam County*, as well as periodic water quality projects conducted by and for the County;
- Washington State Department of Ecology's Environmental Information Management (EIM) database;
- The Jamestown S'Klallam Tribe, which regularly monitors water quality (for bacteria in particular) in the Dungeness and Sequim Bay watersheds;
- The Lower Elwha Klallam Tribe, which provided data on the Elwha River system and Colville Creek;
- The Quileute Tribe, which monitors water quality primarily in the Quillayute watershed; and
- The Olympic National Forest, which collects water quality data as part of preparing watershed analyses for areas with U.S. Forest Service timberlands.

While additional entities such as the Makah Indian Tribe, Clallam Conservation District, and other State agencies also conduct water quality monitoring and may have useful data, these data either were not available or accessible at the time this report was prepared. The majority of ratings are based on data from the past five years; however, sometimes data from as long ago as 1994 were all that were available.

The only source of data available for rating *biological integrity* was from the *Streamkeepers of Clallam County's* counts of macroinvertebrates (e.g., bugs) at various sites around the County.

Finally, *physical habitat integrity* information was primarily derived from the following (see Appendix H for complete citations):

- The "Limiting Factors Analyses" for Water Resource Inventory Areas 17, 18, 19 and 20;
- The "Final Draft WRIA 18 / Elwha-Dungeness Watershed Plan," Chapter 2 (July 2003);
- The "Status of Pacific Salmon & Their Habitats on the Olympic Peninsula, Washington," and
- "Watershed Facts," a page on the Clallam County web site at: www.clallam.net.



Streamkeepers of Clallam County

is a citizen-based watershed monitoring program that provides volunteer opportunities and project assistance in an effort to protect and restore salmon populations. “Stream Teams” complete quarterly water quality and B-IBI monitoring at established sites on Clallam County streams, as well as conduct special projects as needed. Chemical data can give us snapshots of the stream condition at the time of sample collection. Biological data used with chemical monitoring data can give us additional insights into long-term, cumulative impacts to a stream.

These energetic, hard-working volunteers guarantee that data are collected that are invaluable in assessing and protecting the region’s precious resources.

The Streamkeepers train volunteers to assess:

Biological Health—they collect data on benthic macroinvertebrates (stream bugs), fish and wildlife, noxious weeds, and microbiology;

Physical Health—they perform annual “streamwalks,” develop reach maps and a photographic record, gather data on flows, gradients, cross sections, erosion and revetments, substrate and pools, large woody debris, and riparian vegetation;

Chemical Health—they collect data on temperature, dissolved oxygen, conductivity, turbidity, nitrates, pH and fecal coliform data.

Measures: Physical, Chemical and Biological Measures of Watershed Health

The following measures were used to develop ratings of watershed health for Clallam County:

Bacteria is a common contaminate of water. There are many indicators that can be used to measure the amount of bacteria in water, such as fecal coliform bacteria, E. coli bacteria, Enterococci bacteria. All of these indicators measure the amount of bacteria that comes only from the digestive tract of warm-blooded animals, like mammals and birds. The presence of bacteria suggests that feces or sewage may be getting into the water, either from humans, their livestock, pets or wild animals. Since pathogens and viruses travel with bacteria, an increase in the amount of bacteria in the water means that there is an increased risk of disease for the people who swim, wade, drink or eat shellfish from contaminated water. Bacteria do not usually directly cause problems for fish and aquatic invertebrates, but their presence may often indicate other problems, such as low dissolved oxygen.

Water temperature controls the metabolic and reproductive activities for aquatic life. An increase in temperature may mean an increase in metabolic activity, providing conditions for disease-causing organisms and undesirable algae, as well as lowering the amount of instream dissolved oxygen. Weather, streamflow, the amount of intact streamside vegetation, groundwater, industrial inputs, irrigation diversions and human-related stormwater impacts can influence water temperatures. Optimal levels of temperatures for salmonids have been determined, and levels above those can be lethal; salmon eggs, juveniles and spawning adults are especially sensitive to high temperatures.

Dissolved Oxygen is the oxygen that is present in water and therefore available for fish and other aquatic animals to use. The amount of dissolved oxygen is critical and may indicate the presence of other pollutants. Large rivers and streams that have high water volumes or steep channels usually stay well oxygenated. Small streams or streams impacted heavily by water withdrawals may be more easily depleted. Altitude, streamflow, water temperature, quantity and types of plants, and sediment affect dissolved oxygen concentrations in streams. Because oxygen is more easily dissolved in cold water, warm water will hold less oxygen than if it were cold. Human activities such as the removal of riparian plants can cause water temperatures to increase, and dissolved oxygen levels to lower. In addition, nutrients and other organic waste discharged into streams are decomposed by bacteria that uses oxygen in the water, thus leaving less oxygen instream for other aquatic wildlife. Fish and aquatic invertebrates are impaired below certain levels of dissolved oxygen.

The ***pH*** of a water sample is a measure of the concentration of hydrogen ions. pH is measured on a scale from 1 to 14, with 1 being most acidic, 7 neutral, and 14 the most basic or alkaline. The pH of water influences the many chemical interactions that can occur, such as the toxicity of pollutants. An increase or decrease can signal that a pollutant has entered the stream. A decline in pH can result in a reduction in salmon egg production and hatching success, and in the emergence of aquatic insects, important as a food source for fish and other wildlife.

Sediment is a natural component of streams, but excessive sediment from erosion can be carried into streams. Its causes include naturally highly erosive soils, destruction of streamside vegetation, increases in flow velocities, downcutting and/or incision, agricultural and logging practices and urban runoff. Sediment is measured as total suspended solids.

Turbidity is a measurement of the amount of light that is scattered or absorbed in water. Suspended silt and clay, organic matter and plankton can contribute to turbidity. Sediment deposited on the stream bottom can fill gravel spaces, and smother eggs and juvenile fish. It also can increase turbidity and reduce light penetration, reducing the productivity of aquatic vegetation and invertebrates. The ability of salmon to find and capture food is impaired in turbid conditions.

Nitrate-nitrogen and **phosphorus** are basic nutrients required for plant growth, usually occurring at low levels in surface waters. High levels can result from fertilizers and the breakdown of organic matter (including animal waste) in excessive amounts. Excessive nutrients over-stimulate plant growth, leading to increased algae blooms and rapid growth of other plants, causing the over-enrichment of water bodies (eutrophication). Phosphorus occurs in natural waters; excessive amounts can occur from fertilizers, detergents, cleaning agents, sewage and food residues, soil erosion and decomposing vegetation in groundwater. Salmon and trout are sensitive to increased nitrogen levels, and ammonia (an unstable form of nitrogen) can be toxic to fish. Nitrates are also a concern for humans in groundwater used for drinking.



Benthic Macroinvertebrates, or those small bugs living on rocks and in stream channels are critical as food sources for many aquatic wildlife, including salmonids, other fish and birds. By collecting, classifying by taxa, and counting these macroinvertebrates, a determination can be made about the health of the stream. Some bugs need cold, clear water to survive, as do salmon (e.g., mayflies, caddis flies and stoneflies). These types of aquatic insects are those that are preferred by salmonids, while some other species of fish can eat insects that tolerate warmer stream temperatures, and themselves may be able to tolerate some types of pollution (e.g., low dissolved oxygen and turbid conditions).



Methods: About the Health Ratings

After reviewing several examples of ratings and indexes of watershed health developed in the state and across the nation, Clallam County decided to borrow and/or design techniques that would make use of as much environmental data and information as were available, reliable, pertinent and current (preferably within five years but no older than 10). Water quality, biological conditions and habitat integrity were rated according to the following scale:

Healthy: Ecologically intact; no known significant impacts to human health or salmonid populations or lifestages.

Compromised: Showing signs of degradation; slight exceedance of human health-based water quality standards; impacts to one or more salmonid life-stages.

Impaired: Not likely to support self-sustaining salmon populations; exceedance of human health-based water quality standards.

Highly Impaired: Highly adverse to salmon and possibly other life-forms; substantial exceedance of human health-based water quality standards.

Critically Impaired: Unable to support a variety of once-native life forms; exceeding any human health-based water quality standard by 100% or more.

These ratings are reported in Chapter 3, in a rating box—one for each watershed in Clallam County.



Streamkeeper volunteers update the database weekly

How to Read the Rating Boxes in Chapter 3

Water quality ratings for various sites on a stream are listed here (RM = River Mile). These were calculated using water temperature, dissolved oxygen and fecal coliform data using the Clallam County Water Quality Index (CCWQI). Appendix B1 contains details of this method.

The level of confidence in the ratings is stated here, to assist the reader in assessing how much certainty to place in the ratings. A specific analysis was used to assign confidence, as described in Appendix E.

***Current Overall Health Based on Information Below:
Salt Creek—COMPROMISED***

1. Water quality conditions according to CCWQI = HEALTHY

Salt Creek	RM	1.4 = 4.5 (healthy)
		1.5 = 4.5 (healthy)
		4.2 = 5.0 (healthy)
		5.4 = 4.5 (healthy)
		6.9 = 5.0 (healthy)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): HIGH CONFIDENCE

2. Biological conditions according to B-IBI = COMPROMISED

Salt Creek	RM	1.5 = 38 (compromised)
		4.2 = 45 (compromised)
		5.4 = 38 (compromised)

OVER-ALL B-IBI CONFIDENCE RATING: HIGH CONFIDENCE

3. Habitat integrity in Salt Creek, according to LFA 19 and CC Watershed Facts = COMPROMISED

Habitat concerns include:

- a. Excessive sediment input impacting streams
- b. Lack of sufficient and quality LWD
- c. Impacts of estuarine habitat alteration; loss of wetlands
- d. Road impacts

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: MODERATE CONFIDENCE

The over-all health rating is the average of the ratings for the three factors below: water quality, biological conditions and habitat integrity.

Biological conditions are rated for various stream sites (RM = River Mile) using the Benthic Index of Biological Integrity (B-IBI). Appendix C1 describes this rating method.

Habitat integrity ratings are qualitative estimations based on available literature (listed on pg. 10). Specific habitat concerns are also listed here. Appendix D contains a more detailed description.



*“Biological assessments [such as the B-IBI] provide direct measures of the cumulative response of the biological community to all sources of stress: they measure the condition of the aquatic resource to be protected. Therefore, **biocriteria** set the biological endpoint, or target, to which **water quality** should be managed . . . Credible assessments of biological condition can be accomplished with far fewer samples than with parameter-specific [water quality] monitoring.”*

~U.S. EPA, July 21, 2003, “Guidance for 2004 Assessment, Listing and Reporting Requirements Pursuant to Section 303(d) and 305(b) of the Clean Water Act.

Chapter 3

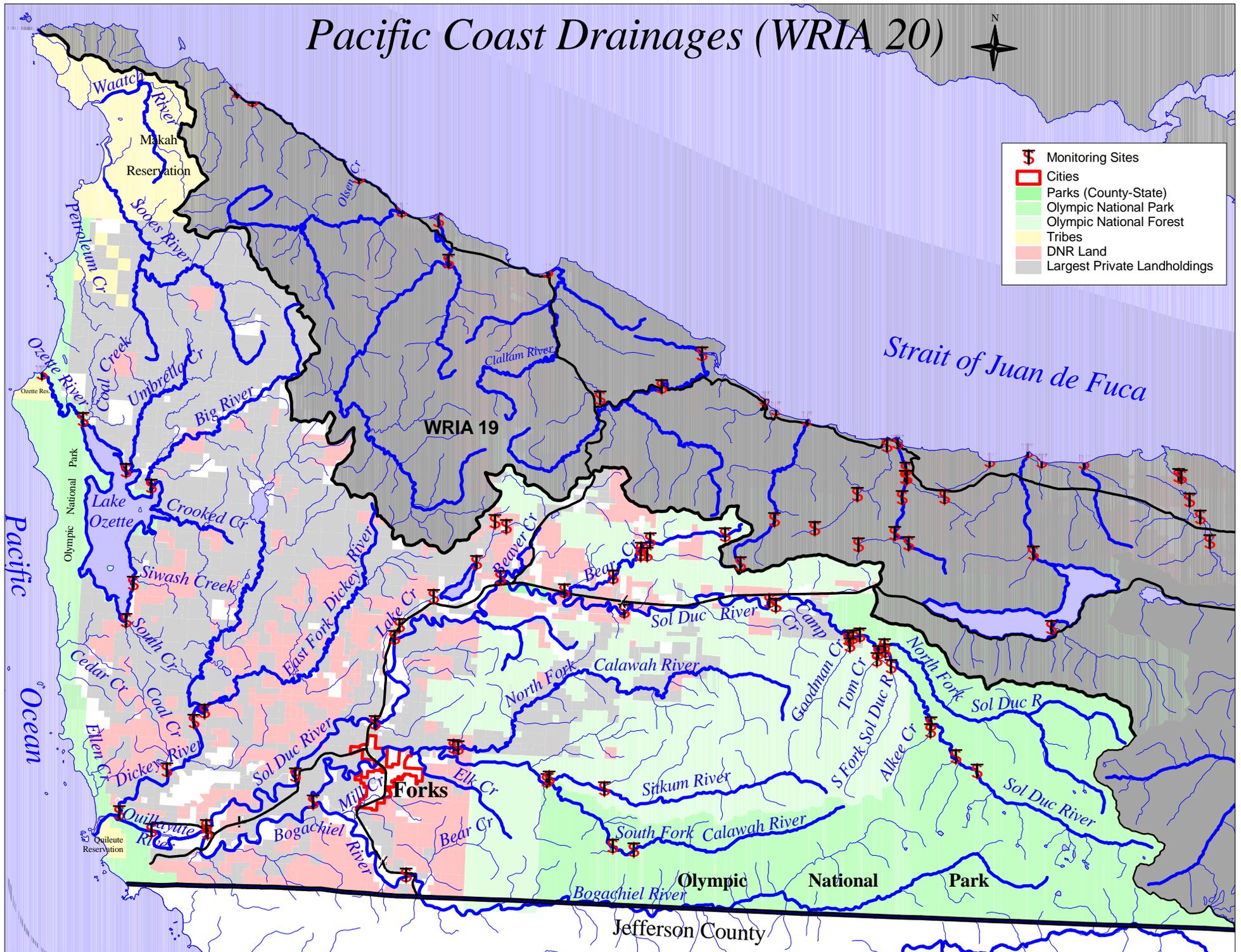
Streams & Rivers by Watershed



Pacific Coast Drainages (WRIA 20)



- Monitoring Sites
- Cities
- Parks (County-State)
- Olympic National Park
- Olympic National Forest
- Tribes
- DNR Land
- Largest Private Landholdings



PACIFIC COAST DRAINAGES

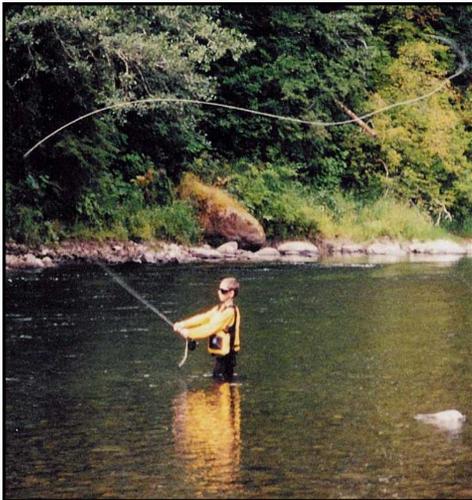
WRIA 20

- *Quillayute River*
 - ◊ *Dickey River*
 - ◊ *Sol Duc River & Tributaries*
 - North Fork, South Fork, Alckee, Bear, SF Bear,*
 - Beaver, Camp & Lake Creeks, Goodman & Tom Creeks*
 - ◊ *Bogachiel River*
 - ◊ *Calawah River*
 - South Fork, North Fork, Sitkum*
- *Ozette River Watershed*
 - Ozette & Big Rivers, Coal, Crooked, Siwash,*
 - South & Umbrella Creeks & Ozette Lake*
- *Sooes Basin*

State of the Waters ~ Quillayute River Watershed: Quillayute, Dickey, Sol Duc, Bogachiel & Calawah Rivers & Tributaries

General Description:

The Quillayute River is a broad, low-gradient river, extending for 5.6 miles in the lowest reaches of the greater Quillayute watershed—the largest basin in Clallam County. Four large river basins feed into the Quillayute River and comprise the majority of the watershed; these are the Dickey, Sol Duc, Bogachiel and Calawah Rivers. The Dickey River sub-basin, containing Dickey Lake, is 108 square miles, entering the Quillayute River at RM 1.6. The Sol Duc River sub-basin (226 square miles) contains Lake Pleasant, developed with residential and recreation areas. Hwy. 101, the major transportation route for the Western Olympic Peninsula, follows this scenic river valley. The confluence of the Sol Duc River and the Bogachiel River (sub-basin area 162 square miles) is located at the upper extent of the Quillayute River at RM 5.6. The City of Forks sits on the Forks Prairie near the confluence (forks) of the Calawah River with the Bogachiel, around RM 10. Mill Creek is a small tributary to the Bogachiel that flows through the City. Groundwater from the Forks Prairie aquifer supports local development and the City. The Calawah River sub-basin has an area of 133 square miles. Land ownership in the Quillayute watershed includes Olympic National Forest, Olympic National Park, the Quileute Tribe (around the Quillayute River mouth), Washington Dept. of Natural Resources, Clallam County, City of Forks, and private landowners.



Fly fishing on the Sol Duc

*Health ratings
for the
Quillayute
Watershed start
on page 22.*

Primary human activities in all sub-basins of this watershed include: forestry, tourism, and residential and commercial development, the majority of which is in the City of Forks. Some of the known impacts of clear-cutting timber and road development (such as has been practiced in this watershed) include increased runoff (causing erosion and movement of dirt and soil into streams and estuaries), and increased streamflow (which scours out existing channels). Some roads in this watershed closely parallel the streams and act as dikes, disconnecting potential off-channel habitat and increasing sediment inputs into the stream.

Typical environmental impacts of tourism and development include nonpoint source pollution (see Chapter 1 for information), increased runoff due to increased impervious surfaces and vegetation removal, and alterations to the flora, fauna and natural habitat in general.

What do the health ratings mean to people?

While it is hard to generalize across such a large watershed, certain similarities exist in these rivers: conditions on stream reaches in Olympic National Park are generally better than those outside the Park. Most development in this watershed draws groundwater as a drinking

water source; the safety of community supplies is tested according to state regulations. There are no known groundwater contamination problems, however, the only data that has been collected has been by water purveyors for the purpose of compliance with state regulations.

What do the health ratings mean to fish?

Habitat integrity for all Quillayute sub-basins was rated as impaired due to specific problems. On the other hand, most stocks of salmonids are surviving. Water quality and biological conditions were often rated as compromised. The 303 (d) listings for increased water temperature and dissolved oxygen show that water quality degradation has occurred in these rivers. Salmon need cold temperatures and lots of dissolved oxygen to thrive, and these poor conditions will add to the stress caused by other environmental factors. Fine sediment in streams fills up the “interstitial” spaces between the gravel that fish need for spawning and feeding, and therefore negatively impacts the survival success of salmon.

Excessive sedimentation is a problem in the No.

Fork Calawah, the lower Bogachiel, the Dickey, as well as in numerous small tributaries, where fine sediments are generally high, with some stream banks collapsing, causing debris flows. Sedimentation and incision is worsened by high precipitation levels, lack of LWD, and road surfacing materials. Other sediment sources are logging, wildfires and subsequent salvages after the burns. In some of the rivers severe aggradation has occurred. Past alterations have impacted wetland habitat in some areas. Natural mass wasting occurs on several systems, including the Calawah and Sol Duc and contributes the greatest volume of sediment to the river.

PARTICULAR CONCERNS

(generalized for entire region)

- Excessive sedimentation and/or aggradation in many stream reaches
- Warm stream temperatures; compromised water quality in tribs. and smaller rivers
- Lack of protection from erosion and degraded habitat from lack of large woody debris (LWD)
- Loss of wetlands functions
- Degraded riparian habitat, from road development
- Inaccessible off-channel habitat
- Lack of data on biological conditions

RECOMMENDATIONS

(generalized for entire region)

- Address blockages for fish passage
- Leave large wood where it exists in the floodplain
- Maintain and conserve off-channel habitat
- Protect beaver population which provide important habitat and water quality functions
- Increase LWD to increase nutrient cycling & prevent erosion, provide habitat for fish, and to reduce stream velocity
- Reduce riparian roads and/or their impacts; improve roads and route sediment out of channels
- Revegetate open riparian areas/protect riparian zones
- Address sediment sources
- Reduce water velocity in Quillayute River
- Start monitoring biological conditions
- Report habitat integrity for areas not covered by Watershed Analyses

Current Overall Health Based on Information Below:

Quillayute River (mainstem)—IMPAIRED

1. Water quality conditions according to CCWQI = IMPAIRED

Site 7 = 2.5 (impaired)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): MODERATE

Quillayute River is on the 303(d) list for dissolved oxygen and temperatures.

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST. The LFA listed biological conditions as good.

3. Habitat integrity overall, according to the LFA WRIA 20 and CC Watershed Facts = IMPAIRED TO HIGHLY IMPAIRED

Habitat concerns include:

- a. Riparian roads forming dikes, disconnecting habitat, and sedimentation
- b. Lack of LWD in the mainstem
- c. Warm temperatures
- d. Estuarine habitat is altered, extremely limited and impacted by upstream problems

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: MODERATE

Current Overall Health Based on Information Below:

Dickey River—IMPAIRED

1. Water quality conditions according to CCWQI = COMPROMISED

Dickey RM 0.15 = 4.0 (compromised)
(approx) 7.50 = 3.3 (impaired)

E. Fork RM 0.00 = 5.0 (healthy)

Coal Crk RM 0.00 = 5.0 (healthy)
(Dickey trib.)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): MODERATE

E. Fork Dickey River & Coal Crk. are on the 303(d) list for temperature

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity overall, according to the LFA WRIA 20 and CC Watershed Facts = IMPAIRED TO HIGHLY IMPAIRED

Habitat concerns include:

- a. Blockages for fish passage
- b. Riparian roads forming dikes, disconnecting habitat, and sedimentation
- c. Collapsing banks add sediment and degrade habitat
- d. Fine sediments are high, resulting in poor spawning habitat quality and quantity
- e. Lack of LWD in some reaches
- f. Warm temperatures
- g. Wind-thrown trees resulting in degraded riparian corridors, lack of buffers

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: MODERATE

***Current Overall Health Based on Information Below:
Bogachiel River—IMPAIRED/COMPROMISED***

1. Water quality conditions according to CCWQI = HEALTHY

Bogachiel River RM 00.0 = 5 (healthy)
15.0 = 5 (healthy)

OVER-ALL CCWQI CONFIDENCE RATING: MODERATE CONFIDENCE

**2. Biological conditions according to B-IBI = AMPLE DATA
DO NOT EXIST**

**3. Habitat integrity overall, according to the LFA WRIA 20
and CC Watershed Facts = IMPAIRED TO HIGHLY
IMPAIRED (*lacking specific data regarding many habitat conditions*)**

Habitat concerns include:

- a. Poor riparian conditions
- b. Excessive aggradation of sediment
- c. Collapsing banks add sediment and degrade habitat
- d. Lack of LWD
- e. Floodplain impacts; encroaching development, particularly SR 110
- f. Warm temperatures, 303(d) listing for temperature & dissolved oxygen.

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: MODERATE
CONFIDENCE

***Current Overall Health Based on Information Below:
Calawah River—IMPAIRED***

1. Water quality conditions according to CCWQI = COMPROMISED

Calawah RM 0.0 = 5.0 (healthy)
S. Fk. Calawah RM 5.0 = 5.0 (healthy)
6.0 = 2.0 (highly impaired)
N. Fk. Calawah RM 0.4 = 5.0 (healthy)
0.5 = 5.0 (healthy)
Sitkum River RM 0.0 = 5.0 (healthy)
0.1 = 2.5 (impaired)
2.8 = 4.0 (compromised)

OVER-ALL CCWQI CONFIDENCE RATING: HIGH CONFIDENCE

**2. Biological conditions according to B-IBI = AMPLE DATA DO
NOT EXIST.**

**3. Habitat integrity overall, according to the LFA WRIA 20 and CC
Watershed Facts = IMPAIRED TO HIGHLY IMPAIRED**

Habitat concerns include:

- a. Excessive sedimentation
- b. Channel instability
- c. Lack of LWD
- d. Floodplain impacts; retaining pool refuges in summer
- e. Warm temperatures, 303(d) listings for temperatures/dissolved oxygen

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: MODERATE
CONFIDENCE

***Current Overall Health Based on Information Below:
Sol Duc River & Tributaries—COMPROMISED-HIGHLY IMPAIRED***

1. Water quality conditions according to CCWQI = Sol Duc—COMPROMISED; TRIBS—COMPROMISED

Sol Duc	RM	00.0 = 4.5 (healthy)	53.4 = 5.0 (healthy)
		6.50 = 4.0 (compromised)	53.5 = 4.5 (healthy)
		13.0 = 4.0 (compromised)	55.0 = 5.0 (healthy)
		19.0 = 4.5 (healthy)	61.6 = 5.0 (healthy)
		36.0 = 5.0 (healthy)	63.0 = 2.5 (impaired)

OVER-ALL CCWQI CONFIDENCE RATING FOR SOL DUC: HIGH CONFIDENCE

Tribs:

N. Fork	RM	0.0 = 5.0 (healthy)	Lake Crk.	RM	0.0 = 4.0 (compromised)
S. Fork	RM	0.0 = 5.0 (healthy)			0.7 = 3.0 (impaired)
		1.0 = 4.0 (compromised)			1.6 = 2.0 (highly impaired)
Alckee Crk.	RM	0.0 = 5.0 (healthy)			2.0 = 2.5 (impaired)
		0.3 = 5.0 (healthy)			2.75 = 2.0 (highly impaired)
Bear Crk.	RM	0.0 = 4.0 (compromised)			4.5 = 4.0 (compromised)
		0.1 = 5.0 (healthy)			5.0 = 5.0 (healthy)
		2.5 = 4.0 (compromised)			7.0e = 4.5 (healthy)
		5.1 = 3.0 (impaired)			7.0w = 5.0 (healthy)
		5.8 = 4.5 (healthy)	Lake trib/LB RM		6.2 = 4.0 (compromised)
		8.9 = 5.0 (healthy)	Goodman	RM	0.0 = 5.0 (healthy)
S. Fork Bear RM		0.2 = 5.0 (healthy)			0.1 = 4.5 (healthy)
		0.5 = 5.0 (healthy)	Tom Crk.	RM	0.0 = 5.0 (healthy)
Beaver Crk.	RM	0.0 = 4.0 (compromised)			
Camp Crk.	RM	0.0 = 3.0 (impaired)			
		0.4 = 5.0 (healthy)			

OVER-ALL CCWQI CONFIDENCE RATING FOR TRIBS: HIGH CONFIDENCE

Sol Duc River & Tributaries continued:

2. Biological conditions according to B-IBI = Sol Duc: AMPLE DATA DO NOT EXIST; Bear Creek: HEALTHY

Bear	RM	0.1 = 47.3 (healthy)
		2.5 = 42.0 (compromised)
		5.1 = 45.3 (healthy)
Bear SF	RM	0.2 = 47.3 (healthy)

OVER-ALL B-IBI CONFIDENCE RATING (FOR WATERSHED): HIGH CONFIDENCE

3. Habitat integrity overall for Sol Duc and its creeks, according to the LFA WRIA 20 and CC Watershed Facts = IMPAIRED TO HIGHLY IMPAIRED

Habitat concerns include:

- a. Loss of off-channel habitat
- b. Excessive sedimentation
- c. Poor riparian conditions and loss of wetlands
- d. Lack of LWD
- e. Warm temperatures and low dissolved oxygen; 303(d) listing for temperature & dissolved oxygen

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: MODERATE CONFIDENCE



*Streamkeeper volunteer measuring stream cross-section
at Bear River RM 5.1*

State of the Waters ~ Ozette River Watershed

General Description:

Ozette Lake is the third largest natural lake in Washington State and a popular tourist destination within Olympic National Park. The Lake is drained to the Pacific Ocean by the Ozette River; Coal Creek is a major tributary to the Ozette River. The larger tributaries that drain into Ozette Lake are Big River, Umbrella Creek, Crooked Creek, Siwash Creek, South Creek and Quinn Creek. These are low gradient, low elevation streams which provide spawning and rearing habitat for salmon and steelhead, as do Ozette River and Lake. While the Olympic National Park surrounds Ozette Lake, most of the tributary sub-basins that drain into the Lake are private timber lands. It has been estimated that over 90% of this basin has been clearcut sometime in the past, and many riparian corridors have transitioned from conifer to alder stands.

What do the health ratings mean to people?

Lake water was not tested, and streams don't have ample biological data to be rated. However, Ozette Lake is used as a water source by local residents and the Olympic National Park and compromised water quality conditions could impact those uses and potentially require costly treatment. High flows result in turbid conditions within the tributaries that feed Ozette Lake, especially in Big River

and Umbrella Creek. If the Lake is turbid, it impacts the condition of drinking water. A transition from coniferous to deciduous forest affects timber resources as well as habitat. An accumulation of tannic acids within the estuary could also be a concern.

What do the health ratings mean to fish?

According to the LFA, both water temperature and dissolved oxygen levels in Ozette Lake are adequate for salmon use, but the Lake is rated as poor for biological processes and sediment quality. Conditions along the edge of Ozette Lake have changed as water levels have fluctuated, and vegetation has invaded what was once good spawning habitat for sockeye salmon and other species.

The LFA rates Ozette streams poor to fair for the percent of fine sediments, and excessive sediment causes problems with spawning, rearing and feeding, as well as viewing predators for salmon. In this watershed, summer temperatures are warmer than State water quality standards in Ozette River, Umbrella Creek, Crooked and No. Fork Crooked Creeks, and Big River, according the LFA.

Current Overall Health Based on Information Below:

Ozette River Watershed—IMPAIRED

1. Water quality conditions according to CCWQI = COMPROMISED

Ozette River	RM	0.0 = 4.5 (healthy)
Siwash Crk.	RM	0.0 = 4.5 (healthy)
Big River	RM	0.0 = 4.5 (healthy)
Coal Crk.	RM	0.0 = 4.0 (compromised)
South Crk.	RM	0.0 = 4.5 (healthy)
Umbrella Crk.	RM	0.0 = 4.5 (healthy)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): MODERATE CONFIDENCE

North Fork Crooked Creek is on the 303(d) list for elevated temperatures.

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

LFA gave a poor rating for biological process in the Ozette River.

3. Habitat integrity overall for the Ozette Watershed, include Lake Ozette, according to the LFA WRIA 20, CC Watershed Facts, Status = IMPAIRED TO HIGHLY IMPAIRED

Habitat concerns include:

- Impacts resulting from past watershed alterations
- Loss of off-channel habitat
- Excessive sedimentation
- Poor riparian conditions; non-coniferous trees dominate, which will be unable to supply future LWD
- Warm temperatures and low dissolved oxygen

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS

- High flows resulting in excessive sedimentation
- Warm stream temperatures in summer in some streams
- Lack of protection from erosion and degraded habitat from lack of LWD
- Loss of wetlands functions
- Degraded riparian habitat and transition from coniferous to deciduous forests
- Lack of data on biological conditions
- Impaired to highly impaired habitat

RECOMMENDATIONS

- Address blockages for fish passage
- Address habitat concerns in box on left
- Reduce riparian roads and/or their impacts
- Revegetate open riparian areas with conifers/protect riparian corridors
- Address other sediment sources
- Continue water quality monitoring
- Start monitoring biological conditions

State of the Waters ~ Sooes Basin

General Description:

The Sooes River is 16.2 miles long and begins in low foothills, draining to the Pacific Ocean at Mukkaw Bay near the Makah Indian Reservation. Tidewater extends to Sooes RM 6, and a falls blocks salmon access at RM 13.8. Streams on the Olympic Peninsula have naturally high rates of erosion, and this erosion has been accelerated by deforestation and road building. The most common floodplain impacts in the Sooes basin are riparian roads, some of which closely parallel the streams, acting as dikes, disconnecting potential off-channel habitat and increasing sediment input into the stream. Channel incision is another floodplain problem here. Historically the streams in these lowlands were unconfined, meandering across their floodplains with extensive logjams in place. As large wood has washed out without being replenished, stream energy has increased and scoured and incised the channel. In some cases the increased bank disturbance has resulted in the invasion of reed canarygrass on the banks, further hardening the incised channels.

What do the health ratings mean to people?

The impacts caused by the riparian roads on the Peninsula and in these watersheds result in excessive sediment entering the channels. This causes turbid conditions which

can be harmful if the water is used for human consumption. Otherwise, there is a lack of data about these watersheds, and further analysis is not valid.

What do the health ratings mean to fish?

The Sooes River provides habitat for winter steelhead, fall chinook, chum and coho salmon. Important salmon and steelhead producing tributaries are: Snag Creek, Pilchuck Creek, Shaffer Creek, Thirty Cent Creek, Miller Creek and Grimes Creek. High water temperatures, low dissolved

oxygen, and excessive sedimentation have been recorded in the Sooes River, all of which negatively impact the success of salmon in the stream. The LFA's habitat rating for floodplain impacts is fair, and the rating for biological processes is poor.

Small streams along the Pacific Coast have little available data with which to determine their current condition, or possible impacts on humans in the watersheds.

Current Overall Health Based on Information Below:

Sooes Basin—IMPAIRED*

(*low confidence in this rating)

1. Water quality conditions according to CCWQI = AMPLE DATA DO NOT EXIST

LFA gave a poor rating for water quality for the Sooes River.

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

LFA gave a poor rating for biological process for the Sooes River.

3. Habitat integrity overall for the Sooes basin, according to the LFA WRIA 20 and CC Watershed Facts = IMPAIRED

Habitat concerns include:

- a. Loss of access for anadromous salmon due to culverts, pipes, small dams and a hatchery weir
- b. Loss of off-channel habitat
- c. Excessive sedimentation
- d. Poor riparian conditions; non-coniferous trees dominate, which will be unable to supply future large woody debris (LWD)
- e. Warm temperatures and low dissolved oxygen

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: MODERATE CONFIDENCE

PARTICULAR CONCERNS

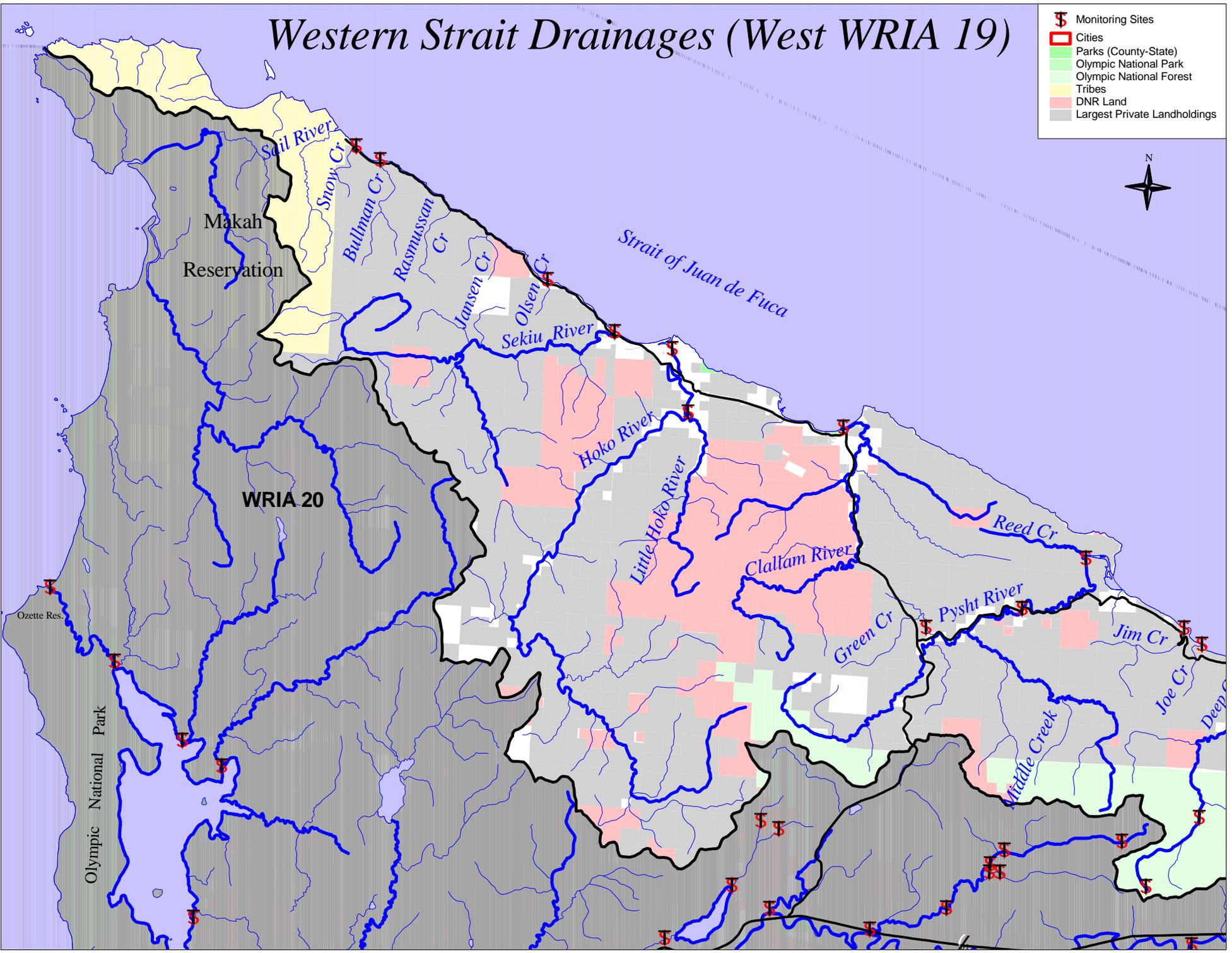
- Excessive sedimentation
- Warm stream temperatures
- Lack of protection from erosion and degraded habitat from lack of LWD
- Degraded riparian habitat
- Habitat is impaired
- Lack of data on water quality and biological conditions

RECOMMENDATIONS

- Address blockages for fish passage
- Leave large wood in the floodplain
- Maintain and conserve off-channel habitat
- Increase LWD to increase nutrient cycling & prevent erosion
- Reduce riparian roads and/or their impacts
- Revegetate open riparian areas with conifers/protect riparian corridors
- Address sediment sources
- Start monitoring water quality & biological conditions

Western Strait Drainages (West WRIA 19)

- Monitoring Sites
- Cities
- Parks (County-State)
- Olympic National Park
- Olympic National Forest
- Tribes
- DNR Land
- Largest Private Landholdings



WESTERN STRAIT DRAINAGES

WEST WRIA 19

- ***Snow, Bullman, Jansen & Olsen Creeks***
- ***Sekiu River***
- ***Hoko & Little Hoko Rivers***
- ***Clallam River & Estuary***
- ***Pysht River & Estuary***
Green Creek
- ***Jim & Joe Creeks***

State of the Waters ~ Snow, Bullman, Jansen & Olsen Creeks

General Description:

Streams in the Western Strait drainages flow northward from a low series of hills parallel to the Strait of Juan de Fuca, and potentially provide productive salmonid habitat. Problems with streambed and sediment are common in these salmon-producing streams. In general, fine sediment levels in streams managed for timber harvest are roughly double the level found in streams in the Olympic National Park. Scour has been documented in a few streams, and a lack of LWD is a pervasive problem. This leads to less storage of adequate spawning gravels, and more rapid transport of all types of sediment. The greater transport rate has led to channel incision and scour in some cases. Snow Creek is a small, steep tributary, which is moderately confined, and in which sedimentation is a concern with high levels of natural sediment input in addition to high sediment impacts from roads. Logging is expected to increase in the Snow Creek basin, which may increase impacts from sedimentation. The lower mainstem of Bullman Creek has a moderate amount of LWD; the entire area is heavily roaded and subjected to a high level of logging, which likely increases sedimentation there.

What do the health ratings mean to people?

These small streams along the Western Strait have little available data with which to determine impacts on humans in the watersheds, although water quality problems are recorded on most of them. To the extent that salmon habitat is limited, so are fishing opportunities. Increased

incision and erosion can lead to flooding and other land use impacts that may cause problems for humans. Turbidity, low dissolved oxygen and high temperatures are problems that may impact human uses of the creeks.

What do the health ratings mean to fish?

These small creeks, with moderate to moderately-steep gradients are predominately winter steelhead streams, support limited coho salmon populations. These creeks generally support winter steelhead, chum and coho salmon, unless limited by steep gradients. Salmon need cold temperatures and lots of dissolved oxygen to thrive, and these poor

conditions will add to the stress caused by other environmental factors in these systems. Fine sediment in streams fills up the “interstitial” spaces between the gravel that fish need for spawning and feeding, and therefore negatively impacts the survival success of salmon.

Varying amounts of data exist for the small streams and rivers entering the Western Strait of Juan de Fuca. Most have been heavily impacted and have excessive sediment and water quality problems.

Current Overall Health Based on Information Below:

Snow, Bullman, Jansen & Olsen Creeks—IMPAIRED*

(*low confidence in this rating)

1. Water quality conditions according to CCWQI = AMPLE DATA DO NOT EXIST

Bullman Creek RM 0.0 = 4 (compromised) Over-all confidence rating: low

Snow Creek RM 0.0 = 4 (compromised) Over-all confidence rating: low

Olsen Creek RM 0.0 = 4 (compromised) Over-all confidence rating: low

The LFA reports high water temperatures for Jansen, Bullman, Olsen and Snow Creeks and high turbidity for Jansen Creek.

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity overall for these Western Strait of Juan de Fuca Streams, according to the LFA WRIA 19 and CC Watershed Facts = IMPAIRED

Habitat concerns include:

- a. Impacts resulting from past and present watershed alterations
- b. Road densities and under-sized culverts impact streams
- c. Loss of off-channel habitat
- d. Mass wasting (landslides) and excessive sedimentation
- e. Warm temperatures, low dissolved oxygen, and high turbidity in some streams

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: MODERATE CONFIDENCE

PARTICULAR CONCERNS

- Impacts from warm stream temperatures & turbidity in some streams
- Lack of protection from erosion and degraded habitat from lack of LWD
- Conversion of riparian habitat
- Lack of ample water quality and biological data
- Impaired habitat

RECOMMENDATIONS

- Enforce and/or revise current environmental regulations to protect salmon
- Protect floodplain habitat; increase off-channel habitat
- Convert open and hardwood to conifers in riparian areas
- Increase instream LWD; stop removal of wood from channels
- Protect critical salmon habitat and address problem areas listed in box on left
- Increase water quality monitoring
- Start monitoring biological conditions

State of the Waters ~ Sekiu River

General Description:

The Sekiu River is 12.5 miles long, with an additional 36.7 miles of tributaries. A watershed analysis has been completed on the Sekiu, and fairly extensive data have been collected for stream temperatures. Most of the areas adjacent to streams in this region have been subjected to timber harvest and removal of LWD from the channels. This has increased the sediment delivery, and in some areas has caused large landslides and debris flows. The Sekiu basin had high levels of sediment fines instream, higher than unmanaged watershed values for the area. Roads and mass wasting are major contributors of the fines, with road density being very high, and was rated as “not properly functioning” in the LFA. A large network of substandard roads and aggressive basin-wide stream salvage operations (log removal) have caused most of the habitat damage. Channelization has occurred in the Sekiu basin, and the Main Line logging road that parallels the mainstem is the greatest floodplain impact in the basin. The road has resulted in channel constrictions in the lower 4.5 miles of the mainstem, causing increased channel instability and a loss of off-channel early juvenile rearing habitat, as well as winter refuge habitat for salmon. While the last large log jams were removed in the 1970’s, new log jams were added to the channel as part of 2001 restoration activities. Cedar salvage continues to diminish the majority of the remaining old-growth derived woody debris in the region. LWD is especially low in the South Fork Sekiu; the North Fork Sekiu was rated in the LFA as “good” for functional LWD, but “poor to fair” for the lack of larger key pieces. Streams in this region are highly susceptible to temperature problems because of the low elevation, and naturally low summer flows.

There are not adequate data on water quality conditions in the Sekiu River to determine impacts on humans; the habitat integrity can be determined, as the impacts are similar to those on other streams along the Western Strait of Juan de Fuca.

What do the health ratings mean to people?

There are not enough data to develop a valid health rating related to impacts on humans.

What do the health ratings mean to fish?

Summer/fall chinook, fall coho, fall chum, sockeye (strays only), winter steelhead and cutthroat have been recorded in the Sekiu River. Temperatures have been above state standards in the Sekiu River. Salmon need cold temperatures and lots of dissolved oxygen to thrive, and these poor

conditions will add to the stress caused by other environmental factors in these systems. Fine sediment in streams fills up the “interstitial” spaces between the gravel that fish need for spawning and feeding, and therefore negatively impacts the survival success of salmon.

Current Overall Health Based on Information Below:

Sekiu River—IMPAIRED*

(*low confidence in this rating)

1. Water quality conditions according to CCWQI = AMPLE DATA DO NOT EXIST

Sekiu River RM 0.0 = 4.5 (healthy) Over-all confidence rating: low

The Sekiu River is on the 303(d) list for elevated water temperatures; there are reported elevated temperatures above state standards in North and South Fork Sekiu and in the mainstem.

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity overall for Sekiu River, according to the LFA WRIA 19, Status and CC Watershed Facts = IMPAIRED TO HIGHLY IMPAIRED

Habitat concerns include:

- a. Impacts resulting from past and present watershed alterations; impacts of wide-spread road building and maintenance
- b. Channelization, constrictions and roads impacting streams and causing landslides and excessive sediment input
- c. Loss of off-channel habitat
- d. Lack of sufficient, high-quality LWD instream

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS

- Lack of ample water quality and biological data
- Habitat is highly impaired
- Main Line Road impacts on stream conditions; high road densities
- Impacts from warm stream temperatures
- Conversion of riparian habitat

RECOMMENDATIONS

- Enforce and/or revise current environmental regulations to protect salmon
- Protect floodplain habitat
- Convert open and hardwood to conifers in riparian areas
- Prevent water withdrawals that cause low flow conditions for salmonids
- Protect critical salmon habitat and address problem areas listed in box on left
- Increase water quality monitoring
- Start monitoring biological conditions

State of the Waters ~ Hoko & Little Hoko Rivers

General Description:

The Hoko River Watershed is large, with about 25 miles of mainstem and about 80 additional linear miles of tributaries. It originates in the foothills of the Olympic Mountains, and drains a steep, incised landscape that has been extensively logged and roaded. The lower 10 miles of the Hoko mainstem flow through a moderately sloped terrain, with a low gradient and plentiful gravel. Rainfall on the Hoko is abundant. The estuary extends into the river for more than a mile. The Little Hoko River is the major tributary in the lower basin, and joins the Hoko at RM 3.5. The Little Hoko flows through a moderately steep terrain. Downstream of RM 3.5, the Little Hoko has a low gradient as it flows through a flat valley to its confluence with the Hoko. Historically, the Hoko basin was a coniferous forest with a few patches of red alder. About 95% of the old growth has been converted into commercially managed tree farms, and nearly all of the basin has been harvested at least once down to the streambanks. Riparian forests are now dominated by red alder. Channels are chronically depleted of large woody debris. The Hoko drainage is greatly impacted by dense riparian roads, with hundreds of separate landslides associated with logging and clearcuts since the 1950s. About 500 acres along the lower mainstem Hoko is non-forest and in agricultural use. The Lower Hoko contains several hundred acres of non-forested state park land, which is managed for wildlife and human uses. Along the mainstem, a railroad grade extensively impacts the floodplain, contributing sediment and constricting the channel. In spite of this, the Hoko River contains abundant spawning and potentially high quality rearing habitat. The Little Hoko has been channelized and diked in the lower two miles, contributing to downcutting and scouring problems. Water withdrawals serving several communities impact summer flows in this basin with naturally low stream flows. A 1.2 million dollar restoration project was completed between 1994-98, and the results are currently being assessed. The estuary has been altered by forest practices, yet eelgrass is present and provides fish habitat at the river mouth.

What do the health ratings mean to people?

There are not enough data to develop a valid health rating related to impacts on humans, however, a public water system uses water resources from this basin.

What do the health ratings mean to fish?

The Hoko mainstem and Little Hoko both support chinook, chum, coho, and winter steelhead. Low summer flows impact upstream migration and spawning, especially for fall chinook and sometimes coho salmon. Summer temperatures have been recorded above state standards in the Little Hoko River, due to conversion impacts. Salmon need cold temperatures and lots of dissolved

oxygen to thrive, and these poor conditions will add to the stress caused by other environmental factors in these systems. Fine sediment in streams fills up the “interstitial” spaces between the gravel that fish need for spawning and feeding, and therefore negatively impacts the survival success of salmon. Over 48 miles of suitable spawning habitat exist for fall coho on the Hoko.

Current Overall Health Based on Information Below:

Hoko & Little Hoko Rivers—IMPAIRED/COMPROMISED*

(*low confidence in this rating)

1. Water quality conditions according to CCWQI = AMPLE DATA DO NOT EXIST

Hoko River RM 0.0 = 5 (healthy)

Little Hoko RM 0.0 = 4 (compromised)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): LOW

The Little Hoko River is on the 303(d) list for elevated water temperatures (pre-restoration).

Note: Recent data indicate lower peak temperatures since restoration activities.

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity overall for Hoko and Little Hoko Rivers, according to the LFA WRIA 19, Status and CC Watershed Facts = IMPAIRED

Habitat concerns include:

- a. Impacts resulting from past and present watershed alterations
- b. Channelization, constrictions and road density impacting streams and causing landslides and excessive sediment input
- c. Encroachments to the floodplain, such as dikes, and loss of off-channel habitat
- d. Severe lack of sufficient, high-quality LWD instream
- e. Low flows in the summer and early fall
- f. Blockages for fish passage
- g. Estuarine habitat alteration

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS

- Lack of ample water quality and biological data
- Habitat is impaired
- Impacts from railroad grade on stream conditions; high road densities
- Impacts from low flows and warm stream temperatures; impacts from water withdrawals for human water supplies
- Sediment transport and excessive water velocity from lack of LWD
- Future logging impacts
- Impacts from floodplain encroachments

RECOMMENDATIONS

- Reduce riparian road impacts and sediment inputs to lessen channel widening and pool fill
- Protect/replant conifer riparian areas
- Prevent water withdrawals that cause low flow conditions for salmonids
- Protect critical salmon habitat and address problem areas listed in box on left
- Reduce sediment inputs / sources of turbidity
- Increase water quality monitoring
- Start monitoring biological conditions

State of the Waters ~ Clallam River & Estuary

General Description:

The Clallam River is one of the least studied systems in the Western Strait of Juan de Fuca. Although there is limited information available for sediment levels, fairly detailed stream temperature data have been recorded. The Clallam River is about 13.4 miles long, with steep gradients in the headwaters and low gradients downstream. Forest practices have increased the Clallam River's fluvial sediment load over pristine levels. Most of the upper watershed is intact second growth managed by DNR under a landscape management plan. Logging impacts are primarily historic; the upper watershed is not currently delivering much sediment to the system. Road densities associated with logging have been too high for properly functioning habitat conditions to exist. Roads and railroad sites have a history of failure here, and mass wasting sites are the major contributors of the fines in the basin. The floodplain is bisected by a highway near RM 4.4-5.6, resulting in the loss of off-channel early juvenile rearing habitat. Water withdrawals in the watershed reduce stream flows in the river. The Clallam River estuary is an excellent nursery area for salmonids. However, human disturbance has degraded this habitat, resulting in delayed migration or blockage of spawning habitat to adult chinook. Several saltwater marshes have been filled, and sloughs and wetlands have been cut-off from their connections to the main channel. The mouth is occasionally blocked with a sandbar formation, which is a potential obstruction to anadromous salmonid access.

What do the health ratings mean to people?

Compromised water quality and impaired habitat indirectly impact humans, for example, as recreational uses become limited.

What do the health ratings mean to fish?

The Clallam River supports coho and chum salmon, and winter steelhead. Salmon need cold temperatures and lots of dissolved oxygen to thrive, and these poor conditions will add to the stress caused by other environmental factors in these

systems. Fine sediment in streams fills up the "interstitial" spaces between the gravel that fish need for spawning and feeding, and therefore negatively impacts the survival success of salmon.

Habitat integrity impacts are similar to those on other streams along the Western Strait of Juan de Fuca.

***Current Overall Health Based on Information Below:
Clallam River—COMPROMISED-IMPAIRED***

1. Water quality conditions according to CCWQI = COMPROMISED

Clallam River	RM	0.0 = 4.0	(compromised)
& Slough	Site #1	= 3.5	(compromised)
	Site #2	= 3.0	(impaired)
	Site #3	= 3.5	(compromised)
	Site #4	= 3.5	(compromised)
	Site #5	= 4.0	(compromised)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): HIGH CONFIDENCE

Two separate reaches on the Clallam River are on the 303(d) list for excessive temperatures; pH has been reported outside the normal range.

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity overall for Clallam River, according to the LFA WRIA 19 = IMPAIRED

Habitat concerns include:

- a. Impacts resulting from past and present watershed alterations
- b. Channelization, constrictions and roads impacting streams and causing landslides and excessive sediment input
- c. Encroachments to the floodplain, such as dikes, and loss of off-channel habitat
- d. Low flows in the summer and early fall
- e. Blockages for fish passage
- f. Possible impacts of estuarine habitat alteration

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: LOW CONFIDENCE

PARTICULAR CONCERNS

- Compromised water quality
- Impaired habitat
- Lack of data on biological conditions
- High stream temperatures
- Sediment transport and excessive water velocity from lack of LWD
- Impacts from floodplain encroachments

RECOMMENDATIONS

- Assess and correct impacts of blockages at the mouth
- Reduce riparian road impacts and sediment inputs to lessen channel widening and pool fill
- Protect/replant conifers in riparian areas
- Increase instream LWD where needed; stop removal of wood from channels
- Prevent increase in water withdrawals causing low flow conditions for salmonids
- Protect critical salmon habitat and address problem areas listed in box on left
- Continue water quality monitoring
- Start monitoring biological conditions

State of the Waters ~ Pysht River & Estuary, Green Creek, & Jim & Joe Creeks

General Description:

The Pysht River is approximately 16.3 miles long, with eight tributaries adding another 35.6 miles of stream length. In the headwaters, the gradient is steep and the U.S. Forest Service owns the surrounding land. Downstream, the river has a low gradient in the lower 11 miles. A large portion of surrounding land is managed by two industrial forest owners. Logging has impacted the water quality and quantity conditions in the Pysht. In the Pysht, there have been large shifts in channel bed elevation (mostly incision), with very low rates of lateral channel migration occurring, as well as significant channel aggradation at most sites studied. Green Creek also has highly unstable channel banks, with frequent lateral movement of the channel and significant aggradation. The cause of the channel instability problems is likely a combination of low levels of LWD throughout the watershed and high levels of sediment, which resulted in the loss of large pool habitat and thermal changes in the lower river. Sediment sources are primarily roads and mass wasting, many of which came from early logging techniques. Jim and Joe Creeks enter the Strait of Juan de Fuca east of the Pysht River. Jim Creek has a high sediment load for several reasons: logging in the upper reaches, road densities, road building spoils, and lack of LWD. In Joe Creek, naturally high sediment loads are coupled with a heavily roaded watershed, resulting in sediment problems in the creek. Lack of LWD is another streambed problem in Joe Creek. Hwy. 112 affects several streams in this group by preventing channel migration, losses of riparian forest, by rip-rap impacts, and with impassable culverts. Temperature in the lower Pysht is a big issue. The Pysht Estuary is a large and important salmon rearing habitat. Although it is thought that the estuary is recovering from the heavy impacts of the past, there are still some concerns about the continued loss of eelgrass and other estuary habitat, and active restoration efforts may be necessary. All Strait of Juan de Fuca chum stocks have declined and are “stocks of concern” (numbers have crashed in the last 6-7 years).

What do the health ratings mean to people?

Compromised water quality and impaired habitat indirectly impact humans, for example, as recreational uses become limited.

What do the health ratings mean to fish?

The Pysht River supports coho and chum salmon, and winter steelhead. Chinook may no longer be viable in the system. Channel instability in the Pysht, its tributaries and in Jim and Joe Creeks impacts the incubation survival rate of salmon in the basin. Fine sediment in streams fills up the “interstitial” spaces between the

gravel that fish need for spawning, incubation and feeding, and therefore negatively impacts the survival success of salmon. Salmon need cold temperatures and lots of dissolved oxygen to thrive; these poor conditions will add to the stress caused by other environmental factors in these systems.

***Current Overall Health Based on Information Below:
Pysht River, & Green, Jim & Joe Creeks—
IMPAIRED/COMPROMISED***

1. Water quality conditions according to CCWQI = COMPROMISED

Pysht River	RM	0.0	= 4.0 (compromised)	Over-all confidence rating: moderate
@ Hwy 112			= 4.0 (compromised)	Over-all confidence rating: low
Green Creek	RM	0.45	= 4.5 (healthy)	Over-all confidence rating: low
Joe Creek	RM	0.0	= 4.5 (healthy)	Over-all confidence rating: low
Jim Creek	RM	0.0	= 4.5 (healthy)	Over-all confidence rating: low

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): LOW CONFIDENCE

In the lower miles of the Pysht, temperatures are elevated.

Not currently on the 303(d) list.

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity overall for Pysht, its tributaries and Jim & Joe Creeks, according to the LFA WRIA 19, Status and CC Watershed Facts = IMPAIRED

Habitat concerns include:

- a. Impacts resulting from past and present watershed alterations; lack of large conifers in riparian areas for Pysht River
- b. Channelization, constrictions and road density impacting streams and causing landslides and excessive sediment input
- c. Encroachments to the floodplain and loss of off-channel habitat
- d. Blockages for fish passage
- e. Possible impacts of estuarine habitat alteration

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS

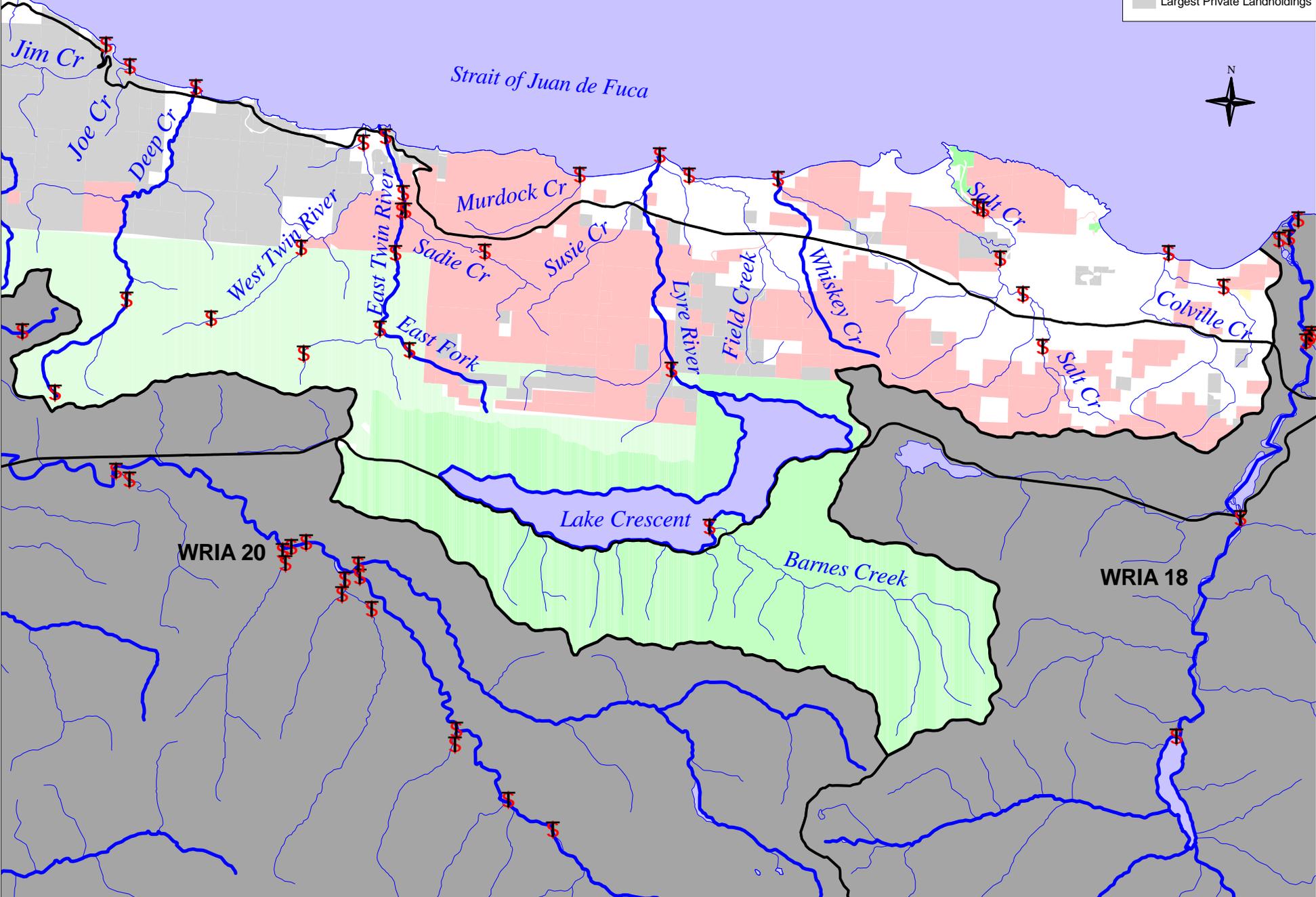
- Compromised water quality
- Impaired habitat
- Lack of data on biological conditions
- Possible high stream temperatures
- Sediment transport and excessive water velocity from lack of LWD
- Impacts from floodplain encroachments and conversion

RECOMMENDATIONS

- Protect/replant conifers in riparian areas
- Increase instream LWD where needed; stop removal of wood from channels
- Prevent water withdrawals causing low flow conditions for salmonids
- Protect critical salmon habitat and address problem areas listed in box on left
- Increase water quality monitoring
- Start monitoring biological conditions

Central Strait Drainages (East WRIA 19)

- \$ Monitoring Sites
- Cities
- ▭ Parks (County-State)
- ▭ Olympic National Park
- ▭ Olympic National Forest
- ▭ Tribes
- ▭ DNR Land
- ▭ Largest Private Landholdings



CENTRAL STRAIT DRAINAGES

EAST WRIA 19

- *Deep Creek*
- *East Twin River*
 - *E. Fork East Twin & Sadie Creek*
- *West Twin River*
- *Lake Crescent / Lyre River System*
- *Murdock Creek*
- *Field, Whiskey & Colville Creeks*
- *Salt Creek*

State of the Waters ~ Deep Creek

General Description:

The Deep Creek watershed drains a basin area of 17.3 square miles, with elevation changes from the estuary to 3,400 feet, flowing from forest land into the Central Strait of Juan de Fuca. Although relatively small, Deep Creek is known for its former productive anadromous fish runs. The drainage has historically been managed for commercial timber production, but the core is unlogged intact habitat, protected under the Northwest Forest Plan (late successional reserve). All but 5% of the land is in U.S. Forest Service, Department of Natural Resources or private timber company ownership. Timber harvest occurred in the 1920-30's, in the 1950's and again in the 1970-80's, all of which caused significant impacts. This resulted in numerous mid-slope roads using side-cast construction in the headwaters, which is prone to failure and mass wasting, as well as clearcuts on steep slopes. Fire in the early 1930's resulted in significant mass wasting. Sedimentation is the major limiting factor for Deep Creek, and the channel is severely degraded as a direct result of the mass wasting history. A dam break occurred in November 1990, scouring out the upper channel, with a network of scour and subsequent slope failures occurring. Debris flows have resulted in extensive channel incision and instability. LWD is lacking and the conversion of riparian vegetation from old conifers to hardwood or open areas will result in a future lack of LWD, as well as high water temperatures. The lack of old trees is thought to increase the frequency and severity of peak flow events, resulting in water velocities and channel incision. Channel incision has contributed to floodplain impacts, such as a lack of off-channel habitat, and this has severely impacted all salmonid species in the creek. Excessive sedimentation has also impacted the estuary, where the delta has increased in recent years. Significant creek restoration has occurred in the basin since 1997, and the watershed was adopted into the IMW Program in 2004 (see Glossary). Signs of improvement in habitat parameters and some fish recovery have been recorded.

What do the health ratings mean to people?

Water quality appears healthy, however, the large-scale timber harvests that trigger flooding events may present problems to humans living in the

watershed, as well as limit fishing opportunities.

What do the health ratings mean to fish?

Deep Creek supports coho, fall chum and winter steelhead. All stocks of salmon have been severely impacted; in particular, chum numbers have collapsed since the 1990 flood described above. Because of severely degraded habitat condition, treaty and sport fisheries closures have occurred. Fine sediment in streams fills up the "interstitial" spaces between the gravel that fish need for spawning, incubation and feeding, and therefore negatively

impacts the survival success of salmon. Salmon need cold temperatures and lots of dissolved oxygen to thrive, and these poor conditions will add to the stress caused by other environmental factors in these systems. Lack of off-channel habitat especially impacts juvenile winter refuge rearing for fall coho and winter steelhead, and early juvenile rearing needs of fall chinook, fall coho and steelhead.

***Current Overall Health Based on Information Below:
Deep Creek—COMROMISED/IMPAIRED***

1. Water quality conditions according to CCWQI = HEALTHY

Deep Creek RM 0.0 = 4.5 (healthy)
4.5 = 4.0 (compromised)
7.4 = 5.0 (healthy)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): HIGH CONFIDENCE

On the 303(d) list for fine sediment and temperature violations.

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity overall for Deep Creek, according to the LFA WRIA 19, Status and CC Watershed Facts = IMPAIRED TO HIGHLY IMPAIRED

Habitat concerns include:

- a. Impacts resulting from past and present watershed alterations
- b. Road construction and density, mass wasting, and excessive sediment input impacting streams
- c. Lack of sufficient and quality LWD
- d. Impacts of estuarine habitat alteration

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS

- Impaired to highly impaired habitat
- Lack of data on biological conditions
- Impacts from high riparian road densities, excessive road-derived sedimentation & scour in some streams
- High stream temperatures
- Sediment transport and excessive water velocity from lack of LWD

RECOMMENDATIONS

- Reduce riparian road impacts and sediment inputs to lessen channel widening and pool filling
- Increase off-channel habitat and protect floodplain habitat
- Protect/replant conifers in riparian areas
- Prevent water withdrawals causing low flow conditions for salmonids
- Protect critical salmon habitat and address problem areas listed in box on left
- Reduce sources of turbidity
- Continue water quality monitoring
- Start monitoring biological conditions

State of the Waters ~ The Twin Rivers: West Twin & East Twin

General Description:

The East and West Twin Rivers drain a basin area of 28.8 square miles, and enter the Central Strait of Juan de Fuca east of the Pysht River. Deep Creek, and the West and East Twin Rivers share similar physical characteristics, and the mouths of each stream are in close proximity to each other. The gradients in all three rivers are moderate to steep except in the lower 2 miles. These streams have high natural erosion rates due to a mixed geology, with less erodible basalt in their headwaters, glacial out-wash in the lower plain, and siltstones. The stream channels change quickly to variations in flow and sediment inputs. Most problems in this region are due to historic mid-slope roads that impact streams either directly, or through the input of excessive sediment. These streams have few roads in the floodplain. LWD is lacking throughout, and there is concern about sedimentation from roads. Fish passage is also an issue in the East Fork of the East Twin River. Estuarine impacts exist near the mouths of both the Twin Rivers—increased sedimentation has occurred, and historic gravel and clay removal has removed beach between the two rivers. These activities have resulted in a loss of eelgrass habitat, which is important for juvenile salmon. A major landslide exists between the Twin Rivers and Deep Creek that is close to smelt spawning areas, which are an important prey food for young salmon. The East and West Twin Rivers and Deep Creek are all in the IMW Program (see Glossary), and significant restoration is occurring in the East Twin.

What do the health ratings mean to people?

Water quality appears very healthy, however, impaired habitat indirectly impacts human uses such as recreational uses.

What do the health ratings mean to fish?

West and East Twin Rivers have major spawning areas for coho, but these rivers have never produced large numbers of fall chum. Winter steelhead are also found in the Twins. Limiting factors include lack of LWD, excessive sedimentation, blockages and estuarine impacts. Fine sediment fills up the “interstitial” spaces between the gravel that fish need for

spawning, incubation and feeding, and therefore negatively impacts the survival success of salmon. Lack of off-channel habitat especially impacts juvenile winter refuge rearing for fall coho and winter steelhead, and early juvenile rearing needs of fall chinook, fall coho and steelhead.

Habitat integrity impacts are similar to those on other streams along the Central Strait of Juan de Fuca.

***Current Overall Health Based on Information Below:
West & East Twin Rivers—COMPROMISED/IMPAIRED***

1. Water quality conditions according to CCWQI = HEALTHY

West Twin	RM 0.4	= 4.5 (healthy)
	3.7	= 5.0 (healthy)
	6.1	= 5.0 (healthy)
East Twin	RM 0.3	= 5.0 (healthy)
	1.5	= 5.0 (healthy)
	@Sadie	= 5.0 (healthy)
	2.8	= 5.0 (healthy)
	4.6	= 5.0 (healthy)
	6.4	= 5.0 (healthy)
EF East Twin	@ 3040 Rd	= 5.0 (healthy)
Sadie Creek	@ E. Twin	= 5.0 (healthy)
	@ 3040 Rd	= 5.0 (healthy)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): HIGH CONFIDENCE

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity overall for the Twin Rivers, according to the LFA WRIA 19 and CC Watershed Facts = COMPROMISED TO IMPAIRED

Habitat concerns include:

- a. Impacts resulting from past and present watershed alterations
- b. Road construction and density, mass wasting, and excessive sediment input impacting streams
- c. Lack of sufficient and quality LWD
- d. Impacts of estuarine habitat alteration

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: MODERATE CONFIDENCE

PARTICULAR CONCERNS

- Compromised to impaired habitat
- Lack of data on biological conditions
- Sediment transport and excessive water velocity from lack of LWD
- Lack of off-channel habitat areas
- Impacts to estuary

RECOMMENDATIONS

- Reduce road impacts and sediment inputs to lessen channel widening and pool filling
- Increase off-channel habitat and protect floodplain habitat
- Protect/replant conifers in riparian areas
- Protect critical salmon habitat and address problem areas listed in box on left
- Continue water quality monitoring
- Start monitoring biological conditions

State of the Waters ~ Lake Crescent/Lyre River System & Murdock Creek

General Description:

The Lyre River has a total length of 16.8 miles, with a basin covering 66.1 square miles. The Lyre is the only watershed in the region that is fed by a natural lake, Lake Crescent, resulting in a unique flow, temperature and water chemistry regime. Lake Crescent, located at RM 5.2, is a large, deep lake of 4,700 acres with a depth of 640 feet. The Lake and surrounding land lies within the Olympic National Park. Below the park boundary the Lyre River is managed primarily for commercial timber production and low-density rural residences. A natural falls at RM 2.7 limits salmon access above it. In general, the LWD levels in the river are good, except in the lower reaches which are lacking in large wood. The lower reaches are surrounded by a riparian habitat that will no longer supply future LWD necessary to allow sediments to accumulate, raising the streambed to enable the floodplain to connect with the river. The lowest mile of the mainstem has been channelized and bulk-headed, and valuable LWD has been removed. Of the major tributaries, Susie Creek provides good salmon habitat. Major historic landslides on Boundary Creek continue to introduce fines into the Lyre. As a tributary to Lake Crescent, Barnes Creek is a major spawning stream for trout in Lake Crescent. The Limiting Factors Analysis did not describe habitat and water quality conditions in Lake Crescent. While the Lyre estuary is minimal, estuary-dependent fish such as chum are found there, as well as a documented surf smelt spawning area west of the mouth. Major limiting factors in the watershed are fine sediments, altered riparian areas, lack of large wood, mainstem channelization, and “stream cleaning” of LWD. Murdock Creek is an independent stream west of the Lyre, with spawning steelhead habitat in the lower mile. An on-going problem is the deposit of road spoils along Hwy. 112 adding to the sediment load. Development on the east side is also a concern, related to the basin hydrology.

What do the health ratings mean to people?

The Lyre River is used as a domestic water supply for some residents in the Joyce area.

What do the health ratings mean to fish?

The Lyre produces fall chum, fall coho and winter steelhead. Hatchery planting of winter and summer steelhead occurs. Low numbers of chinook and pink salmon have also been reported in the Lyre River. Lake Crescent has unique salmon and trout, some which move downstream into the Lyre to spawn. These include

kokanee, Lake Crescent cutthroat and Beardslee trout. Domestic water supplies withdrawn from the Lyre have the potential to impact streamflows needed by fish. Lack of off-channel habitat especially impacts fall coho and winter steelhead juvenile winter refuge rearing.

***Current Overall Health Based on Information Below:
Lyre River, Barnes Creek & Murdock Creek—
COMPROMISED***

1. Water quality conditions according to CCWQI = COMPROMISED

Lyre River RM 0.0 = 4.5 (healthy)
5.0 = 3.5 (compromised)

Barnes Crk. RM 0.0 = 5.0 (healthy)

Murdock Crk. RM 0.0 = 4.5 (healthy)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): MODERATE CONFIDENCE

2. Biological conditions according to B-IBI = COMPROMISED

Barnes Crk. RM 0.0 = 35.3 (compromised)

OVER-ALL B-IBI CONFIDENCE RATING: MODERATE CONFIDENCE

3. Habitat integrity in the lower reaches of the Lyre River and tributaries, and in Murdock Creek, according to LFA 19, CC Watershed Facts & Status = COMPROMISED

Habitat concerns include:

- a. Excessive sediment input impacting streams
- b. Lack of sufficient and quality LWD
- c. Channelization in lower reaches
- d. Impacts of estuarine habitat alteration

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS

- Compromised biological and habitat conditions
- Impacts from historic mass wasting in the Lyre
- Sediment transport and water velocity from lack of LWD; riparian conditions which will not lead to available LWD in the future
- Impacts from channelization (lack of off-channel habitat, increased velocities, degraded habitat)

RECOMMENDATIONS

- Increase off-channel habitat and protect flood-plain habitat
- Protect/replant conifers in riparian areas
- Protect critical salmon habitat and address problem areas listed in box on left
- Continue water quality monitoring
- Continue biological conditions monitoring
- Prevent increased water withdrawals which might impact streamflows

State of the Waters ~ Field, Whiskey & Colville Creeks

General Description:

Field, Whiskey and Colville Creeks are small, salmon-producing streams flowing into the Central Strait of Juan de Fuca, that have moderately steep gradients in the lower reaches. Lack of LWD, a conversion of the riparian zone to alder or to open areas, wetland conversion, culverts and excessive sedimentation are believed to be problems in all these streams. All have limited salmon production, except Colville, which has excellent coho production potential, although a collapsed trestle blocks four miles of salmon and cutthroat trout habitat on the stream. On Whiskey Creek, part of the sedimentation is natural, due to the area geology, but part is also likely a result of extensive logging, and from a railroad grade. Lower Whiskey Creek reaches are in poor shape, lacking LWD, with an incised channel, creating inner slope failures contributing to sediment loads. The excessive sedimentation and scour in Field Creek, (which also has a naturally high sediment load), is likely the result of extensive logging due to land conversion, as well as development activities in the area. The upper portions have patchy amounts of LWD, with very few pieces of LWD in the lower reaches. Colville Creek is incised upstream and the streambed widens into a valley in the downstream reaches. Dredging has occurred in this valley, resulting in an unstable, channelized stream that needs meanders. Livestock have stream access, leading to water quality problems including sediment inputs. Sedimentation from Field Creek degrades offshore eelgrass bed habitat. Bulkheads have been constructed near the mouth of Whiskey Creek. Freshwater Bay, offshore from Colville Creek, is the site of a large kelp bed with considerable diverse habitat, and eelgrass, which together are important resources for both juvenile and adult salmon.

What do the health ratings mean to people?

Compromised water quality and impaired habitat uses become limited. indirectly impact humans, for example, as recreational

What do the health ratings mean to fish?

Field, Whiskey and Colville Creeks provide steelhead and coho production; sedimentation is a problem in all three creeks. Fines have been such a severe problem in Whiskey Creek that chum could not be successfully incubated. Fine sediment in streams fills up the “interstitial” spaces between the gravel that fish need for spawning, incubation and feeding, and therefore negatively impacts the survival success of salmon. Salmon need cold temperatures and lots of dissolved oxygen to thrive, and these poor conditions will add to the stress caused by other environmental factors in these systems. Lack of off-channel habitat especially impacts juvenile winter refuge rearing for fall coho and winter steelhead, and early juvenile rearing needs of fall chinook, fall coho and steelhead.



Streamkeeper volunteer collecting samples from a smolt trap

***Current Overall Health Based on Information Below:
Field, Whiskey & Colville Creeks—IMPAIRED***

1. Water quality conditions according to CCWQI = COMPROMISED

Field Creek RM 0.00 = 4.5 (healthy)

Whiskey Creek RM 0.00 = 5 (healthy)

Colville Creek RM 0.00 = 5 (healthy)
@ Ranger Rd. = 3 (impaired)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): MODERATE CONFIDENCE

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity in Field, Whiskey and Colville Creeks, according to LFA 19 = IMPAIRED TO HIGHLY IMPAIRED

Habitat concerns include:

- a. Excessive sediment input impacting streams
- b. Lack of sufficient and quality LWD
- c. Impacts of estuarine habitat alteration
- d. Animal access to streams
- e. Blockages and constrictions

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: LOW CONFIDENCE

PARTICULAR CONCERNS

- Compromised water quality
- Impaired to Highly Impaired habitat
- Lack of data on biological conditions
- Impacts from excessive sedimentation in some streams
- Riparian conditions which will not lead to available LWD in the future
- Bulkheading near the mouth of Whiskey Creek

RECOMMENDATIONS

- Increase off-channel habitat and protect floodplain habitat
- Protect/replant conifers in riparian areas
- Protect critical salmon habitat and address problem areas listed in box on left
- Continue water quality monitoring
- Start monitoring biological conditions

State of the Waters ~ Salt Creek

General Description:

Salt Creek enters saltwater on the east end of the Central Strait of Juan de Fuca. Sedimentation is a problem in Salt Creek, and is likely the result of heavy logging adjacent to west side tributaries in the 1980s. A few areas of Salt Creek have high LWD loadings, but upstream of RM 2 there is a particular lack of large wood. This area is also channelized and incised. The Camp Hayden Road is a riparian road constructed in the floodplain along the mainstem from RM 1-2. A private road cuts across the estuary, and prevents the lateral migration of Salt Creek, disconnecting it from potential wetlands and the tidally-influenced reaches of the creek, with an adverse impact to salmonid habitat. About 15 acres of tidal marsh have been lost to the road. Animal grazing along some of the banks could decrease water quality, as well as increase erosion. In addition, water quality issues for the Salt Creek/Crescent Bay area include residential runoff. Crescent Bay is comprised of an extensive eelgrass bed within the main bay, and lush diverse kelp beds fringing Tongue Point and extending west to Agate Point. The shallow eelgrass is important for sand lance and juvenile salmon, and the kelp is also important for salmon habitat. Major factors limiting salmon habitat in Salt Creek are lack of LWD, land conversion, loss of wetlands and salt marsh, and increased culverts, riparian degradation and stormwater.



Streamkeeper volunteer monitors on Salt Creek

What do the health ratings mean to people?

Water quality conditions appear healthy, but compromised biological conditions indicate problems exist. Human uses, particularly

recreation, are impacted when these conditions become degraded.

What do the health ratings mean to fish?

Salt Creek and its tributaries provide important coho salmon spawning and rearing habitat throughout the mainstem and tributaries downstream of a passable dam at RM 6.5. The creek used to support chum, now existing at very low levels. Chinook have not been documented there in recent years, and winter steelhead are declining. Lack of LWD impacts salmonid habitat by

allowing the channel to become destabilized, with a lack of pools and shade. The high value salt marsh and estuarine habitat provide important rearing and holding for salmon entering and leaving the stream, as well as for sand lance. Land conversion impacts riparian habitat, increases sedimentation and creates habitat loss in the watershed.

***Current Overall Health Based on Information Below:
Salt Creek—COMPROMISED***

1. Water quality conditions according to CCWQI = HEALTHY

Salt Creek	RM	1.4 = 4.5 (healthy)
		1.5 = 4.5 (healthy)
		4.2 = 5.0 (healthy)
		5.4 = 4.5 (healthy)
		6.9 = 5.0 (healthy)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): HIGH CONFIDENCE

2. Biological conditions according to B-IBI = COMPROMISED

Salt Creek	RM	1.5 = 38 (compromised)
		4.2 = 45 (compromised)
		5.4 = 38 (compromised)

OVER-ALL B-IBI CONFIDENCE RATING: HIGH CONFIDENCE

3. Habitat integrity in Salt Creek, according to LFA 19 and CC Watershed Facts = COMPROMISED

Habitat concerns include:

- a. Excessive sediment input impacting streams
- b. Lack of sufficient and quality LWD
- c. Impacts of estuarine habitat alteration; loss of wetlands
- d. Road impacts

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: MODERATE CONFIDENCE

PARTICULAR CONCERNS

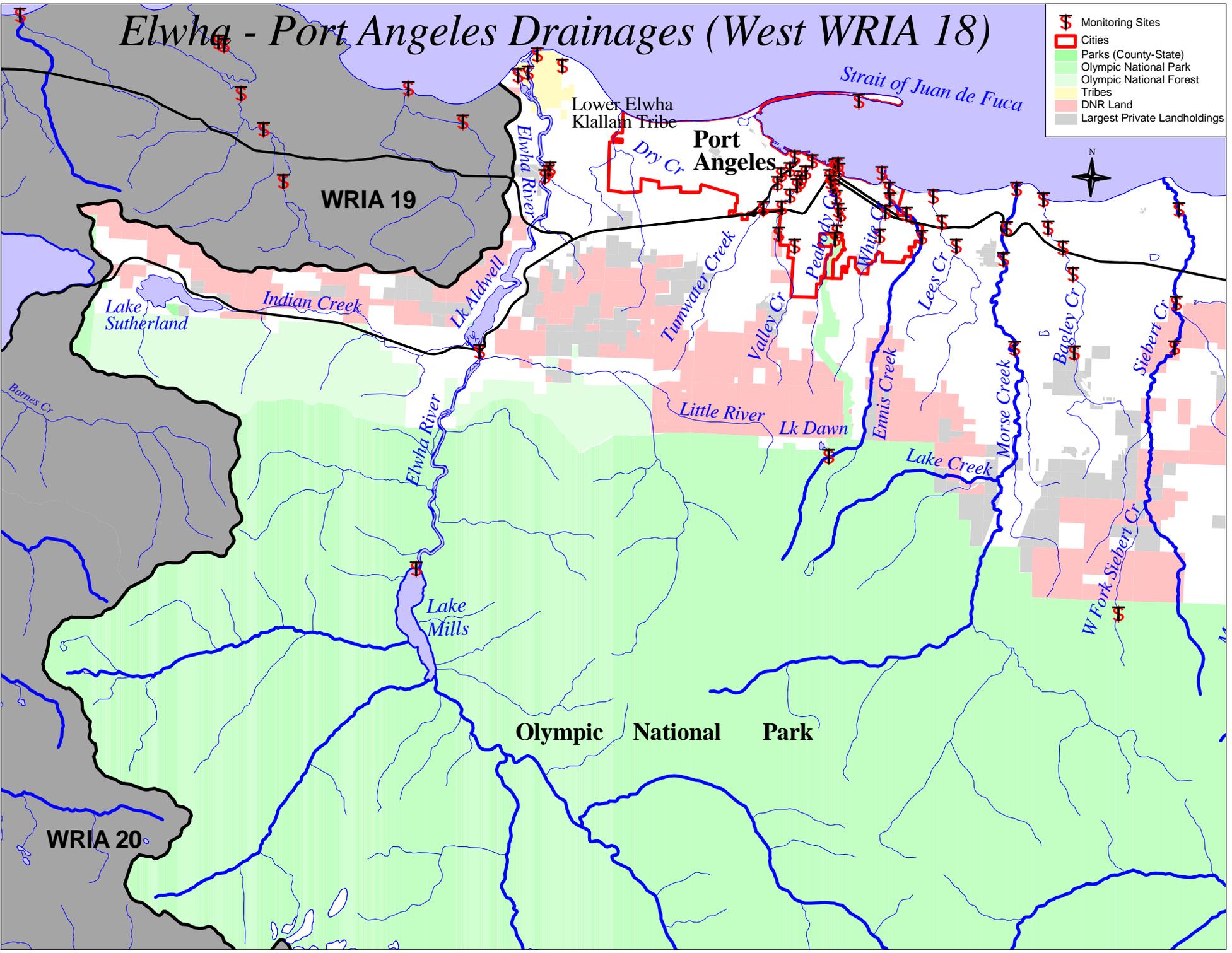
- Compromised habitat and biological conditions
- Sediment transport and excessive water velocity from lack of LWD
- Impacts from road constrictions
- Impacts from loss of wetlands and creek/estuarine tidal inter-connections
- Potential water quality impacts from future development

RECOMMENDATIONS

- Increase wetland habitat and protect floodplain habitat
- Protect/replant conifers in riparian areas
- Protect critical salmon habitat and address problem areas listed in box on left
- Continue monitoring water quality & biological conditions
- Follow recommendations in upcoming (2004) technical assessment (by LEKT and NOSC)

Elwha - Port Angeles Drainages (West WRIA 18)

- \$ Monitoring Sites
- ▭ Cities
- ▭ Parks (County-State)
- ▭ Olympic National Park
- ▭ Olympic National Forest
- ▭ Tribes
- ▭ DNR Land
- ▭ Largest Private Landholdings



Lower Elwha
Klallam Tribe

Port
Angeles

WRIA 19

WRIA 20

Olympic National Park

Strait of Juan de Fuca

Lake
Sutherland

Lake
Mills

Lk Dawn

Little River

Lake Creek

W Fork Siebert Cr.

Siebert Cr.

Bagley Cr.

Morse Creek

Lees Cr.

Ennis Creek

Valley Cr.

Tumwater Creek

Dry Cr.

Elwha River

Elwha River

Indian Creek

Barnes Cr.

ELWHA RIVER SYSTEM & PORT ANGELES AREA STREAMS WEST WRIA 18

- *Elwha River Watershed*
 - *Lake Aldwell & Mills*
- *Little River, Indian Creek & Lake Sutherland*
- *Dry Creek*
- *Tumwater Creek & Port Angeles Harbor*
- *Valley Creek*
- *Peabody Creek*
- *Ennis Creek*
 - *Lake Dawn & White Creek*
- *Lees Creek*
- *Morse Creek*

State of the Waters ~ Elwha River Watershed

General Description:

The Elwha River is one of the largest, and historically the most productive river along the Strait of Juan de Fuca, emptying into salt water west of Port Angeles. It originates deep in the Olympic National Park, with most of the tributary headwaters originating at or above the 4,000 foot elevation. The Elwha drains 321 square miles, 83% of which is located in the Park, and is considered outstanding habitat. The mainstem is approximately 45 miles in length, with 100 miles of tributary streams. Annual precipitation in the upper watershed, which is influenced by the rainshadow from the Olympic Mountains, averages 200+ inches, and 56 inches in



Spawning chum salmon in Boston Charley Creek

Evaluating the Elwha River Watershed is complicated by the impacts of 2 dams, and their imminent removal. This rating is for the system as it is currently functioning, prior to dam removal and river restoration

the lower drainages. Elwha supported legendary runs of salmon until hydroelectric dams were constructed in the early part of the 20th century, without fish passage facilities. Ecological changes associated with the dams, including lack of gravel recruitment and channelization, led to the collapse of these fish stocks by the 1970s. Removal of the dams on the Elwha is planned to restore the river ecosystem. The Elwha's lower floodplain has been extensively logged and altered, with dikes, channelization and other constrictions in several places. LWD is now chronically low below the Elwha Dam at Lake Aldwell. Dikes and jetties cut off the estuary and have destroyed estuarine habitat. The water quality in the Elwha is generally excellent, however warm water temperatures in the reservoirs impact downstream water quality.

What do the health ratings mean to people?

The Elwha River provides domestic and industrial water to the City of Port Angeles, the Elwha Tribe and small community-based

systems. Harmful bacteria from septic systems are also a potential health risk for humans unless surface water supplies are treated.

What do the health ratings mean to fish?

In the Elwha River, spring, summer/fall chinook, coho, summer and fall chum, and upper and lower pink salmon, and summer and winter steelhead and cutthroat trout are found, with spawning Dolly Vardens documented. Because most of the Elwha River is located in the Park, it does not have most of the problems found in the region's

other streams, although roads and culverts pose a problem in the floodplain. Elevated temperatures are thought to be responsible for outbreaks of a fish gill parasite which has caused pre-spawning mortality of up to 70% in some years for summer chinook salmon. Water quantity is also a limiting factor during low snow pack years, in combination with industrial and municipal withdrawals. adding to the temperature problems.

Current Overall Health Based on Information Below:

Elwha River Watershed—IMPAIRED

1. Water quality conditions according to CCWQI = COMPROMISED

Elwha River @Lower Elwha Rd.	= 4.0	(compromised)
@Levee Access Rd.	= 4.0	(compromised)
WDFW Hatchery/Site 1	= 4.0	(compromised)
Site 2	= 4.5	(healthy)
Site 3	= 3.5	(compromised)
@Old RR Grade	= 4.0	(compromised)
@ Hwy 101	= 4.5	(healthy)
@Lake Mills Site 1	= 3.0	(impaired)
Beach Lake Site 1	= 3.0	(impaired)
Site 2	= 3.0	(impaired)
Site 3	= 3.0	(impaired)
Estuary (Bosco Slough) Site 2	= 4.0	(compromised)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): HIGH CONFIDENCE

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity overall for the Elwha Watershed, according to LFA 18, Watershed Plan, CC Watershed Facts = HEALTHY above dams, CRITICALLY IMPAIRED below dams

Habitat concerns include:

- a. Impacts from dams
- b. Impacts resulting from watershed alterations
- c. Loss of off-channel habitat, estuarine processes
- d. Lack of recruitment of riverbed sands and gravels
- g. Excessive stream temperatures/low flows
- h. Lack of large wood in lower river
- i. Warm temperatures, PCBs

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS

- Compromised water quality
- Critically impaired habitat below dams
- Warm stream temperatures
- Potential impacts from stormwater runoff and septics from current/future development
- Low stream flows during low snow pack

RECOMMENDATIONS

- Complete dam removal and floodplain and channel restoration
- Address habitat concerns in box on left
- Riparian restoration
- Structures within the channel migration zone
- Assess potential water quality problems, especially highway/stormwater runoff
- Establish or maintain water quality and quantity monitoring
- Start monitoring biological conditions
- Protect existing historic floodplain

State of the Waters ~ Little River, Indian Creek & Lake Sutherland

General Description:

Little River is approximately 7.5 miles long, and is located in the middle reach of the Elwha River Watershed, just upstream from Lake Aldwell. It is a large tributary entering from the east, is sparsely populated and has a history of extensive logging in some areas, along with other significant land uses that impact its habitat quality, such as gravel extraction. There is debate about whether or not passage impediments occur within the main channel that may prevent access to a major part of the watershed. Indian Creek enters the Elwha from the west, draining from Lake Sutherland. The water quality in both Little River and the Lake Sutherland/Indian Creek complex is impaired because of timber harvesting and development activities. Runoff and septic systems from dense housing developments on the shores of Lake Sutherland may increase the potential for nutrient enrichment in the lake.



Streamkeeper volunteer collects data on Little River near its confluence with the Elwha River, 1999

What do the health ratings mean to people?

The impacts caused by the logging and associated road building have resulted in excessive sediment entering the channels. This causes turbid conditions which can be harmful if the water is used for human consumption.

Lake Sutherland is used as an unpermitted drinking water source. Indian Creek is in continuity with groundwater, making it susceptible to impacts from nearby well withdrawals, particularly during the low flow season.

What do the health ratings mean to fish?

In Little River and Indian Creek summer/fall chinook, coho, fall chum and upper pink salmon, winter steelhead and cutthroat trout are projected following dam removal. Lake Sutherland and Indian Creek currently contain kokanee, which are expected to eventually resume as a Sockeye stock, once the dams are removed. There are some algal problems reported in the Lake, posing severe problems for fish spawning. Excessive nutrients in some areas may decrease

oxygen, which suffocates macroinvertebrates and causes problems for fish. Salmon need cold temperatures and lots of dissolved oxygen to thrive, and poor conditions add to the stress caused by other environmental factors in these systems. Fine sediment in streams fills up the “interstitial” spaces between the gravel that fish need for spawning and feeding, and therefore negatively impacts the survival success of salmon.

Current Overall Health Based on Information Below:

***Little River Watershed, Indian Creek/Lake Sutherland—
IMPAIRED*** (*low confidence in this rating)

1. Water quality conditions according to CCWQI = AMPLE DATA DO NOT EXIST

Monitoring data show that temperature criteria have been met for the two years monitored, 1996 and 2001, in both Indian Creek and Little River. Data for Indian Creek show very little diurnal variation during low flows, which indicates that a good deal of the flow comes from groundwater.

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity overall for the Little River Watershed, Indian Creek/Lake Sutherland, according to LFA 18 & Watershed Plan = IMPAIRED

Habitat concerns include:

- a. Impacts resulting from past logging and gravel extraction practices
- b. Excessive sediment yield (landslides from clearcuts)
- c. Excessive sedimentation in Little River
- d. Lake Sutherland: sediment from road impacts, algal blooms, excessive nutrients, contaminants, bacteria

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: MODERATE CONFIDENCE

PARTICULAR CONCERNS

- Lack of data on biological conditions and water quality
- Impaired habitat
- Impacts from excessive sedimentation in Little River
- Bacteria & nutrients in Lake Sutherland
- Degraded riparian habitat
- Potential impacts from current/future development

RECOMMENDATIONS

- Start an extensive water quality sampling program for bacteria, nutrients, and other potential contaminants in lakes, streams and groundwater
- Start monitoring biological conditions
- Assess fish passage and actions to preserve water quantity during low flow periods
- Prevent water withdrawals that may impact streamflow

State of the Waters ~ Dry Creek

General Description:

Dry Creek has a small watershed (6.3 square miles) on the west side of Port Angeles. It drains the north side of the foothills of the Elwha River, immediately south of HWY 101. This area was historically forested with very large cedars—indicative of a large forested wetland. Much of this area overlies a perched water table and wetland that has been drained and filled to accommodate industrial development east of Dry Creek, and modified for the airport. After flowing over a glacial out-wash plain, Dry Creek flows over an impassable 50-foot bedrock falls and enters a ravine flowing another mile before entering the Strait of Juan de Fuca. The soils in the area have a high erosion potential and steep slopes. Disturbances can greatly increase the chance of slides locally. Low flows in the anadromous reach (downstream of RM 1.0) are a concern in Dry Creek. Reaches of Dry Creek were historically intermittent, however the extent is not known. The stream was rerouted into a channel that is much smaller than necessary to contain peak flows, and severe erosion has occurred. Virtually all of the coastal lowland sub-watershed has been clearcut, and much of the lower watershed is rural residential and agricultural.

Varying amounts of data exist for the small streams and rivers entering the Strait of Juan de Fuca. They have been impacted by logging, road building and development in the Port Angeles basin, and most of them have some water quality problems.

What do the health ratings mean to people?

These small streams along the Western Strait have little available data with which to determine impacts on humans in the watersheds, although water quality problems are recorded on most of them. To the extent that salmon habitat is limited, so are fishing opportunities. Increased

incision and erosion can lead to flooding and other land use impacts that may cause problems for humans. Turbidity, low dissolved oxygen and high temperatures are problems that may impact human uses of the creeks.

What do the health ratings mean to fish?

Dry Creek supported coho and winter steelhead in the past and their status is now unknown; only cutthroat are found above the falls, with few coho seen below them. Salmon need cold temperatures and lots of dissolved oxygen to thrive, and elevated temperatures in Dry Creek create poor

conditions adding to the stress caused by other environmental factors in the system. Fine sediment in streams fills up the “interstitial” spaces between the gravel that fish need for spawning and feeding, and therefore negatively impacts the survival success of salmon.

Current Overall Health Based on Information Below:

Dry Creek—IMPAIRED*

(*low confidence in this rating)

1. Water quality conditions according to CCWQI = AMPLE DATA DO NOT EXIST

On 303(d) list for temperature exceedences.

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity overall for Dry Creek, according to LFA 18, Watershed Plan, CC Watershed Facts = IMPAIRED

Habitat concerns include:

- a. Impacts resulting from past and present watershed alterations
- b. Chronically low LWD
- c. Loss of off-channel habitat
- d. Excessive erodibility of watershed
- e. Increase in stormwater runoff causing habitat degradation

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS

- Impaired habitat
- Lack of data on water quality and biological conditions
- Impacts from excessive sedimentation
- Impacts from warm stream temperatures
- Impacts of nonpoint sources such as runoff from highway and other roads, septic systems and improper waste disposal, the landfill, and possible impacts of runoff from the airport

RECOMMENDATIONS

- Remediate stormwater impacts
- Prevent further head-cutting on relocated reaches of Dry Creek
- Implement a LWD strategy
- Restore a functional riparian zone if possible
- Start monitoring water quality and biological conditions

State of the Waters ~ Tumwater Creek & Port Angeles Harbor

General Description:

Tumwater Creek is a small independent drainage of approximately 5.6 square miles, entering salt water near the western end of Port Angeles harbor. The upper portion of the watershed has been modified by past and ongoing forest harvest and rural residential development. Urban and rural development in the Port Angeles area have had substantial impacts in Tumwater Creek. The central and lower portions have been heavily impacted by agriculture, and residential and commercial development. The creek is completely constrained by culverts, bulkheads, armoring and roads in the lower 0.5 mile of stream. The lower one-quarter mile is culverted under waterfront industrial and city street properties, and the following one-half mile is confined and channelized between a high valley wall and a road. The upper watershed has experienced extensive rural conversion, with associated animal and stormwater impacts. Of particular concern is a very large, active slide area, initially caused by altered stormwater drainage. Fine sediment is a continuing source of excessive sediment into the creek. Increased stormwater flows, and the interception of groundwater is causing additional erosion and head-cutting. Watershed residents, local government agencies, Trout Unlimited and others are exploring restoration opportunities on Tumwater Creek, particularly on the active landslide.



*Old storm drain pipe upstream
of the 8th Street Bridge*

What do the health ratings mean to people?

There are not enough data to develop a valid health rating related to impacts on humans, although elevated fecal

ratings could pose a health risk for humans. Unstable banks cause problems for streamside property owners.

What do the health ratings mean to fish?

Coho salmon, winter steelhead and cutthroat have been recorded in Tumwater Creek. Fall chum are believed to have been extirpated. The status of temperatures and

dissolved oxygen is a data gap. The general condition of the channel and estuary is highly degraded, and represent poor to hazardous conditions for salmonids.

***Current Overall Health Based on Information Below:
Tumwater Creek—IMPAIRED; PA Harbor—IMPAIRED***

1. Water quality conditions according to CCWQI =

Tumwater Creek: IMPAIRED

Tumwater Crk. RM	0.1	= 2 (highly impaired)
	0.4	= 3 (impaired)
	0.6	= 3 (impaired)
	0.8	= 2 (highly impaired)
	0.8a	= 1 (critically impaired)
	0.8c	= 3 (impaired)
	0.8d	= 1 (critically impaired)
	0.8e	= 3 (impaired)
	1.4	= 5 (healthy)

PA HARBOR: COMPROMISED

PA Harbor	@Hollywood	= 5 (healthy)
	@ Peabody	= 1 (critically impaired)
	@ Rayonier	= 4 (compromised)
	@ Sea Farms	= 5 (healthy)
	@slip 71	= 4 (compromised)

Port Angeles Harbor is on the 303(d) list for dissolved oxygen violations.

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): MODERATE CONFIDENCE

All water quality ratings are based on fecal coliform data only.

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity overall for Tumwater Creek & PA Harbor, according to the LFA 18, Watershed Plan, and CC Watershed Facts = IMPAIRED TO HIGHLY IMPAIRED

Habitat concerns include:

- a. Impacts resulting from conversion and development; stormwater run-off impacts
- b. Channelization, constrictions and roads impacting stream
- c. Excessive sediment input
- d. Loss of off-channel habitat
- e. Lack of sufficient, high-quality LWD instream

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS

- Impaired water quality
- Impaired to Highly Impaired habitat
- Lack of data on biological conditions
- Impacts from altered hydrology
- Impacts from excessive stormwater/ erosion and inputs of sediment
- Constrictions on channel
- Degraded channel conditions and lack of LWD in channel
- Degraded riparian zones
- Impacts from creek flowing through log storage yard without treatment

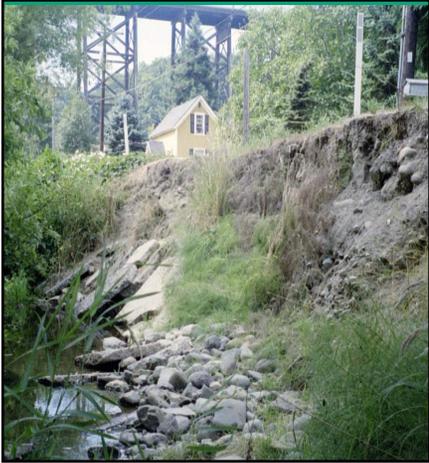
RECOMMENDATIONS

- Remediate stormwater management in the watershed
- Restore functional estuary processes
- Remove channel constrictions and restore functional floodplain processes
- Implement a LWD strategy
- Survey creek for illegal discharge pipes
- Restore functional riparian zones
- Start monitoring biological conditions
- Continue monitoring water quality

State of the Waters ~ Valley Creek

General Description:

Valley Creek is a small independent drainage, 2.4 square miles, that drains moderately steep headwaters just north of Olympic National Park. It enters salt water near the western end of Port Angeles Harbor. The creek is approximately 4.9 miles long and has been significantly altered to accommodate timber production, and residential urban and industrial development in Port Angeles. At least 60% of the watershed is in urban land use, with 50% in impervious surfaces (1988). The headwaters originate in an upland sub-watershed over 2400 feet in elevation. The watershed is broad, with the stream running through a ravine-like valley, continuing into an elongated and rather narrow coastal lowland characterized by urbanization along the valley rim. The upper reaches are largely confined within a steep, wooded ravine, and flow through lands managed for timber. The middle reaches remain confined by the steep ravine, but the quality of vegetation decreases as the stream moves into more urbanized areas. The lower reaches historically meandered, but have been channelized, diked and confined, with a lack of pools and LWD. Like neighboring Tumwater (west) and Peabody (east) creeks, Valley Creek exits through culverted lower reaches under the central downtown area of Port Angeles, and flows into the harbor. The stream has been channelized, and constrained next to a road paralleling it along the valley floor. Despite the level of degradation, significant restoration has occurred. An estuary restoration project of 1.5 acres was completed in 1998; a box culvert at Hwy. 101 was retrofitted in 2002, and a channelized reach was remeandered in 2003. Filling has degraded estuarine habitat and industrialization has degraded harbor water quality, designated by EPA as water quality limited, because of highly contaminated bottom sediments.



*Erosion on bank of Valley Creek
below the 8th Street Bridge*

Since 1999, the volunteer-based Valley Creek Restoration Committee has been very active in estuary and stream restoration as well as watershed planning and education.

What do the health ratings mean to people?

Thermal pollution, turbidity, untreated stormwater inputs, and nonpoint pollution from high-density areas are water quality concerns in Valley Creek. These sources could

introduce such contaminants as hydrocarbons (oils and grease), heavy metals, pesticides, herbicides, excessive nutrients (from fertilizers) and bacterial waste.

What do the health ratings mean to fish?

Valley Creek historically supported fall chum, coho and winter steelhead. The level of habitat degradation has been

so great that chum have been extirpated, and coho and winter steelhead productivity is currently limited.

Current Overall Health Based on Information Below:

Valley Creek—IMPAIRED/COMPROMISED

1. Water quality conditions according to CCWQI = COMPROMISED

Valley Crk.	RM	0.0 = 2.0 (highly impaired)
		0.4 = 2.0 (impaired)
		0.5 = 5.0 (healthy)
		0.6 = 5.0 (healthy)
		0.7 = 5.0 (healthy)
		1.0 = 3.7 (compromised)
		1.2 = 4.0 (compromised)
		2.2 = 4.0 (healthy)
East Fork	RM	0.6 = 5.0 (healthy)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): HIGH CONFIDENCE

2. Biological conditions according to B-IBI = COMPROMISED

Valley Creek	RM	0.4 = 34.7 (impaired)
		0.7 = 38.0 (compromised)
		1.0 = 44.0 (compromised)
		1.2 = 44.0 (compromised)
		2.2 = 46.0 (healthy)

OVER-ALL B-IBI CONFIDENCE RATING: HIGH CONFIDENCE

3. Habitat integrity overall for Valley Creek, according to LFA 18, Status & CC Watershed Facts = IMPAIRED TO HIGHLY IMPAIRED

Habitat concerns include:

- a. Impacts resulting from past and present logging
- b. Blockages for fish passage
- c. Channelization, constrictions and roads impacting stream; excessive sediment input
- d. Encroachments to the floodplain, loss of off-channel habitat
- e. Estuarine habitat alteration
- f. Lack of sufficient, high-quality LWD instream; degraded riparian zones

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS

- Compromised water quality and biological conditions
- Impaired to highly impaired habitat
- Severe impacts from untreated stormwater and nonpoint source pollution, especially in the lower creek, estuary and Port Angeles Harbor
- Impacts from floodplain encroachments
- Impacts from continued development
- Degraded stream habitat

RECOMMENDATIONS

- Set a goal of preserving corridor as a natural reserve, restoring lower creek consistent with habitat potential, LWD
- Improve passage conditions; remove culverts as possible, “open up creek”
- Reestablish floodplain/reduce and/or eliminate constrictions
- Remediate stormwater management
- Survey creek for illegal discharge pipes
- Restore riparian vegetation
- Support and maintain monitoring programs

State of the Waters ~ Peabody Creek

General Description:

Peabody Creek is a small, rain-dominated independent drainage, entering salt water in Port Angeles Harbor in downtown Port Angeles. The watershed is 2.6 square miles in size, with headwaters in the lower foothills at the northern boundary of Olympic National Park. The 4.8 mile stream drains off the low foothills paralleling the Strait of Juan de Fuca, through heavily urbanized areas of Port Angeles. Historic logging has occurred throughout the watershed, and while the watershed shows the alterations caused by logging, within the Park the present forest condition appears dense and mature. A portion of the upper stream corridor was added to Olympic National Park. Lower elevations show significant alteration due to clearing and development. There is floodplain development, many culverts and some stretches are totally covered up with roads. Sewage was historically discharged directly into Peabody Creek. The creek still serves as a Combined Sewer Overflow (CSO) for a portion of Port Angeles. An upgrade will eliminate this CSO in the near future. Vast quantities of stormwater are currently routed into the creek. Various nonpoint source and possibly point-source pollutants are known to enter the creek. There are impassable culverts at 5th and 8th streets, where the creek is routed underneath downtown Port Angeles.



Creative bank stabilization along Peabody Creek. Unfortunately, tires can degrade and become a source of contamination.

What do the health ratings mean to people?

Impaired water quality and biological conditions may make this stream (and the public beach adjacent to its mouth) undesirable and unhealthy for recreational use by residents and visitors.

Also, the potential for flooding of city streets and private property exists if any culverts become blocked.

What do the health ratings mean to fish?

Coho salmon and winter steelhead are believed to have been extirpated, and only cutthroat trout remain in Peabody Creek. Storm drains deliver a mixture of pollutants, largely associated with road surfaces. Fine sediment is known to be a serious problem, and Peabody Creek typically has very high turbidities during storm events. Elevated peak flows from stormwater

inputs are a serious problem in the creek. Fine sediment in streams fills up the “interstitial” spaces between the gravel that fish need for spawning and feeding, and therefore negatively impacts the survival success of salmon. Changes in the creek’s flow regime may also impact the success of spawning and rearing fish.

Current Overall Health Based on Information Below:

Peabody Creek—HIGHLY IMPAIRED

1. Water quality conditions according to CCWQI = IMPAIRED

Peabody Crk.	RM	0.0	= 1.0 (critically impaired)*	RM	0.6	= 4.0 (compromised)*
		0.2	= 3.3 (impaired)		0.6a	= 5.0 (healthy)*
		0.2b	= 1.0 (critically impaired)*		0.9	= 1.0 (critically impaired)*
		0.2c	= 3.0 (impaired)*		1.0	= 4.0 (compromised)
		0.3	= 2.0 (highly impaired)*		1.3	= 5.0 (healthy)
		0.4	= 1.0 (critically impaired)*		1.4	= 3.7 (compromised)
		0.5	= 3.5 (compromised)			

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): HIGH CONFIDENCE

*Rating based on fecal coliform data only.

Both pH and nitrates have been recorded outside the normal range.

2. Biological conditions according to B-IBI = HIGHLY IMPAIRED

Peabody Crk.	RM	0.2	= 12 (critically impaired)
	RM	0.5	= 16 (critically impaired)
	RM	1.0	= 16 (critically impaired)
	RM	1.4	= 48 (healthy)

OVER-ALL B-IBI CONFIDENCE RATING: MODERATE CONFIDENCE

3. Habitat integrity overall for Peabody Creek, according to LFA 18, Watershed Plan, & CC Watershed Facts = IMPAIRED TO HIGHLY IMPAIRED

Habitat concerns include:

- a. Impacts of stormwater and nonpoint source pollution
- b. Impacts from turbidity and excessive fine sediment
- c. Impacts from culverts and other constrictions, especially deteriorating culverts

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS

- Impaired water quality
- Highly impaired biological conditions
- Impaired to highly impaired habitat
- Impacts from excessive road-derived sedimentation
- Impacts from stormwater inputs and other pollutants
- Possible future impacts from deteriorating culverts placed under fill
- Impacts from floodplain encroachments
- Preservation of habitat for state-listed salamander

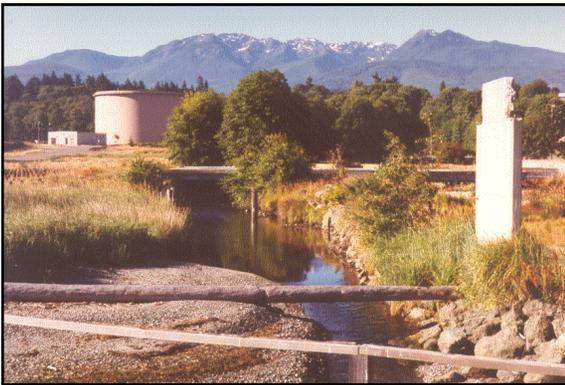
RECOMMENDATIONS

- Collect, detain, and treat stormwater
- Protect and preserve critical habitat for state-listed salamander
- Correct passage problems
- Remove instream fill on ONP lands
- Implement LWD/riparian improvement projects
- Restoration for continued support of cutthroat, water quality and other salmonids
- Continue monitoring programs

State of the Waters ~ Ennis Creek Lake Dawn & White Creek

General Description:

Ennis Creek is a significant independent drainage, entering salt water at the eastern end of Port Angeles harbor. It is the smallest snow-fed stream on the North Olympic Peninsula, and is 8.65 miles long. The headwaters are located within Olympic National Park, and it is generally considered the healthiest of the Port Angeles urban streams. Lake Dawn, created in the early 20th century, lies at approximately 2000 feet. Both Ennis Creek and White Creek, a major tributary to Ennis, pass through forested lands, commercial and residential communities. LWD presence below RM 3.0 is poor; lack of pools and spawning gravel is a problem for Ennis Creek. The box culvert at Hwy 101 is a perennial fish passage problem. White Creek is heavily degraded from urbanization in its lower reaches (including construction of a motel over the watercourse, which is now encased in a bottomless culvert). Culverts are a major impact in White Creek, and on the whole are impassable. The channel in the upper White Creek is steep and tightly confined, and the habitat is badly degraded. The floodplain downstream of White Creek is partially channelized and constrained by dikes, armored banks, a parking lot, and several bridges associated with the former mill (clean-up is anticipated in the next several years), and/or sewage treatment plant.



Looking upstream Ennis Creek near the mouth. Port Angeles wastewater treatment plant is in the background, 2000

What do the health ratings mean to people?

Indications of fecal problems could cause human health concerns, but not enough data exists to make a valid evaluation.

What do the health ratings mean to fish?

Ennis Creek supports coho, winter steelhead and cutthroat trout; Dolly Varden have been documented there, and fall chum are believed to have been extirpated in the creek. The upper reaches of Ennis have relatively un-degraded conditions. White Creek has

coho salmon, winter steelhead, and cutthroat trout, with little production potential due to impassable culverts. Nonpoint source pollution, combined with degraded habitat make conditions in White Creek very poor for salmonid production.

Current Overall Health Based on Information Below:

Ennis Creek & White Creek—IMPAIRED

1. Water quality conditions on Ennis Creek according to CCWQI = IMPAIRED

Ennis Creek	RM	0.1 = 4.0 (compromised)
		0.7 = 4.0 (compromised)
		1.0 = 3.0 (impaired)
		1.4 = 5.0 (healthy)
		6.6 = 3.5 (compromised)
White Creek (trib.)	RM	0.0 = 1.0 (critically impaired)
		0.3 = 2.0 (highly impaired)
		0.8 = 2.0 (highly impaired)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): MODERATE CONFIDENCE

2. Biological conditions on Ennis Creek according to B-IBI = IMPAIRED

Ennis Creek	RM	0.1 = 28 (impaired)
		1.4 = 32 (impaired)

OVER-ALL B-IBI CONFIDENCE RATING: MODERATE CONFIDENCE

3. Habitat integrity overall for Ennis Creek, according to LFA 18, Watershed Plan, CC Watershed Facts = GOOD; for White Creek = IMPAIRED

Habitat concerns include:

- Impacts resulting from agriculture, residential and commercial development
- Constrictions and roads impacting streams and excessive sediment input
- Encroachments to the floodplain and loss of off-channel habitat
- Blockages for fish passage
- Possible impacts of estuarine habitat alteration

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS

- Impaired water quality, biological conditions and habitat
- Impacts from runoff of golf course
- Impacts from floodplain constrictions, encroachments and conversion
- Fish passage barriers
- Lack of sufficient LWD
- Stormwater impacts in Ennis and White Creek watersheds
- Potential leachate from old landfills

RECOMMENDATIONS

- Improve HWY 101 culvert on Ennis for safe fish passage
- Consider opportunities to restore and provide long-term protection and restoration of Ennis Creek riparian corridor and estuary, and to restore habitat and recover salmon
- Continue monitoring programs
- Conduct reconnaissance for illegal discharge pipes

State of the Waters ~ Lees Creek

General Description:

Lees Creek is a small, independent drainage which enters saltwater in the Strait of Juan de Fuca just east of Port Angeles city limits. The lower portion of the stream lies in a steep, wooded ravine which is very unstable. Clearing of vegetation up to, and over the edge of the ravine has occurred in sections. Unwanted material has also been dumped into the ravine. Water quality is affected in the agricultural areas of both the East and West Forks of Lees Creek. Approximately 25% of the East Fork has horse and hobby farms where the riparian vegetation has been removed, there is direct animal access to the creek, and the banks have been trampled. Similar impacts occur on some reaches of the West Fork. Fertilizers and pesticides may also enter the creek in these reaches. Landfills in this watershed have been the subject of great scrutiny and water quality monitoring; safeguards are used to prevent leaching into the environment. The specific effects of the stormwater runoff are unknown. The creek is a naturally “closed channel” in the summer due to the mouth being isolated from the Strait by a natural sand spit during low flows.



Streamkeepers volunteers doing a stream transect at Lees Creek RM 0.1

What do the health ratings mean to people?

Direct animal access in streams can result in elevated fecal coliform levels, which may cause a health risk for humans.

What do the health ratings mean to fish?

Lees Creek is only known to support cutthroat trout; coho salmon and winter steelhead are believed to be extirpated. Current productivity is judged to be low, with a limited potential for improvement due to the alteration of the watershed, and the short stream length. Fine sediment in streams fills up the “interstitial” spaces

between the gravel that fish need for spawning, incubation and feeding, and therefore negatively impacts the survival success of salmon. Lack of off-channel habitat especially impacts juvenile winter refuge rearing for fall coho and winter steelhead, and early juvenile rearing needs.

Current Overall Health Based on Information Below:

Lees Creek—IMPAIRED

1. Water quality conditions according to CCWQI = COMPROMISED

Lees Creek RM 0.1 = 4.3 (compromised)
 0.6 = 4.5 (healthy)
 0.8 = 3.5 (compromised)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): HIGH CONFIDENCE
 Nitrate data show higher than normal levels in Lees Creek.

2. Biological conditions according to B-IBI = COMPROMISED

Lees Creek RM 0.1 = 33 (impaired)
 0.6 = 43 (compromised)
 0.8 = 39 (compromised)

OVER-ALL B-IBI CONFIDENCE RATING: HIGH CONFIDENCE

3. Habitat integrity overall for Lees Creek, according to LFA 18, Watershed Plan, CC Watershed Facts = IMPAIRED TO HIGHLY IMPAIRED

Habitat concerns include:

- a. Fish passage barriers
- b. Concrete bulkheads and channel-lining on East Fork
- c. Unrestricted animal access
- d. Channel ditching and draining
- e. Floodplain/wetland constrictions on West Fork
- f. Chronic depletion of LWD

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS

- Compromised water quality and biological conditions
- Impaired to highly impaired habitat
- Stormwater runoff impacts in developed areas
- Impacts of historic logging and conversion of riparian forest to pasture or housing development
- Fine sediment levels in spawning gravels
- Impacts from direct animal access to stream
- Potential leachate from old landfills

RECOMMENDATIONS

- Improve passage conditions
- Restore riparian corridors; implement LWD recovery strategy; fence livestock from channel on both East and West Forks
- Correct floodplain constrictions
- Evaluate flow and water quality impacts from mill landfills, roads and agricultural areas
- Continue monitoring programs

State of the Waters ~ Morse Creek

General Description:

Morse Creek is the largest of the independent drainages to the Strait of Juan de Fuca between the Dungeness and Elwha Rivers. This moderate-sized watershed of 52.7+ mi² drains steep headwaters in Olympic National Park. The upper reaches lie at elevations exceeding 6000 feet, well above timberline, and are steep and confined, flowing through forested and alpine meadow vegetation. The middle reaches below the Park flow through heavily forested foothills, passing through moderately incised canyons with falls and cascades. Morse Creek continues to be confined in a ravine-line canyon through large portions of its lower reach. Between RM 3-1, the creek flows through a bottom-land, where below RM 1.7 the valley broadens into a relatively wide floodplain. As with many of the streams on the Olympic Peninsula, as Morse Creek flows downstream conditions become more degraded. This is especially true in the lower 2.5 miles, channelized for development and Hwy. 101, with subsequent stormwater impacts to the creek. Land uses outside the Park include hydroelectric generation, logging and residential development. Like other high elevation watersheds on the peninsula, Morse exhibits two peaks in annual discharge: one associated with winter rainstorms and the other resulting from spring snowmelt.



Looking north towards the mouth of Morse Creek

What do the health ratings mean to people?

Surface and groundwater is removed for domestic use in Port Angeles. While the over-all water quality rating is healthy, this is based on limited data, taken from a limited number of reaches. Because of concerns over possible nonpoint source and point source impacts, additional mon-

itoring is needed to understand the water quality in the creek. As development continues, careful monitoring will help deflect additional negative human impacts on the creek.

What do the health ratings mean to fish?

Morse Creek is known to have produced a high diversity of salmon species for a stream of its size. It currently supports coho, summer/fall chum, and pink salmon, summer/winter steelhead and cutthroat trout. Dolly Varden have been documented there, and spring/summer chinook are believed to be extirpated. Degraded conditions in the estuary and lower creek, especially important for rearing of juvenile fish, may heavily impact the success of these

species, as well as other impacts farther upstream. Healthy water quality ratings for temperature and dissolved oxygen translate into very good conditions for fish. However, the biological integrity of the creek, measured by the macroinvertebrate sampling, indicates that conditions are compromised for "bugs," an indicator the health of the stream could be better. This may mean that less "high quality" food is available for fish.

Current Overall Health Based on Information Below:

Morse Creek —COMPROMISED/HEALTHY

1. Water quality conditions according to CCWQI = HEALTHY

Morse Creek RM 0.3 = 4.5 (healthy)
 1.1 = 5.0 (healthy)
 2.0 = 5.0 (healthy)
 4.0 = 5.0 (healthy)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): HIGH CONFIDENCE

2. Biological conditions according to B-IBI = COMPROMISED

Morse Creek RM 0.3 = 35.5 (compromised)
 1.1 = 35.0 (impaired)
 2.0 = 36.0 (compromised)

OVER-ALL B-IBI CONFIDENCE RATING: HIGH CONFIDENCE

3. Habitat integrity according to LFA 18, Watershed Plan, Status, CC Watershed Facts overall = HEALTHY TO IMPAIRED

Excellent in upper watershed (above RM 9), logging has occurred in the middle reach where habitat integrity remains good to excellent (RM 3-9), and in poor to critical condition in the lower 2.5 miles where it has been severely altered by high-density residential development.

Habitat concerns include:

- a. LWD is lacking in many lower reaches; riparian vegetation is fair in ravine areas, but it has been removed or only young trees are growing along the stream in the lower reaches
- b. Channelization, dense residential development, road crossings/other floodplain constrictions in lower 2 mi.; sediment from logging practices; unstable channels downcutting
- c. Abandoned fly ash dump above creek at RM 1.5 (possible leakage of toxic compounds to creek)
- d. Stormwater management, septic systems, fish rearing facilities, runoff from golf courses and lawns
- e. Historic conditions in the estuary have been substantially altered and/or lost

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

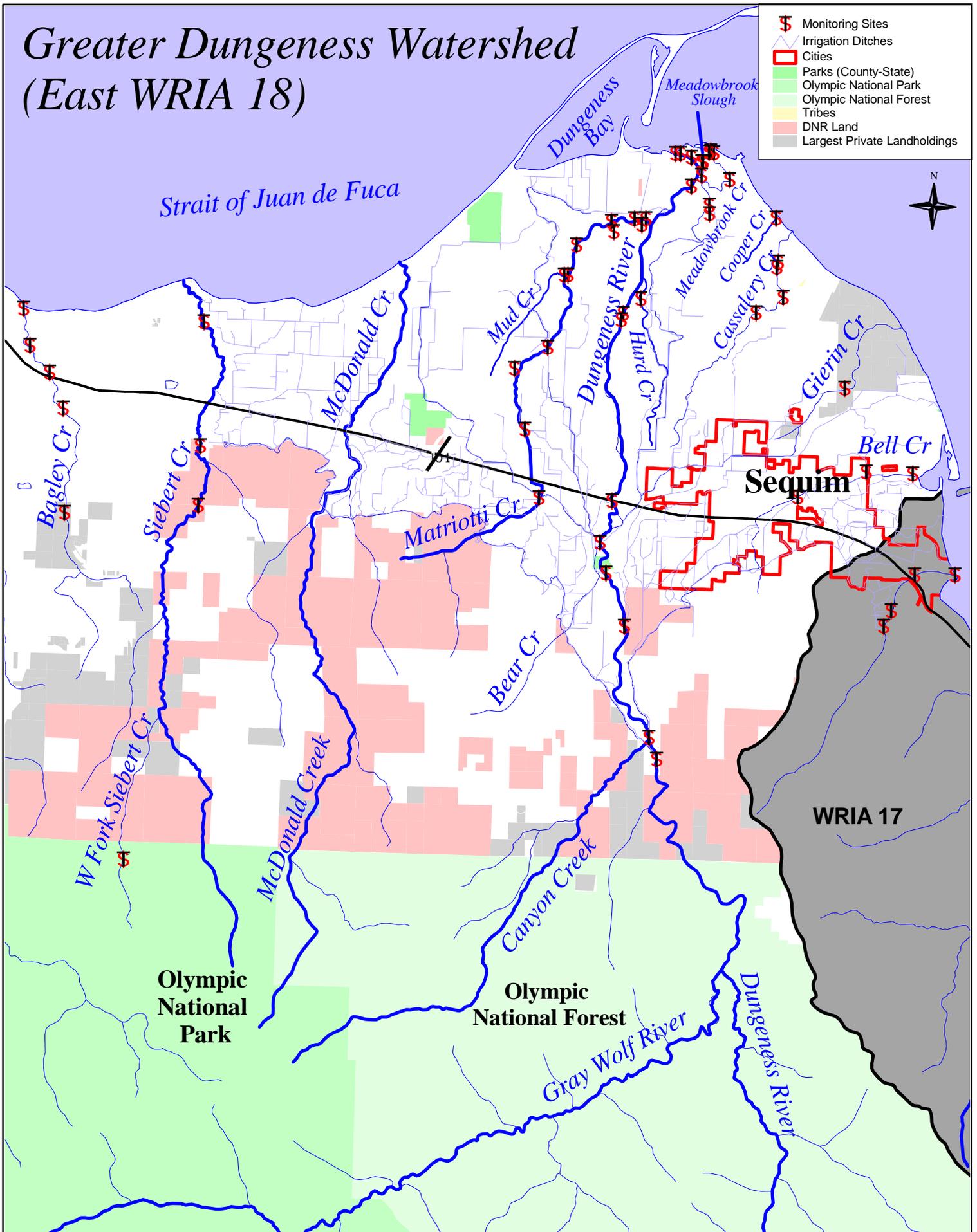
PARTICULAR CONCERNS

- Compromised biological conditions
- Impaired to critically impaired habitat in lower river
- Land development on stream, channelization, channel constriction & instability from bank hardening, roads and other floodplain constrictions
- Nonpoint sources issues listed under Habitat Concerns
- Impacts of future conversion activities
- Potential leachate from old landfills

RECOMMENDATIONS

- Restore floodplain functions below RM 1.7
- Restore riparian functions
- Reestablish estuarine characteristics & function
- Establish comprehensive water quality monitoring program; develop strategy to deal with creosoted pilings at Railroad Bridge
- Develop strategies to retain sediment in creek (e.g., restoration, LWD placement, etc.)
- Monitor & treat future stormwater runoff as needed prior to infiltration
- Continue monitoring programs

Greater Dungeness Watershed (East WRIA 18)



- \$ Monitoring Sites
- △ Irrigation Ditches
- Cities
- Parks (County-State)
- Olympic National Park
- Olympic National Forest
- Tribes
- DNR Land
- Largest Private Landholdings



WRIA 17

Olympic National Park

Olympic National Forest

Sequim

GREATER DUNGENESS RIVER WATERSHED

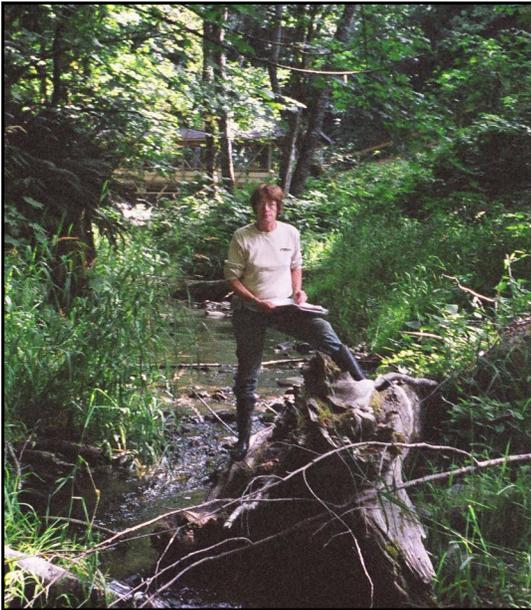
EAST WRIA 18

- ***Bagley Creek***
- ***Siebert Creek***
- ***McDonald Creek***
- ***Dungeness River & Bay***
 - Gray Wolf River, Canyon & Bear Creeks***
 - Hurd Creek***
 - Matriotti Creek & Tribs***
- ***Meadowbrook Creek & Slough***
- ***Cooper Creek***
- ***Cassalery Creek***
- ***Gierin Creek***
- ***Bell Creek***

State of the Waters ~ Bagley Creek

General Description:

Bagley Creek is a medium-sized independent drainage to the Strait of Juan de Fuca, with approximately 9.5 miles of streams and tributaries. With its headwaters in the foothills, the Bagley Creek watershed is comprised mostly of very shallow soils over glacial till, making it highly susceptible to flooding and channel erosion. The predominant land use is commercial forest or private woodlots, pasture/grassland and rural residential. Bagley is considered the most responsive creek to flooding in the County caused by rainfall or rain-on-snow events. The stream was closed to new surface water appropriations in 1948.



Streamkeeper volunteer stands atop "large woody debris" at Bagley Creek RM 0.7

What do the health ratings mean to people?

The over-all health conditions are rated as compromised-impaired, reflecting the excessive sediment rates which cause nonpoint source pollution in the stream. In addition, the limited fecal coliform counts taken do not

reflect possible bacteria contamination caused by animal access into the stream, with possible harmful effects on humans.

What do the health ratings mean to fish?

Bagley Creek historically supported coho and chum salmon steelhead, cutthroat and rainbow trout. Coho salmon, winter steelhead and cutthroat are the only fish now known to exist in Bagley Creek. The habitat along the creek has been degraded throughout much of the watershed and is reflected in the impaired rating for biological integrity. The macroinvertebrate sampling

also indicates impaired conditions for fish in Bagley Creek. Nutrient or fecal coliform problems, if they exist, would not necessarily harm fish, and therefore directly impact conditions for them in the creek, but may indicate other problems that would be harmful, such as on dissolved oxygen levels.

***Current Overall Health Based on Information Below:
Bagley Creek—COMPROMISED-IMPAIRED***

1. Water quality conditions according to CCWQI = COMPROMISED

Bagley Creek	RM 0.0 = 4.0 (compromised)	RM 1.8 = 4.0 (compromised)
	0.7 = 5.0 (healthy)	4.6 = 5.0 (healthy)
	1.2 = 4.0 (compromised)	

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): HIGH CONFIDENCE

Bagley Creek is on the 303(d) list for fecal coliform bacteria levels.

2. Biological conditions according to B-IBI = COMPROMISED

Bagley Creek	RM 0.0 = 34.0 (impaired)
	0.7 = 37.0 (compromised)
	1.2 = 33.3 (impaired)
	1.8 = 34.0 (impaired)
	4.6 = 40.0 (compromised)

OVER-ALL B-IBI CONFIDENCE RATING: HIGH CONFIDENCE

3. Habitat integrity according to the LFA 18, Watershed Plan WRIA 18, and CC Watershed Facts = IMPAIRED

Habitat concerns include:

- a. Culverts that block fish passage and cause bank erosion and deposition
- b. Lack of large woody debris in some reaches (assessed in the LFA as having fair LWD and riparian conditions, and poor pool and substrate conditions)
- c. Poor bank conditions south of HWY 101; trampled banks, little riparian cover, direct animal access to stream
- d. Degraded riparian conditions in middle and upper watershed
- e. High fine sediment levels from stormwater and agricultural runoff; high nutrient levels
- f. Extensive and continued conversion activities cause accelerated stream power and sediment transport and eroding banks, impacting water quality and degrading habitat

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS

- Impaired habitat integrity
- Compromised water quality and biological conditions

RECOMMENDATIONS

- Address habitat concerns listed in box on left
- Continue monitoring programs
- Address sources of fecal coliform contamination, such as excluding direct animal access to channels
- Adopt instream flow recommendations

State of the Waters ~ Siebert Creek

General Description:

Siebert Creek is an independent drainage with 31.2 miles of mainstem stream and tributaries, and headwaters located in Olympic National Park. The creek is 12.4 miles long, and drains 19.5 square miles of the northwest flank of Blue Mountain, with the upper reaches typically steep and incised at elevations up to 3,800 feet. The lower reaches contain both moderate and low-gradient habitat. Land uses include commercial forestry, Olympic National Park, private woodlots, pastures or grasslands, and increasing levels of residential development. Siebert Creek is the westernmost stream influenced directly by irrigation flows from the Dungeness River, and was closed in 1973 to new surface water appropriation. A recent volunteer group made up of watershed residents and others brought much-needed attention to the habitat needs of Siebert Creek, and was very active in restoration, education and watershed planning.

What do the health ratings mean to people?

Siebert Creek flows out of Olympic National Park, where conditions are healthy; the rest of the creek remains largely undisturbed, with conditions that are generally healthy. As with many streams on the Olympic Peninsula, as they flow downward towards the Strait of Juan de Fuca or the ocean, conditions can become more degraded by human activities, land use changes or by natural occurrences such as land-

slides. Signs indicate that human activities may be having a degrading impact on the water quality of the lower reaches of Siebert. Ratings of compromised biological conditions and habitat integrity will continue to reflect land use impacts, and may impact human activities related to the stream.

What do the health ratings mean to fish?

Siebert Creek historically supported coho and chum salmon, steelhead, cutthroat and rainbow trout and Dolly Varden have been documented there (probably using it for foraging and/or over wintering habitat). The mainstem and tributaries currently support coho salmon, winter steelhead and cutthroat trout. The stream has been characterized in the LFA as having ideal fish habitat throughout, except in the East Fork. A few eroding stream banks have been not-

ed in the lower section, immediately downstream of HWY 101, meaning excessive sediment is entering the creek, which may limit spawning and food gathering success for fish. Healthy ratings for water temperatures and dissolved oxygen mean that the water quality conditions for fish are good, while the compromised biological integrity, indicates that some changes are occurring that may impact conditions for fish.



Streamkeeper volunteers collecting macroinvertebrates on Siebert Creek

***Current Overall Health Based on Information Below:
Siebert Creek—COMPROMISED***

1. Water quality conditions according to CCWQI = HEALTHY

Siebert Crk. RM	0.6 = 4.5 (healthy)
	3.0 = 5.0 (healthy)
	3.8 = 4.5 (healthy)
West Fork: RM	2.3 = 4.0 (compromised)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): HIGH CONFIDENCE

pH has been recorded outside the normal range, though evidence suggests this may be normal for this system.

2. Biological conditions according to B-IBI = COMPROMISED

Siebert Crk. RM	0.6 = 41.0 (compromised)
	3.0 = 42.0 (compromised)
	3.8 = 44.7 (compromised)
West Fork: RM	2.3 = 46.0 (healthy)

OVER-ALL B-IBI CONFIDENCE RATING: HIGH CONFIDENCE

3. Habitat integrity according to the LFA 18, Status, Watershed Plan WRIA 18 & CC Watershed Facts = HEALTHY in the upper watershed, except in the East Fork, where sedimentation is a problem; **COMPROMISED** in lower reaches

Habitat concerns include:

- a. Unstable slide prone areas and forest roads adding excessive sediment into creek
- b. Instability, erosion & excessive fine sediments below RM 3.4
- c. Lack of large woody debris in some reaches; riparian vegetation removal along some stream banks
- d. Riprap and bank hardening at Old Olympic Highway; erosion entering from Emery Crk.
- e. Over-all low juvenile fish populations reflecting degraded lower-channel conditions
- f. Impacts of future conversion activities

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS

- Compromised biological conditions
- Potential impacts of future development
- Habitat integrity shows some signs of becoming degraded in lower watershed
- Possible impacts on water quality from leachate from an old landfill
- Increased levels of bacterial contamination at high flows

RECOMMENDATIONS

- Continue monitoring programs
- Address habitat concerns listed in box on left
- Address sources of fecal coliform contamination, including monitoring & treatment of future stormwater runoff as needed prior to infiltration
- Protect high quality reaches; implement stream buffer protection/restoration

State of the Waters ~ McDonald Creek

General Description:

McDonald Creek is an independent drainage to salt water, entering the Strait of Juan de Fuca west of Dungeness Bay. The drainage is 13.6 miles long, draining approximately 23 square miles of the northwest flank of Blue Mountain. The headwaters originate at approximately 4,700 feet; it flows through a deeply incised coastal upland, and across a marine bluff to saltwater. The creek, similar to other streams with their headwaters in the foothills, is subject to hydrologic and stormwater effects as a result of permanent forest cover loss, (forestry and conversion to residential development). These impacts increase stream power, erosion, and sediment transport lower in the system. Primary land uses are commercial timber and private woodlots. An administrative closure for new water rights is in place.

What do the health ratings mean to people?

While ample data do not exist for a CCWQI rating, past records of elevated fecal coliform and dissolved oxygen samples may be considered important concerns for humans in the watershed, and should be closely monitored. They are indicators of other problems in the watershed as

well, which may include animal access to surface waters, excessive sediment, septic or other problems associated with development and lack of proper flushing at the mouth. This possible bacterial contamination can cause risks to human health.

What do the health ratings mean to fish?

McDonald historically supported coho and chum salmon, steelhead, cutthroat and rainbow trout. Currently coho salmon, winter steelhead and cutthroat are found. Excessive sediment impacts salmon when they are feeding, spawning and trying to see predators in order to keep away from them. Instability in the channel means habitat conditions are

generally less than good for salmon survival and reproduction. Elevated dissolved oxygen is harmful to aquatic ecosystems and directly impacts fish. Irrigation water from the Dungeness River entering the creek can impact the migration patterns of both the McDonald Creek fish, as well as attract Dungeness River fish to McDonald Creek.

Current Overall Health Based on Information Below:

McDonald Creek—IMPAIRED*

(*low confidence in this rating)

1. Water quality conditions according to CCWQI = AMPLE DATA DO NOT EXIST

Nitrate data show higher than normal levels

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity according to the LFA 18, Status, Watershed Plan WRIA 18 & CC Watershed Facts = IMPAIRED

Habitat concerns include:

- a. Impacts of timber harvest on Forest Lands in upper watershed (in rain-on-snow zone), that occurred in the 1980s-early 1990s, resulting in damage to steep ravine walls and subsequent sediment inputs into watershed
- b. Conversion for residential development of large areas of forest lands to non-forest cover
- c. Critical depletion of LWD in some reaches
- d. Instability, erosion & excessive fine sediments below RM 3.4
- e. Poor pool percentage and fair pool frequency
- f. Impacts of Dungeness River irrigation water on water quality and on fish migration patterns; impacts of fish bypass system/dam on upstream migration on adults and outmigration of juvenile salmonids

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS

- Ample water quality data do not exist to rate this stream
- No data exist to rate the biological conditions
- The habitat integrity is impaired
- Several Agnew area wells have high nitrates

RECOMMENDATIONS

- Increase water quality monitoring
- Start collecting data on biological conditions
- Address the habitat concerns listed in the box on left
- Address the sources of fecal coliform contamination, and the temperature and dissolved oxygen problems

State of the Waters ~ Dungeness River & Bay

General Description:



A view upstream from the Railroad Bridge on the Dungeness River

The Dungeness River is a large watershed draining 270 square miles, emptying into Dungeness Bay and the Strait of Juan de Fuca. The mainstem extends 31.9 miles; a primary tributary, the Gray Wolf River extends for 17.4 miles, with a total of 546 miles of streams and tributaries in the watershed (including Caraco, Gold and Silver Creeks). The watershed, located in the rainshadow of the Olympic Peninsula, is the only one in the coastal Northwest where an irrigation system is necessary for agriculture. The irrigation system, river and many small streams interact with the groundwater system supplying domestic water for residences and the City of Sequim. The river flows from elevations approaching 6000 feet, flattening to a floodplain in the lower 15 miles, with the upper watershed in the National Park and Forest. Land uses include National Park and Forest, private forestry, and residential and agriculture uses. Growing urbanization is replacing most commercial irrigated farmland. Water use has exceeded available water in the past; extensive water conservation and improved management practices have decreased irrigation use in recent years. An administrative closure is in place for new water rights. Conversion in the watershed continues to present problems for water quality, quantity and habitat. Extensive planning and community involvement are attempting to address these problems.

A TMDL Report established water quality goals so standards would be met. Pollution sources include:

- **Animal access**
- **Impacts of flooding on fish habitat**
- **Intermittent vegetative cover on lower river**
- **Erosion, compaction, sedimentation**
- **Channel dynamics**
- **Lack of high-quality habitat**
- **Low summer flows**
- **Elevated bacterial counts**

What do the health ratings mean to people?

The Dungeness is one of the most highly studied and inventoried rivers in the County. A major health concern is consumption of contaminated shellfish. Due to excessive fecal coliform counts there has been an expanding shellfish

closure in Dungeness Bay since 1997. Habitat degradation in the lower 10 miles has resulted in ESA threatened stocks of salmon, and fishing closures, or limits for many years.

What do the health ratings mean to fish?

Multiple studies have indicated that excessive sedimentation, low flows, and warm temperatures are limiting factors in the Dungeness River. The river supports spring/summer chinook, coho, fall chum, summer chum, upper and lower pink, summer steelhead and winter steelhead, cutthroat trout, although most of these stocks are not considered healthy. Dolly Varden are also found spawning in the river.

Fecal coliform contamination is not known to directly affect fish, but is often an indicator of other water quality impacts in the watershed, i.e., high fine sediment levels in the substrate (from stormwater or agricultural runoff), and high nutrient levels in the stream (which may cause excessive plant growth and affect dissolved oxygen levels); all may be harmful to fish.

***Current Overall Health Based on Information Below:
Dungeness River and Bay—IMPAIRED***

1. Water quality conditions according to CCWQI = HEALTHY - COMPROMISED*

Dungeness River RM 0.0 = 5 (healthy)
 0.1 = 5 (healthy)
 0.3 = 5 (healthy)
 0.8 = 4 (compromised)
 3.2 = 4 (compromised)
 Hwy 101 = 5 (healthy)

OVER-ALL CCWQI CONFIDENCE RATING :

HIGH CONFIDENCE

The Dungeness River is on the 303(d) list for impaired (low) streamflow in late summer; pH has been recorded outside the usual range, though evidence suggests that this may be normal for this system.

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity according to the LFA 18, Watershed Plan WRIA 18, Status, & CC Watershed Facts = HEALTHY in the upper watershed; HIGHLY/CRITICALLY IMPAIRED

below RM 10.5, except in protected side channels. ***Habitat concerns include:***

- a. Degraded habitat conditions; channelization, diking, loss of floodplain causing flooding, instability, erosion, excessive sediment conditions and poor habitat in lower river
- b. Encroaching floodplain development; loss of riparian vegetation, slope instability, lack of LWD in lower river, except in restored areas
- c. Low flow conditions in late summer/early fall, impeding adult salmon migration, decreasing usable juvenile habitat; warm water temperatures, impaired water quality conditions
- d. Impacts on groundwater of bacterial and nitrate contamination
- e. Severely degraded estuarine conditions; shellfish harvest closure

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS

- Fecal coliform and other known water quality contamination in the surface and groundwater in the lower watershed.
- Shellfish harvest closure in Dungeness Bay.
- No data exist to rate biological conditions
- The habitat integrity is highly to critically impaired in the lower watershed

*Editor's Note: The water quality rating for this stream illustrates two important distinctions!

First, the relatively healthy CCWQI rating is based on water quality for aquatic life (primarily temperature and DO), whereas fecal coliform data collected and analyzed and compared to human health-based standards used for regulating shellfish harvest show that the lower Dungeness River and Bay have serious problems. In fact, so serious that shellfish harvest is not recommended in most of Dungeness Bay. (The River is subject to more-stringent standards because it flows into the Bay and affects its water quality.)

Second, combining measurements of streamflow with counts of fecal coliform is necessary to represent the actual "loading" of bacteria into a water body. The CCWQI rating method does not incorporate streamflow, and so it therefore does not reflect the complete picture as accurately as it could. Ecology recently analyzed loading data and determined whether water quality goals have been met for various sites.

For detailed and updated information, the reader should refer to water quality studies found at: www.ecy.wa.gov/programs/wq/tmdl/watershed/Dungeness/index.html

RECOMMENDATIONS

- Continue water quality monitoring throughout the lower watershed
- Start monitoring biological conditions
- Address habitat concerns listed in box on left, LFA and other studies and plans
- Address sources of fecal coliform contamination, and implement TMDL recommendations for irrigation ditches, the lower river and Dungeness Bay
- Address nitrate contamination in groundwater

State of the Waters ~ Gray Wolf River, Canyon & Bear Creeks (Dungeness River Tributaries)

General Description:

The Gray Wolf River is the largest tributary to the Dungeness River, draining the mountainous, federally-owned portions of the upper watershed and entering the right bank of the Dungeness River at RM 15.8. The Gray Wolf is located in a deep, narrow canyon, which is naturally confined by topography, and is a largely unspoiled wilderness area, with a few exceptions. Below RM 11.8 several tributaries enter the Dungeness, including Canyon and Bear Creeks. Canyon Creek has a hatchery on it which is a complete barrier to upstream fish passage. Bear Creek has a low dam on it that is used for irrigation purposes. While the habitat provided by both smaller streams is degraded by watershed alterations and development, both could provide important tributary and side-channel habitat for salmonids.

What do the health ratings mean to people?

There are not any reported concerns regarding water quality in these Dungeness River tributaries.

What do the health ratings mean to fish?

Gray Wolf currently supports spring/summer chinook, coho and upper pink salmon and cutthroat trout. The presence of chum is unknown. There is limited information available about the upper reaches, due to limited survey efforts and accessibility problems. In the Gray Wolf, there are not any reported concerns regarding water quality or habitat integrity (no indications of fine sediment concerns), although sediment, particularly from forest roads in the upper watershed, is identified as a concern for the Dungeness River. Canyon Creek supports coho and upper river

pink salmon, winter steelhead and cutthroat trout, and has good habitat above the dam; habitat is poor downstream of it and fish passage is restricted by the dam. High turbidity levels resulting from the active slide upstream of the dam in Canyon Creek may periodically affect salmon in the stream. Lower in the watershed, in Bear Creek, coho and fall chum salmon, and winter steelhead and cutthroat trout are found, where stormwater flows and high fine sediment impact fish spawning and access to food.

***Current Overall Health Based on Information Below:
Gray Wolf River, Canyon and Bear Creeks—
IMPAIRED****

(*low confidence in this rating)

1. **Water quality conditions according to CCWQI = AMPLE DATA DO NOT EXIST**
2. **Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST**
3. **Habitat integrity according to the LFA 18 and Watershed Plan WRIA 18 = HEALTHY in Gray Wolf; IMPAIRED TO HIGHLY IMPAIRED in Canyon and Bear Creeks.**

Habitat concerns include:

- a. There are no identified habitat concerns in the Gray Wolf River; although some loss of pool condition has been reported, and LWD is noted as being located outside the channel, on the edge of the ordinary high water mark
- b. Impacts on fish passage in Bear Creek of an irrigation dam, and upstream and downstream habitat; degraded riparian conditions on Bear Creek; animal access on upstream portion of creek
- c. Impacts on Bear Creek of stormwater flows and high fine sediment loads
- d. Impacts on Canyon Creek of hatchery facilities; lack of LWD and limited riparian vegetation on lower part of creek; impacts of active slide on water quality and quantity conditions

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: MODERATE CONFIDENCE

PARTICULAR CONCERNS

- Ample water quality data do not exist to rate the water bodies in these watersheds
- No data exist to rate biological conditions
- Habitat is impaired to highly impaired in Bear and Canyon Creeks

RECOMMENDATIONS

- Increase water quality monitoring in all tributaries to the Dungeness River
- Start collecting data on biological conditions
- Address habitat concerns listed in box on left
- Protect the existing habitat in the Gray Wolf

State of the Waters ~ Hurd Creek (Lower Dungeness River Tributary)

General Description:

Hurd Creek is a relatively small, low elevation tributary to the lower Dungeness River, entering the right bank at RM 2.7. It is a short, low gradient stream, that is spring-fed in the lower 1/4 mile of stream, and which provides significant high quality tributary rearing and refuge habitat for salmonids and other fish. The channel flows through a Washington Department of Fish and Wildlife fish hatchery facility, where it has been completely modified for use as a component of current and historic hatchery activities. No obvious water quality or quantity problems have been identified on Hurd Creek, though the watershed is altered by rural residential development.

What do the health ratings mean to people?

The water quality rating for Hurd Creek is compromised, making it potentially unhealthy for recreational use by streamside residents (there is no public access to Hurd Creek).

What do the health ratings mean to fish?

The conditions in most of Hurd Creek are healthy for several species of salmonids including coho, summer and fall chum, lower river pink salmon, winter steelhead and cutthroat trout. The cold water and small-stream habitat provide good rearing conditions. The stream has been heavily impacted by unrestricted animal access in the past; however this has been resolved. While the activities on part of the creek at the hatchery have impacted it, there are portions that are no longer in use at the hatchery that may be restored to healthy habitat on Hurd Creek. That, and the willingness of local landowners to improve habitat conditions on their reaches of the creek give opportunities for increased production and rearing habitat on this system.

Current Overall Health Based on Information Below:

Hurd Creek—COMPROMISED

1. Water quality conditions according to CCWQI = COMPROMISED

Hurd Creek RM 0.2 = 4.3 (compromised)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): MODERATE CONFIDENCE

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity according to the LFA 18 and Watershed Plan WRIA 18 = HEALTHY throughout the creek, except through the hatchery property.

Habitat concerns include:

- a. Lack of riparian cover in hatchery area
- b. Insufficient LWD throughout the system (upstream of Woodcock Rd., the LWD conditions are poor; downstream there are some log jams, beaver dams and remnant LWD pieces)
- c. Riparian conditions are poor upstream of Woodcock Rd., although they are reported to be good throughout the rest of the channel.

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: MODERATE CONFIDENCE

PARTICULAR CONCERNS

- Compromised water quality
- No data exist to rate biological conditions
- Habitat conditions through the hatchery

RECOMMENDATIONS

- Increase water quality monitoring
- Start collecting data on biological conditions
- Address habitat conditions listed in box on left

State of the Waters ~ Matriotti Creek *(Lower Dungeness River Tributary)*

General Description:

Matriotti Creek is the largest low elevation tributary to the lower Dungeness River, entering the river at RM 1.3. The character and location of the creek has been significantly altered from its historic condition. It is one of the streams that is extensively linked to, and affected by, the irrigation network in the Dungeness River watershed. Stormwater flows, high fine sediment loads and fecal coliform bacteria have been conveyed to this creek through the irrigation system. Considerable stream restoration activities have occurred on Matriotti over the years, particularly water quality improvements to farms and the irrigation system. Mud Creek is a tributary. Land uses are agriculture, an animal park and residential. A list of septic systems of concern is a current focus for water quality improvement.

What do the health ratings mean to people?

The water quality conditions are rated as compromised-impaired in the Matriotti Creek basin. Fecal coliform enters the Dungeness River through the creek, and eventually ends up in

Dungeness Bay. Elevated fecal counts for a number of years in the lower river and bay have caused the shutdown of shellfish harvesting due to possible human health risks.

In 2002, a TMDL water clean-up plan established water quality goals so that standards would once again be met.

What do the health ratings mean to fish?

Matriotti Creek supports coho, fall and summer chum, and lower river pink salmon, winter steelhead and cutthroat trout. Mud Creek supports coho salmon, winter steelhead and cutthroat trout. No rating data exists for biological conditions; the habitat integrity is rated as impaired. Habitat degradation affects the success of salmonids in this creek; considerable effort has been focused on small stream restoration projects in Matriotti Creek, and more is recommended. Although fecal

coliform is not known to directly affect salmonids, it is often an indicator of other water quality impacts in the watershed which can affect fish. These include direct animal access to the channel (affecting riparian conditions and bank stability), high fine sediment levels in the substrate (from stormwater or agricultural runoff), and high nutrient levels in the stream (which may cause excessive plant growth and affect dissolved oxygen levels), all possible threats to fish in the creek.

**Current Overall Health Based on Information Below:
Matriotti Creek Basin—COMPROMISED-IMPAIRED**

**1. Water quality conditions according to CCWQI =
COMPROMISED (MATRIOTTI)**

Matriotti Creek	RM	0.1	=	3.7	(compromised)
		0.3	=	3.3	(impaired)
		0.7	=	4.0	(compromised)
		1.4	=	4.0	(compromised)
		1.9	=	3.0	(impaired)
		3.2	=	3.7	(compromised)
		4.8	=	4.0	(compromised)
		6.0	=	4.0	(compromised)

COMPROMISED-IMPAIRED (TRIBS)

Beebe Crk		=	4.0	(compromised)
Lotzgesell Crk		=	3.3	(impaired)
Mud Crk	RM	0.0	=	3.3 (impaired)
Trib.@Dorothy Hunt Ln.		=	3.5	(compromised)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): HIGH CONFIDENCE

Note that temperature, fecal coliform, and DO are all rated as poor in the LFA. pH has been recorded outside the usual range, though evidence suggests this may be normal for this system. Matriotti Creek is on the 303(d) list for fecal coliform.

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity according to the LFA 18, and Watershed Plan WRIA 18 = IMPAIRED

Habitat concerns include:

- a. Floodplain alteration from historic conditions; channelization & straightening, disconnection from its adjacent wetlands; poor pool presence & character; lack of sufficient/high quality LWD throughout much of creek (except in some restored areas); impacts of rapidly developing watershed
- b. Direct animal access; destroyed riparian corridor & habitat functions
- c. Stormwater flows, with fine sediment/pollutants entering through irrigation ditches

Detailed water quality studies may be found at:

www.ecy.wa.gov/programs/wq/tmdl/watershed/dungeness/

Additional ratings: Mud Creek

RM	0.14	=	3.0	(impaired)
	0.18	=	1.0	(critically impaired)
	0.52	=	1.0	(critically impaired)
	0.80	=	3.0	(impaired)
	1.75	=	5.0	(healthy)

Low confidence on these Mud Creek ratings; fecal only & not many records.

PARTICULAR CONCERNS

- Compromised water quality; known fecal coliform problems
- No data exist to rate biological conditions
- Habitat integrity is impaired
- Several Carlsborg-area wells have high nitrates

RECOMMENDATIONS

- Continue water quality monitoring
- Start collecting data on biological conditions
- Address habitat concerns listed in box on left
- Implement TMDL strategies, to address fecal coliform contamination
- Address all possible sources of groundwater nitrates

State of the Waters ~ Meadowbrook Creek

General Description:

Meadowbrook Creek is a very small, low elevation watershed, immediately east of the mouth of the Dungeness River, that historically drained either into the river mouth or directly into Dungeness Bay. Deep groundwater feeds this creek, which has a watershed of only 0.5 square miles. The stream is generally low gradient with limited flushing capability. Before they were filled, the historic wetlands at the mouth provided rich habitat for fish and wildlife. Changing conditions at the mouth sometimes result in flooding at and upstream of Dungeness Way. Primary land uses include agriculture and residential development.

What do the health ratings mean to people?

Impaired water quality impacts recreational use of these waters, particularly including activities such as bird-watching. Meadowbrook Creek is included in the Lower Dungeness River TMDL, which addresses fecal coliform problems in the creek, and impacts to the Dungeness River and Bay.

In 2002, a TMDL water clean-up plan established water quality goals so that standards would once again be met.

What do the health ratings mean to fish?

Coho salmon, winter steelhead and cutthroat trout are found in Meadowbrook Creek. Water quality conditions in the creek, such as excessive sediment and channels choked by reed canary grass impact salmon when they are feeding, spawning and trying to see predators in order to keep away from them. Elevated dissolved oxygen and temperatures cause algae to grow, which are harmful conditions for the aquatic ecosystem and directly impact fish in the creek. Increased temperatures and silted conditions result in a grouping of more tolerant bugs that can withstand such conditions. Salmon need high quality macroinvertebrates to eat, such as the larvae of mayflies, stoneflies and caddis flies, which need cold, clean water to thrive, and the warm water conditions in Meadowbrook Creek are harmful to fish.

Current Overall Health Based on Information Below:

Meadowbrook Creek & Slough—IMPAIRED-HIGHLY IMPAIRED

1. Water quality conditions according to CCWQI = IMPAIRED (CREEK & SLOUGH)

Meadowbrook Creek	RM	0.2	=	2.5 (impaired)
		0.3	=	3.5 (compromised)
		0.8	=	3.0 (impaired)
		1.9	=	3.3 (impaired)
		2.0	=	3.7 (compromised)

OVER-ALL CCWQI CONFIDENCE RATING: HIGH CONFIDENCE

pH has been recorded outside the usual range, though evidence suggests this may be normal for this system. Bacterial pollution levels exceed state water quality standards as identified in the Lower Dungeness TMDL study.

Meadowbrook Slough		0.05	=	3.0 (impaired)
		0.2	=	1.0 (critically impaired)
		0.2L	=	3.5 (compromised)
		0.2R	=	5.0 (healthy)
		0.45	=	4.0 (compromised)

OVER-ALL CCWQI CONFIDENCE RATING: MODERATE-HIGH CONFIDENCE

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity according to the LFA 18 and Watershed Plan WRIA 18 = HIGHLY IMPAIRED

Habitat concerns include:

- Historic wetlands and floodplain functions at/near the mouth have been significantly altered by channelization and fill, and the construction of the dike on the lower Dungeness River.
- Poor pool presence and riparian condition; lack of LWD throughout the system
- Uncontrolled animal access into creek
- Constrictions on the channel/estuary; lack of connection of the creek to the estuarine functions
- Warm water conditions
- Irrigation groundwater returns impact instream flows

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS

- No data exist to rate biological conditions
- Habitat integrity is highly impaired
- Impaired water quality in creek and slough
- Flooding near creek mouth

RECOMMENDATIONS

- Continue water quality monitoring
- Start collecting data on biological conditions
- Address habitat concerns listed in box on left
- Address sources of fecal coliform contaminations, and warm water temperatures

State of the Waters ~ Cooper Creek

General Description:

Cooper Creek is a very small independent drainage east of the Dungeness plain, entering salt water between Sequim Bay and the Dungeness River. It is fed by groundwater discharge. This short, approximately 1 mile long drainage has similar characteristics to other neighboring drainages, and it has been heavily altered. It drains low elevation areas and is affected by irrigation from the Dungeness River. Primary land uses are agriculture and expanding rural residential development.

What do the health ratings mean to people?

The water quality rating for Cooper Creek is compromised. High fecal coliform bacteria readings are an important concern for humans in the watershed and may impact water quality in Dungeness Bay. These

indicators, as identified in the TMDL for the Lower Dungeness River, should be closely monitored. More monitoring is needed to properly understand the status of this creek.

What do the health ratings mean to fish?

Cooper Creek is a short, heavily altered stream. The status of coho, fall chum and winter steelhead in the creek is unknown; it supports cutthroat trout. The highly impaired habitat integrity rating indicates conditions which are very poor for the spawning and rearing of salmonids in Cooper Creek. There are excessive temperatures caused

by lack of riparian cover, and the lack of normal tidal flushing also indicates poor conditions, including excessive sediment, causing poor spawning and feeding conditions for fish. More monitoring is needed to properly understand the degraded creek conditions and their impacts on fish.

Current Overall Health Based on Information Below:

Cooper Creek—IMPAIRED

1. Water quality conditions according to CCWQI = COMPROMISED

Cooper Creek At mouth = 4.3 (compromised)

Bacterial pollution levels exceed state water quality standards as identified in the Lower Dungeness TMDL study.

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): MODERATE CONFIDENCE

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity according to the LFA 18 and Watershed Plan WRIA 18 = Highly IMPAIRED

Habitat concerns include:

- a. The majority of the creek is channelized, much of its floodplain and riparian zone have been significantly modified and degraded; riparian condition is generally poor, and is composed primarily of reed canary grass and other non-coniferous vegetation
- b. Few good pools or sufficient LWD exist
- c. The estuary is impacted by a tide gate which limits influx of tidal action and hinders fish passage

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: MODERATE CONFIDENCE

PARTICULAR CONCERNS

- No data exist to rate biological conditions
- Highly impaired habitat
- Water quality is compromised

RECOMMENDATIONS

- Increase water quality monitoring
- Start collecting data on biological conditions
- Address habitat concerns listed in box on left
- Address sources of fecal coliform, as identified in the Lower Dungeness TMDL



Streamkeeper monitoring RM 1.1 on Cassalery Creek

State of the Waters ~ Cassalery Creek

General Description:

Cassalery Creek is a relatively small independent drainage to salt water east of the Dungeness. It is approximately 4 miles in length, draining a 3.2 square mile watershed of low elevation land on the east side of the lower Dungeness Valley. Cassalery Creek is fed by groundwater discharge. It is a low velocity, low gradient stream that flows primarily through rural agricultural land, and provides irrigation water conveyance. Land uses are rural agricultural and residential development.

What do the health ratings mean to people?

The over-all health rating of highly impaired reflects the impacts of agriculture and development upon this small watershed. Because it is a low velocity, low gradient stream, with very limited flows (often none in the upper sections during the late summer) there is no way for the stream to “flush” itself of, or to dilute pollutants out of the system.

Therefore, any impacts on the stream have cumulative effects downstream. Both the high fecal coliform readings and high nitrate trend are important concerns for humans in the watershed, and indicators that should be closely monitored.

What do the health ratings mean to fish?

Cassalery Creek historically supported coho and chum salmon, steelhead, cutthroat and rainbow trout. Coho, winter steelhead and cutthroat trout are now found in the creek. The highly impaired rating for biological conditions and highly/critically impaired rating for habitat integrity indicate that there are problems for fish in the creek. These ratings reflect a specific response by the aquatic wildlife to human activities across the landscape drained by this stream. Increased temperatures

and silted conditions result in a grouping of more tolerant bugs that can withstand such conditions. Salmonids need high quality macroinvertebrates to eat which need cold, clean water to thrive, such as the larvae of mayflies, stoneflies and caddis flies. The concerns listed under habitat integrity are all conditions limiting the success of salmonids in the stream.

Current Overall Health Based on Information Below:

Cassalery Creek—HIGHLY IMPAIRED

1. Water quality conditions according to CCWQI = COMPROMISED

Cassalery Creek RM 0.5 = 3.0 (impaired)
 0.6 = 4.0 (compromised)
 1.1 = 4.5 (healthy)
 1.6 = 4.5 (healthy)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): HIGH CONFIDENCE

Cassalery Creek is on the 303(d) list for fecal coliform. No fecal data were available for the two up stream sites, otherwise their ratings may have been lower.

2. Biological conditions according to B-IBI = HIGHLY IMPAIRED

Cassalery Creek RM 0.5 = 20.0 (highly impaired)
 0.6 = 18.0 (highly impaired)
 1.1 = 16.0 (critically impaired)
 1.6 = 19.5 (highly impaired)

OVER-ALL B-IBI CONFIDENCE RATING: HIGH CONFIDENCE

3. Habitat integrity according to the LFA 18 and Watershed Plan WRIA 18 = HIGHLY-CRITICALLY IMPAIRED

Habitat concerns include:

- a. Straightened and channelized creek, and isolation from floodplain
- b. Lack of sufficient LWD; insufficient functional riparian zones, and unrestricted animal access
- c. Significant infestation of non-native vegetation, i.e., reed canary grass
- d. Used for irrigation conveyance; possible impacts from input of treated water
- e. Degraded estuary; culvert at mouth limits tidal influx and possibly fish passage

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: MODERATE CONFIDENCE

PARTICULAR CONCERNS

- Water quality is compromised
- Biological conditions are highly impaired
- Habitat integrity is highly impaired
- Several wells north of Sequim have high nitrate levels

RECOMMENDATIONS

- Increase water quality monitoring
- Continue collecting data on biological conditions
- Address habitat concerns listed in box on left
- Address sources of fecal coliform, such as stopping direct animal access to stream
- Address all possible sources of groundwater nitrates

State of the Waters ~ Gierin Creek

General Description:

Gierin Creek is a small independent drainage on the east side of the Dungeness plain, entering saltwater north of Sequim Bay. It is fed by groundwater discharges and from irrigation diversions from the Dungeness River. There are 8.3 miles of streams and tributaries in the 3.1 square mile watershed. Primary land uses are agriculture, pasture/grassland and commercial timber. An approximately 140 acre fresh/brackish water marsh is maintained by a tidal gate. This marsh replaced an historic salt marsh, and is managed exclusively for wildlife and fish habitat by the landowners. The floodplain is generally intact; however the main channel has been moved, and flow is now discharged through the tidegate. Agriculture, golf courses, and suburban residential development occur on the associated uplands in the watershed. The headwaters are within the City of Sequim and may be impacted by urban land uses.

What do the health ratings mean to people?

While ample data do not exist for a CCWQI rating, quite a bit of investigation has gone on by many agencies and landowners over the past five years to try to better understand this watershed. More data are

needed for analysis to identify whether or not there are any health risks or problems for humans in the watershed.

What do the health ratings mean to fish?

Coho and cutthroat trout are found in Gierin Creek, and the status of winter steelhead is unknown. No rating data exist for biological conditions; habitat integrity has been rated as impaired—highly impaired in Gierin Creek. Direct animal access to the channel still occurs in the upper creek, which affects riparian condition and bank

stability. Increased fine sediment levels in the substrate from storm-water or agricultural runoff, and high nutrient levels in the stream may cause excessive plant growth, affect dissolved oxygen levels, and cause problems with the spawning and food gathering success of salmonids in the creek.

Current Overall Health Based on Information Below:

Gierin Creek—IMPAIRED*

(*low confidence in this rating)

1. Water quality conditions according to CCWQI = AMPLE DATA DO NOT EXIST

Gierin Creek @ Holland Rd = 3.0 (impaired) Data are fecal coliform only

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): LOW CONFIDENCE

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity according to the LFA 18 and Watershed Plan WRIA 18 = IMPAIRED TO HIGHLY IMPAIRED

Habitat concerns include:

- a. Historic saltmarsh maintained as a freshwater marsh with loss of wetlands and estuarine functions
- b. Channelization, and restricted intertidal flows exist with accompanying accumulations of sediment and cycles of dredging
- c. Streambanks trampled by direct animal access in some areas
- d. Lack of pools, except where they have been dug as part of restoration projects
- e. Poor riparian habitat from Holland Road to above Port Williams Road
- f. Possible fish access problems at Victoria Falls and at the tidegate

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: MODERATE CONFIDENCE

PARTICULAR CONCERNS

- Ample water quality data do not exist to rate the water bodies in this watershed
- No data exist to rate biological conditions
- Habitat integrity is impaired to highly impaired
- Several wells north of Sequim have high nitrates

RECOMMENDATIONS

- Increase water quality monitoring
- Start collecting data on biological conditions
- Address habitat concerns listed in box on left
- Address sources of fecal coliform, excessive sediment and high temperatures
- Address all possible sources of groundwater nitrates

State of the Waters ~ Bell Creek

General Description:

Bell Creek is a relatively small independent drainage to saltwater, entering Washington Harbor just outside the mouth of Sequim Bay. It is 3.8 miles long and drains a watershed of over 8.9 square miles, including the south, west and north slopes of Bell Hill. At least once in its geologic history it is believed to have been an active channel of the Dungeness River. Former wetlands and a tributary channel were converted for irrigation conveyance to irrigate some of the most productive lands in the region. Bell Creek has served as a conveyance channel for Dungeness River irrigation water for over 100 years, leading to unnatural alterations of its flow regime. Land uses are agriculture, rural and urban residential and small businesses, and flooding has occurred in developed areas of the middle watershed.

What do the health ratings mean to people?

Impaired water quality impacts recreational uses; fecal coliform presents health risks to humans if they consume shellfish that retain it in their bodies. Harvest of shellfish is prohibited off the mouth of the

creek in Washington Harbor. In addition, watershed alterations have caused repeated flooding of streets and private property in the City.

What do the health ratings mean to fish?

Studies indicate coho, steelhead and cutthroat trout numbers have shown some increases in Bell Creek; the status of fall chum salmon is unknown, and Dolly Varden have been documented there. While flow data are not reported here, fish passage is also affected in Bell Creek by low flow conditions, which also impacts water quality conditions. Some reaches are completely obstructed by non-native, invasive plant species. It is unknown to what extent these areas may preclude upstream adult

salmonid passage or strand juveniles. Other problems for fish include animals in the creek, affecting riparian conditions and bank stability, high fine sediment levels in the substrate from stormwater or agricultural runoff, and high nutrient levels, which may cause excessive plant growth and affect dissolved oxygen levels. Critically impaired habitat ratings reflect these conditions and the fact that there is not enough high quality food for salmonids in Bell Creek.

CURRENT OVERALL HEALTH BASED ON INFORMATION BELOW:

BELL CREEK—HIGHLY IMPAIRED

1. Water quality conditions according to CCWQI = IMPAIRED

Bell Creek RM 0.10 = 3.0 (impaired)
 0.10a = 4.3 (compromised)
 0.80 = 2.0 (highly impaired)
 1.80 = 3.5 (compromised)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): HIGH CONFIDENCE

pH has been recorded outside the usual range, though evidence suggests this may be normal for this system.

Additional sites with fecal coliform bacteria data only:

Bell Creek RM 1.32 = 5 (healthy)	RM 2.90 trib = 1 (critically impaired)
2.21 = 4 (compromised)	3.20 trib = 4 (compromised)
2.40 = 4 (compromised)	3.80 = 2 (highly impaired)
2.47 = 3 (impaired)	4.20 = 3 (impaired)
2.70 = 2 (highly impaired)	

Bell Creek is on the 303(d) list for elevated fecal coliform.

2. Biological conditions according to B-IBI = HIGHLY IMPAIRED

Bell Creek RM 0.10 = 14.7 (critically impaired)
 0.50 = 28.0 (impaired)
 0.80 = 14.0 (critically impaired)
 1.80 = 20.0 (highly impaired)

OVER-ALL B-IBI CONFIDENCE RATING: HIGH CONFIDENCE

3. Habitat integrity according to LFA 18 and Watershed Plan WRIA 18 = HIGHLY IMPAIRED TO CRITICALLY IMPAIRED, except where restoration has occurred.

Habitat concerns include:

- a. Lower 2 miles of creek are channelized, and lower 0.25 mile is diked; channel bed near the mouth heavily cemented substrate w/fines; sediment transport capacity is low; riparian condition generally poor throughout much of the creek; limited intact areas remain
- b. All areas that have not been restored are extremely deficient in LWD and pools
- c. Unscreened irrigation diversions that may allow fish to enter irrigation ditches, and/or fields

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: MODERATE CONFIDENCE

PARTICULAR CONCERNS

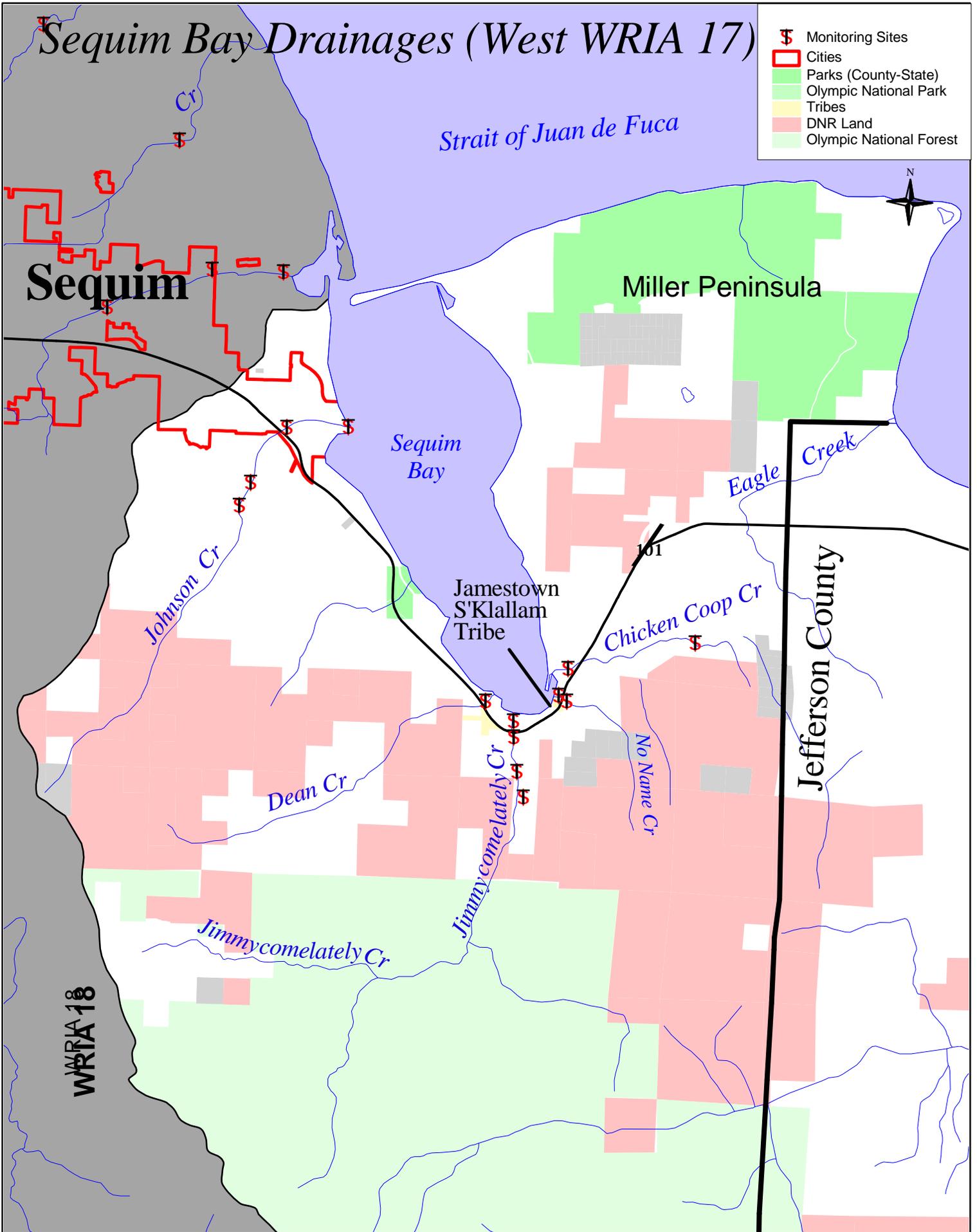
- Habitat is highly to critically impaired
- Biological conditions are highly impaired
- Water quality is impaired
- Loss of wetlands to mediate flows, clean water and provide habitat
- Impacts of increased stormwater runoff
- Channelization and constrictions eliminating stream connection to floodplain and estuary
- Potential impacts of future development

RECOMMENDATIONS

- Identify/mitigate sources of bacterial pollution
- Add septic of concern identified in Sequim’s Surface Water Management Plan to County’s Septics of Concern list
- Mitigate stormwater impacts on stream water quality; manage stormwater to maximize aquifer recharge & natural streamflows in creek
- Address issues regarding illegal, and/or relinquished surface water diversions
- Restore restricted estuarine functions
- Address habitat concerns listed in box on left
- Continue monitoring programs

Sequim Bay Drainages (West WRIA 17)

- Monitoring Sites
- Cities
- Parks (County-State)
- Olympic National Park
- Tribes
- DNR Land
- Olympic National Forest



Sequim

Strait of Juan de Fuca

Miller Peninsula

Sequim Bay

Eagle Creek

Jamestown S'Klallam Tribe

Chicken Coop Cr

Johnson Cr

Dean Cr

No Name Cr

Jefferson County

Jimmycomelately Cr

Jimmycomelately Cr

WRIA 18

101

SEQUIM BAY DRAINAGES

WEST WRIA 17

- *Johnson Creek*
- *Dean Creek*
- *Jimmycomelately Creek*
- *Chicken Coop Creek*
- *“No Name Creek”*

State of the Waters ~ Johnson Creek

General Description:

Johnson Creek is the third largest stream within the Sequim Bay watershed. It flows from the foothills of the Olympic Mountains into the west portion of Sequim Bay. With a total length of 7.4 miles, the east branch originates near the top of Burnt Hill, at approximately 660 feet, and the west branch flows from a pond/lake at approximately 240 feet through the City of Sequim land, draining the east side of Bell Hill. The upper creek flows through a ravine, and the lower 2 miles are low in gradient. Average annual flows are 13.2 cfs; suggested regulatory flows are between 5-26 cfs. Land uses include a BPA power line road, agriculture, rural and suburban residential, and a marina and trailer park in lower Johnson Creek.

What do the health ratings mean to people?

The ratings of compromised for water quality and biological conditions, and the 303(d) listing for bacterial contamination shows that water quality degradation has occurred. This kind of contamination

may affect humans in several ways, such as the prohibition of shellfish harvest in the Johnson Creek tidelands, (the fecal coliform pathogens in shellfish present health risks to humans).

What do the health ratings mean to fish?

Compromised B-IBI ratings indicate there may not be adequate high quality food for salmonids in Johnson Creek. Because the samples rated were very limited, new samples need to be analyzed in order to understand the current biological integrity of the creek. The creek historically supported coho, winter steelhead and cutthroat trout, and they are still currently found there. It is estimated that the habitat could

support chum salmon, and that low summer flows probably limit use by species other than chum. Channelization and other development impacts habitat and spawning areas, limiting the extent and use of the creek by fish. Heavy sediment and turbidity also negatively impact fish, both in trying to find food and in spawning success.

State of the Waters ~ Dean Creek

General Description:

Dean Creek is an intermittent stream draining about one square mile. The creek drains the east side of Burnt Hill and the northwest side of Lookout Hill, flowing behind the casino into the southwest corner of Sequim Bay. The headwaters of Dean Creek begin at an elevation of 690 feet, approximately four miles from its mouth. The creek is in a very degraded condition, has been culverted in various locations, and experiences severe flooding.

Dean Creek will be restored as a part of the JCL Creek-Lower Sequim Bay Estuary Restoration Project.

Proposed restoration activities include:

- **Realignment**
- **Addition of LWD**
- **Addition of spawning gravels**
- **Replanting with native vegetation**
- **Removal of fill, reconstruction of channel to keep stream flowing above ground**

What do the health ratings mean to people?

While there is a definite data gap regarding water quality, quantity and habitat on Dean Creek, the creek shares many of the same impairments, on a smaller scale, of a much-studied creek directly to the east, Jimmycomelately Creek. Sediment coming down in stormwater runoff from the

un-finished development in upper area of the watershed contributes to poor conditions in Dean Creek, and eventually enters into Sequim Bay, impacting the gathering of safe shellfish resources there.

What do the health ratings mean to fish?

Coho and cutthroat, and possibly winter steelhead are known to exist, or have existed in the past in Dean Creek. Because of the critically impaired conditions, there is little, if any, spawning or rearing habitat left for salmonids or other fish in the creek. Extreme low flows, which often go underground near the bay, severely limit fish passage

during natural spawning periods. Heavy sediment loads and turbidity make conditions difficult for fish to find their food, hide from predators or spawn successfully. They also result in insufficient high-quality macroinvertebrates needed as food for the fish in the creek.

Current Overall Health Based on Information Below:

Dean Creek—HIGHLY IMPAIRED*

(*low confidence in this rating)

1. Water quality conditions according to CCWQI = AMPLE DATA DO NOT EXIST

Dean Creek @Old Blyn Hwy. = 4 (compromised) Only fecal coliform was tested

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): LOW CONFIDENCE

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity according to the LFA 17, CC Watershed Facts and JCL Restoration Plans = CRITICALLY IMPAIRED

Habitat concerns include:

- a. Episodes of significant sedimentation, mostly from past straightening, road and land clearing activities, and existing un-maintained road in upper reaches
- b. Lack of streambank stability, with bank scour, no pools, and lack of LWD
- c. Small diversion dam without a fish screen near RM 1.0
- d. Low flows

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS (prior to restoration)

- Ample water quality data do not exist to rate the stream in this watershed
- No data exist to rate biological conditions
- Habitat integrity is critically impaired
- Stormwater impacts on water quality, and other nonpoint source inputs into Sequim Bay, including excessive sediment from un-maintained roads
- Impacts of straightening, constrictions, culverts, and continued dredging in the lower reaches

RECOMMENDATIONS

- Increase water quality monitoring
- Start collecting data on biological conditions
- Address habitat concerns listed in box on left, and in particular, implement JCL-Lower Sequim Bay Restoration Plan which includes Dean Creek
- Manage stormwater to avoid water quality and quantity impacts
- Manage forest/DNR property to ensure no water quality problems in creek

State of the Waters ~ Jimmycomelately Creek (JCL)



*JCL Estuary prior to removal
of log yard and restoration*

The Summer Chum Recovery Project

This project is led by the WDFW, with help from dedicated volunteers and the Jamestown S’Klallam Tribe. Each year when chum return to JCL to spawn, a certain number are trapped and spawned, with the eggs going to the hatchery or instream incubation sites, to be raised as part of the recovery program. This extraordinary effort is aimed at preserving the genetic viability of this ESA-listed stock until the JCL Restoration Project is completed and fish return to spawn naturally.

General Description:

JCL Creek is the largest stream in the Sequim Bay watershed. It flows nearly 19 miles from its headwaters at about 3,800 feet in Olympic National Forest to its mouth in South Sequim Bay. The creek drains approximately 15.4 mi². A broad, flat valley is a central feature in the creek’s upper watershed. Several major sub-drainages contribute to JCL Creek, and west and south forks flow north into the head of Sequim Bay. Coniferous forests surround the upper meadows and dominate the downstream section. The relatively steep portion of the watershed ends approximately 1.8 miles from saltwater, where the creek enters a more gently sloping area that was historically wetlands. The drainage is predominately federal and state forestland, with the rural community of Blyn consisting mostly of single-family dwellings, small farms and tribal facilities including a casino. The lower mile of channel was moved and confined in the early 1900s, isolating it from its floodplain and estuary. A major restoration project is currently in progress on the Jimmycomelately Creek.

What do the health ratings mean to people?

Water quality and biological conditions are rated compromised for JCL, indicating impacts for people related to the dysfunctional state of the watershed. Degraded habitat conditions for the threatened summer chum salmon severely limit runs, and no fishing is allowed on this stock. Some of the native shellfish in the bay have also been

impacted, causing conditions that make gathering and marketing difficult, if not impossible. Fecal coliform contamination makes the consumption of shellfish dangerous to humans. In addition, a major human impact includes flooding of residences because of the constricted creek conditions.

What do the health ratings mean to fish?

The B-IBI indicates compromised conditions and the habitat integrity is rated as critically impaired for fish. Sedimentation and temperature problems impair ability of salmon to successfully feed, spawn and rear in JCL. While summer chum have been spawning in the lower reaches, in the past eggs have usually been covered with

sediment, flooded out or dredged out to prevent flooding. Other species in JCL include coho, cutthroat and winter steelhead. In the estuary, the eelgrass communities have diminished and heavy algae blooms limit dissolved oxygen for fish at the base of the bay.

Current Overall Health Based on Information Below:

JCL—IMPAIRED*

* Critical status of JCL Summer Chum may justify a lower over-all rating than impaired

1. Water quality conditions according to CCWQI = COMPROMISED

JCL	RM	0.1 = 3.5 (compromised)
	@ Hwy 101	= 5.0 (healthy)
		0.2 = 4.5 (healthy)
		0.6 = 3.5 (compromised)
		0.8 = 5.0 (healthy)

OVER-ALL CCWQI CONFIDENCE RATING (FOR WATERSHED): HIGH CONFIDENCE

pH has been recorded outside the usual range, though evidence suggests this may be normal for this system.

2. Biological conditions according to B-IBI = COMPROMISED

JCL	RM	0.1 = 38.0 (compromised)
		0.2 = 38.0 (compromised)
		0.6 = 39.3 (compromised)
		0.8 = 46.0 (healthy)

OVER-ALL B-IBI CONFIDENCE RATING: HIGH CONFIDENCE

3. Habitat integrity according to the LFA 17, Status, CC Watershed Facts and JCL Restoration Plans = CRITICALLY IMPAIRED (prior to restoration)

Habitat concerns have included:

- Upper watershed culverts cause sediment deposition, resulting in migration blockages
- Reduced LWD, riparian corridor, pool habitat and increased sediment/temperatures in upper creek
- Lower creek was moved, straightened, channelized, and disconnected from the estuary, constricting both flows and tidal action, and causing sediment build-up in lower half mile, resulting in dikes/retaining walls to control flooding
- Estuary dysfunctional with fill, roads, log yard activities, eelgrass communities destroyed and intertidal and sub-tidal habitat degraded; lack of functional connection between the creek and estuary (tidal flows/channels)

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: HIGH CONFIDENCE

PARTICULAR CONCERNS

- Habitat is critically impaired (however, most concerns are being addressed by the JCL Creek-Lower Sequim Bay Estuary Restoration Project)
- Water quality and biological conditions are compromised
- Sustaining summer chum during creek restoration
- Short-term water quality impacts of restoration activities, especially excessive sediment problems
- Stormwater impacts on water quality/quantity
- Livestock access on creek
- Septic problems near creek

RECOMMENDATIONS

- Address habitat concerns listed in box on left and, in particular, by completing implementation of the JCL-Lower Sequim Bay Restoration Plan
- Continue support for the summer chum broodstock program until it is completed
- Implement/monitor revegetation plan
- Monitor to determine if restoration goals were met
- Continue ambient water quality monitoring
- Update data on biological conditions, particularly through stream and estuary restoration

State of the Waters ~ Chicken Coop & “No Name” Creeks

General Description:

Chicken Coop Creek enters the southeast corner of Sequim Bay to the northeast of JCL Creek. The mainstem is 1.3 miles long, with an additional 3.1 miles of tributaries. The mouth of Chicken Coop Creek shares a high intertidal zone with an adjacent unnamed system (“No Name” Creek), just a few dozen meters to the southwest. Chicken Coop Creek has multiple road crossings and barriers, and the habitat is severely fragmented. The floodplain habitat below East Sequim Bay Road is described as a forested wetland/wet meadow complex that provides some good habitat for fish. The low-gradient habitat above the road deteriorates in quality and is dominated by reed canary grass. Land uses are agricultural and rural residential.

What do the health ratings mean to people?

Ample data do not exist to allow a water quality rating to be developed for this report. Known excessive sediment conditions may impact shellfish in the bay, just off the mouth of the creek.

Fecal coliform bacteria contamination makes the consumption of shellfish dangerous to humans, and can lead to a closure of the bay for tribal, commercial and recreational shellfish harvest.

What do the health ratings mean to fish?

Coho and cutthroat trout are the only salmonids known to be in Chicken Coop Creek. Available information suggests that excessive sediment may impact the habitat for salmonids. The severely degraded habitat and road crossings bisecting the creek in multiple areas create unsustainable habitat conditions for salmon

survival. In addition, the low or intermittent flows cause problems for salmon migrating upstream to spawn during late summer, and early fall. Fecal coliform is not known to adversely affect salmonids, although it is often an indicator of other water quality impacts in the watershed that can adversely affect fish.

Current Overall Health Based on Information Below:

Chicken Coop & “No Name” Creeks—HIGHLY IMPAIRED*

(*low confidence in this rating)

1. Water quality conditions according to CCWQI = AMPLE DATA DO NOT EXIST

Chicken Coop Creek	@ Old Blyn Hwy.	= 4 (compromised)	Over-all confidence rating: low
	@ Chicken Coop Rd.	= 4 (compromised)	Over-all confidence rating: low
“No Name” Creek	@ Tribal Center	= 5 (healthy)	Over-all confidence rating: low
	@ Chicken Coop Rd.	= 5 (healthy)	Over-all confidence rating: low

Based on fecal data only. Chicken Coop Creek is on the 303(d) list due to elevated fecal coliform.

2. Biological conditions according to B-IBI = AMPLE DATA DO NOT EXIST

3. Habitat integrity according to the LFA and DWP = HIGHLY IMPAIRED

Habitat concerns include:

- Habitat is severely degraded, fragmented, LWD is lacking, and streambank is dominated by shrubs and non-native invasive species (i.e. reed canary grass)
- Multiple culverts are present at road crossings and fish passage barriers; stream is head-cutting as a result of at least one of these culverts, and excessive sediment degrades conditions
- Animal access to creek is causing degraded riparian and bank conditions
- Primary limiting factor is extremely low and intermittent flows

OVER-ALL HABITAT INTEGRITY CONFIDENCE RATING: LOW CONFIDENCE

PARTICULAR CONCERNS

- Ample water quality data do not exist to rate the water bodies in this watershed
- No data exist to rate biological conditions
- Habitat integrity is highly impaired
- Stormwater impacts on water quality and quantity
- Elevated fecal coliform readings have possible impacts on shellfish
- Problem septic systems cause health issues

RECOMMENDATIONS

- Increase water quality monitoring
- Start collecting data on biological conditions
- Address habitat concerns listed in box on left
- Address sources of fecal coliform contamination, such as repairing/replacing failing septic systems
- Monitor & treat future stormwater runoff as needed prior to infiltration
- Control sediment sources in watershed

Information for **Miller Peninsula** water resources within Clallam County are extremely limited or do not exist. Residents are served by individual or small community wells, and there are no known groundwater quality or quantity problems. The only perennial stream is Eagle Creek, draining southeastern Miller Peninsula, and flowing into the west side of Discovery Bay (in Jefferson County). In Clallam County, the habitat condition is unknown upstream of Hwy. 101; downstream alterations include dams, culverts, clearing of native vegetation and development. More extensive habitat assessments are needed for Miller Peninsula in addition to monitoring of water quality and biological conditions.

Appendix



Appendix

A. Glossary & Acronyms

B1. Clallam County Water Quality Index

B2. Clallam County Water Quality Index Report for Streamkeepers' Data

C1. 10 Metric B-IBI Stream Health Scoring Method

C2. B-IBI Report for Streamkeepers Data

D. Habitat Integrity Ratings

E. Uncertainty Analysis for Health Ratings

F. Washington State Freshwater Surface Water Quality Standards

G. 1998 303(d) List for Water Quality-Impaired Streams in Clallam County

H. References

A. Glossary of Terms

- Ambient monitoring**—monitoring that is done to determine existing environmental conditions or pollution levels in the environment; acts as a baseline for comparison with future conditions.
- Aggrade**—to raise the grade or level of a river valley, stream bed, etc. by depositing detritus, sediment or the like; (aggradation).
- Beneficial use**—activities that use water, such as swimming or fishing, that are defined in the WA State Water Quality Standards.
- Benthic organisms**—organisms, usually invertebrates, that live in the middle or lower depths of a body of water.
- Biological integrity**—ability to support and maintain a balanced, integrated adaptive assemblage of organisms having the full range of elements (genes, species and assemblages) and processes (mutation, demography, biotic interactions, nutrient and energy dynamics, and metapopulation processes) expected in the natural habitat of a region.
- Blockages**—impassable areas limiting upstream or downstream fish passage.
- Cfs**—cubic feet per second; a measurement of streamflow.
- Contaminant**—a substance that is not naturally present in the environment, or is present in amounts that can, in sufficient concentration, adversely affect the environment.
- Conductivity**—a measure of the ability of a solution to carry an electrical current; depends on the total concentration of ionized substances dissolved in the water.
- Cumulative effects**—the combined environmental impacts that accrue over time from a series of similar or related individual actions, contaminants, or projects. Although each action may seem to have a negligible impact, the combined effects can be severe.
- Degraded**—reduced in quality or value, e.g., degraded habitat.
- Deposition**—the settlement or accumulation of material out of the water column and onto the stream bed. Deposition occurs when the energy of flowing water is unable to support the load of suspended sediment.
- Dissolved oxygen**—oxygen that is dissolved in water and therefore available for fish and other aquatic animals to use. If the amount of dissolved oxygen in the water is too low, aquatic animals may avoid the water or die. Wastewater and naturally occurring organic matter contain oxygen-demanding substances that consume dissolved oxygen.
- Ecosystem**—a community of living organisms interacting with one another and with their physical environment, such as a forest, stream, estuary, etc. A watershed ecosystem can be thought of as the sum of organisms (including humans) living in all parts of the watershed.
- Erosion**—wearing away of rock or soil by the gradual detachment of soil or rock fragments by flowing water, wind, freeze/thaw cycles, landslides, bedrock decomposition and other weathering.
- Fecal coliform bacteria**—bacteria found in the intestinal tracts of mammals.
- Floodplain**—land bordering a stream/river covered with water at high flows.
- Fluvial**—of, or pertaining to, rivers.
- Geomorphic**—pertaining to the form or shape resulting from processes that affect the surface of the earth.
- Habitat**—the specific area or environment in which a particular plant or animal lives, which must provide all basic requirements for life.
- Habitat integrity**—unimpaired condition of the habitat; a state of being complete or undivided; the habitat has all of the components necessary to provide all of the basic requirements for life.
- Habitat restoration**—action taken to correct specific problems identified through watershed analysis or other full watershed inventories.
- Habitat enhancement**—action taken to create conditions in the physical environment optimizing survival of the population in question.
- Incised channel**—a channel which has been cut into by erosion; may result in an entrenched channel.
- IMW**—Intensively Managed Watersheds program concentrates monitoring and research at a few locations; over-seen by an interagency committee.
- Invertebrates**—animals without an internal skeleton of cartilage or bone.
- Macroinvertebrate**—Invertebrates that are large enough to see with the unaided eye, including aquatic insects.

Mainstem—the main channel of a stream or river.

Nitrate—a nutrient, which is a stable form of nitrogen (NO₃); sources include human/animal wastes and fertilizers.

Nonpoint source pollution—pollution entering water from dispersed and uncontrolled sources, such as runoff. Potential nonpoint sources include forest practices, agricultural practices, on-site sewage disposal, and road runoff.

Point source pollution—a source of pollutants from a single point, such as a wastewater treatment pipe.

Pollutant—a contaminant that adversely alters the physical, chemical or biological properties of the environment.

Riparian area—the areas immediately adjacent to a stream or river where the vegetation, soils and microclimate are products of the presence and influence of water; includes wetlands and lakes and those portions of floodplains and valley bottoms that support riparian vegetation.

River mile (RM)—a measurement of river corridor length beginning at the mouth of the river.

Sediment—solid materials including boulders, cobbles, gravel, sand, silt and clay, that may be transported by water, ice or air.

Sedimentation—sediment which has settled to the bottom of the waterbody.

Species—a group of organisms in nature that are similar in structure and capable of successfully producing offspring; the lowest and most fundamental category in the classification of living things or similar organisms.

Stock—fish spawning in a particular lake or stream (or portion of it) at a particular season, which do not interbreed with any group spawning in a different place, or in the same place at a different season; a “population” of salmon.

Substrate—the bottom material of a water body, such as mud, sand, gravel or cobble. Different organisms are usually associated with particular substrate types.

Taxa—categories in the classification system, e.g., family, genus, species are each a taxon and collectively are taxa; taxon = singular.

TMDL (Total Maximum Daily Load) or Water Cleanup Plan (under Section 303(d) of the Federal Clean Water Act)—plans which identify pollution problems, allocate maximum allowable pollution from various sources, develop strategies to achieve those limits, and require a monitoring plan to assess effectiveness.

Turbidity—a measurement of the amount of material suspended in water.

Watershed—the geographic region within which all the water drains into a particular river, stream or body of water. A watershed includes hills, lowlands, and the body of water into which the land drains.

Water Resource Inventory Area (WRIA)—Washington State is divided into 62 watershed areas used by state and local agencies to organize information and planning activities. Clallam County includes part of WRIA 17: Quilcene-Snow, WRIA 18: Elwha-Dungeness, WRIA 19: Lyre-Hoko, and WRIA 20: Sol Duc-Hoh.

B-IBI: Benthic Index of Biological Integrity
CCWQI: Clallam County Water Quality Index
CWA: Federal Clean Water Act
DOE/Ecology: Washington Department of Ecology
DWP: Draft Watershed Plan for WRIA 18: Elwha-Dungeness

Acronyms

IMW: Intensively Managed Watersheds Program
USEPA/EPA: U.S. Environmental Protection Agency
USFWS: U.S. Fish and Wildlife Service
WDFW: Washington Department of Fish and Wildlife
WRIA: Water Resource Inventory Area

B1. Clallam County Water Quality Index (CCWQI)

March 2004

Water quality for Clallam County water bodies was evaluated with respect to human health and fish and wildlife habitat needs. Potential human health effects were evaluated by comparison of data to existing and proposed state water quality standards. Fish and wildlife requirements were evaluated by use of known limitations for salmonids, which are assumed to be the most sensitive species utilizing these waters based on numerous documents, reports and studies in the scientific and grey (unpublished) literature, in addition to comparison to existing and proposed state water quality standards. The rating scales used to determine the water quality index (CCWQI) for each water body and the criteria for rating each water quality parameter were developed by Clallam County, with preliminary assistance from Westech Company (Westech 2003). One limitation of this indexing method is that streamflow is not directly included (though low flows may be indirectly reflected by high water temperatures). Another disadvantage of not having streamflow information is that fecal coliform ratings are based on bacterial colony counts rather than loading (which combines the count with the volume of water carrying the load).

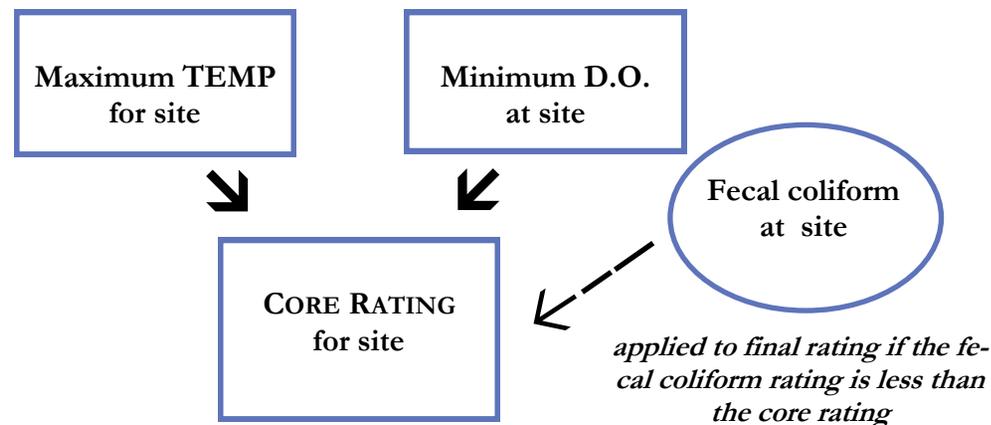
Rating scale used for each parameter and for the CCWQI:

4.5 – 5	Healthy	Ecologically intact; no known significant impacts to human health or salmonid populations or lifestages.
3.5 – 4.4	Compromised	Showing signs of degradation; slight exceedance of human health-based water quality standards; impacts to one or more salmonid lifestages.
2.5 – 3.4	Impaired	Not likely to support self-sustaining salmon populations; exceedance of human health-based water quality standards.
1.5 – 2.4	Highly impaired	Highly adverse to salmon and possibly other life-forms; substantial exceedance of human health-based water quality standards.
<1.5	Critically impaired	Unable to support a variety of once-native life forms; exceeding any human health-based water quality standard by 100 % or more.

Note: The rating system was structured to the extent possible to consider the number of lifestages affected and the severity of those effects. The rating system could possibly be made more specific by rating each stream reach based on species and lifestages present, variations and criteria for health, and productivity of the species; however, this would be a complex exercise for which the data do not presently exist.

Method used to determine the CCWQI for each water body:

1. All reliable measurements from the past 10 years (since 1993) were considered for each parameter at each site, however, the vast majority of data used was from 1997 or later. Sources included Streamkeepers; Clallam County; Ecology; USFS, and Jamestown, Lower Elwha, and Quileute Tribes.
2. Each site was rated for each parameter for which data were available according to the criteria listed below.
3. The core rating for each site was determined by averaging the ratings obtained for temperature and DO, these being the conditions which the most sensitive users (salmonids) are most sensitive to.
4. If a rating for fecal coliform was also available then the final site rating was determined by first comparing it to the core average. When the fecal rating *was less than* the core average then the fecal coliform rating was averaged together with the temp and DO ratings. (i.e., if the core rating was $((5+5)/2) = 5$, but the fecal rating was 3, then the final rating was $((5+5+3)/3) = 4.3$.) In this way, fecal coliform degradation is accounted for but does not supercede the importance of temperature and DO.
5. If there is a low level of confidence in the final site rating due to the number of parameters tested or the number of measurements made (see confidence criteria in Appendix E), then a qualifier of “NA” (Not Applicable) was reported and the site rating was not used in the determination of a CCWQI for the stream.
6. A CCWQI was estimated by averaging the site ratings, assuming that at least one site for the water body had a rating with at least moderate confidence.

Data utilized for CCWQI ratings:

Criteria used to determine ratings for individual water quality parameters

Temperature Criteria (based on salmonid species and lifestages)

- 5 <60.8 degrees F (<16.0 degrees C)
- 4 60.8 – 64.4 degrees F (16.0 – 18.0 deg C)
- 3 64.5 – 68.0 degrees F (18.1 – 20.0 deg C)
- 2 68.1 – 69.8 degrees F (20.1 – 21.0 deg C)
- 1 >69.8 degrees F (>21.0 deg C)

Temperature rating method: The maximum temperature recorded is used to rate the site for temperature; however, at least one data record must be from July-October (if this condition is not met, then adequate data does not exist to rate the stream for temperature).

Note: Based on the scientific literature, it is not possible to optimize temperature values at one temperature for all lifestages and all streams simultaneously. First, adults tend to need warmer water for living conditions than eggs (incubation) and early rearing stages. Second, rising and falling temperatures in streams (day/night, seasons, altitudes and sun/shade etc.) are a natural rhythm to which salmonids have adapted. Finally, the upper limit of “healthy” conditions (16 deg C) does not by any means reflect optimum conditions (NMFS 1999, Reiser and Bjornn 1979); for example, a sustained duration of near-16 degree water would NOT be healthy for some species, nor would impaired conditions be caught using the criteria above if a stream’s natural temperatures were always well below 16. Unfortunately, these factors limit the ability to establish one number as a rating.

Dissolved Oxygen Concentration Criteria (mg/L) (based on salmonid species and lifestages)

- 5 >9.5
- 4 8.6 – 9.5
- 3 7.6 – 8.5
- 2 6.5 – 7.5
- 1 <6.5

DO rating method: The minimum DO concentration recorded is used to rate the site for DO; however, at least one data record must be from July-October (if this condition is not met, then adequate data does not exist to rate the stream for DO).

Fecal Coliform Criteria (colonies/100ml) (based on human health effects)

	Geometric mean of # colonies/100ml		Frequency
5	<50	and	<10% of samples >100
4	50 - 99	and	<10% of samples >200
3	100 - 199	and	<10% of samples >=500
2	200 - 500	and	10-25% of samples >=500
1	>500	or	>25% of samples >=500

Fecal Coliform rating method: The geometric mean of all samples recorded *and* the frequency of high counts are used to rate the site for fecal coliform.

pH Criteria (Standard pH Units) (based on salmonid species and lifestages)

Considered an indication of potential problem if any pH records are <6.5 or >8.5 (“red flag”).

Nitrate Criteria (mg/L) (based on knowledge of typical levels in local surface waters)

Considered an indication of potential problem if any nitrate concentrations are 2 mg/L or greater (“red flag”).

References cited:

Westech Company. 2003. State of the Waters Report: Tasks 3 and 4, Water Quality Rating Criteria. Submitted to: Clallam County Natural Resources Division. Port Angeles, WA.

Reiser, D.W. and T.C. Bjornn. Oct. 1979. Habitat Requirements of Anadromous Salmonids. Prepared for the USDA Pacific Northwest Forest and Range Experiment Station. General Technical Report PNW-96. 54 pgs.

National Marine Fisheries Service, NW Region Habitat Conservation Division. 1999. Approval of Oregon Water Quality Standards for Dissolved Oxygen, Temperature, and pH: Part V. Analysis of Effects on Listed, Proposed and Candidate Species, and Designated Critical Habitat. 24 pgs.

B2. Clallam County Water-Quality Index (CCWQI) Report for Streamkeepers' Data (incl. confidence scores)

Site	Water Temperature (deg C)			DO Concentration (mg/L)			Fecal Coliform (colonies/100ml)					Final Site Rating	pH Red flag?	Nitrate-Nitrogen Red flag?		Site Freq. Confidence	Breadth Confidence	Site-Rating Confidence				
	n/n s *	Max.	Rating	Freq. Confi- dence	n/n s *	Min.	Rating	Freq. Confi- Core dence	Rating	geom. n	% greater than 100			200	500Rating				n	flag?	n	flag?
PA Harbor@Hollywood	0/0				0/0					1	2	0	0	0	5	1	5	0	0	1	0	0.5
PA Harbor@MLS	0/0				0/0					2	1	0	0	0	5	2	5	0	0	2	0	1
PA Harbor@Peabody	0/0				0/0					2	142	50	50	50	1	3	1	0	0	3	0	1.5
PA Harbor@RP	0/0				0/0					12	6	17	8	0	4	3	4	0	0	3	0	1.5
PA Harbor@SF	0/0				0/0					12	2	0	0	0	5	3	5	0	0	3	0	1.5
PA Harbor@slip71	0/0				0/0					1	86	0	0	0	4	2	4	0	0	2	0	1
Peabody 0.2a1	0/0				0/0					1	28000	100	100	100	1	2	1	0	0	2	0	1
Peabody 0.2a2	0/0				0/0					2	7534	100	100	100	1	3	1	0	0	3	0	1.5
Peabody 0.2a3	0/0				0/0					1	670	100	100	100	1	2	1	0	0	2	0	1
Peabody 0.2a4	0/0				0/0					2	16893	100	100	100	1	3	1	0	0	3	0	1.5
Peabody 0.2a5	0/0				0/0					1	1	0	0	0	5	1	5	0	0	1	0	0.5
Tumwater 0.7	0/0				0/0					1	44	0	0	0	5	1	5	0	0	1	0	0.5
Tumwater 0.7a	0/0				0/0					2	19	50	0	0	4	3	4	0	0	3	0	1.5
Average Site-Rating Confidence: 1.6										Site-Count Score: 3					Overall Confidence of the CCWQI: 2.3							
<u>Alcree Creek</u>																						
Alcree 0.0	1/1	9.2	5	1	1/1	10.7	5	1	5								5	0	0	1	2	1.5
Average Site-Rating Confidence: 1.5										Site-Count Score: 1					Overall Confidence of the CCWQI: 1.2							
<u>Bagley Creek</u>																						
Bagley 0.0	8/4	12.7	5	3	8/4	9.3	4	3	4.5	16	27	25	13	0	3	3	4	7	8	3	3	3
Bagley 0.7	15/8	13	5	3	15/8	10.1	5	3	5	4	17	0	0	0	5	3	5	7	15	3	3	3
Bagley 1.2	20/10	13.2	5	3	20/10	8.1	3	3	4								4	8	20	3	2	2.5
Bagley 1.8	16/8	12.5	5	3	16/8	7.7	3	3	4								4	8	16	3	2	2.5
Bagley 4.6	12/6	11	5	3	12/6	9.9	5	3	5								5	8	12	3	2	2.5
Average Site-Rating Confidence: 2.7										Site-Count Score: 3					Overall Confidence of the CCWQI: 2.8							
<u>Barnes Creek</u>																						
Barnes 0.0	85/26	13.2	5	3	82/26	9.9	5	3	5								5	71	41	3	2	2.5
Average Site-Rating Confidence: 2.5										Site-Count Score: 1					Overall Confidence of the CCWQI: 1.7							
<u>Bear Creek</u>																						
Bear 0.0	2/2	9.7	5	2	2/2	10.3	5	2	5								5	0	0	2	2	2
Bear 0.1	16/7	14	5	3	16/7	10.3	5	3	5	15	5	0	0	0	5	3	5	6	15	3	3	3
Bear 2.5	11/5	14	5	3	11/5	9.1	4	3	4.5								4.5	1	10	3	2	2.5
Bear 5.1	16/7	14.3	5	3	16/7	8	3	3	4								4	6	13	3	2	2.5
Average Site-Rating Confidence: 2.5										Site-Count Score: 3					Overall Confidence of the CCWQI: 2.7							
<u>Bear Creek SF</u>																						
Bear SF 0.2	16/7	12	5	3	16/7	10	5	3	5								5	6	14	3	2	2.5
Average Site-Rating Confidence: 2.5										Site-Count Score: 1					Overall Confidence of the CCWQI: 1.7							

*n/n_s shows the total sample count (n) and the subset of samples taken from July through October (n_s).
Scores from 2.50-3.00 suggest High Confidence; 1.50-2.49 suggest Moderate Confidence; 0-1.49 suggest Low Confidence
STREAMKEEPERS' DATA ONLY

Site	Water Temperature (deg C)			DO Concentration (mg/L)			Fecal Coliform (colonies/100ml)					Final Site Rating	pH Red flag?	Nitrate-Nitrogen Red flag?	Site Freq. Confidence	Breadth Confidence	Site-Rating Confidence						
	n/n s*	Max.	Rating	Freq. Confidence	n/n s*	Min.	Rating	Freq. Confi-Core Rating	n	geom. mean	% greater than 100							% greater than 200	% greater than 500	Freq. Confidence			
<u>Beaver Creek</u>																							
Beaver 0.0	2/2	10.9	5	2	2/2	9.6	5	2	5						5	0	0	2	2	2			
Average Site-Rating Confidence: 2										Site-Count Score: 1				Overall Confidence of the CCWQI: 1.5									
<u>Bell Creek</u>																							
Bell 0.1	19/10	17.1	4	3	20/10	7	2	3	3	18	26	11	6	6	4	3	3	9	⊗	21	3	3	3
Bell 0.1a	11/1	12.8	5	1	11/1	11.3	5	1	5	1	1	0	0	0	5	1	5	5	⊗	9	1	3	2
Bell 0.8	8/3	18.7	3	3	9/3	6.4	1	3	2								2	4		10	3	2	2.5
Bell 1.4	2/0	13.7			2/0	13.6				1	20	0	0	0	5	1	5	1	⊗	3	1	0	0.5
Bell 1.7	3/0	11.8			3/0	11.5				1	1	0	0	0	5	1	5	2		4	1	0	0.5
Bell 1.8	12/5	18	4	3	12/5	8	3	3	3.5								3.5	5		11	3	2	2.5
Bell 2.3	5/0	5.1			5/0	12.3				1	20	0	0	0	5	1	5	0		3	1	0	0.5
Bell 2.4	1/0	10			0/0													0		0			
Average Site-Rating Confidence: 1.6										Site-Count Score: 3				Overall Confidence of the CCWQI: 2.3									
<u>Big River</u>																							
Big 0.0	2/2	9.4	5	2	2/2	8.7	4	3	4.5								4.5	0		0	2.5	2	2.25
Average Site-Rating Confidence: 2.2										Site-Count Score: 1				Overall Confidence of the CCWQI: 1.6									
<u>Bogachiel River</u>																							
Bogachiel 0.0	2/2	13.4	5	2	2/2	9.6	5	2	5								5	0		0	2	2	2
Bogachiel 15.0	2/2	11.9	5	2	2/2	9.9	5	2	5								5	0		0	2	2	2
Average Site-Rating Confidence: 2										Site-Count Score: 2				Overall Confidence of the CCWQI: 2									
<u>Bullman Creek</u>																							
Bullman 0.0	1/1	13.5	5	1	1/1	8.45	3	2	4								4	0		0	1.5	2	1.75
Average Site-Rating Confidence: 1.7										Site-Count Score: 1				Overall Confidence of the CCWQI: 1.3									
<u>Calawah River</u>																							
Calawah 0.0	2/2	11.3	5	2	2/2	11.3	5	2	5								5	0		0	2	2	2
Average Site-Rating Confidence: 2										Site-Count Score: 1				Overall Confidence of the CCWQI: 1.5									
<u>Calawah River NF</u>																							
N. Fk Calawah 0.4	1/1	8.7	5	1	1/1	10.1	5	1	5								5	0		0	1	2	1.5
Average Site-Rating Confidence: 1.5										Site-Count Score: 1				Overall Confidence of the CCWQI: 1.2									
<u>Calawah River SF</u>																							
S. Fk Calawah 5.0	2/2	8.4	5	2	2/2	11.5	5	2	5								5	0		0	2	2	2
Average Site-Rating Confidence: 2										Site-Count Score: 1				Overall Confidence of the CCWQI: 1.5									
<u>Camp Creek</u>																							
Camp 0.0	2/2	24.2	1	3	2/2	8.2	3	3	2								2	0		0	3	2	2.5
Average Site-Rating Confidence: 2.5										Site-Count Score: 1				Overall Confidence of the CCWQI: 1.7									
<u>Cassalery Creek</u>																							
Cassalery 0.5	15/7	15.8	5	3	14/6	8.4	3	3	4	12	314	92	83	50	1	3	3	6		15	3	3	3
Cassalery 0.6	2/1	11.2	5	1	2/1	11.1	5	1	5	6	73	33	33	17	2	3	4	1		2	1.6	3	2.33
Cassalery 1.1	23/10	15.7	5	3	22/9	9.3	4	3	4.5								4.5	12		21	3	2	2.5
Cassalery 1.6	25/12	15.2	5	3	24/11	8.9	4	3	4.5								4.5	13		23	3	2	2.5
Average Site-Rating Confidence: 2.5										Site-Count Score: 3				Overall Confidence of the CCWQI: 2.7									

*n/n_s shows the total sample count (n) and the subset of samples taken from July through October (n_s).

Scores from 2.50-3.00 suggest High Confidence; 1.50-2.49 suggest Moderate Confidence; 0-1.49 suggest Low Confidence

STREAMKEEPERS' DATA ONLY

Site	Water Temperature (deg C)			DO Concentration (mg/L)			Fecal Coliform (colonies/100ml)					Final Site Rating	pH Red flag?	Nitrate-Nitrogen Red flag?	Site Freq. Confidence	Breadth Confidence	Site-Rating Confidence						
	n/n s*	Max.	Rating	Freq. Confi- dence	n/n s*	Min.	Rating	Freq. Confi- Core dence Rating	geom. n	% greater than 100	% greater than 200							% greater than 500Rating					
<u>Cedar Creek</u>																							
Cedar 0.0	1/1	10.8	5	1	1/1	8.3	3	2	4				4	0	0	1.5	2	1.75					
Average Site-Rating Confidence: 1.6										Site-Count Score: 2			Overall Confidence of the CCWQI: 1.8										
<u>Charlie Creek</u>																							
Charlie Creek	1/1	13.8	5	1	1/1	8.2	3	2	4				4	0	0	1.5	2	1.75					
Average Site-Rating Confidence: 1.7										Site-Count Score: 1			Overall Confidence of the CCWQI: 1.3										
<u>Clallam River</u>																							
Clallam 0.0	1/1	14.7	5	1	1/1	8.3	3	2	4				4	0	0	1.5	2	1.75					
Clallam River #1	3/3	19.4	3	3	2/2	9.2	4	3	3.5				3.5	2	⊗	0	3	2	2.5				
Clallam River #2	3/3	19.8	3	3	2/2	7.7	3	3	3				3	2	⊗	0	3	2	2.5				
Clallam River #3	3/3	18	4	3	2/2	8.1	3	3	3.5				3.5	2	0	0	3	2	2.5				
Clallam River #4	3/3	15.7	5	2	2/2	7.5	2	3	3.5				3.5	2	0	0	2.5	2	2.25				
Clallam River #5	3/3	15.1	5	2	2/2	8.4	3	3	4				4	2	0	0	2.5	2	2.25				
Average Site-Rating Confidence: 2.2										Site-Count Score: 3			Overall Confidence of the CCWQI: 2.6										
<u>Coal Creek</u>																							
Coal (Dickey) 0.0	1/1	11.4	5	1	1/1	9.6	5	1	5				5	0	0	1	2	1.5					
Coal (Ozette) 0.0	2/2	9.8	5	2	2/2	7.7	3	3	4				4	0	0	2.5	2	2.25					
Average Site-Rating Confidence: 1.8										Site-Count Score: 2			Overall Confidence of the CCWQI: 1.9										
<u>Colville Creek</u>																							
Colville 0.0	1/1	11.9	5	1	1/1	9.6	5	1	5				5	0	0	1	2	1.5					
Average Site-Rating Confidence: 1.5										Site-Count Score: 1			Overall Confidence of the CCWQI: 1.2										
<u>Deep Creek</u>																							
Deep 0.0	1/1	13.5	5	1	1/1	9.13	4	2	4.5				4.5	0	0	1.5	2	1.75					
Average Site-Rating Confidence: 1.7										Site-Count Score: 1			Overall Confidence of the CCWQI: 1.3										
<u>Dickey River</u>																							
Dickey 0.15	1/1	12.4	5	1	1/1	9.5	4	2	4.5				4.5	0	0	1.5	2	1.75					
Average Site-Rating Confidence: 1.7										Site-Count Score: 1			Overall Confidence of the CCWQI: 1.3										
<u>Dickey River EF</u>																							
E. Fk. Dickey 0.0	1/1	12.5	5	1	1/1	9.7	5	1	5				5	0	0	1	2	1.5					
Average Site-Rating Confidence: 1.5										Site-Count Score: 1			Overall Confidence of the CCWQI: 1.2										
<u>Dungeness River (Extensive, additional data available from Ecology, Jamestown S'Klallam Tribe, and Clallam County)</u>																							
DCCD 7.2	0/0				0/0					6	7	0	0	0	0	5	3	5	0	0	3	0	1.5
DHD 10.7	0/0				0/0					6	8	0	0	0	0	5	3	5	0	0	3	0	1.5
DIC 8.9	0/0				0/0					5	8	0	0	0	0	5	3	5	0	0	3	0	1.5
DSPC 6.9	0/0				0/0					3	6	0	0	0	0	5	2	5	0	0	2	0	1
DSPT 6.9	0/0				0/0					13	5	0	0	0	0	5	3	5	0	0	3	0	1.5
Average Site-Rating Confidence: 1.9										Site-Count Score: 3			Overall Confidence of the CCWQI: 2.4										

*n/n_s shows the total sample count (n) and the subset of samples taken from July through October (n_s).
 Scores from 2.50-3.00 suggest High Confidence; 1.50-2.49 suggest Moderate Confidence; 0-1.49 suggest Low Confidence
STREAMKEEPERS' DATA ONLY

Site	Water Temperature (deg C)			DO Concentration (mg/L)			Fecal Coliform (colonies/100ml)					Final Site Rating	pH Red flag?	Nitrate-Nitrogen Red flag?	Site Freq. Confidence	Breadth Confidence	Site-Rating Confidence						
	n/n s*	Max.	Rating	Freq. Confidence	n/n s*	Min.	Rating	Freq. Confidence	Rating	n	geom. mean							% greater than 100	% greater than 200	% greater than 500	Rating		
<u>E. Twin River</u>																							
E. Twin @Sadie	1/1	10.9	5	1	1/1	10.7	5	1	5								5	0	0	1	2	1.5	
E. Twin 0.3	4/4	13.1	5	3	3/3	10.3	5	2	5								5	0	0	2.5	2	2.25	
E. Twin 1.5	707/25	13.7	5	3	8/8	10.29	5	3	5								5	1	0	3	2	2.5	
Average Site-Rating Confidence: 2										Site-Count Score: 3					Overall Confidence of the CCWQI: 2.5								
<u>E. Twin River EF</u>																							
E. Twin E. Fk. @3040	3/3	11.6	5	2	3/3	10.56	5	2	5								5	0	0	2	2	2	
Average Site-Rating Confidence: 2										Site-Count Score: 1					Overall Confidence of the CCWQI: 1.5								
<u>Elk Creek</u>																							
Elk 0.2	1/0	7.2			1/0	12												1	0				
Elk 1.1	1/0	9.5			1/0	10.8				2	7	0	0	0	5	2	5	1	0	2	0	1	
Elk 1.9	2/1	12.1	5	1	2/1	8.9	4	2	4.5								4.5	2	1	1.5	2	1.75	
Elk 2.9	1/1	12.1	5	1	1/1	9.7	5	1	5								5	1	0	1	2	1.5	
Average Site-Rating Confidence: 1.1										Site-Count Score: 3					Overall Confidence of the CCWQI: 2								
<u>Ellen Creek</u>																							
Ellen 0.0	1/1	10.2	5	1	1/1	10.1	5	1	5								5	0	0	1	2	1.5	
Average Site-Rating Confidence: 1.5										Site-Count Score: 2					Overall Confidence of the CCWQI: 1.7								
<u>Ennis Creek</u>																							
Ennis 0.1	19/8	12.9	5	3	19/8	10	5	3	5	18	30	28	17	17	2	3	4	9	18	3	3	3	
Ennis 0.7	0/0				0/0					1	70	0	0	0	4	2	4	0	0	2	0	1	
Ennis 1.0	0/0				0/0					6	20	33	33	0	3	3	3	0	0	3	0	1.5	
Ennis 1.4	19/9	12.9	5	3	19/9	10	5	3	5								5	10	16	3	2	2.5	
Ennis 6.6	2/1	9.5	5	1	2/1	7	2	2	3.5								3.5	2	0	1.5	2	1.75	
Average Site-Rating Confidence: 2.1										Site-Count Score: 3					Overall Confidence of the CCWQI: 2.5								
<u>Field Creek</u>																							
Field 0.0	2/2	13	5	2	1/1	9.3	4	2	4.5								4.5	0	0	2	2	2	
Average Site-Rating Confidence: 2										Site-Count Score: 1					Overall Confidence of the CCWQI: 1.5								
<u>Goodman Creek</u>																							
Goodman (Sol Duc) 0.0	2/2	9.4	5	2	2/2	10.8	5	2	5								5	0	0	2	2	2	
Goodman 0.0	2/2	9.4	5	2	2/2	10.5	5	2	5								5	0	0	2	2	2	
<u>Green Creek</u>																							
Green 0.45	1/1	13.6	5	1	1/1	9.39	4	2	4.5								4.5	0	0	1.5	2	1.75	
Average Site-Rating Confidence: 1.7										Site-Count Score: 1					Overall Confidence of the CCWQI: 1.3								
<u>Hoko River</u>																							
Hoko 0.0	1/1	15.9	5	1	1/1	9.76	5	1	5								5	0	0	1	2	1.5	
Average Site-Rating Confidence: 1.5										Site-Count Score: 1					Overall Confidence of the CCWQI: 1.2								

*n/n_s shows the total sample count (n) and the subset of samples taken from July through October (n_s).

Scores from 2.50-3.00 suggest High Confidence; 1.50-2.49 suggest Moderate Confidence; 0-1.49 suggest Low Confidence

STREAMKEEPERS' DATA ONLY

Site	Water Temperature (deg C)		DO Concentration (mg/L)		Fecal Coliform (colonies/100ml)				Nitrate-				Freq. Confidence	Final Site Rating	pH Red flag?	Site Nitrogen Red flag?		Site-Freq. Confidence	Breadth Confidence	Rating Confidence
	n/n	s*	Max.	Rating	Freq. Confi- dence	n/n	s*	Min.	Rating	Freq. Confi- dence	Rating	geom. % greater than n mean				100	200			
<u>Jim Creek</u>																				
Jim 0.0	1/1		12.2	5	1	1/1	9.1	4	2	4.5										
Average Site-Rating Confidence: 1.7										Site-Count Score: 1				Overall Confidence of the CCWQI: 1.3						
<u>Jimmycomelately Creek</u>																				
Jimmycomelately 0.1	13/8		14.1	5	3	13/8	7.4	2	3	3.5	14	14	7	7	0	5	3			
Jimmycomelately 0.2	14/6		14.8	5	3	14/6	9.4	4	3	4.5										
Jimmycomelately 0.6	15/7		15.6	5	3	15/7	7.1	2	3	3.5										
Jimmycomelately 0.8	12/5		13.2	5	3	12/5	9.8	5	3	5										
Average Site-Rating Confidence: 2.6										Site-Count Score: 3				Overall Confidence of the CCWQI: 2.8						
<u>Joe Creek</u>																				
Joe 0.0	1/1		11.9	5	1	1/1	9.27	4	2	4.5										
Average Site-Rating Confidence: 1.7										Site-Count Score: 1				Overall Confidence of the CCWQI: 1.3						
<u>Johnson Creek</u>																				
Johnson 0.0	9/5		15	5	3	9/5	9.3	4	3	4.5	18	29	17	11	11	2	3			
Johnson 0.6	8/3		13.5	5	2	9/4	10	5	3	5										
Johnson 1.4	3/1		14.5	5	1	3/1	9.66	5	1	5										
Johnson 1.7	0/0					0/0					1	150	100	0	0	3	2			
Average Site-Rating Confidence: 2										Site-Count Score: 3				Overall Confidence of the CCWQI: 2.5						
<u>Lake Creek</u>																				
Lake 0.0	0/0					0/0					13	11	15	8	0	4	3			
Lake 0.7	13/4		17.4	4	3	13/4	8.4	3	3	3.5										
Lake 1.6	12/4		22.1	1	3	12/4	6.7	2	3	1.5	1	8	0	0	0	5	1			
Lake 4.5	2/2		8.8	5	2	2/2	8.9	4	3	4.5										
Average Site-Rating Confidence: 2.3										Site-Count Score: 3				Overall Confidence of the CCWQI: 2.6						
<u>Lake Trib @LB 6.2 mi.</u>																				
Lake trib @LB 6.2	16/7		10.6	5	3	16/7	8.6	4	3	4.5										
Average Site-Rating Confidence: 2.5										Site-Count Score: 1				Overall Confidence of the CCWQI: 1.7						
<u>Lees Creek</u>																				
Lees 0.1	25/11		14	5	3	24/10	9.2	4	3	4.5	17	19	12	6	0	4	3			
Lees 0.6	17/8		13.7	5	3	16/7	9.14	4	3	4.5										
Lees 0.8	25/12		15	5	3	24/11	7.34	2	3	3.5										
Average Site-Rating Confidence: 2.6										Site-Count Score: 3				Overall Confidence of the CCWQI: 2.8						
<u>Little Hoko River</u>																				
Little Hoko 0.0	1/1		14.8	5	1	1/1	7.89	3	2	4										
Average Site-Rating Confidence: 1.7										Site-Count Score: 1				Overall Confidence of the CCWQI: 1.3						

*n/n_s shows the total sample count (n) and the subset of samples taken from July through October (n_s).
 Scores from 2.50-3.00 suggest High Confidence; 1.50-2.49 suggest Moderate Confidence; 0-1.49 suggest Low Confidence

STREAMKEEPERS' DATA ONLY

Site	Water Temperature (deg C)			DO Concentration (mg/L)				Fecal Coliform (colonies/100ml)					Final Site Rating	pH Red flag?	Nitrate-Nitrogen Red flag?		Site Freq. Confidence	Breadth Confidence	Site-Rating Confidence					
	n/n s*	Max.	Rating	Freq. Confidence	n/n s*	Min.	Rating	Freq. Confi-Core Rating	geom. n	% greater than 100	% greater than 200	% greater than 500			Freq. Confidence	n				flag?	n	flag?		
<u>Lyre River</u>																								
Lyre 0.0	2/2	16.8	4	3	1/1	9.8	5	1	4.5									4.5	0	0	2	2	2	
Lyre 5.0	2/2	18.5	3	3	1/1	9.05	4	2	3.5									3.5	0	0	2.5	2	2.25	
Average Site-Rating Confidence: 2.1										Site-Count Score: 2					Overall Confidence of the CCWQI: 2									
<u>McDonald Creek</u>																								
McDonald-01	5/0	9.8			5/0	11.5												5	5	☹				
McDonald-02	6/0	12.5			6/0	10.7												6	6					
McDonald-03	4/0	13.8			4/0	10.2												4	4					
Average Site-Rating Confidence: 0										Site-Count Score: 3					Overall Confidence of the CCWQI: 1.5									
<u>Morse Creek</u>																								
Morse 0.3	25/13	15	5	3	24/12	9	4	3	4.5	19	10	5	0	0	5	3		4.5	13	24	3	3	3	
Morse 1.1	7/5	13	5	3	6/4	10	5	3	5									5	4	7	3	2	2.5	
Morse 1.1a	0/0				0/0					7	61	57	43	29	1	3		1	0	0	3	0	1.5	
Morse 2.0	22/10	15.2	5	3	22/10	10	5	3	5									5	10	20	3	2	2.5	
Morse 4.0	4/3	13	5	2	4/3	10.35	5	2	5									5	1	3	2	2	2	
Average Site-Rating Confidence: 2.4										Site-Count Score: 3					Overall Confidence of the CCWQI: 2.7									
<u>Murdock Creek</u>																								
Murdock 0.0	2/2	11.8	5	2	1/1	9.43	4	2	4.5									4.5	0	0	2	2	2	
Average Site-Rating Confidence: 2										Site-Count Score: 1					Overall Confidence of the CCWQI: 1.5									
<u>Olsen Creek</u>																								
Olsen 0.0	1/1	11.8	5	1	1/1	8.51	3	2	4									4	0	0	1.5	2	1.75	
Average Site-Rating Confidence: 1.7										Site-Count Score: 1					Overall Confidence of the CCWQI: 1.3									
<u>Ozette River</u>																								
Ozette 0.0	2/2	15.5	5	2	2/2	8.6	4	3	4.5									4.5	0	0	2.5	2	2.25	
<u>Peabody Creek</u>																								
Peabody 0.0	0/0				0/0					16	146	63	56	44	1	3		1	0	0	3	0	1.5	
Peabody 0.2	8/4	13.5	5	3	8/4	9	4	3	4.5	17	161	59	53	47	1	3		3.3	6	8	☹	3	3	3
Peabody 0.2a	0/0				0/0					11	234	82	55	45	1	3		1	0	0	3	0	1.5	
Peabody 0.2a6	0/0				0/0					1	640	100	100	100	1	2		1	0	0	2	0	1	
Peabody 0.2b	0/0				0/0					6	146	50	50	33	1	3		1	0	0	3	0	1.5	
Peabody 0.2c	0/0				0/0					1	170	100	0	0	3	2		3	0	0	2	0	1	
Peabody 0.3	0/0				0/0					10	87	50	30	10	2	3		2	0	0	3	0	1.5	
Peabody 0.4	0/0				0/0					2	100	50	50	50	1	3		1	0	0	3	0	1.5	
Peabody 0.4a	0/0				0/0					3	70	33	33	0	3	3		3	0	0	3	0	1.5	
Peabody 0.5	12/7	14.2	5	3	12/7	7	2	3	3.5	3	40	0	0	0	5	2		3.5	9	12	☹	2.6	3	2.83
Peabody 0.6	0/0				0/0					1	86	0	0	0	4	2		4	0	0	2	0	1	
Peabody 0.6a	0/0				0/0					1	42	0	0	0	5	1		5	0	0	1	0	0.5	
Peabody 0.9	0/0				0/0					5	145	60	60	60	1	3		1	0	0	3	0	1.5	
Peabody 1.0	7/3	12.1	5	2	7/3	8	3	3	4	2	21	0	0	0	5	2		4	5	7	☹	2.3	3	2.66
Peabody 1.3	4/1	8	5	1	3/0	10			5									5	4	☹	1	1	1	1
Peabody 1.4	11/4	12.5	5	3	11/4	9.49	4	3	4.5	12	16	25	17	17	2	3		3.7	6	12	3	3	3	
Average Site-Rating Confidence: 2										Site-Count Score: 3					Overall Confidence of the CCWQI: 2.5									

*n/n_s shows the total sample count (n) and the subset of samples taken from July through October (n_s).

Scores from 2.50-3.00 suggest High Confidence; 1.50-2.49 suggest Moderate Confidence; 0-1.49 suggest Low Confidence

STREAMKEEPERS' DATA ONLY

Site	Water Temperature (deg C)			DO Concentration (mg/L)			Fecal Coliform (colonies/100ml)					Final Site Rating	pH Red flag?	Nitrate-Nitrogen Red flag?	Site Freq. Confidence	Breadth Confidence	Site-Rating Confidence						
	n/n _s *	Max.	Rating	Freq. Confidence	n/n _s *	Min.	Rating	Freq. Confidence	Rating	geom. mean	% greater than 100							% greater than 200	% greater than 500	Freq. Confidence			
<u>Pysht River</u>																							
Pysht @Hwy112	2/2	16.9	4	3	1/1	8.7	4	2	4								4	1	0	2.5	2	2.25	
Pysht 0.0	1/1	14.9	5	1	1/1	8.18	3	2	4								4	0	0	1.5	2	1.75	
Average Site-Rating Confidence: 2 Site-Count Score: 2 Overall Confidence of the CCWQI: 2																							
<u>Sadie Cr.</u>																							
Sadie @ E. Twin	3/3	11.9	5	2	3/3	10.32	5	2	5								5	0	0	2	2	2	
Sadie @3040 Rd.	1/1	11.1	5	1	1/1	9.66	5	1	5								5	0	0	1	2	1.5	
Average Site-Rating Confidence: 1.7 Site-Count Score: 2 Overall Confidence of the CCWQI: 1.8																							
<u>Salt Creek</u>																							
Salt 1.4	6/4	12.2	5	3	5/3	9.3	4	3	4.5								4.5	1	1	3	2	2.5	
Salt 1.5	9/5	13.1	5	3	9/5	8.7	4	3	4.5								4.5	7	7	3	2	2.5	
Salt 4.2	9/4	13.6	5	3	9/4	9.8	5	3	5								5	7	8	3	2	2.5	
Salt 5.2	1/0	5.8			1/0	13.1												0	1				
Salt 5.4	10/4	13.3	5	3	10/4	9.5	4	3	4.5								4.5	8	7	3	2	2.5	
Salt 6.9	2/1	11.1	5	1	2/1	12	5	1	5								5	0	1	1	2	1.5	
Average Site-Rating Confidence: 1.9 Site-Count Score: 3 Overall Confidence of the CCWQI: 2.4																							
<u>Sekiu River</u>																							
Sekiu 0.0	1/1	15.3	5	1	1/1	8.65	4	2	4.5								4.5	0	0	1.5	2	1.75	
Average Site-Rating Confidence: 1.7 Site-Count Score: 1 Overall Confidence of the CCWQI: 1.3																							
<u>Siebert Creek</u>																							
Siebert 0.6	22/10	15.2	5	3	22/10	9.2	4	3	4.5	18	9	6	6	0	5	3	4.5	12	⊕	22	3	3	3
Siebert 3.0	21/9	14.5	5	3	21/9	10.1	5	3	5								5	10	21	3	2	2.5	
Siebert 3.8	20/8	13.8	5	3	20/8	9.2	4	3	4.5								4.5	11	19	3	2	2.5	
Average Site-Rating Confidence: 2.6 Site-Count Score: 3 Overall Confidence of the CCWQI: 2.8																							
<u>Siebert Creek WF</u>																							
Siebert WF 2.3	11/6	12.1	5	3	11/6	8.1	3	3	4								4	7	11	3	2	2.5	
Average Site-Rating Confidence: 2.5 Site-Count Score: 1 Overall Confidence of the CCWQI: 1.7																							
<u>Sitkum River</u>																							
Sitkum 0.0	2/2	8.3	5	2	2/2	11.2	5	2	5								5	0	0	2	2	2	
Average Site-Rating Confidence: 2 Site-Count Score: 1 Overall Confidence of the CCWQI: 1.5																							
<u>Siwash Creek</u>																							
Siwash 0.0	1/1	10.6	5	1	1/1	8.8	4	2	4.5								4.5	0	0	1.5	2	1.75	
Average Site-Rating Confidence: 1.7 Site-Count Score: 1 Overall Confidence of the CCWQI: 1.3																							
<u>Snow Creek</u>																							
Snow 0.0	1/1	13.4	5	1	1/1	7.99	3	2	4								4	0	0	1.5	2	1.75	
Average Site-Rating Confidence: 1.7 Site-Count Score: 1 Overall Confidence of the CCWQI: 1.3																							

n/n_s shows the total sample count (n) and the subset of samples taken from July through October (n_s).
Scores from 2.50-3.00 suggest High Confidence; 1.50-2.49 suggest Moderate Confidence; 0-1.49 suggest Low Confidence

STREAMKEEPERS' DATA ONLY

Site	Water Temperature (deg C)			DO Concentration (mg/L)						Fecal Coliform (colonies/100ml)				Final Site Rating	pH Red flag?	Nitrate-Nitrogen Red flag?	Site Freq. Confidence	Site-Breadth Confidence	Site-Rating Confidence	
	n/n s*	Max.	Rating	Freq. Confidence	n/n s*	Min.	Rating	Freq. Confidence	Rating	n	geom. mean	% greater than 100	% greater than 200							% greater than 500
<u>Sol Duc River</u>																				
Sol Duc 0.0	2/2	11.3	5	2	2/2	10.4	5	2	5						5	0	0	2	2	2
Sol Duc 53.4	2/2	11.3	5	2	2/2	10.9	5	2	5						5	0	0	2	2	2
Sol Duc 55.0	2/2	9.4	5	2	2/2	10.8	5	2	5						5	0	0	2	2	2
Sol Duc 61.6	2/2	10.4	5	2	2/2	10.3	5	2	5						5	0	0	2	2	2
Average Site-Rating Confidence: 2										Site-Count Score: 3					Overall Confidence of the CCWQI: 2.5					
<u>Sol Duc River NF</u>																				
N. Fk. Sol Duc 0.0	2/2	9	5	2	2/2	11	5	2	5						5	0	0	2	2	2
Average Site-Rating Confidence: 2										Site-Count Score: 1					Overall Confidence of the CCWQI: 1.5					
<u>Sol Duc River SF</u>																				
S. Fk. Sol Duc 0.0	2/2	10.5	5	2	2/2	10.6	5	2	5						5	0	0	2	2	2
Average Site-Rating Confidence: 2										Site-Count Score: 1					Overall Confidence of the CCWQI: 1.5					
<u>South Creek</u>																				
South 0.0	1/1	10.9	5	1	1/1	8.7	4	2	4.5						4.5	0	0	1.5	2	1.75
Average Site-Rating Confidence: 1.7										Site-Count Score: 1					Overall Confidence of the CCWQI: 1.3					
<u>Tom Creek</u>																				
Tom 0.0	2/2	10.1	5	2	2/2	10.1	5	2	5						5	0	0	2	2	2
Average Site-Rating Confidence: 2										Site-Count Score: 1					Overall Confidence of the CCWQI: 1.5					
<u>Tumwater Creek</u>																				
Tumwater 0.1	0/0				0/0					18	46	33	28	11	2	3	2	0	0	1.5
Tumwater 0.4	0/0				0/0					6	33	33	17	0	3	3	3	0	0	1.5
Tumwater 0.6	0/0				0/0					9	30	22	11	0	3	3	3	0	0	1.5
Tumwater 0.8	0/0				0/0					10	47	30	10	10	2	3	2	0	0	1.5
Tumwater 0.8a	0/0				0/0					1	880	100	100	100	1	2	1	0	0	1
Tumwater 0.8b	0/0				0/0					7	152	57	43	43	1	3	1	0	0	1.5
Tumwater 0.8c	0/0				0/0					2	93	50	50	0	3	3	3	0	0	1.5
Tumwater 0.8d	0/0				0/0					9	46	44	33	33	1	3	1	0	0	1.5
Tumwater 0.8d1	0/0				0/0					1	1	0	0	0	5	1	5	0	0	0.5
Tumwater 0.8d2	0/0				0/0					1	594	100	100	100	1	2	1	0	0	1
Tumwater 0.8e	0/0				0/0					11	47	18	18	9	3	3	3	0	0	1.5
Tumwater 1.4	0/0				0/0					1	30	0	0	0	5	1	5	0	0	0.5
Average Site-Rating Confidence: 1.7										Site-Count Score: 3					Overall Confidence of the CCWQI: 2.3					
<u>Umbrella Creek</u>																				
Umbrella 0.0	2/2	9.9	5	2	2/2	8.7	4	3	4.5						4.5	0	0	2.5	2	2.25
Average Site-Rating Confidence: 2.2										Site-Count Score: 1					Overall Confidence of the CCWQI: 1.6					

*n/n_s shows the total sample count (n) and the subset of samples taken from July through October (n_s).

Scores from 2.50-3.00 suggest High Confidence; 1.50-2.49 suggest Moderate Confidence; 0-1.49 suggest Low Confidence

STREAMKEEPERS' DATA ONLY

Site	Water Temperature (deg C)			DO Concentration (mg/L)				Fecal Coliform (colonies/100ml)							Final Site Rating	pH Red flag?	Nitrate-Nitrogen Red flag?		Site Freq. Confidence	Breadth Confidence	Site-Rating Confidence	
	n/n s*	Max.	Rating	Freq. Confidence	n/n s*	Min.	Rating	Freq. Confidence	Rating	n	geom. mean	% greater than 100	% greater than 200	% greater than 500			Rating	Freq. Confidence				n
<u>Valley Creek</u>																						
Valley 0.0	0/0				0/0					16	32	38	25	13	2	3	2	0	0	3	0	1.5
Valley 0.4	21/10	15	5	3	21/10	7.5	2	3	3.5	18	43	28	28	22	2	3	3	13	19	3	3	3
Valley 0.5	0/0				0/0					7	13	0	0	0	5	3	5	0	0	3	0	1.5
Valley 0.6	0/0				0/0					4	10	0	0	0	5	3	5	0	0	3	0	1.5
Valley 0.7	8/5	15.3	5	3	8/5	9.6	5	3	5	6	12	0	0	0	5	3	5	5	7	3	3	3
Valley 1.0	2/0	9.6			2/0	11.9				2	110	50	50	50	1	3	1	2	2	3	0	1.5
Valley 1.2	6/4	15	5	3	5/3	9	4	3	4.5	9	9	11	0	0	4	3	4.3	4	4	3	3	3
Valley 2.2	21/11	14.3	5	3	21/11	8.7	4	3	4.5								4.5	12	20	3	2	2.5
Average Site-Rating Confidence: 2.4										Site-Count Score: 3					Overall Confidence of the CCWQI: 2.7							
<u>Valley Creek EF</u>																						
Valley EF 0.6	1/1	6.7	5	1	1/1	10.7	5	1	5								5	1	1	1	2	1.5
Average Site-Rating Confidence: 1.5										Site-Count Score: 1					Overall Confidence of the CCWQI: 1.2							
<u>W. Twin River</u>																						
W. Twin 0.4	1/1	13.1	5	1	1/1	9.39	4	2	4.5								4.5	0	0	1.5	2	1.75
Average Site-Rating Confidence: 1.7										Site-Count Score: 1					Overall Confidence of the CCWQI: 1.3							
<u>Whiskey Creek</u>																						
Whiskey 0.0	2/2	11.6	5	2	1/1	10.7	5	1	5								5	0	0	1.5	2	1.75
Average Site-Rating Confidence: 1.7										Site-Count Score: 1					Overall Confidence of the CCWQI: 1.3							
<u>White Creek</u>																						
White 0.0	0/0				0/0					3	87	67	33	33	1	3	1	0	0	3	0	1.5
White 0.3	0/0				0/0					9	17	22	11	11	2	3	2	0	0	3	0	1.5
White 0.8	0/0				0/0					9	9	11	11	11	2	3	2	0	0	3	0	1.5
Average Site-Rating Confidence: 2										Site-Count Score: 3					Overall Confidence of the CCWQI: 2.5							

*n/n_s shows the total sample count (n) and the subset of samples taken from July through October (n_s).
Scores from 2.50-3.00 suggest High Confidence; 1.50-2.49 suggest Moderate Confidence; 0-1.49 suggest Low Confidence
STREAMKEEPERS' DATA ONLY

C1. 10 - Metric B-IBI Stream Health Scoring Method

B-IBI Grading System

45.1-50	Healthy	Supporting the full range of biological diversity expected for that site.
35.1-45	Compromised	Many of the most sensitive species no longer present: impacts expected to one or more salmon lifestages.
27.1-35	Impaired	Notable loss of biodiversity and key species (mayflies, stone flies and caddis flies); not likely to support self-sustaining salmon populations.
17.1-27	Highly Impaired	Substantial loss of once-native life-forms, with taxa richness reduced by about half; highly adverse to salmon.
10-17	Critically Impaired	Increasingly dominated by species adapted to disturbed environments.

The “biological integrity” of the stream is defined as “the ability to support and maintain a balanced, integrated, adaptive biological system having the full range of elements (genes, species, and assemblages) and processes (mutation, demography, biotic interactions, nutrient and energy dynamics, and metapopulation processes) expected in the natural habitat of the region,” (Karr 1997).

As human influence and impacts increase along a gradient from low to high, indexes of biological integrity reflect these changes. The ***Benthic*** Index of Biologic Integrity (B-IBI), based on counts of “benthic macroinvertebrates” (aquatic insects), was developed by Karr (1997) and is used by ***Streamkeepers of Clallam County***. Three specific types of aquatic insects are monitored because they typically reflect the ***health*** of the stream: mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddis flies (Trichoptera). Because some bugs are more tolerant of pollution than others, their presence or absence can indicate ***water quality*** conditions.

Developed using the “SalmonWeb” monitoring protocol, the B-IBI works well for Clallam County streams. B-IBI ratings are composed of several biological attributes or “metrics” that are sensitive to changes in biological integrity. The multi-metric approach compares what is found at a monitoring site to what is expected using a regional baseline conditions designed and calibrated for the Puget Sound Lowlands, that reflects little or no human impact. The ratings are based on a 10-metric, genus-level score from SAMPLES COLLECTED IN 1999 or later. Each metric was chosen because of its consistency in responding to several types of human disturbance: urbanization, forestry, agriculture, grazing and recreation.

The B-IBI includes the following macroinvertebrate information:

- Pollution tolerance,
- Number and abundance of macroinvertebrates, and
- Population attributes (e.g., number of predators).

A B-IBI is created by first identifying and counting all benthic macroinvertebrates found from a stream sampling event, from under rocks and from the bottom of the stream bed. Each metric is tabulated using these raw counts of species per family. They are then converted to a 1, 3, or 5 in order to facilitate comparisons between areas both over time and space (i.e., between sampling site, watersheds or regions). A value of “5” is assigned for the range of expected results in an UNDISTURBED SITE. A value of “3” is designated for results expected from a SOMEWHAT DEGRADED SITE, and a value of “1” is assigned for values expected in SEVERELY DEGRADED SITES. The individual 1, 3, and 5 metric scores are added together for a TOTAL B-IBI score. Since there are ten metrics, a Total B-IBI score can range from 10 (i.e., 10 x 1) to 50 (i.e., 10 x 5). The Total B-IBI score can then be interpreted using the qualitative grading system as shown above, where 10 = Critically Impaired and 50 = Healthy.

For more information, see <http://www.clallam.net/streamkeepers> and <http://www.salmonweb.org/salmonweb/bibi>.

C2. B-IBI Report for Streamkeepers Data (including confidence information)

B-IBI SCORE RATINGS AND DEFINITIONS:

45.1-50	Healthy	Supporting the full range of biological diversity expected for that site.
35.1-45	Compromised	Many of the most sensitive species no longer present; impacts expected to one or more salmon life-stages.
27.1-35	Impaired	Notable loss of biodiversity and key species (mayflies, stoneflies, and caddis flies); not likely to support self-sustaining salmon populations.
17.1-27	Highly impaired	Substantial loss of once-native life-forms, with taxa richness reduced by about half; highly adverse conditions for salmon.
10-17	Critically impaired	Increasingly dominated by species adapted to disturbed environments.

<i>Site/Date</i>	<i>Visit ID</i>	<i>QC</i>	<i>Specimens counted per adjusted replicate</i>			<i>B-IBI score (scale of 10-50)</i>	<i>Rating</i>	<i>Site-Rating Confidence</i>	<i>Average Site- Rating Confidence</i>	<i>Site-Count Score</i>	<i>Overall Confidence</i>
<i>Bagley 0.0</i>											
10/9/1999	337		927	409	--	34	Impaired	1			
<i>Bagley 0.7</i>											
10/11/2000	78		509	523	297	30	Impaired	3			
10/13/2001	286		<i>* Replicate subsampled. 572* 1286 632*</i>			38	Compromised				
10/15/2002	1129		<i>* Replicate subsampled. 260 583* 595</i>			34	Impaired				
10/8/2003	3933		755	1063	700	40	Compromised				
<i>Bagley 1.2</i>											
10/9/1999	338		1197	1003	507	36	Compromised	3			
10/11/2000	79		718	446	489	34	Impaired				
10/13/2001	287		658	1403	950	30	Impaired				
<i>Bagley 1.8</i>											
10/9/1999	342		875	668	--	34	Impaired	2			
10/11/2000	80		615	935	819	34	Impaired				
<i>Bagley 4.6</i>											
10/14/2001	298		1026	1267	1544	42	Compromised	3			
10/15/2002	1121		647	944	535	38	Compromised				
								2.4	3	2.7	

<i>Site/Date</i>	<i>Visit ID</i>	<i>QC</i>	<i>Specimens counted per adjusted replicate</i>			<i>B-IBI score (scale of 10-50)</i>	<i>Rating</i>	<i>Site-Rating Confidence</i>	<i>Average Site- Rating Confidence</i>	<i>Site-Count Score</i>	<i>Overall Confidence</i>
------------------	-----------------	-----------	---	--	--	---	---------------	-----------------------------------	--	-----------------------------	-------------------------------

Site/Date	Visit ID	QC	Specimens counted per adjusted replicate			B-IBI score (scale of 10-50)	Rating	Site-Rating Confidence	Average Site- Rating Confidence	Site-Count Score	Overall Confidence
Barnes 0.0											
10/6/2001	1722		337	447	--	36	Compromised	3			
9/21/2002	1614		454	250	458	34	Impaired		3	1	2
10/10/2003	4643		268	396	335	36	Compromised				
Bear 0.1											
9/19/2000	60		828	907	760	48	Healthy	3			
9/16/2001	314		945	1049	787	46	Healthy				
10/13/2002	1289		906	759	951	48	Healthy				
Bear 2.5											
9/19/2000	61		1909	1573	2015	40	Compromised	3			
9/16/2001	303		2202	1223	2761	44	Compromised				
Bear 5.1											
9/20/2000	64		* Replicate subsampled. 613* 676* 845*			44	Compromised	3			
9/15/2001	316		1251	1330	2217	44	Compromised				
10/12/2002	1293		* Replicate subsampled. 1992 668* 703*			48	Healthy				
Bear SF 0.2											
9/20/2000	63		* Replicate subsampled. 612* 588* 665*			46	Healthy	3			
9/15/2001	315		1807	1412	1268	48	Healthy				
10/12/2002	1290		866	1218	1293	48	Healthy		3	3	3
Bell 0.1											
10/10/1999	461		1487	854	1320	18	Highly impaired	3			
10/1/2000	44		255	437	482	14	Critically impaired				
9/30/2001	312		551	355	463	12	Critically impaired				
Bell 0.5											
10/10/1999	223		1521	564	1910	28	Impaired	2			
Bell 0.8											
10/26/2002	1303		* Replicate subsampled. 563* 705 736*			16	Critically impaired	3			
10/17/2003	3948		5132	352	4534	12	Critically impaired				
Bell 1.8											
10/4/2000	45		682	1063	987	20	Highly impaired	2			
									2.5	3	2.75
Cassalery 0.5											
10/10/1999	462		325	488	346	20	Highly impaired	3			
9/22/2000	81		425	570	667	16	Critically impaired				

Site/Date	Visit ID	QC	Specimens counted per adjusted replicate			B-IBI score (scale of 10-50)	Rating	Site-Rating Confidence	Average Site- Rating Confidence	Site-Count Score	Overall Confidence
9/22/2001	305		323	--	--	24	Highly impaired				
Cassalery 0.6											
10/1/2002	1312		500	309	--	18	Highly impaired				
Cassalery 1.1											
9/25/1999	276		491	400	--	12	Critically impaired				
9/22/2000	82		440	2994	1121	18	Highly impaired				
10/1/2002	1314		278	448	501	18	Highly impaired				
Cassalery 1.6											
9/25/1999	277		328	618	--	18	Highly impaired				
10/13/2000	83		696	1243	1272	30	Impaired				
9/22/2001	306		944	--	--	16	Critically impaired				
10/1/2002	1313		619	523	--	14	Critically impaired				
								2.25	3	2.6	
Ennis 0.1											
9/19/2000	73	?	314	278	--	34	Impaired				
9/16/2001	308	?	253	--	--	22	Highly impaired				
10/4/2002	1365	?	Caution: All rep counts are < 250			109	46	61	32	Impaired	
10/5/2003	3672		Caution: All rep counts are < 250			49	102	40	22	Highly impaired	
Ennis 1.4											
9/19/2000	74		274	528	--	32	Impaired				
9/16/2001	309	?	Caution: All rep counts are < 250			156	92	168	38	Compromised	
10/3/2002	1320	?	Caution: All rep counts are < 250			78	190	172	32	Impaired	
10/5/2003	3671		Caution: All rep counts are < 250			110	47	18	32	Impaired	
								1.5	2	1.75	
Jimmycomelately 0.1											
9/30/2000	42	?	1450	--	--	34	Impaired				
9/29/2001	313		579	2646	1671	38	Compromised				
10/10/2002	1285		* Replicate subsampled. 557* 534* 551*			44	Compromised				
10/5/2003	3669		971	1618	3082	36	Compromised				
Jimmycomelately 0.2											
10/5/2000	43		454	568	--	36	Compromised				
10/10/2002	1286		* Replicate subsampled. 564* 542* 543*			40	Compromised				
								3			
Jimmycomelately 0.6											
10/1/2001	307		444	282	288	38	Compromised				
10/11/2002	1287		368	305	622	32	Impaired				
10/5/2003	3670		688	1234	1680	48	Healthy				
Jimmycomelately 0.8											
								2			

Site/Date	Visit ID	QC	Specimens counted per adjusted replicate				B-IBI score (scale of 10-50)	Rating	Site-Rating Confidence	Average Site- Rating Confidence	Site-Count Score	Overall Confidence
10/11/2002	1288		1025	1168	944	46	Healthy		2.5	3	2.75	
Johnson 0.0												
10/9/1999	283		* Replicate subsampled. 487*				42	Compromised	2			
Johnson 0.6												
10/9/1999	284		733	648	707	42	Compromised	2				
Lake 0.7												
9/18/2000	58	?	Caution: All rep counts are < 250				14	Critically impaired				
9/19/2001	317		619	533	--	22	Highly impaired					
Lake trib @LB 6.2												
9/19/2000	120		1331	1046	1684	48	Healthy					
9/15/2001	302		1785	2102	564	48	Healthy					
10/13/2002	1296		536	980	339	48	Healthy		2	2	2	
Lees 0.1												
10/7/2000	55		518	974	631	32	Impaired	2				
9/21/2002	1310		259	337	--	34	Impaired					
Lees 0.6												
10/14/1999	220		319	255	--	40	Compromised	3				
10/11/2000	56		290	1000	--	40	Compromised					
10/6/2001	239		308	367	500	46	Healthy					
9/20/2003	3663		1840	2287	2318	46	Healthy					
Lees 0.8												
10/14/1999	221		609	703	639	36	Compromised	3				
10/12/2000	57		* Replicate subsampled. 1650				40	Compromised				
10/6/2001	240		2503	1559	2435	42	Compromised					
9/21/2002	1311		635	966	635	38	Compromised		2.7	3	2.85	
Morse 0.3												
10/1/1999	259		694	913	1116	32	Impaired	3				
9/15/2000	71		* Replicate subsampled. 716*				38	Compromised				
9/15/2001	311		3185	673	881	32	Impaired					
9/28/2002	1321		* Replicate subsampled. 627*				40	Compromised				
10/4/2003	3941		Caution: All rep counts are < 250				119	126	85	34	Impaired	
Morse 1.1												
									2			

10/1/1999	280		<i>1455</i>	<i>525</i>	<i>--</i>	<i>36</i>	<i>Compromised</i>			
9/28/2002	1366		<i>823</i>	<i>517</i>	<i>658</i>	<i>34</i>	<i>Impaired</i>			
<i>Morse 2.0</i>									<i>3</i>	
10/3/1999	281		<i>437</i>	<i>402</i>	<i>342</i>	<i>34</i>	<i>Impaired</i>			
9/18/2000	72		<i>2355</i>	<i>1036</i>	<i>1204</i>	<i>36</i>	<i>Compromised</i>			
9/15/2001	310		<i>784</i>	<i>463</i>	<i>--</i>	<i>38</i>	<i>Compromised</i>			
<i>Morse 4.0</i>									<i>n/a</i>	
10/6/1999	282	? <i>Caution: All rep counts are < 250</i>	<i>248</i>	<i>212</i>	<i>170</i>	<i>36</i>	<i>Compromised</i>			
								<i>2.7</i>	<i>3</i>	<i>2.85</i>

D. Habitat Integrity Ratings

4.5—5.0	Healthy	Ecologically intact.
3.5—4.4	Compromised	Showing signs of degradation; impacts to one or more salmonid lifestages.
2.5—3.4	Impaired	Not likely to support self-sustaining salmon populations.
1.5—2.4	Highly Impaired	Highly adverse to salmon and possibly other life-forms.
<= 1.4	Critically Impaired	Unable to support a variety of once-native life forms.

The rating for the physical habitat condition of the stream, as derived from written descriptions, is a much more qualitative analysis than that for water quality and biological conditions, and is open to revision as more information becomes available. Information from the references listed on page 10 was analyzed regarding habitat conditions and the amount of degradation that has occurred (e.g., sedimentation, channelization, disconnection from floodplains, lack of riparian corridors, flow restrictions, elevated temperatures, impacts from logging and development, nonpoint source pollution, and other human-induced impacts). Based on the type, amount, and severity of impacts, a qualitative rating was given as shown above. Habitat concerns are also listed following each rating. Because the amount and quality of information on rivers and streams across the County is extremely varied, for some watersheds (or portions thereof) the habitat integrity rating may be very accurate, while in others, only those living or working there may be able to fill in an accurate picture of conditions there.

Note that a Physical Habitat Index (PHI) is under development by *Streamkeepers of Clallam County*. It quantitatively assesses physical aspects of the stream channel and riparian zone in regard to their ability to support the full life-cycle of Pacific Northwest salmonids by comparing physical habitat data collected by *Streamkeepers* to norms for healthy streams. The PHI will help resource managers better understand the data, track trends and hot-spots, and will help all of us know more specifically what is needed to protect and restore streams.

E. Uncertainty Analysis for Health Ratings

(March-April 2004)

Specific analyses for determining the level of confidence in the ratings obtained for water quality, B-IBI, and habitat integrity are described below. After a review of results obtained using these methods by Clallam County and Linda Newberry, adjustments may have been necessary to account for factors not included in the quantitative analysis. For example, while the number of site ratings is an easy *estimate* of how representative the data is of the water body overall, it is limited because it does not account for the geographical distribution of sites.

I. Uncertainty Analysis for CCWQI Ratings

The confidence in a water quality rating (CCWQI) is based on numerous factors, including:

- the number of measurements made of a certain parameter at a certain site (**frequency**),
- the number of parameters measured (**breadth**),
- data quality,¹ and
- the number of sites on a water body that were visited (**site count**).

The step-by-step analysis was conducted as follows:

1. For each **parameter** (temp, DO, fecal coliform) at each site, determine the confidence score of each rating based on **frequency** of measurements, as follows:

If a healthy rating was determined for the parameter,

Score 3 if at least 4 measurements were used ($n \geq 4$);*

Score 2 if 2-3 measurements were used ($n = 2-3$);*

Score 1 if only 1 measurement was used ($n = 1$).*

*Note that for temp and DO, this number of records must be from July-October, i.e., $n_s \geq 4/3/2/1$. If no temp and/or DO measurements from July-October were in the data set then there were inadequate data to establish a rating for that parameter.

¹All water quality data used in this analysis were considered adequate due to the high level of training and QA/QC documentation associated with the protocols used by Streamkeepers, Ecology, USFS, and tribes. Because of the non-regulatory nature of the analyses conducted for this report, Streamkeepers' data labeled as "questionable" *was* utilized (that for which equipment calibration and sampling techniques were considered adequate but which was collected other than under a Quality Assurance Project Plan or "QAPP"). Approximately 10-15% of the total number of data records were in this category.

If an unhealthy rating was determined for the parameter,

Score 3 if at least 2 measurements were used ($n \geq 2$);**

Score 2 if only 1 measurement was used ($n=1$);**

Score 1 if no measurements from July-Oct. were available (in the case of temp and DO).

**Note that for temp and DO, this number of records must be from July-October, i.e., $n_s \geq 2/1$. If no temp and/or DO measurements from July-October were in the data set then there were inadequate data to establish a rating for that parameter.

2. For each site, average the confidence scores based on **frequency** for all available parameters to obtain **Site Frequency Confidence**.
3. For each site, determine the confidence score based on **breadth** of parameters tested to obtain **Breadth Confidence**, as follows:
 - Score 3** if at least 3 parameters were tested (temp, DO, & bacteria at minimum)
 - Score 2** if 2 parameters were tested
 - Score 1** if only 1 parameter was tested, provided it was either temp or DO
 - Score 0** if only bacteria was tested
4. For each site, average **Site Frequency Confidence** and **Breadth Confidence** to obtain the score for **Site Rating Confidence**.
5. For all sites on a water body, average all available **Site Rating Confidence** scores to obtain **Average Site Rating Confidence**.
6. For each water body, determine the confidence score based on the **number** of sites to obtain the score for **Site Count**, as follows:
 - Score 3** if at least 3 sites were used
 - Score 2** if 2 sites were used
 - Score 1** if only 1 site was used
7. For each water body, average the scores for **Average Site Rating Confidence** and **Site Count** to obtain the score for **Overall Confidence of the CCWQI rating**, where:
 - 2.50 – 3.0** = High confidence
 - 1.50 – 2.49** = Moderate confidence
 - 0 – 1.49** = Low confidence

II. Uncertainty Analysis for B-IBI Ratings

The confidence in a biological integrity rating (B-IBI) is based on numerous factors, including:

- the number of years a measurement was made at a certain site (**frequency**),
- data quality, and
- the number of sites on a water body that were visited (**site count**).

The step-by-step analysis was conducted as follows:

1. For each site, determine the scores for **Site Rating Confidence** based on **frequency**, as follows:
 - If a healthy rating was determined for the site (average of all years),
 - Score 3** no matter how many years were used, as long as there were 3 replicates
 - If an unhealthy rating was determined for the site (average of all years),
 - Score 3** if at least 2 years (=2 samples) were used, as long as there were 3 replicates
 - Score 2** if only 1 year (=1 sample) was used, as long as there were 3 replicates
 - OR
 - If multiple years were used but there were less than 3 replicates
 - Score 1** if only 1 year was used & there were less than 3 replicates
2. For all sites on a water body, average all available scores for **Site Rating Confidence** to obtain **Average Site Rating Confidence**.
3. For each water body, determine the confidence score based on the **number** of sites to obtain the score for **Site Count**, as follows:
 - Score 3** if at least 3 sites were used
 - Score 2** if 2 sites were used
 - Score 1** if only 1 site was used
4. For each water body, average the scores for **Average Site Rating Confidence** and **Site Count** to obtain the score for **Overall Confidence of the B-IBI rating**, where:
 - 2.50 – 3.0** = High confidence
 - 1.50 – 2.49** = Moderate confidence
 - 0 – 1.49** = Low confidence

III. Uncertainty Analysis for Habitat Integrity Ratings

The confidence in a habitat integrity rating is based on two factors:

- the number of references available, and
- the quality of references available (subjectively determined by Linda Newberry, consultant for the project).

The step-by-step analysis was conducted as follows:

1. For each water body, determine the confidence based on **Number of References Available**, as follows:
 - Score 3** if at least 3 references were used
 - Score 2** if 2 references were used; or if a single reference is from the highest quality reference list
 - Score 1** if only 1 reference was used
2. For each water body, determine the confidence based on **Quality of References Available**, as follows:
 - Score 3** for: Limiting Factors Analysis WRIA 18 (LFA 18), Watershed Plan WRIA 18, Status of Pacific Salmon and Their Habitats (Status), or a specific additional watershed/restoration plan, e.g., Jimmycomelately Restoration Plan
 - Score 2** for: Limiting Factors Analysis WRIA's 17, 19 & 20 (LFA 17, 19 & 20)—in many areas there are not very much data for individual streams, and some descriptions were more generalized over a region
 - Score 1** for: Clallam County Watershed Facts (CC Watershed Facts)
3. For each water body, average the scores for **Number of References Available** and **Quality of References Available** to obtain the score for **Overall Confidence of the Habitat Integrity rating**, where:

2.50 – 3.0	=	High confidence
1.50 – 2.49	=	Moderate confidence
0 – 1.49	=	Low confidence

F. Washington State Freshwater Surface Water Quality Standards

<i>Parameter</i>	<i>Class AA, Extraordinary</i>	<i>Class A, Excellent</i>	<i>Class B, Good</i>
Temperature	Shall not exceed 16.0°C*	Shall not exceed 18.0°C*	Shall not exceed 21.0°C*
pH	Shall be within the range 6.5-8.5	Same as for Class AA	Same as for Class AA
Dissolved Oxygen	Shall exceed 9.5 mg/L	Shall exceed 8.0 mg/L	Shall exceed 6.5 mg/L
Turbidity	Shall not exceed 5 NTU (Nephelometric turbidity units) over background turbidity when the background is 50 NTU or less, or have more than a 10% increase in turbidity when the background is more than 50 NTU.	Same as for Class AA	Shall not exceed 10 NTU (Nephelometric turbidity units) over background turbidity when the background is 50 NTU or less, or have more than a 20% increase in turbidity when the background is more than 50 NTU.
Fecal coliform bacteria (FC)	<u>Part 1</u> : shall not exceed 50 FC/100ml (geometric mean) <u>Part 2</u> : not more than 10% of all samples used to calculate geomean can exceed 100 FC/100ml.	<u>Part 1</u> : shall not exceed 100 FC/100ml (geometric mean) <u>Part 2</u> : not more than 10% of all samples used to calculate geomean can exceed 200 FC/100ml.	<u>Part 1</u> : shall not exceed 200 FC/100ml (geometric mean) <u>Part 2</u> : not more than 10% of all samples used to calculate geomean can exceed 400 FC/100ml.

*due to human activities. When natural conditions exceed the standard, no temperature increases will be allowed which will raise water temperature by more than 0.3°C.

See **Appendix G** for a list of streams with exceedences of these standards.

Source: Chapter 173-201A WAC, Water Quality Standards for Surface Waters of the State of Washington, 1997.

*G. 1998 303(d) List for Water Quality–Impaired Streams in Clallam County **

WRIA	Waterbody Name	Parameter	WRIA	Waterbody Name	Parameter
17	Chicken Coop Creek	Fecal Coliform	20	Bogachiel River	Dissolved Oxygen, Temperature
17	Johnson Creek	Fecal Coliform	20	Canyon Creek	Temperature
17	Sequim Bay	Dissolved Oxygen, pH	20	Coal Creek	Temperature
18	Bagley Creek	Fecal Coliform	20	Crooked Creek, N.F.	Temperature
18	Bell Creek	Fecal Coliform	20	Dickey River, E.F., M.F. & W.F.	Temperature
18	Cassalery Creek	Fecal Coliform	20	Elk Creek	Temperature
18	Dry Creek	Temperature	20	Fisher Creek	Temperature
18	Dungeness River	Instream Flow	20	Lake Creek	Dissolved Oxygen, Temperature
18	Elwha River	PCB-1254, Temperature	20	Line Creek	Temperature
18	Matriotti Creek	Fecal Coliform	20	Maple Creek	Temperature
18	Port Angeles Harbor	Dissolved Oxygen	20	Maxfield Creek	Temperature
19	Clallam River	Temperature	20	Nolan Creek	Temperature
19	Deep Creek	Fine Sediment, Temperature	20	Owl Creek	Temperature
19	Green Creek	Temperature	20	Rock Creek	Temperature
19	Little Hoko River	Temperature	20	Soleduck River	Dissolved Oxygen, Temperature
20	Sekiu River, & N.F. & S.F.	Temperature	20	Split Creek	Temperature
20	Alder Creek	Temperature	20	Tower Creek	Temperature
20	Anderson Creek	Temperature	20	Willoughby Creek	Temperature
20	Beaver Creek	Temperature	20	Winfield Creek	Temperature

*Section 303(d) of the federal Clean Water Act requires states to periodically prepare a list of all surface waters in the state for which beneficial uses, such as drinking, recreation, aquatic habitat, and industrial uses, are impaired by pollutants. Above are water-quality limited rivers, streams, lakes, and estuaries in Clallam County (WRIA's 17-20) that fall short of state surface water standards (listed in Appendix F) and are not expected to improve within the next 2 years.

2002/2004 303(d) List Update: (EPA did not require states to submit a 303(d) list for 2000.) The preliminary draft of Washington's latest Water Quality Assessment has been available for public review since 1/15/04. For information on how to review and comment and other public involvement opportunities, see the web page for this process: www.ecy.gov/programs/wq/303d/2002/2002-index.html.

H. References

- Clallam County. 2002. Watershed Facts. Online resource. (www.clallam.net/environment/imagemaps/watershed_map.htm) Clallam County, Port Angeles, WA.
- Correa, G. 2002. Salmon and Steelhead Habitat Limiting Factors, WRIA 17 Quilcene-Snow Basin. Washington State Conservation Commission, Olympia, WA.
- ENTRIX, Inc. 2003. Final Draft Watershed Plan, Water Resource Inventory Area 18. Prepared for: WRIA 18 Initiating Governments. Port Angeles, WA.
- Haring, D. 1999. Salmon and Steelhead Habitat Limiting Factors, WRIA 18, Final Report. Washington State Conservation Commission, Olympia, WA.
- Hempleman, C. and Sargeant, D. 2002. Water Cleanup Plan for Bacteria in the Lower Dungeness Watershed, TMDL Submittal Report. Washington Department of Ecology, Olympia, WA.
- Jamestown S’Klallam Tribe. 2003. The “Undevelopment” of Jimmycomelately Creek & Estuary. Sequim, WA.
- Karr, J. 1997. Measuring Biological Integrity. In *Principles of Conservation Biology*. ed. G. K. Meffe and C.R. Carrol. 483-485. Sunderland, MA: Sinaeur.
- Karr, J., Horner, R., and Horner, C. 2003. EPA’s Review of Washington’s Water Quality Criteria: An Evaluation of Whether Washington’s Criteria Protects Stream Health and Designated Uses. National Wildlife Federation. NY.
- McHenry, M. L., Lichatowich, J., and Kowalski-Hagaman, R. 1996. Status of Pacific Salmon & Their Habitats on the Olympic Peninsula, Washington. Lower Elwha Tribe. Port Angeles, WA.
- McNulty, T. 1996. A Natural History Guide Olympic National Park. Houghton Mifflin Company, Boston, New York.
- Parametrics, Pacific Groundwater Group, Inc., Montgomery Water Group, Inc., & Caldwell & Assoc. 2000. Stage 1 Technical Assessment as of Feb. 2000, WRIA 17. Prepared for WRIA 17 Planning Unit. Jefferson County, WA.
- Puget Sound Water Quality Action Team. 2002. Puget Sound UPDATE 2002. Eighth Report of the Puget Sound Ambient Monitoring Program. Puget Sound Water Quality Action Team. Olympia, WA.
- Rossano, E.M. 1996. Diagnosis of Stream Environments with Index of Biological Integrity for Japanese Streams. Tokyo, Japan: Sankaido.
- Salmonweb*: www.cbr.washington.edu/salmonweb/.
- Sargeant, D. 2002. Dungeness River and Matriotti Creek Fecal Coliform Bacteria Total Maximum Daily Load Study. WA Department of Ecology. Olympia, WA.
- Shreffler, D. 2000. A Preliminary Plan for Restoring Jimmycomelately Creek and the Lower Sequim Bay Estuary, Phase I. For the Jamestown S’Klallam Tribe. Sequim, WA.
- Shreffler, D. 2003. A Conceptual Plan for Restoring the Lower Sequim Bay Estuary, and Channel Design for Realignment of the Jimmycomelately Creek Channel. For the Jamestown S’Klallam Tribe. Sequim, WA.

- Smith, C. 2000. Salmon and Steelhead Habitat Limiting Factors in the North Washington Coastal Streams of WRIA 20. Washington State Conservation Commission, Olympia, WA.
- Smith, C. 1999. Salmon and Steelhead Habitat Limiting Factors in the Western Strait of Juan de Fuca. (WRIA 19.) Washington State Conservation Commission, Olympia, WA.
- Snohomish County Public Works Surface Water Management. 2000. The State of the Waters, Water Quality in Snohomish County's Rivers, Streams and Lakes. 2000 Assessment. Thornburg, K. and Williams, G. Snohomish County, WA.
- Summers, J. H. VII. 2001. Salmon Recovery Index Watershed Monitoring Program. Water Quality Index Report, October 2000 - September 2001. Environmental Assessment Program, Washington State Department of Ecology. Olympia, WA.
- U.S. EPA. 1999. Projects/Reports. Mid-Atlantic Integrated Assessment, The State of Maryland's Freshwater Streams. U.S. Environmental Protection Agency. Office of Research & Development, U.S. EPA Region 111-Philadelphia, PA.
- Washington Department of Fish and Wildlife & Western Washington Treaty Indian Tribes. 1993. 1992 Washington State Salmon and Steelhead Stock Inventory. Olympia, WA.

EVALUATION

We want to know what you think of this first edition of *State of the Waters of Clallam County, 2004*. Please use this form to comment and mail to CLALLAM COUNTY DCD at the address on reverse.

Thank you – your feedback will assist us as future editions are prepared.

- What did you find most valuable about this publication?
- Was there too much information, or something missing?
- Did the format appeal to you? Was it clear and easy to follow, or confusing?
- All comments are welcome, with or without your name.



Please fold and tape closed

*Place
Stamp
Here*

Clallam County Dept. of Community Development

223 E. 4th Street, Suite 5

Port Angeles, WA 98362

Subj: *State of the Waters* update