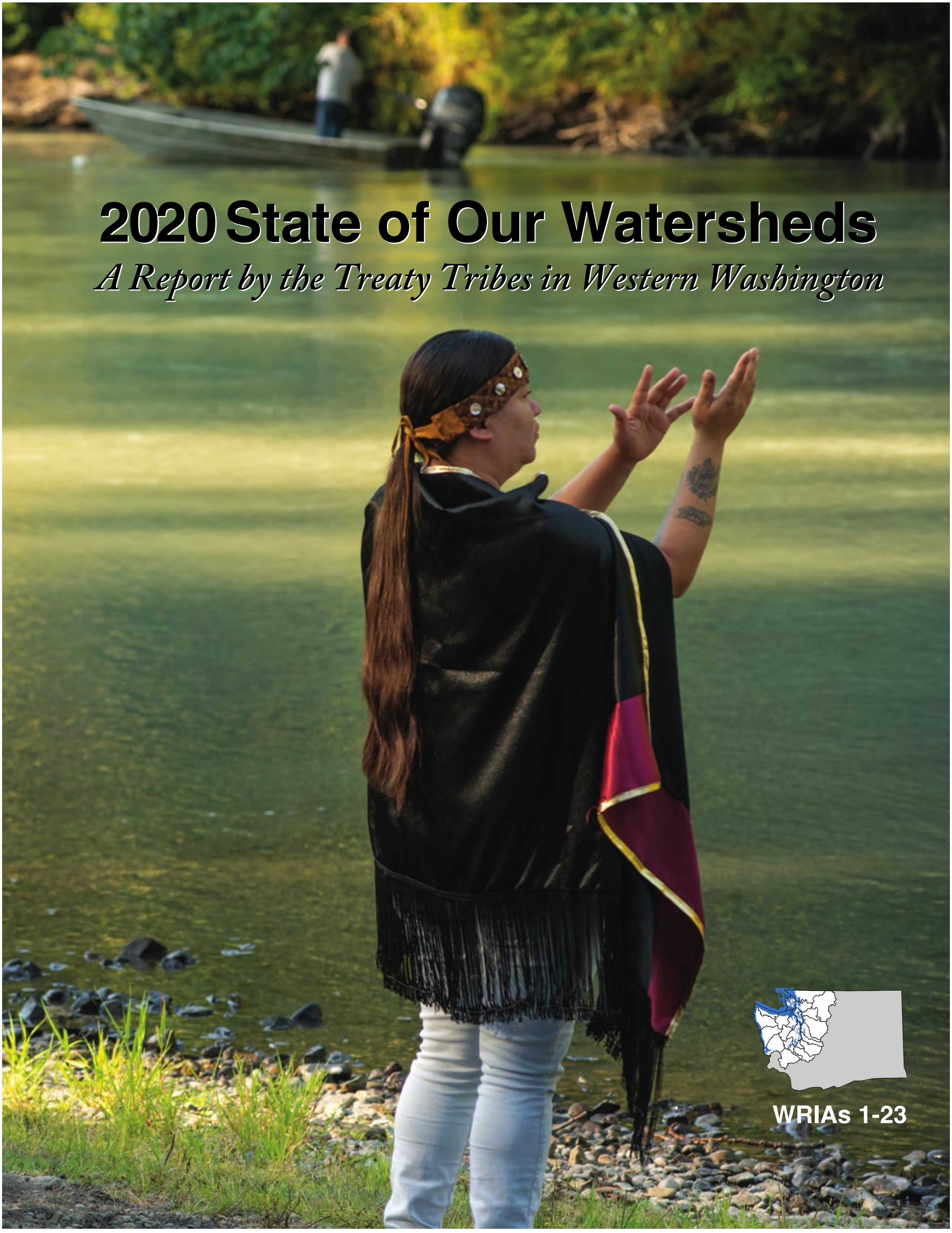
2020 State of Our Watersheds

A Report by the Treaty Tribes in Western Washington



Northwest Indian Fisheries Commission Member Tribes

2020 State of Our Watersheds Report

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Cover: Nisqually tribal dancers and singers welcome the first salmon back to the Nisqually River during the annual ceremony at a traditional fishing spot, while a Nisqually fisherman tends his net in the background. *Photo: Debbie Preston, NWIFC*

Letter From NWIFC Chair

Dear Reader,

In sharing this 2020 State of Our Watersheds Report I want to share several of the truths that I have learned in the nearly 50 years that I have been a tribal fisheries manager:

- We must never forget the value of salmon to the spiritual, community and economic vitality of tribes and the ecology of the watersheds that sustain us all.

- We must acknowledge that our salmon continue to decline because we are losing their habitat faster than it can be restored. We must reverse that trend. We must protect what sustains them.

- Fisheries managers can't make more fish. Only hatcheries and healthy habitat can do that and both depend on good habitat for their survival.

- We aren't managing salmon for today. We are managing them for future generations.

If cutting harvest were the answer to restoring salmon, we would have been successful a long time ago. State and tribal fisheries managers have reduced harvest by 80-90 percent over the past four decades, yet salmon continue to disappear. That is because restoring and protecting salmon habitat are the true keys to salmon recovery.

This 2020 State of Our Watersheds Report documents environmental conditions and tracks trends to hold us all accountable to the need for urgent action to protect our region's watersheds and their habitats.

This update of the 2016 State of Our Watersheds Report provides a watershed by watershed characterization of actual conditions and the cumulative result of our choices.

Each tribal chapter focuses on habitat loss and degradation as it relates to tribal communities, economies and treaty-reserved fishing rights. A wide range of science and data are used to document current salmon habitat trends and efforts to resolve our most pressing problems that are being created by population growth, polluted stormwater runoff, climate change and other factors.

While this report's findings remain grim, there is still cause for hope.

At the urging of tribes, Washington Gov. Jay Inslee in late 2019 directed his state natural resources agencies to develop a consistent approach for uniform, science-based riparian (streamside) habitat management and guidance to protect salmon and their habitat. Riparian habitat is among the most important for salmon. Among its many benefits is shade from trees and other vegetation that helps keep water temperatures low to aid salmon survival at all life stages.

Another bright spot appeared this year when – for the first time – treaty tribal and state salmon co-managers included habitat recovery as part of fisheries management planning. Part of that effort will include a science-based instream flow assessment from a salmon point of view.

We also continue to advance solutions to support salmon recovery and treaty rights protection through *gw∂dzadad*, our strategy for protecting and rebuilding salmon habitat that takes its name from the Lushootseed word that means "Teachings of our Ancestors."

Both the 2020 State of Our Watershed Report and the *gw∂dzadad* habitat strategy are available at *geo.nwifc.org/sow* and *nwtreatytribes.org/habitatstrategy.*

Adding even more encouragement is the Billy Frank Jr. Salmon Coalition that was created in 2018. The coalition brings together leaders and innovators across policy, science, politics, business, conservation, recreational and other areas who are willing to challenge the status quo on salmon recovery.

We know the status quo isn't working when it comes to salmon recovery. We know what the science says needs to be done. We know that we must move forward together to address habitat because it is the most important action we can take recover salmon.

COVID19, while painful, has shown us that we can change, we can be far sighted and prioritize decisions that sustain us. My hope is that we use this collection of stories and science from each watershed to create the change that's needed to recover salmon.

Lorraine Loomis

Executive Summary

Since time immemorial, the treaty Indian tribes have lived in harmony throughout the watersheds of western Washington. They have always been and continue to be leaders in the region's salmon recovery effort and conservation measures. No other people know these watersheds as well as the tribes. The tribes believe that if salmon are to survive, their partners (state and federal agencies) must make real gains in habitat protection and restoration, today not tomorrow. We all have a stake in the protection and restoration of salmon.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe salmon recovery efforts should focus on the protection and restoration of these watersheds.

The State of Our Watersheds (SOW) Report examines key indicators of habitat quality and quantity across more than 20 watersheds in western Washington that lie within tribal Usual and Accustomed fishing areas as defined by U.S. v. Washington (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the restoration, protection and harvest of the salmon resource.

The goal of the SOW Report is to assess the health of western Washington watersheds and to gauge progress toward recovering salmon. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information on this initiative can be found at *www.treatyrightsatrisk.org*.

For this report, tribes focused on the portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the SOW Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify how regional salmon recovery plans are progressing.

Principal Findings

Degraded Nearshore Habitat Unable to Support Forage Fish

Nearshore areas provide critical rearing and foraging habitat for salmon and steelhead and are important cultural gathering areas. During the past century, these nearshore areas have been directly and negatively degraded by human development. Shoreline modifications, such as armoring, interrupt the movement of sediment and can starve beaches of sediment, which negatively affects forage fish spawning habitat.

Since reported in the 2016 SOW Report, shoreline armoring has been reduced by about one mile and the state has permitted the addition of about 6.7 miles of armor replacement. Overall, from 2015 to 2018, the amount of armoring has been reduced for Puget Sound but the reductions are not shared across the region. For example, in the Squaxin Area of Interest, from 2015-2018 in Pierce, Mason and Thurston counties, 167 Hydraulic Project Approvals were issued, resulting in 4,084 feet of new bulkhead, while 2,779 feet of bulkhead were removed, for a net increase of 1,305 feet of additional bulkhead.

Estuary Habitat Restoration Is Occurring, but More Funding and Staff Time Are Required

The habitat provided by the estuaries in western Washington continues to be degraded by the region's population growth. Estuary habitat has been lost throughout Puget Sound, along the straits and along the coast. Nonetheless, in some areas there are signs of improvement. For example, since the publication of the 2016 SOW Report, there has been local success in the recovery of estuarine habitat. In the Stillaguamish's Salmon Recovery Plan, 88% of the 10-year target of 548 acres of estuarine habitat restoration is complete. From 2014 through 2019, 330 acres of estuarine habitat was restored bringing the total restored area to 480 acres. In addition, 250 acres of estuarine habitat have been acquired for future restoration. In the Swinomish Area of Interest, six pocket estuary sites have restored 33.6 acres of usable habitat, increasing the estimated chinook smolt production by about 48,000 smolts.

There are other projects underway that have moved from the conceptual stage to an active status since 2015, but these types of restoration projects need continued support and funding if we are going to be able to create ecologically resilient estuaries to support salmon recovery.

Commercial Shellfish Growing Conditions Dependent on Proper Water Quality Management

Shellfish have long provided cultural, ecological and economic value to western Washington. However, shellfish growing beds have been experiencing degraded water quality conditions caused by human activities. Washington State Department of Health (WADOH) conducts sanitary surveys and water quality assessments in shellfish growing areas to determine harvest suitability; and conducts point-source pollution evaluations to determine the causes of pollution. It is critical that water resources are protected in the watersheds in order for there to be a productive shellfish industry.

In the Puget Sound Region, over 280,000 total acres of growing areas in 2020, 34% (98,052 acres) had either prohibited or restricted status. Overall, over the past five years, there has been an increase in the number of acres approved for commercial growing.

Water Quality Management Still Needs Attention

Streams across the region are being impaired by high water temperatures, reduced dissolved oxygen and increased turbidity. TMDLs (Total Maximum Daily Limit) are being exceeded and additional actions need to be taken to bring these water bodies into compliance with their TMDL permit.

In the Makah area, in 2016, 40 waterbodies were placed on the 303(d) list for water pollution, a 25% increase since 2012. Water temperature remains by far the most common pollutant followed by dissolved oxygen. The Big River is the single most polluted waterbody by total length, of which 16.1 miles are impaired by water temperature, dissolved oxygen and pH.

In the Skagit watershed, the primary management recommendation of the 2004 Lower Skagit Tributaries Temperature TMDL – 100% riparian reforestation or enrollment in reforestation program by 2020 – continues to be unmet. Only 51% of riparian acreage along fish-bearing streams within the Lower Skagit Temperature TMDL watersheds are currently forested or planted for reforestation.

Forest Cover is Improving

The loss of forest cover occurs as timber harvest operations and land conversions take place. Since the 2016 SOW Report, overall there was little to no change in forest cover but some areas showed improvement in forest cover across the region. For example, in the Makah Area forest cover conditions improved by about 15% in land having greater than 75% forest cover.

Although it is a temporary impact, the rapid removal of forest cover in watersheds can have dynamic effects on watershed stability and overall quality of habitat for salmonids. Large clearcuts, inadequate buffers, mass wasting and poorly constructed and/or maintained forest roads all have led to the degradation of salmon habitat. For the overall ecological health and resiliency of critical salmon habitat, the focus needs to be on ending non-sustainable harvest practices and managing forestlands in a holistic, sustainable manner.

Riparian Forest Cover Is Diminishing

Since statehood in 1889, Washington has lost an estimated 50% of its riparian habitat. Diminishing riparian forests in the lowlands of western Washington continues to impair habitats critical to the recovery of the region's anadromous salmon. The number of 6th-level Hydrologic Units rated for Properly Functioning riparian forest cover shrank by 37.9% between 2011 and 2016. In 2011, NMFS identified for most of Puget Sound that degraded riparian areas are a limiting factor to the recovery of chinook salmon.

Forest Land Conversion Is Slowing

Conversion of forestlands continues in some lowland watershed areas that are already in severely damaged condition. For the overall health of critical salmon habitat, attention needs to focus on preventing the permanent loss of forest cover and restoring it in lowland forests.

For example, in the Snohomish watershed from 2000 through 2009, about 4,000 acres of land were converted from managed forestlands to other zoning such as residential or commercial. This represents an average of 399 acres of land converted per year. Since 2010, around 1,024 acres of land was converted from managed forestlands to other zonings, an average of 102 acres of land converted per year. This is a nearly 75% decrease in the average annual acres converted out of forestland between the two decades.

Streams Lack Large Woody Debris

Large woody debris (LWD) plays an important role in channel stability, habitat diversity, and overall habitat quantity and quality. Unfortunately, the potential to restore LWD to improve salmon habitat is often restricted by land management approaches and policies. Land use and forest and river management have all resulted in extremely decreased quantities of instream wood in western Washington. To address decreased quantities of instream wood in western Washington, tribes are constructing engineered logjams in their local watersheds to rebuild the supply and/or create opportunities to retain LWD in key salmon and steelhead streams.

For example, since 2016, there are 18 new large woody debris or engineered logjam (ELJ) projects in the Nooksack River watershed. Two projects are in a proposal phase, five projects are actively progressing and 11 projects have been completed. Although efforts are underway, there are still obstacles to restoring once-functioning river systems by federal, state and local land-use policies.

Alarming Number of Stream Crossings, High Road Densities

The number of road crossings are continuing to negatively impact the health of aquatic life in lowland watersheds. The projected population growth in western Washington and associated land conversions will require more roads and stream crossings throughout lower portions of the watersheds. While some improvements are taking place in both forest and urban environments, the negative impacts outweigh the limited gains.

Approximately 90% of the Quinault's Area of Interest (excluding the upper Queets and Quinault watersheds) have road densities of more than 3 miles of road for every 1 square mile of land. At this level streams cease to function properly. Road crossings were generally highest with values of over 1 per mile of stream, in the headwaters of the Chehalis and Skookumchuck rivers as well as in watersheds near the twin cities of Chehalis and Centralia.

In the Suquamish's Area of Interest, the drainage units impacted by high road densities greater than 3 miles of road per square mile remain at 94%, while since 2015, there was an increase of 19%, from 37% to 44%, of the area negatively impacted by stream crossings.

Forest Landowners Make Great Progress in Improving Fish Access to Region's Forestlands

Since 2001, forest landowners have been implementing the Forests and Fish Agreement, including repair and maintenance of their forest roads. All state and large private forest roads are required to be brought up to new forest road standards by 2021 through Road Maintenance and Abandonment Plans (RMAP). The goal is to minimize impacts from the roads and remove barriers to fish passage. Overall the forest landowners have made great progress in the completion of their RMAPs. In the Pacific Coast and Puget Sound regions, about 85% and 90% of the obligations have been completed, a 20% and 12% increase from what was reported in the 2016 SOW Report, respectively.

Fish Barriers Cut Off Vast Amounts of Habitat

Fish-passage barriers are one of the main obstacles to salmon recovery. Fish must be able to swim upstream to their freshwater habitat to reproduce and back again to the ocean to survive. Fish-passage barriers, such as culverts, tide gates and levees, still persist in all watersheds, impacting a significant number of stream miles. Progress and commitments are being made by the state but there are serious concerns with the lack of proper funding to accomplish the repairs within the court-ordered timeline.

An example of the progress is in WRIA 01 area, from 2015 through 2019, there were 116 new anadromous barrier culverts found, bringing the total number of barrier culverts to 662, an increase of 58 culverts since 2014. Over that same time period, approximately 58 culverts that were blocking anadromous fish have been repaired or abandoned and are now considered passable to fish.

Impervious Surface Area Impacts Water Quality and Salmonid Habitat

High population densities lead to large amounts of impervious surfaces, such as roads and other infrastructures, negatively impacting the local watersheds and resulting in loss of salmon habitat. Sensitive stream habitat conditions may be lost when 10% of the watershed is covered by impervious surface area. From 2011 to 2016, the total area of impervious surfaces continued to increase but at a slower pace, with a common rate of increase between 0% to 4%.

One of the greatest concerns stemming from impervious surfaces is the stormwater runoff that occurs during our seasonal rain events. Based on recent predictive modeling in Puget Sound, stormwater runoff from high traffic roads is creating Urban Runoff Mortality Syndrome or Pre-Spawn Mortality (PSM) conditions in over 48% of documented coho salmon habitat, resulting in prespawn mortality rates between 10% and 40%. Based on NOAA's latest 2017 model, 471 stream miles of known coho distribution in the Green-Duwamish and Lake Washington basins are predicted to have a PSM rate of 5% or more, with 147 miles predicted to have 35% to 100% PSM. In the 2016 SOW Report, these estimates were 269 miles and 141 miles respectively.

Agricultural Lands Remain Degraded

Agricultural lands are still impaired and reflect the practices that began in the late 1800s with the removal of trees and clearing of lowland forests. Diking soon followed, with lower estuaries being diked to protect the new farmland and to increase its productivity. Impacts included the loss of stream channels, wetlands, stream buffers, increased sediment and pollution in the form of runoff from agricultural activities.

The Snohomish River Basin Salmon Conservation Plan recommends that there be at least 65% forested 150-foot riparian buffers on either side of all fish-bearing streams. Intense human land use puts continuous stress on lowland riparian resources in the Snohomish River watershed. According to our assessment, between 2015 and 2017 there was a net loss of 25 acres of riparian forest cover.

Sensitive Floodplains Being Overdeveloped

Floodplains play a critical ecological role in salmon recovery and creating healthy functioning habitat. Floodplains are essential to maintaining the hydrological function of streams and providing off-channel salmon habitat. Flood management of overdeveloped floodplains often results in diking and armoring streams, altering both streamflows and physical habitat. Despite their critical role in salmon survival, floodplains continually face development pressures. Floodplain management has had mixed results, with improvements in some watersheds but continued degradation in others. Population growth is forecast to increase in the next decade and the remaining floodplain habitat is at risk of being converted to non-habitat use. This raises concerns about an increased need for levees, and degradation of water quality and riparian forests, and an increase in the amount of impervious surface areas in the lower portions of the watersheds, negatively impacting fish habitat and water quality.

All of the tribes understand the importance of protecting floodplains and the habitat they provide. The Jamestown S'Klallam Tribe has been actively working on projects to restore the Dungeness River for more than 30 years. The Puyallup Tribe has ranked the Clarks Creek Channel Stabilization Project as its highest priority in the Clarks Creek basin for storing sediment and reducing downstream sedimentation. The goal of the project is to reduce downstream sediment input to the Puyallup River. It has multiple benefits with regard to helping detain groundwater discharge to the channel and capturing subsurface water flows.

Rapidly Increasing Permit-Exempt Wells Threaten Water for Fish

The state of Washington provides a water right permit exemption to property owners not served by a community water system, allowing users to pump up to 5,000 gallons of groundwater per day. When more water is extracted from an aquifer than is being recharged, aquifer volume is reduced and the natural outflow from the aquifer decreases. This reduces the amount of fresh water available to lakes, wetlands, streams and the Puget Sound nearshore, which can harm salmon at all stages of their life cycle.

Since the 2016 SOW Report, all watersheds have seen an increase in water wells. It is estimated that the majority of wells are drilled for home construction and are suspected as a potential cause for low flow problems found in many watersheds. The cumulative withdrawal of groundwater associated with the continued proliferation of these wells leads to concerns of associated impacts to instream flows, salmon habitat, public health and senior water rights.

Since 1980, over 67,000 wells have been developed in the Puget Sound Region. In the time period from 2015 to 2019, 5,815 of these wells were built, which represents a 40% increase from the number wells built during the previous five years (2010-2014).

In the Pacific Coast Region, over 10,000 wells have been developed and from 2015 to 2019, 1,133 of these wells were built, which is a 74% increase from the number wells built during the previous five years (2010-2014). The vast majority of these wells occurred in the Upper and Lower Chehalis watersheds.

This increasing rate of new well installations threatens groundwater availability and ecosystem health across the region, and actions need to be implemented to protect the instream flows that the fish and wildlife habitat depend upon.

Climate Change Impacts the Region's Resources

As the climate continues to change, impacts to the daily tribal way of life continue. Reductions in the glaciers, extreme weather events and the streamflow impacts observed along coastal Washington are all signs that our climate is changing.

All coastal tribes have observed a shift in the coastal rivers' streamflows which will have a direct impact on the salmon and steelhead populations of the area. Peak flow values are showing an increasing trend while low flows are showing a decreasing trend. This was the same observation as reported in the 2016 SOW Report. The glacier-fed streams of the north coast show an increasing trend over time while mean low flows show a decreasing trend. In rain-dominated streams such as the Chehalis River, both peak and mean low flows show an increasing trend.

Tribes are beginning to respond to the threats brought on by climate change. For example, the Jamestown S'Klallam Tribe is among the tribes on the forefront of addressing vulnerabilities and preparing for climate change. The 2013 Jamestown Climate Vulnerability Assessment and Adaptation Plan provides an assessment of vulnerabilities of tribal resources to the negative impacts of climate change. The plan also identifies adaptive measures that the tribe is working onto completing. Sea level rise, ocean acidification and climate models show potential for increased risks to critical habitats, tribal infrastructure and tribal health.

Ocean Conditions

Ocean conditions have been heavily impacted by warming oceans, including marine heatwaves, ocean acidification and hypoxia (OAH) and harmful algal blooms (HABs). These stressors have severely limited salmon returns and led to the widespread closure of beaches accessed by tribal fishers due to high levels of the toxins. Ocean conditions are predicted to continue to worsen in coming years without significant, coordinated effort at the local, state, national and international levels.

Low oxygen conditions in bottom water have been recorded between June and September for up to 35% and 33% of the summer season off Cape Alava and off Teahwhit Head, respectively. In conjunction with marine heatwaves, these adverse marine conditions have caused the Quileute Tribe to declare three fisheries economic disasters since 2015 and the Hoh Tribe to declare a fisheries economic disaster for their 2015 fall coho fishery, which had very poor returns. Razor clam harvest from the Kalaloch Beach area has been limited in recent years due high levels of biotoxins from HABs. Adverse marine conditions caused the Quinault Indian Nation to close their Dungeness crab fishery early in 2017 and 2018 due to severe hypoxia, and fish kills have been observed in recent years – something that tribal elders cannot recall seeing in the past.

Habitat Restoration Is Happening but More Is Needed

Habitat restoration is happening in western Washington, but more needs to be done to counter the impacts of a growing population and past mismanagement of the region's resources. One habitat restoration highlight over the past decade is the removal of the Elwha River dams. Conditions in the Elwha River watershed have been monitored by the Lower Elwha Klallam Tribe and partners to gauge ecosystem response to the removal of the Elwha dams. Six years following dam removal, there have been positive responses for chinook, steelhead, coho, bull trout and Pacific lamprey. Pink and chum salmon have yet to show a response, but monitoring continues to track their recovery. The return of sand lance and smelt, which are important prey items for juvenile salmonids, has also been observed. River otters and American dippers, closely tied to ecosystem health, are expected to be positively impacted by the return of salmon. It is estimated that to date, over 4 million cubic yards of sediment has been deposited in the Elwha delta since the removal of the dams.

In the Nooksack watershed, the removal of the Middle Fork Nooksack River Dam will restore access to 16 miles of relatively pristine habitat for threatened chinook salmon, bull trout and steelhead. It is estimated that dam removal will increase chinook salmon populations in the Nooksack River region by more than 30% and will increase steelhead habitat in the Middle Fork Nooksack by 45%.

In the Skokomish River estuary, efforts have been underway to return abandoned agricultural land back to nature to allow young salmon, steelhead and other fish species room to access their historical habitats. For decades, human activity blocked these fish from accessing their habitat, and in recent years, a collaborative partnership has worked to restore this vital habitat. Today, the Skokomish is the most complete estuary restoration project in Puget Sound – and fish are taking notice. Last year, spring chinook salmon returned to the watershed to spawn for the first time in nearly a century, after having been reintroduced to the river by the Skokomish Tribe in 2016.

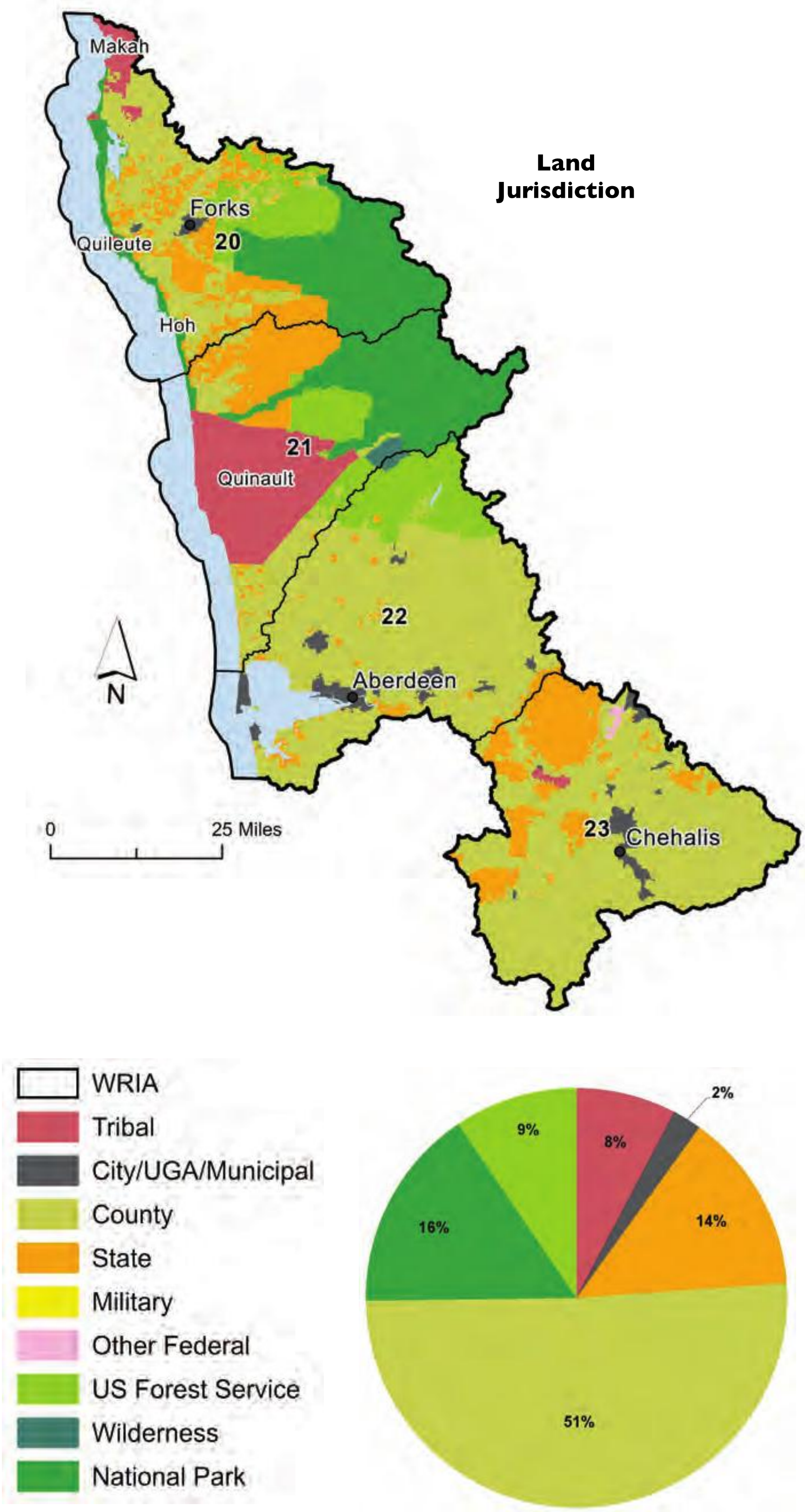
Conclusion

A consistent trend identified in the 2020 State of Our Watersheds Report is that key habitat features, such as riparian vegetation, habitat connectivity and streamflows, continue to be imperiled by human activities. This extensive loss and degradation of habitat, changing climate and ocean conditions threatens salmon, tribal cultures and tribal treaty-reserved rights, wildlife habitat, water quality, and western Washington's economy and quality of life. The principal findings in this report illustrate this alarming trend, but the descriptions contained within each tribe's watershed review provide the most accurate depiction of the habitat issues each tribe faces.

As sovereign nations, the 20 member tribes of the Northwest Indian Fisheries Commission signed treaties with the United States, ceding most of the land that is now western Washington, but reserving rights to harvest salmon and other natural resources. Today those fishing rights are being rendered meaningless because the federal and state governments are allowing salmon habitat to be damaged and destroyed faster than it can be restored. Tribal harvest has been reduced to levels not seen since before the 1974 *U.S. v. Washington* ruling that reaffirmed tribal treaty-reserved rights and status as co-managers with the right to half of the harvestable salmon returning to Washington waters. As the salmon disappear, tribal cultures, communities and economies are threatened like never seen before. Some tribes have lost even the most basic ceremonial and subsistence fisheries that are a foundation of tribal life and culture.

The State of Our Watersheds Report is a tool to assess, address and monitor progress toward protecting and enhancing salmon and wildlife habitat and water quality throughout western Washington. The report also serves as a bellwether – both an indicator and warning – that the trend of habitat loss and degradation must be reversed if we are to restore the salmon resource. If we do not, we will continue down the path we are on now, leading to the extinction of salmon and the loss of tribal treaty-reserved rights, economies and cultures, and a degradation of quality of life and economic vitality for all people of the region. This vision of the future is unacceptable to the treaty Indian tribes in western Washington.

2020 Pacific Coast Regional Report



The Pacific Coast Region (PCR) includes WRIAs 20-23, which extend along the Pacific coastline of Washington state. The land area of these WRIAs covers approximately 4,976 square miles and consists of watersheds in the western half of the Olympic Peninsula and south to the Chehalis River basin. This area is heavily forested with small human population centers, except for parts of the Chehalis River basin. Economies rely upon timber, agriculture, commercial fishery and recreational activities. The Chehalis River basin is the second largest river basin in Washington state, outside the Columbia River basin.

The Pacific Coast area contains eight major river systems, from the Tsoo-Yess River, near Neah Bay, south to the Chehalis River and Grays Harbor estuary. The Grays Harbor estuary is one of two major estuaries on the Washington coast and includes the only deepwater navigation channel and major port. The northern watersheds originate in the steep high-elevation headwaters of the Olympic Mountains and receive more than 200 inches of rain per year, while the upper Chehalis watershed receives just 47 inches of rain per year.[1]

The Pacific Coast watersheds are the ancestral and current homelands to the Makah, Quileute, Hoh tribes and Quinault Indian Nation who have lived and managed the natural resources along the Pacific Coast since time immemorial. The Makah Reservation is located at the northwestern tip of Washington state and, moving south, is followed by the Quileute, Hoh and Quinault reservations.

The Pacific Coast watersheds are home to pink, chum, chinook, coho and sockeye salmon, plus steelhead, bull trout and cutthroat trout. Lake Ozette sockeye and bull trout are listed as threatened species under the Endangered Species Act. The Lake Ozette Sockeye Salmon Recovery Plan was approved by NOAA in May 2009,[2] and notice of the Final Recovery Plan for the coastal (including Puget Sound) recovery unit of bull trout was published in the Federal Register in September 2015 by the USFWS.[3]

Map Data Sources: USFWS 2018,[4] WADNR 2016,[5] WADNR 2018,[6] WADOT 2018,[7] WAECY 1994,[8] WAECY 2000,[9] WAECY 2018a,[10] WAECY 2018b[11]

Chapter Summary

The Northwest Indian Fisheries Commission member tribes have fished, hunted, gathered and harvested along the rivers and tributaries of the Pacific Coast watersheds since time immemorial. No one on this earth is more connected to the watersheds, its water, plants, fish and animals than the region's tribes. At the heart of that connection is salmon which has always been a primary source of life for the tribes.

The limiting factors to salmon recovery include habitat quantity and quality in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribes' Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org.*

For this status report of the Pacific Coast Region (PCR), the tribes have focused on the issues that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Forest Cover Loss Continues

About 5% of the forest cover was removed between 2011 and 2016, and the trend will increase if protective actions are not taken. Loss of conifer forestlands to other uses (and its associated negative effect on fisheries and water quality/quantity) is a concern repeatedly stated in the recovery, management and watershed plans for this region.

Diminished Riparian Forest Cover

Diminishing riparian forests in the PCR continues to impair habitats critical to the recovery of the region's anadromous salmon. The area rated for "Properly Functioning" riparian forest cover shrank by 34.2% between 2011 and 2016. The National Marine Fisheries Service identified degraded riparian areas as a limiting factor to the recovery of chinook salmon.

Road Density and the Number of Road Crossings Have an Impact on Fish Habitat

From 2014 to 2019, road densities at the "Not Properly Functioning" level for Pacific Coast watersheds has increased from 86% to 90%. In addition, the number of road crossings per stream kilometer that are negatively impacting the health of aquatic life increased from 26% to more than 33% of Pacific Coast watersheds.

RMAP Completion a Positive Sign

As of the end of 2019, 85% of the Road Maintenance and Abandonment Plans (RMAPs) have been completed within the PCR, which is 28% higher than the amount that were fixed at the end of 2014.

Blocking Culverts Impact Salmonid Survival

During the first six years of implementing the *U.S. v. WA Culvert Case* injunction, the state of Washington corrected 99 fish blocking culverts. At the current schedule, if additional support is not gained, the corrections of the remaining 226 culverts won't be completed until the year 2034.

Streamflow Trends

The rivers of the PCR continue to experience negative fluctuations in flow. Peak flow values show an increasing trend (mean +12%) while low flow trends are decreasing (mean -27%). If both trends continue as anticipated under predicted climate change conditions, they could threaten salmon habitat and other aquatic ecosystem functions.

Groundwater Withdrawals Impact Surface Flows

Since 1980, more than 10,000 wells have been developed in the PCR. Of these wells, 1,133 were built between 2015-2019, which is a 74% increase in the number wells built during the previous five years (2010-2014). The vast majority of total and new wells in the region exist in the Chehalis watershed. This increasing rate of new well installations threatens groundwater availability and ecosystem health across the region.

Water Quality

In 2014 only 3% of the PCR stream miles were assessed for water quality, a total of ~880 miles. Of the assessed waters, the majority (86%) were determined to be impaired for one or more parameters and are listed in WA Ecology's 305(b) report to EPA. Of the 305(b) listed impaired waters, 83% are identified as salmonid-bearing waters.

Invasive Plant Treatment Continues

Between 2016 and 2019, more than 340 acres of invasive plant species have been treated across the PCR by tribes, agencies, the non-profit 10,000 Years Institute and partners. Knotweed, which has been the target of invasive eradication efforts since the early 2000s, has responded to aggressive multi-year efforts to control the species. Starting in 2015, these efforts expanded to a number of other species including reed canarygrass, tansy ragwort, Scotch broom, herb Robert, and Canada thistle, all of which threaten critical riparian functions and salmon habitat.

Green Crab Threaten Native Species

Over 2,600 European green crabs were captured between 2017-2019 in the Pacific Coast Region (PCR) by Makah Tribe, Washington Department of Fish and Wildlife and partners. Although European green crab occurrences in the PCR have so far been relatively rare compared to other parts of the world, widespread ecosystem-level changes to Washington's coastal ecosystem may occur if action is not taken to limit their spread.

Ocean Conditions

Marine waters off the Olympic Coast are undergoing rapid change, and the occurrence of marine heat waves, hypoxia and ocean acidification, and harmful algal blooms have been increasing. Adverse marine conditions in recent years have had a direct negative effect on tribal fisheries, and since 2015 all four treaty tribes on the Olympic Coast have made fisheries disaster declarations.

Climate Change Impacts the Pacific Coast and Tribal Traditional Practices

Today, the watersheds of the Pacific Coast are experiencing the effects of a changing climate and it is predicted that these effects are going to continue or accelerate into the future. Tribal communities are on the front line of the climate crisis as their traditional practices are now threatened by broad-scale and far-reaching environmental changes. The harms caused by the climate crisis are compounded by ongoing damage to the ecological integrity and resilience of our watersheds as described in this report. In the Pacific Northwest, the observed and projected trends include warmer air temperatures; shrinking glaciers and snowpack; lower summer streamflows; higher winter flood flows; shifts in streamflow patterns and timing; higher stream temperatures; larger and more frequent wildfires; warmer ocean temperatures; rising sea levels; and changing ocean chemistry, including ocean acidification and lower levels of dissolved oxygen.

Conclusion

The tribes want to maintain and restore natural ecosystem conditions that sustain salmon productivity in all watersheds of Pacific Coast Region. While habitat improvement is a major component to sustain salmon productivity, it is recognized that without protecting existing habitat functions, restoration activities cannot reverse the decline of salmon populations within the watershed. In this regard, conclusions on the state of the watershed in 2020 are mixed.

There are clear strategies for restoration and the ongoing restoration is resulting in the acquisition and restoration of critical salmon habitats along the Pacific Coast. However, restoration is expensive and funding remains a challenge. Restoration also requires political leaders and landowners willing to participate, which is a challenge. As restoration and acquisition continues, these two factors greatly affect the pace at which it occurs.

The legacy of European colonization of the landscape remains largely unchanged. Floodplain riparian forest cover is in poor condition, road densities and crossing are high, and non-point pollution continues to threaten salmon habitat. There is a high demand for the forest products of the region and people continue to move into the watershed, either reinforcing development patterns of the past, or bringing new development to previously undeveloped areas.

Changing this legacy of resource and land-use is a long, slow and very contentious process. It requires adherence to the laws and regulations of federal, state and local governments. Implementation of those laws, which happens locally, is often left to volunteerism on the part of the landowner. Politically, this is most palatable, but it has proven inadequate for the needs of salmon habitat recovery. Moving forward, as more people move into the region, better enforcement of the regulatory framework will become even more necessary.

Review of the trends for these key environmental indicators since the 2016 State of Our Watersheds Report shows improvement for some indicators and a steady loss for others in habitat status:

Tribal Indicator	Status	Trend Since SOW 2016 Report
Forestland Cover	About 5% of the forest cover was removed between 2011 and 2016, and the trend would be more loss if protective actions are not taken. Loss of conifer forestlands to other uses (and its associated negative effect on fisheries and water quality/quantity) is a concern repeatedly stated in the recovery, management and watershed plans for this region.	**Declining**
Riparian Forest Cover	Diminishing riparian forests in the PCR continues to impair habitats critical to the recovery of the region's anadromous salmon. The area rated for "Properly Functioning" riparian forest cover shrank by 34.2% between 2011 and 2016. The National Marine Fisheries Service identified degraded riparian areas as a limiting factor to the recovery of chinook salmon.	**Declining**
Road Density & Crossings	From 2014 to 2019, road densities at the "Not Properly Functioning" level for Pacific Coast watersheds have increased from 86% to 90%. In addition, the number of road crossings per stream kilometer that are negatively impacting the health of aquatic life increased from 26% to more than 33% of the Pacific Coast watersheds.	**Declining**
RMAP - Culverts	As of the end of 2019, 85% of the Road Maintenance and Abandonment Plans have been completed within the PCR, which is 28% higher than the amount that were fixed at the end of 2014.	**Improving**
Barriers - Culverts	During the first six years of implementing the *U.S. v. WA Culvert Case* injunction, the state of Washington has corrected 99 fish-blocking culverts. At the current schedule, if additional support is not gained, the corrections of the remaining 226 culverts won't be completed until the year 2034.	**Concerns**
Streamflow	The rivers of the PCR continue to experience negative fluctuations in flow. Peak flow values show an increasing trend (mean +12%) while low flow trends are decreasing (mean -27%). If both trends continue as anticipated under predicted climate change conditions, they could threaten salmon habitat and other aquatic ecosystem functions.	**Concerns**
Wells	Since 1980, over 10,000 wells have been developed in the PCR. Of these wells, 1,133 were built between 2015-2019, which is a 74% increase in the number wells built during the previous five years (2010-2014). The vast majority of total and new wells in the region exist in the Chehalis watershed. This increasing rate of new well installations threatens groundwater availability and ecosystem health across the region.	**Declining**
Water Quality	In 2014 only 3% of the stream miles in the PCR were assessed for water quality, a total of ~880 miles. Of the assessed waters, the majority (86%) were determined to be impaired for one or more parameters and are listed in WA Ecology's 305(b) report to EPA. Of the 305(b) listed impaired waters, 83% are identified as salmonid bearing.	**Declining**
Invasive Species - Plants	Between 2016 and 2019, over 340 acres of invasive plant species have been treated across the PCR by tribes, agencies, the non-profit 10,000 Years Institute and partners. Knotweed, which has been the target of invasive eradication efforts since the early 2000s, has responded to aggressive multi-year efforts to control the species. Starting in 2015, these efforts expanded to a number of other species including reed canarygrass, tansy ragwort, Scotch broom, herb Robert, and Canada thistle, all of which threaten critical riparian functions and salmon habitat.	**Improving**
Invasive Species - Green Crab	Over 2,600 European green crabs were captured between 2017-2019 in the Pacific Coast region by Makah Tribe, Washington Department of Fish and Wildlife and partners. Although European green crab occurrences in the Pacific Coast region have so far been relatively rare compared to other parts of the world, widespread ecosystem-level changes to Washington's coastal ecosystem may occur if action is not taken to limit their spread.	**Concerns**
Ocean Conditions	Marine waters off the Olympic Coast are undergoing rapid change, and the occurrence of marine heat waves, hypoxia and ocean acidification, and harmful algal blooms have been increasing. Adverse marine conditions in recent years have had a direct negative effect on tribal fisheries, and since 2015, all four treaty tribes on the Olympic Coast have made fisheries disaster declarations.	**Declining**

The tribes continue to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

Although the watersheds within the PCR continue to sustain salmonid species, significant threats to fish habitat remain. Land-use practices, particularly associated with forestry activities and road maintenance, continue to alter watershed processes, resulting in degradation of water quality, water quantity and stream channel complexity. There is a need for greater communication and cooperation between natural resources managers to assure achievement of the goals set in the watershed recovery plans for the PCR.

We are still witnessing the continued loss and fragmentation of habitat through barrier culverts, high road densities and crossings, forest cover removal, and extraction of groundwater. The lack of progress on the protection of existing habitat remains the biggest impediment to salmon recovery.

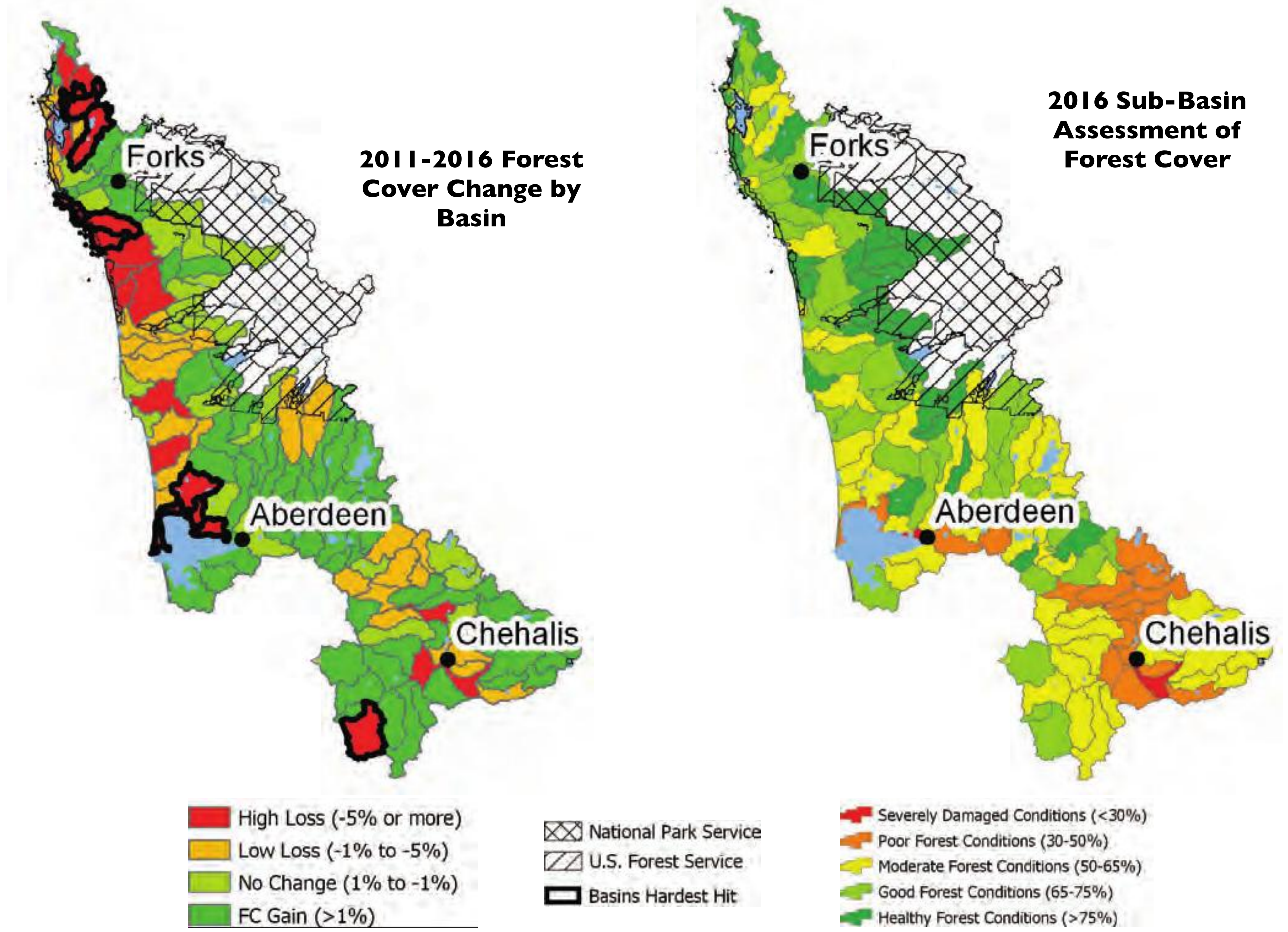
Pressure from population growth, agricultural practices and timberland use will continue to present challenges to salmon conservation and recovery efforts. Land-use management and forest practice regulations continue to allow the further degradation of floodplain and riparian habitat throughout the watershed.

Current habitat conditions and trends indicate the need for continued restoration efforts and land-use regulation reform. The regulatory framework that protects salmon habitat must be upgraded if the underlying assumption to all recovery goals is to be realized – that existing habitat will be protected from loss.

The tribes are committed to partnering with government and private groups to make improvements to salmon habitat, continued participation in the lead entity and regional recovery process, developing strategies for recovery, and participating in the efforts to seek grant funding for the PCR.

Forest Cover Loss Continues

About 5% of the forest cover was removed between 2011 and 2016, and the trend will continue if protective actions are not taken. Loss of conifer forestlands to other uses (and its associated negative effect on fisheries and water quality/quantity) is a concern repeatedly stated in the recovery, management and watershed plans for this region.



Within the Pacific Coastal Region (WRIAs 20-23) and outside of the national park areas, is an area of approximately 4,172 square miles (excluding the main waterways & major lakes). In 2011, 70% of this area was forested. But five years later, due to timber harvesting and some land conversions, only 66% of the area was forested, representing a loss of 5% or 145 square miles of forest cover.

While more than 66% of this region remains forested, many non-park watersheds exhibited a loss in forest cover, with 9 out of 152 basins[1] suffering a greater than 10% loss of forest cover.

Forest cover aids in the reduction of surface runoff, and during wet seasons, the infiltration of precipitation into groundwater. The increase in groundwater and decrease in runoff not only reduces sedimentation, but also moderates peak flows, extends the hydrologic flow duration, and can increase groundwater input into lakes, streams and wetlands. Forest vegetation root mass helps reduce mass wasting events, both in number and size, reducing suspended sediment concentrations. Forest vegetation adjacent to lakes, streams and wetlands provides shade and helps reduce water temperature increases.

The Recovery Plan for Lake Ozette Sockeye Salmon identifies some of the limiting factors to sockeye recovery as high stream temperatures, turbidity and "alterations in lake level variability from removal of wood at the lake outlet and tributary-inflow hydrologic change, coupled with tributary sedimentation and wood removal (that) have altered groundwater hydraulics, hydrology, and inter-gravel flow along the lake shoreline." The Recovery Plan concludes that water availability "changes begin following a significant (10 to 25%) reduction of forest vegetation cover."[2]

The 2011 Coastal Change Analysis Program (C-CAP) Land Cover data used in the 2016 SOW report was reanalyzed by NOAA to comply with the methods used for the 2016 C-CAP analysis. Taking advantage of this reanalysis, the results from this report are not directly comparable to the 2016 SOW report.

Map Data Sources: WADNR 2017,[3] WADOT 2010,[4] NOAA 2016,[5] USGS 2018,[6] NOAA 2011[7]

Diminished Riparian Forest Cover

Diminishing riparian forests in the Pacific Coast Region continues to impair habitats critical to the recovery of the region's anadromous salmon. The area rated for "Properly Functioning" riparian forest cover shrank by 34.2% between 2011 and 2016. The National Marine Fisheries Service (NMFS) identified degraded riparian areas as a limiting factor to the recovery of chinook salmon.[1]

Since statehood in 1889, Washington has lost an estimated 70% of its estuarine wetlands, 50% of its riparian habitat and 90% of its old-growth forest.[2]

Although focusing growth inside UGAs (Urban Growth Areas) is required by GMA (Growth Management Act), the protection of forest cover has not been met by existing regulatory tools. Growth pressures clear land in UGAs, even along riparian corridors and other areas important for salmon habitat.[3]

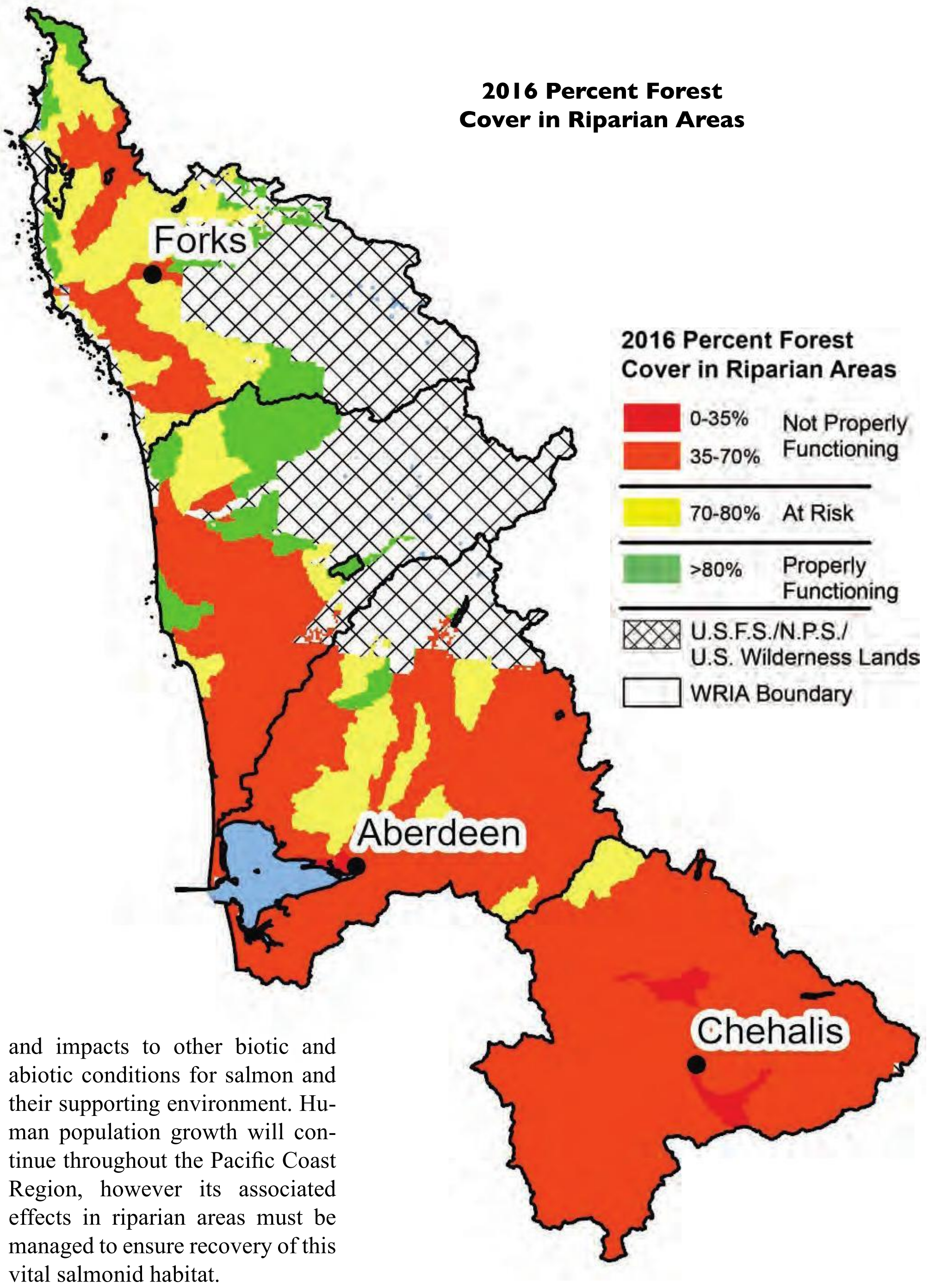
The Pacific Coast Region (PCR) consists of 152 6th level Hydrologic Units (HUCs) from WRIA 20 south through WRIA 23. Of the 152 HUCs, 136 are partially or completely outside of USFS/NPS/Wilderness Areas.

Of these identified HUCs, only 18% were rated "Properly Functioning" riparian forest cover in 2016, down from 28% in 2011.

Of the 38 HUCs identified as "Properly Functioning" riparian forest cover in 2011, only 25 were in the same category in 2016; a reduction of 34.2%.

The NMFS identified degraded riparian areas as a limiting factor important for recovery in their 2011 Implementation Status Assessment Final Report.[4] The assessed riparian zone is 300' from identified salmonid bearing waters and 100' from all other fresh waters.

The diminished riparian function of most watersheds and marine shoreline results in decreased water quality, temperature regulation, cover, bank stability, large woody debris recruitment, sedimentation, detrital/nutrient input, and impacts to other biotic and abiotic conditions for salmon and their supporting environment. Human population growth will continue throughout the Pacific Coast Region, however its associated effects in riparian areas must be managed to ensure recovery of this vital salmonid habitat.



Map Data Sources: SSHIAP 2014,[5] WADNR 2015,[6] WADOT 2010,[7] WAECY 2000,[8] NOAA 2011,[9] NOAA 2016[10]

Road Density and the Number of Road Crossings Have an Impact on Fish Habitat

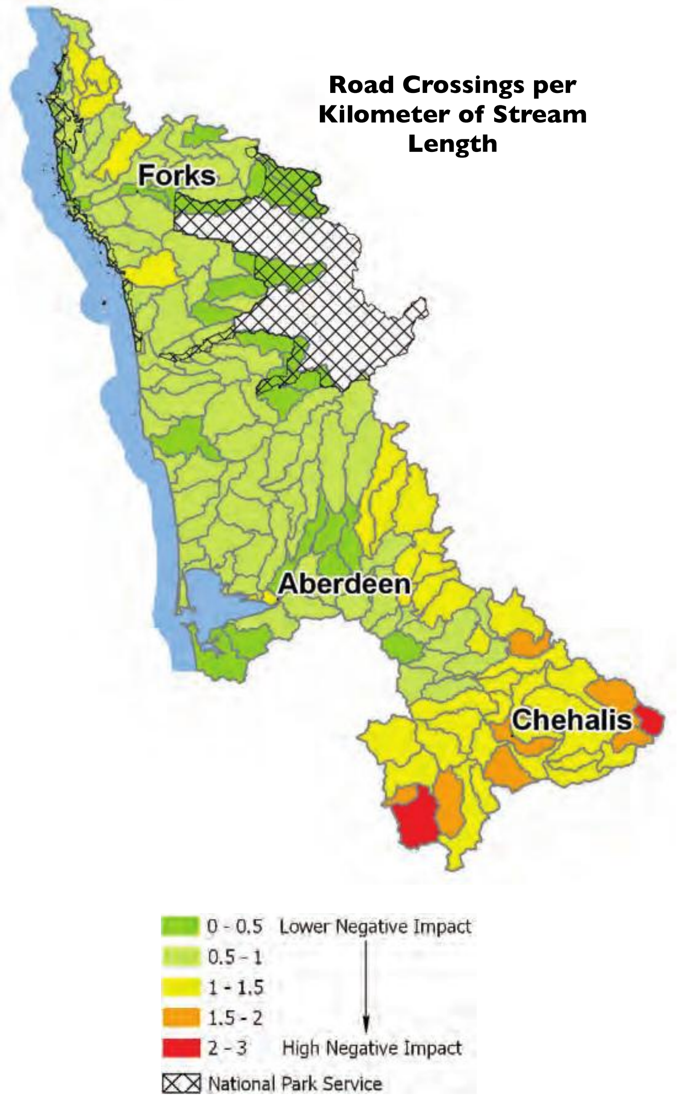
From 2014 to 2019, road densities at the "Not Properly Functioning" level for Pacific Coast watersheds has increased from 86% to 90%. In addition, the number of road crossings per stream kilometer that are negatively impacting the health of aquatic life increased from 26% to more than 33% of the Pacific Coast watersheds.

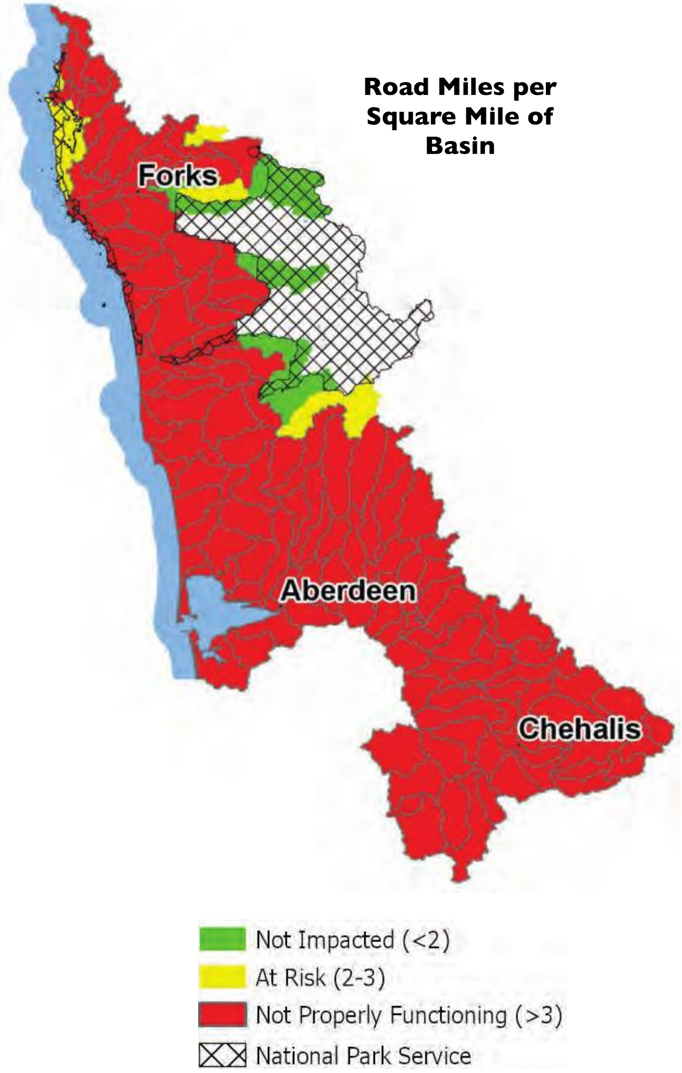
According to a NOAA 1996 report, watershed conditions are at risk when there are between two and three road miles/mi^2, and are considered "not properly functioning" when road miles exceed three miles/mi^2.[1]

Roads significantly elevate on-site erosion and sediment delivery, disrupt subsurface flows essential to the maintenance of base flows which can contribute to increased peak flows and contamination. Roads within riparian zones reduce shading and can reduce woody debris throughout the life of the road. These effects degrade habitat by increasing fine sediment levels, reducing pool volumes, increasing channel width and exacerbating seasonal temperature extremes.[2]

Since 2014, five more sub-basins have gone from "At Risk" to the "Not Properly Functioning Category," with an increase in the number of road miles per square mile of basin area. All but one are located north of the city of Aberdeen.

Several Chehalis River, Quillayute River, Ozette Lake and Sooes River sub-basins are trending towards high negative road crossing impacts. These impacts result from having more than one road crossing per kilometer of stream length, with the highest number of road crossings occurring in the headwaters of the Chehalis and Skookumchuck Rivers. When averages exceed two road crossings per kilometer of stream length, stream health is significantly more likely to become degraded.[3]





Map Data Sources: USGS 2018,[4] WADNR 2014b,[5] WADOT 2010,[6] WAECY 2019[7]

PACIFIC COAST REGION

RMAP Completion a Positive Sign

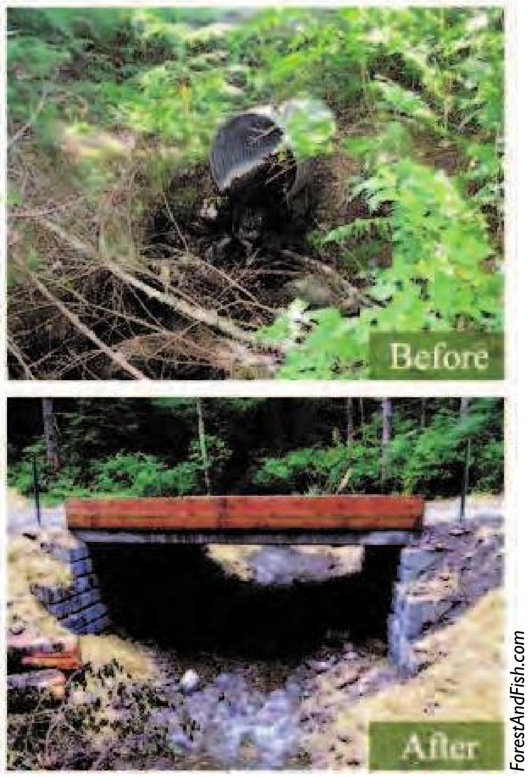
As of the end of 2019, 85% of the RMAPs have been completed within the PCR, which is 20% higher than the amount that were fixed at the end of 2014.

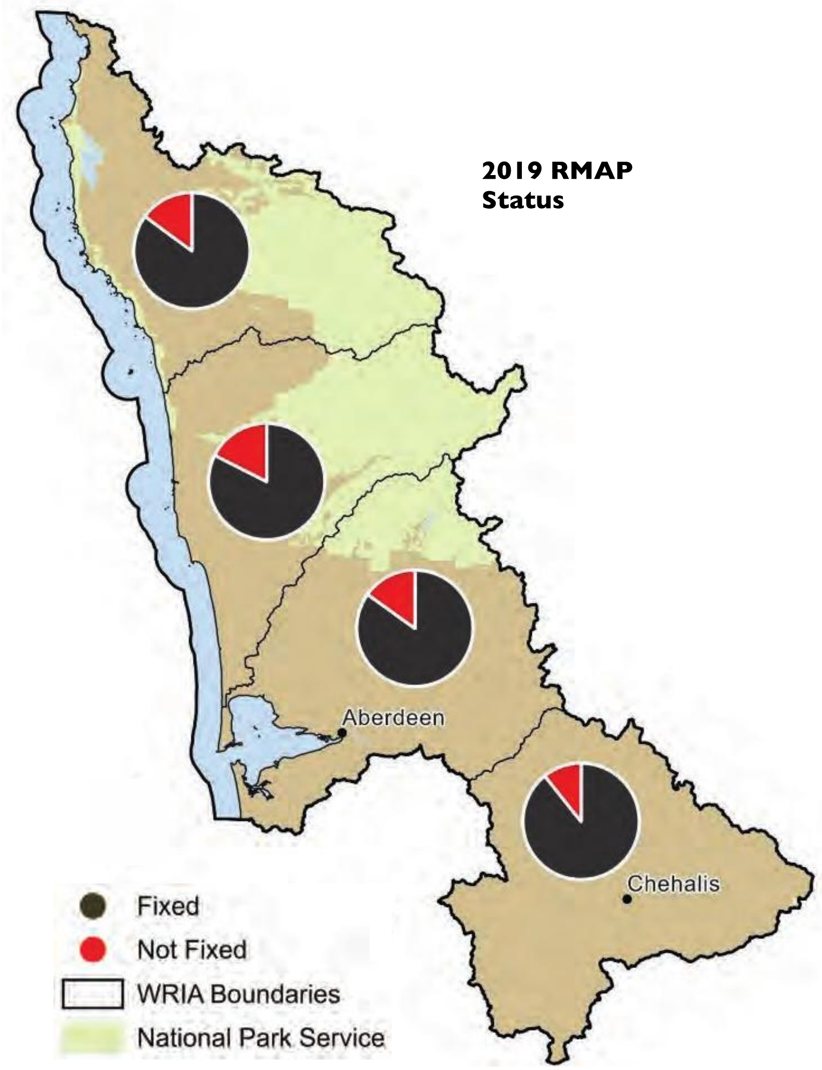
More than 65% of the Pacific Coast Region outside of National Park Service land is dedicated to active forest management. Forest management activities yield a high density of forest roads to facilitate commercial timber harvest. Forest roads are known to contribute to stream channel degradation because if not properly constructed and maintained, they can be a source of sediments to streams, which degrade fish habitat and water quality.[1,2]

Additionally, many of the culverts along these forest roads act as fish barriers, denying salmon and steelhead access to needed spawning and rearing habitat. Both the restriction of access and the degradation of salmonid habitat negatively impact salmon recovery and will continue to do so until corrective measures are taken.

Washington state's forest practices laws require most private forest landowners to prepare and submit a Road Maintenance and Abandonment Plan (RMAP) for their forest roads. To protect water quality and riparian habitat, roads must be constructed and maintained in a manner that will prevent damage to public resources. In the original Forest and Fish Agreement, all forest roads were to be improved and maintained to the standards of the law prior to Oct. 31, 2016; However, due to legislative changes, forest landowners are now able to request an extension until 2021.

As of the end of 2019, 85% of RMAPs have been completed within the PCR. In this region, the state government has met 90% of their RMAP obligations, and private landowners have met 82% of their obligations. There are 394 identified culverts remaining to be fixed; 302 are scheduled to be completed; 24 are yet to be scheduled for repair; and 68 repairs are late. Since 2016, there has been considerable development with RMAP repairs in the PCR. If the RMAP road repairs continue to be fixed as scheduled, the region's RMAP obligations should be met by the end of 2021.





Map Data Sources: WADNR 2019,[3] WADOT 2010,[4] WAECY 2000,[5] WAECY 2008[6]

The RMAP data used in the last report included culverts and other stream crossings in both fish-bearing and non-fish bearing streams. Because the Washington Department of Natural Resources does not appear to have a process to consistently monitor the repair status of those crossings in non-fish bearing streams, only those crossings in fish-bearing streams were used for the RMAP status and trend analysis in this report. Therefore, 1,727 culverts are not included in this analysis for the PCR as their statuses are unknown at this time.

Blocking Culverts Impact Salmonid Survival

During the first six years of implementing the U.S. v. WA Culvert Case Injunction, the state of Washington has corrected 99 fish blocking culverts. At the current schedule, if additional support is not gained, corrections to the remaining 226 culverts would be completed in 14 years or by the year 2034.

The Pacific Coast Region's usable salmon habitat is impacted by barrier culverts and our ability to recover the salmon populations directly depends on the recovery of habitat.

Impaired fish access is one of the more significant factors limiting salmonid productivity in many watersheds.[1] In 2013, the U.S. District Court ruled that "the tribes and their individual members have been harmed economically, socially, educationally and culturally by the greatly reduced salmon harvests that have resulted from state-created or state-maintained fish passage barriers."[2]

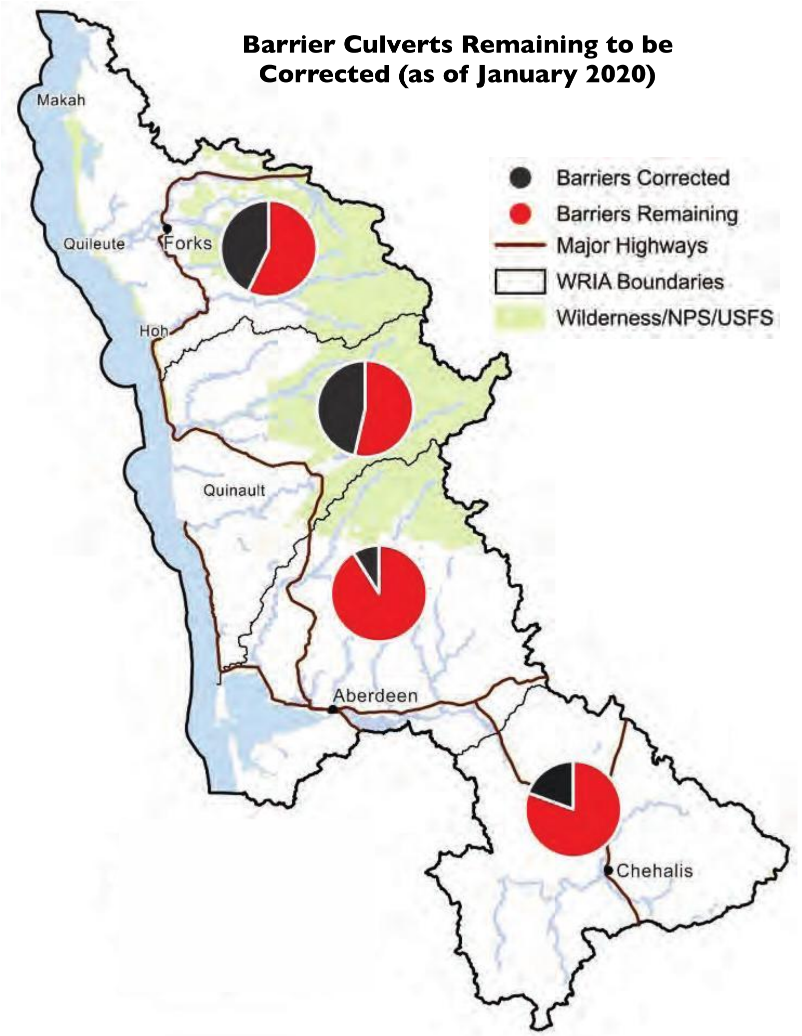
Not only do physical barriers limit fish passage and available habitat, they also can damage water quality and disrupt sediment deposition.[2]

Because of this damage, in 2001 the United States and western Washington tribes brought an action against the state of Washington for their failure to construct and maintain fish passage on state-owned culverts.[3]

In 2007, the Court ruled that the right of taking fish, as secured by the treaties, means that the state must "refrain from building or operating culverts…that hinder fish passage."[2]

In March 2013, the U.S. District Court granted the permanent injunction requested by the federal government and tribes, holding that the tribes "have suffered irreparable injury in that their treaty-based right of taking fish has been impermissibly infringed. The construction and operation of culverts that hinder free passage of fish has reduced the quantity and quality of salmon habitat, prevented access to spawning grounds, reduced salmon production in streams in the case area, and diminished the number of salmon available for harvest."[2]

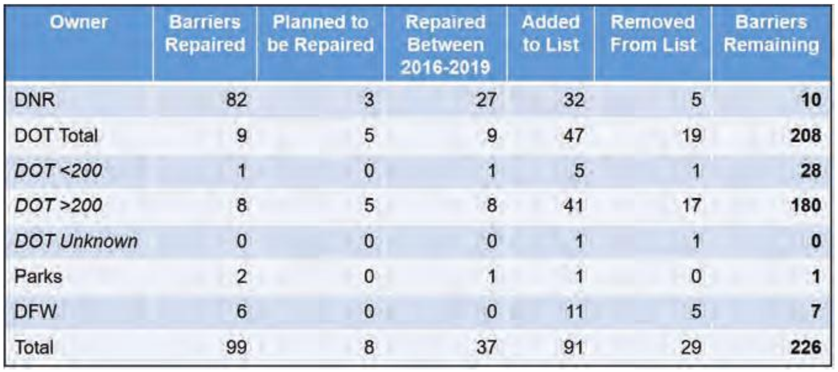
Multiple state agencies were affected by this ruling. Washington State Parks and the Department of Fish and Wildlife were required by state law to fix their injunction culverts by Oct. 31, 2016.[4] This deadline has nearly been met, but because some barrier culverts have been identified since the 2016 deadline, a few corrections still need to be made. Some of Department of Natural Resources' culverts have a longer timeline for correction.[5]



Barrier Culverts Remaining to be Corrected (as of January 2020)

Map Data Sources: WADFW 2019,[7] WADNR 2019,[8] WADNR 2019b,[9] WADOT 2020,[10] WADOT 2019,[11] Curtis 2019,[12] WAECY 2000,[13] WASPS 2016[14]

Washington Department of Transportation (DOT) is required to fix culverts that block 200 meters or more of habitat by 2030. DOT culvert repair funding is less than 12% of where it needs to be to complete repairs by the court-appointed deadline.[6] DOT still needs to fix 180 barrier culverts (>200m of habitat) in the PC region; five are planned for repair in the 2020-2021 construction season.

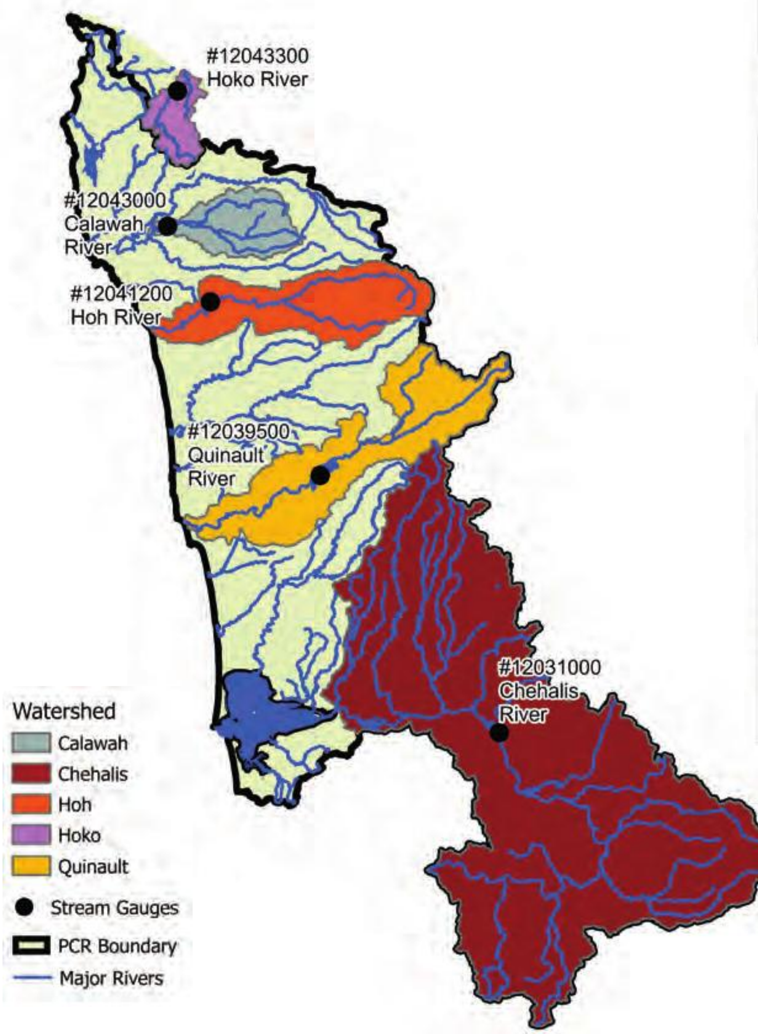


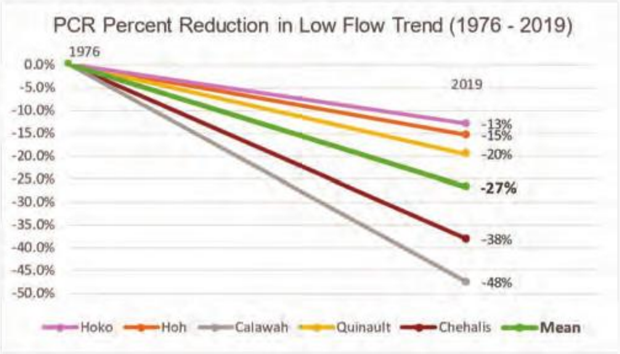
Owner	Barriers Repaired	Planned to be Repaired	Repaired Between 2016-2019	Added to List	Removed From List	Barriers Remaining
DNR	82	3	27	32	5	**10**
DOT Total	9	5	9	47	19	**208**
DOT <200	1	0	1	5	1	**28**
DOT >200	8	5	8	41	17	**180**
DOT Unknown	0	0	0	1	1	**0**
Parks	2	0	1	1	0	**1**
DFW	6	0	0	11	5	**7**
Total	99	8	37	91	29	**226**

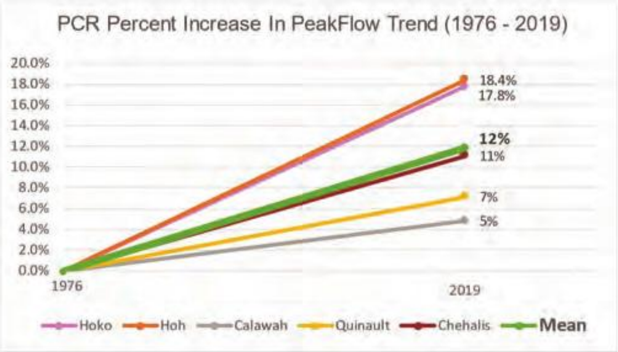
PACIFIC COAST REGION

Streamflow Trends

The rivers of the Pacific Coast Region continue to experience negative fluctuations in flow. Peak flow values show an increasing trend (mean +12%) while low flow trends are decreasing (mean -27%). If both trends continue as anticipated under predicted climate change conditions, they could threaten salmon habitat and other aquatic ecosystem functions.







The Hoko, Hoh, Calawah, Quinault and Chehalis rivers within the Pacific Coast Region (PCR) were evaluated for peak flow and mean daily low flow by water year to determine peak flow and low flow trends since 1976. Stream values vary from year to year, thus the need to look at overall trends for the last 40-plus years.

In order to provide suitable habitat for fish survival, productivity and maintain healthy ecosystems, rivers and streams must have adequate water when it is needed. PCR rivers support stocks of coho, chinook, chum, pink and sockeye salmon as well as native runs of steelhead, bull trout, Dolly Varden and cutthroat trout. The variation in streamflow timing and magnitude shown for the five rivers is typical for streams in the PCR with peak flows in the winter months and low flows in the summer months.

Although values have varied from year to year, streamflows since 1976 for the assessed rivers has followed the same overall trends – increasing peak flows and decreasing low flows. Both trends could threaten salmon habitat and other aquatic ecosystem functions. Increased peak flows cause the scouring of streambeds, channel incision (and subsequent disconnection from the floodplain) and downstream transport of wood resulting in simplified stream channels and greater instability. The trend of increasing peak flows has been shown to make streams less productive.[1]

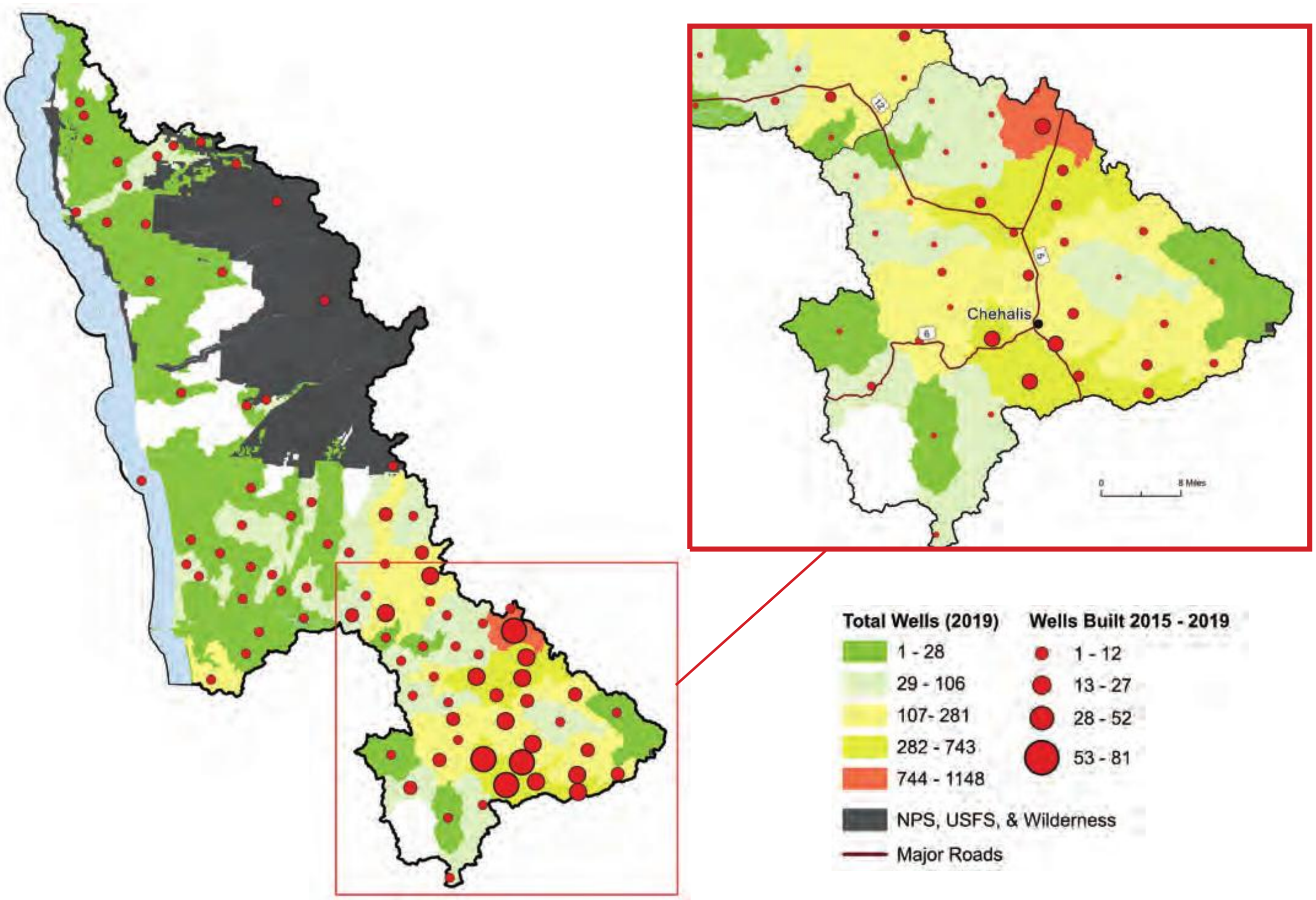
Many studies in the Pacific Northwest[2,3] have documented the relationship between low streamflows and poor salmonid survival. The reduction in streamflows may result in less fish habitat because of dry streambeds or pools which become cut off from the main channel and strand fish. Low flows also contribute to higher water temperatures.

The assessed rivers peak flow trend percent increase had a range of 5% to 18% with a mean trend increase of 12%. The same rivers mean low flow trend percent decrease had a range of 13% to 48% with a mean trend decrease of 27%. These trends should be considered similar across all streams in the PCR and in need of consideration for salmonid restoration and protection.

Map Data Sources: USGS 2019a,[4] USGS 2019b,[5] USGS 2020a,[6] USGS 2020b,[7] USGS 2020c[8]

Groundwater Withdrawals Impact Surface Flows

Since 1980, more than 10,000 wells have been developed in the Pacific Coast region. Between 2015-2019, 1,133 wells were built, which is a 74% increase in the number wells built during the previous five years (2010-2014). The vast majority of total and new wells in the region exist in the Chehalis watershed. This increasing rate of new well installations threatens groundwater availability and ecosystem health across the region.



Population growth within the Pacific Coast region, especially in the Chehalis watershed, will continue to have increased demands on groundwater resources. Washington state instream flow rules allocate river flow for ecological requirements, but state law allows new wells to withdraw 5,000 gallons of groundwater per day without obtaining a permit that would require scientific evidence that water is legally available.[1] Groundwater withdrawals can cumulatively affect streamflows, especially in late summer when flows are naturally low.

An aquifer's natural outflow discharges into lakes, wetlands, streams, and seawater through springs and seeps on the land surface and through groundwater. Adequate natural outflow is essential for sustaining stream base flows, maintaining lake levels, providing fresh water inputs to the nearshore, and preventing seawater intrusion.

As development occurs and more groundwater is extracted than is being recharged, the natural outflow from groundwater subsequently decreases. This reduces the amount of fresh water available to lakes, wetlands, streams, and the Pacific Coast nearshore. Reduced freshwater inputs to the Pacific Coast nearshore can have a negative impact on shellfish and out-migrating juvenile salmonids.

The reduced availability of surface water can have a negative impact on all stages of the salmonid life cycle. Water quality (e.g. temperature, flows) is affected by decreased inputs from groundwater. Lessened groundwater water input concentrates pollutants, increases temperature and diminishing dissolved oxygen. This is detrimental to salmonid migration, spawning and rearing.

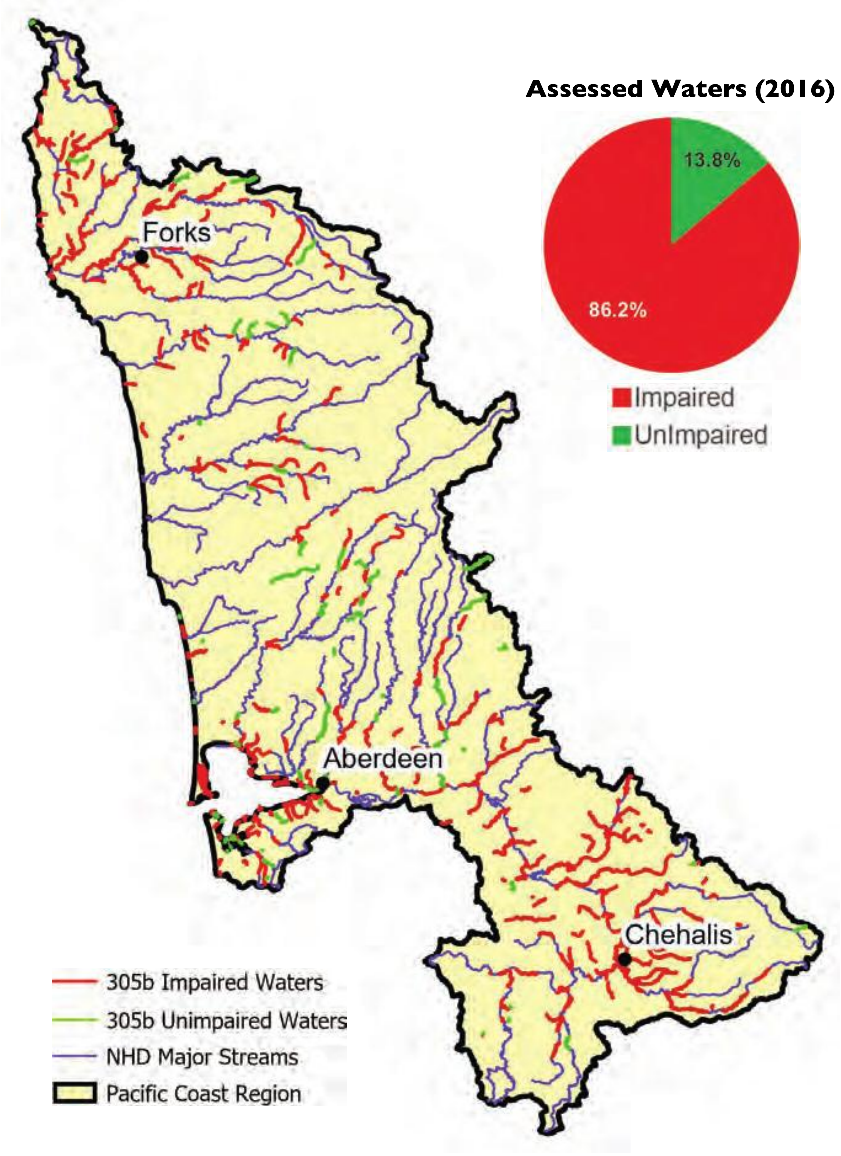
Although total well numbers and new wells installed remain low across much of the Pacific Coast region, population growth within the Chehalis watershed will continue to increase demand on water resources within the region. Wells are drilled without regard to aquifer sensitivity and stream recharge needs, which makes it even a greater demand that something changes as the region's freshwater demand increases. Unchecked growth and its associated increase demand for groundwater must be addressed for the overall ecosystem-level health of the region.

Map Data Sources: USGS 2018,[2] WADNR 2016,[3] WAECY 2018,[4] WAECY 2019[5]

Pacific Coast Region

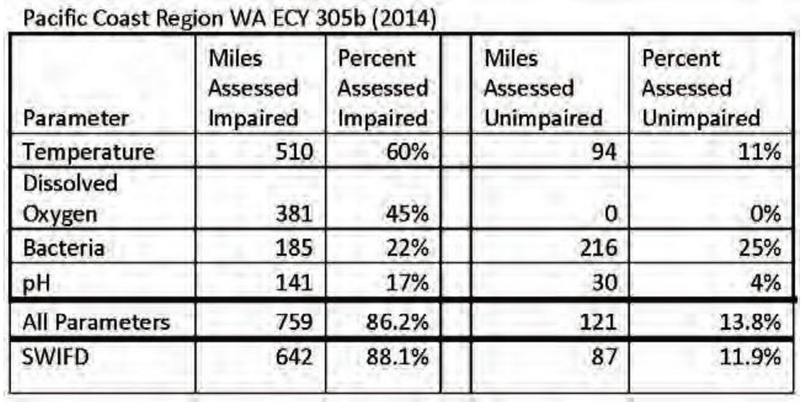
Water Quality

In 2014, only 3% of the PCR stream miles were assessed for water quality, a total of ~880 miles. Of the assessed waters, the majority (86%) were determined to be impaired for one or more parameters and are listed in WA Ecology's 305(b) report to EPA. Of the 305(b) listed impaired waters, 83% are identified as salmonid bearing.



Water quality requirements for salmonids include cool temperatures, high dissolved oxygen, natural nutrient concentrations and low levels of pollutants.[1] If the values of these parameters exceed the desired ranges for a specific location and time of year, the ability of surface waters to sustain fish populations are impaired. WA Ecology's 305(b)[2] & 303(d)[3] reports to U.S. EPA lists waters that are too polluted to meet water quality standards (impaired). Ninety seven percent of freshwater lakes, streams and wetlands are unsampled for water quality and thus is of an unknown quality status. Due to the low level of sampling, the actual degree of water quality impairment could be higher than identified, especially when the unsampled aquatics are adjacent to known impaired waters.

Of the many parameters assessed in the Pacific Coast Region (PCR), the four most prevalent are temperature, dissolved oxygen (DO), bacteria and pH. Comparing the 305(b) listed impaired stream segments to the Statewide Integrated Fish Distribution (SWIFD) data set,[4] 83% are identified as salmonid bearing. Of the WQ Assessed streams that are salmonid bearing, 88% are impaired for one or more parameters. The listed impairments negatively impact the ability of these streams to support a viable salmonid population.



Pacific Coast Region WA ECY 305b (2014)

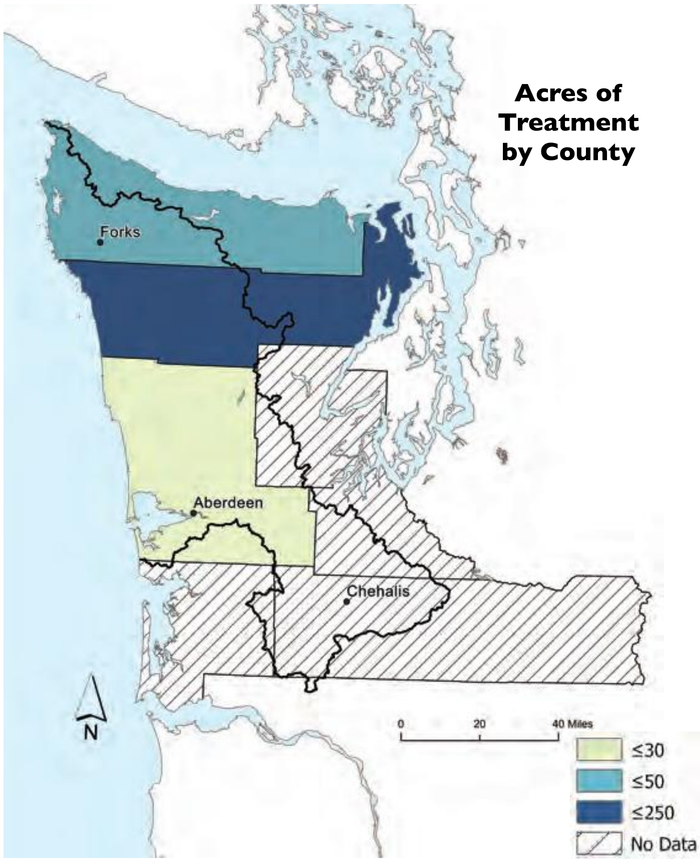
Parameter	Miles Assessed Impaired	Percent Assessed Impaired	Miles Assessed Unimpaired	Percent Assessed Unimpaired
Temperature	510	60%	94	11%
Dissolved Oxygen	381	45%	0	0%
Bacteria	185	22%	216	25%
pH	141	17%	30	4%
All Parameters	759	86.2%	121	13.8%
SWIFD	642	88.1%	87	11.9%

Map Data Sources: WAECY 2014,[5] WAECY 2016,[6] WAECY 2016[7]

Pacific Coast Region

Invasive Plant Treatment Continues

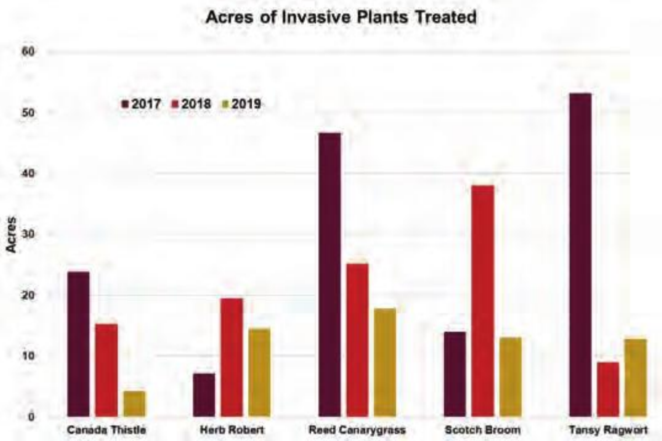
Between 2016 and 2019, more than 340 acres of invasive plant species have been treated across the Pacific Coast Region (PCR) by tribes, agencies, the non-profit 10,000 Years Institute and partners.[1] Knotweed, which has been the target of invasive eradication efforts since the early 2000s, has responded to aggressive multi-year efforts to control the species. Starting in 2015, these efforts expanded to a number of other species including reed canarygrass, tansy ragwort, Scotch broom, herb Robert, and Canada thistle, all of which threaten critical riparian functions and salmon habitat.



Includes treatment of reed canarygrass, tansy ragwort, Scotch broom, herb Robert and Canada thistle.

Jill Silver, 10,000 Years Institutes

Preparing to treat tansy ragwort and reed canarygrass in the Queets estuary.



During the 2016-2019 field seasons, 10,000 Years Institute (10KYI) and their partners conducted inventories and treatments of invasive plant species on the Olympic Peninsula in the Quillayute, Hoh, Queets, and Upper Quinault watersheds.

Of the more than 30 plant species inventoried, five had especially widespread distribution: Reed canarygrass (*Phalaris arundinacea*), tansy ragwort (*Jacobaea vulgaris*), Scotch broom (*Cytisus scoparius*), herb Robert (*Geranium robertianum*), and Canada thistle (*Cirsium arvense*). These five species each display advantageous physical traits that aid in their spread over critical habitats. For example, each tansy ragwort plant can produce more than 200,000 seeds, which may be viable for up to 20 years, and each Scotch broom plant can produce 12,000 seeds which are viable for up to 90 years.[2]

Both manual and chemical treatments are applied to these species by 10KYI. Manual treatments include pulling the plants and removing flowers and seeds. Chemical treatments include targeted herbicide applications by a cut-stump method or spraying.[3]

Japanese knotweed (*Reynoutria japonica*) and Giant knotweed (*Fallopia sachalinensis*) were the focus species of the 2016 State of Our Watersheds Report and have long been the primary species targeted in salmon recovery efforts. As a result of aggressive multi-year efforts to control these species, knotweed is significantly reduced in area compared to the other species treated by 10KYI. However, with very deep buried rhizomes, knotweed continues to regrow in treated areas and requires continuing maintenance treatment.[4]

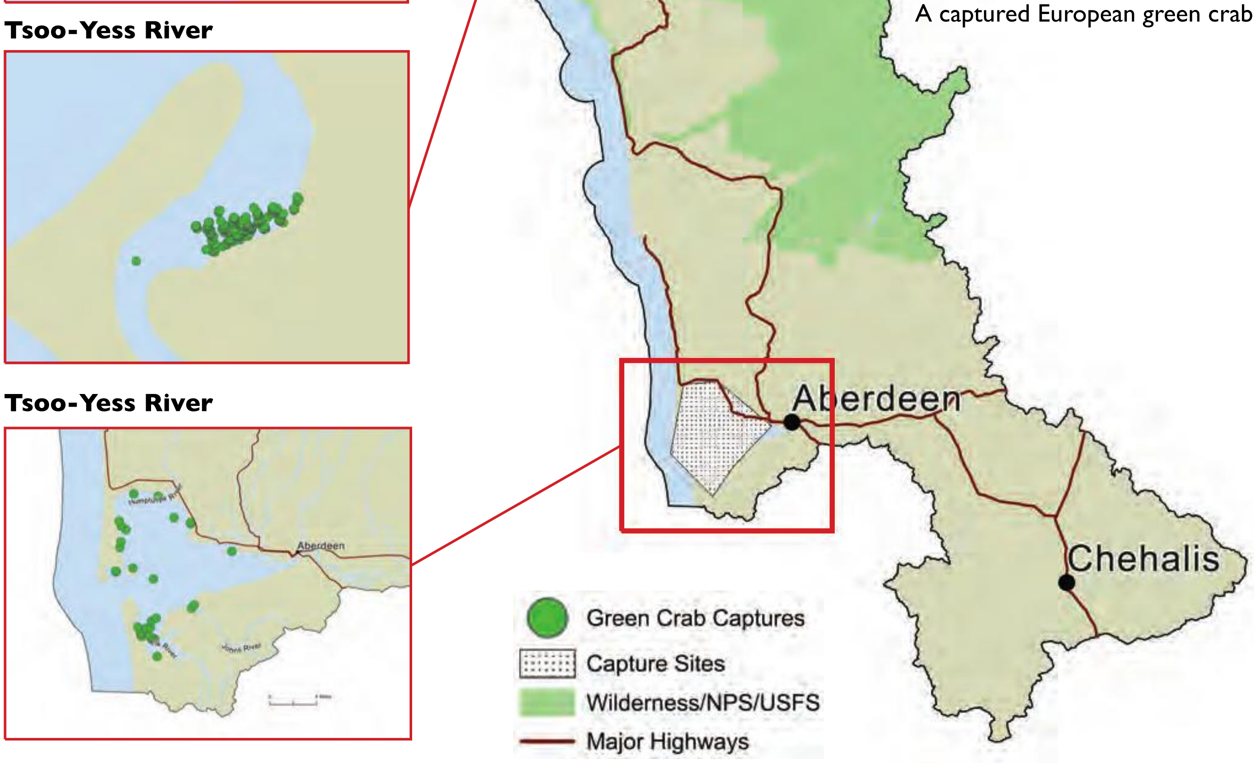
In addition to 10KYI, tribes and Washington state agencies continue to monitor and treat invasive non-natives and noxious weeds across the PCR. In 2019, the Quileute Tribe implemented a new multi-species approach to invasive plant management. During their first year of implementation, the tribe has treated Japanese, bohemian, and Giant knotweeds, Himalayan and evergreen blackberries, purple loosestrife, tansy ragwort, Canada thistle, Scotch broom, English ivy, and herb Robert both on and off-reservation.[5]

Work is ongoing to identify, treat and monitor these invasive species within the PCR. The continuation of funding for invasive plant inventory, treatment and monitoring projects is critical to maintaining ecosystem-level health and the biological integrity of salmon habitat across the region.

Map Data Sources: 10KYI 2019,[1] WAECY 2018[6]

Green Crab Threaten Native Species

Over 2,600 European green crabs were captured between 2017-2019 in the Pacific Coast region by Makah Tribe, Washington Department of Fish and Wildlife and partners. Although European green crab occurrences in the Pacific Coast region have so far been relatively rare compared to other parts of the world, widespread ecosystem-level changes to Washington's coastal ecosystem may occur if action is not taken to limit their spread.

Waatch River

Tsoo-Yess River

Tsoo-Yess River

2019 Green Crab Capture Areas

Kelly Martin, Washington Sea Grant

A captured European green crab.

European green crab (*Carcinus maenas*) were first identified in Washington state in the late 1990s in Willapa Bay and Grays Harbor, and their range has been expanding in recent years.[1] Since they were first sighted, Washington Sea Grant, Washington Department of Fish and Wildlife, tribes, U.S. Fish and Wildlife Service and partners have been monitoring green crab presence both in the Pacific Coast Region and in Puget Sound.

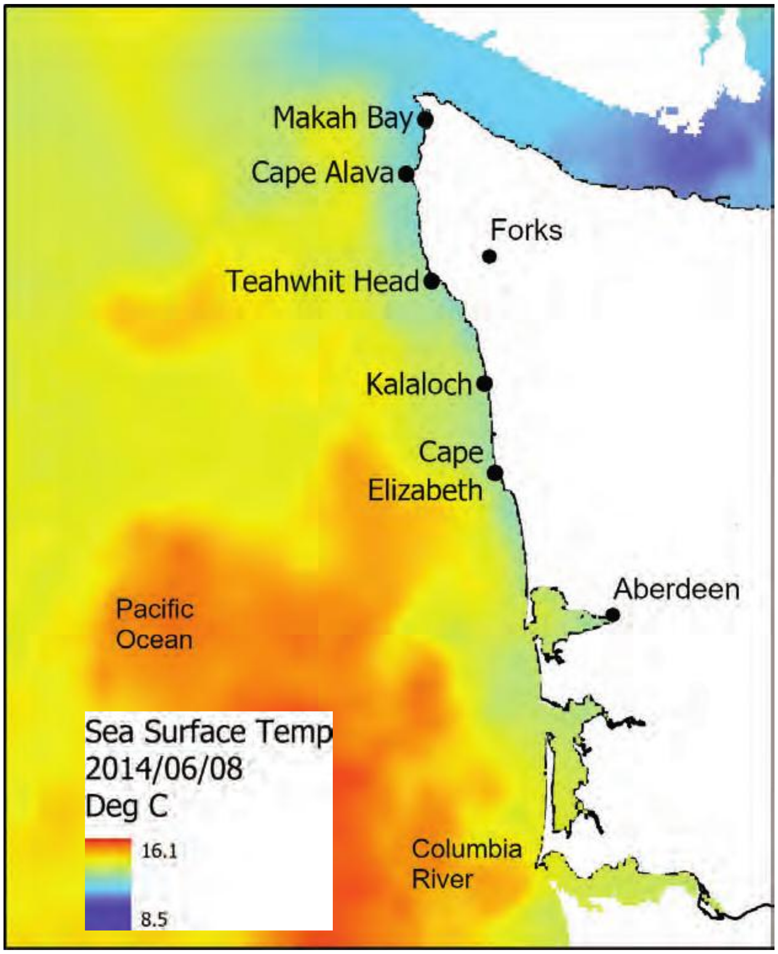
Between 2017-2019, 2,671 European green crabs were captured in the Pacific Coast region. Over 2,500 of these were captured in Makah's Waatch and Tsoo-Yess rivers. In addition to Makah, 142 live green crabs also were captured in Grays Harbor.

The presence of European green crabs in the Pacific Coast region and more recently in the Puget Sound region has prompted concern for a potential statewide invasion. Although green crab and Dungeness crab habitat are not thought to overlap in Washington, green crabs have been shown to have the potential to outcompete juvenile Dungeness crab for space and food in other parts of the world.[2] In addition to being a potential future threat to native crabs, the green crab is competing with native fish, bird, clam and oyster species for resources. The continued monitoring and subsequent trapping and removal of European green crab across the Pacific Coast region is essential to understand how quickly they are dispersing which can provide insights into best methods to limit their spread.

Map Data Sources: Makah Tribe 2020,[3] WDFW 2019,[4] WADNR 2016,[5] WAECY 2018,[6] WAECY 2000,[7] WADOT 2010,[8] WADOT 2018[9]

Ocean Conditions

*Marine waters off the Olympic Coast are undergoing rapid change, and the occurrence of marine heat waves (MHW), hypoxia and ocean acidification, and harmful algal blooms (HABs) have been increasing. Adverse marine conditions in recent years have had a direct negative effect on tribal fisheries. Since 2015, all four treaty tribes on the Olympic Coast have made fisheries disaster declarations (*https://www.fisheries.noaa.gov/national/funding-and-financial-services/fishery-disaster-determinations*).*



Map Data Sources: NASA JPL 2014,[4] WADOT 2010,[5] NWIFC 2020[6]

Marine Heat Waves

MHWs are defined as short periods of abnormally high temperatures in the ocean which exceed a seasonally averaged threshold (i.e. temperature anomaly) for at least five days over a large area. In the past six years, the waters off Washington's coast have experienced three major MHWs – the 2014-16 "Blob" and the Northeast Pacific Marine Heatwave of 2019 (NEP19). The Blob covered an area greater than 4.5 million km^2, while NEP19 covered an area almost twice that at its peak. Both the Blob and NEP19 co-occurred with an El Nino event, adding further stress to the ecosystem. Currently, a MHW is forming in the northeast Pacific (NEP20), and its extent and impacts have yet to be seen.

Hypoxia and Ocean Acidification

The cold, nutrient rich waters that are upwelled off the Washington coast are part of the reason why these waters are highly productive and also are the driver of the hypoxia and locally enhanced acidification observed there. Hypoxia off the Olympic coast is most severe to the south and relatively minor to the north. Sites in the south (off Cape Elizabeth) have documented that hypoxic conditions are present for an average of 50% of the summer (maximum of 98%), while sites to the north (off Makah Bay and Cape Alava) recorded hypoxic conditions for an average of 3% of the summer (maximum of 18%).

Harmful Algal Blooms

HABs generally occur during warm, nutrient rich periods. McCabe et al.[1] and McKibben et al.[2] have found that HABs in the California Current Ecosystem (CCE) are strongly correlated with El Nino events and warm phase of the Pacific Decadal Oscillation (PDO). All major *Pseudo-nitzschia* HAB events have occurred after periods of warming. Projected warming across the region raises concerns about the frequency and severity of HAB events in the region (Ritzman et al. 2018[3]). In 2015, the CCE experienced a significant HAB that was driven by the combination of the Blob and a strong El Nino causing widespread closures of shellfish fisheries, including razor clams and Dungeness crabs.

Climate Change Impacts the Pacific Coast and Tribal Traditional Practices

The watersheds of the Pacific Coast are experiencing the effects of a changing climate, and these trends are projected to continue or accelerate in the future. Tribal communities are on the front line of the climate crisis as traditional practices that have been sustained since time immemorial are now threatened by broadscale and far-reaching environmental changes. The harms caused by the climate crisis are compounded by ongoing damage to the ecological integrity and resilience of our watersheds as described in this report.

In the Pacific Northwest (PNW), the observed and projected trends include warmer air temperatures; shrinking glaciers and snowpack; lower summer streamflows; higher winter flood flows; shifts in streamflow patterns and timing; higher stream temperatures; larger and more frequent wildfires; warmer ocean temperatures; rising sea levels; and changing ocean chemistry, including ocean acidification and lower levels of dissolved oxygen.

In marine and coastal ecosystems, changes to water chemistry and temperature can alter the range, distribution and abundance of fish, shellfish, waterfowl and other marine species important to the tribes.[1] For example, ocean acidification interferes with shell formation, hence hindered development and survival of a number of marine species, including crabs, clams and oysters. In addition, ocean acidification has the potential to alter marine food webs and change distribution of finfish, including Pacific salmon.[2] The marine waters of Washington have become 10% to 40% more acidified since 1800.[3]

Low-lying tribal lands are susceptible to the direct effects of sea level rise (SLR), as well as flooding and erosion from stronger coastal storms and greater storm surge.[4] In vulnerable areas, flooding and erosion reduce traditional tribal shellfish harvesting areas, damage culturally important sites, and threaten tribal communities and infrastructure.

Global SLR is caused by the physical expansion of warmer water and the melting of ice sheets and glaciers, but locally, relative SLR includes the effects of vertical land movement. In western Washington, vertical land movement is dominated by tectonic forces, so the amount of relative sea level rise varies over time and location.[5]

Relative SLR at Toke Point in Willapa Bay is 1.6 inches per century; however, due to ground uplift, tidal records in Neah Bay show a relative drop in sea level at the equivalent of 6.7 inches per century. Average wave heights in the northeast Pacific Ocean have been increasing since the 1970s and this may contribute to coastal flooding and erosion more than relative SLR.[7]

Changing watershed processes pose a threat to salmon populations, which need adequate amounts of cool, clean water to survive. Overall, temperatures in PNW streams warmed by about 0.3°F (0.17°C) per decade from 1976 to 2015.[8] As stream temperatures increase, the length of time that rivers exceed salmon temperature limits for reproduction and survival grows longer. Loss of glaciers and snowpack contributes to lower summer streamflows, warmer waters, greater winter floods, and more exposed sediment washing into rivers. In Olympic National Park, glacier surface area decreased 34 percent from 1980 to 2009.[9] From 1950 to 2010,

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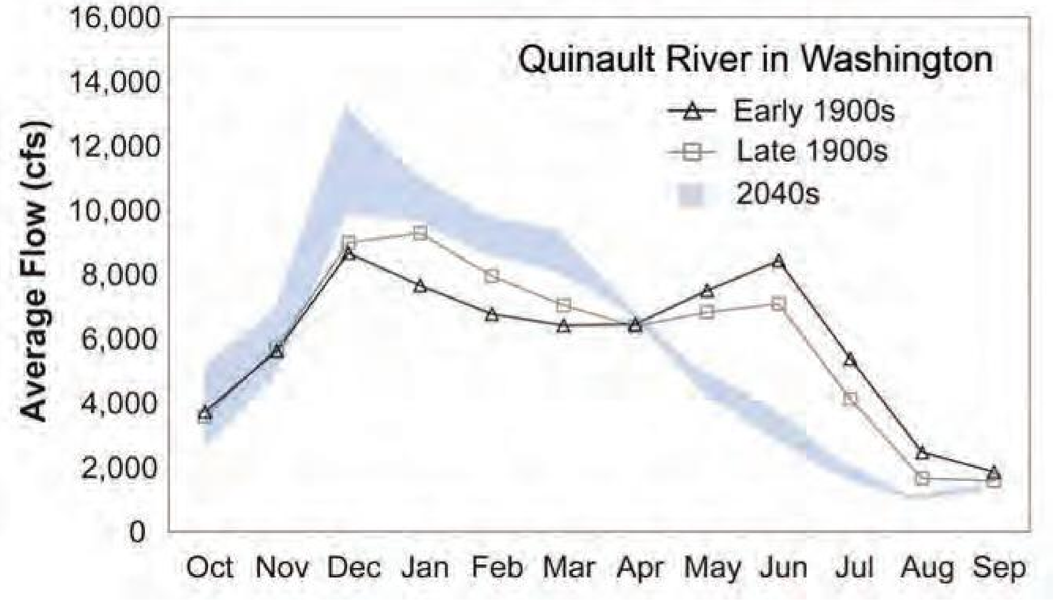

Streamflow changes in the Quinault River during the 20th century. Projections for the 2040s show a shift from two periods of high flows (from winter precipitation and spring snow melt) to just one. The 2040s curve is shaded to represent a range across a number of different climate scenarios. Source: University of Washington Climate Impacts Group cited in USGCRP 2009.[12]

(Continued from previous page)

summer streamflows decreased 33 percent in snow-dominated watersheds and 36 percent in mixed rain-snow watersheds in the PNW.[10] At the same time, winter flood risk is increasing since the top 1 percent of extreme rainfall events increased in frequency by 12 percent in the PNW during the 20th century.[11]

In addition to changes in streamflow and water temperatures, climate change leaves salmon and steelhead at risk from lower levels of dissolved oxygen, more sediment in streams, greater susceptibility to disease, competition from warm-water species, and changes to the type and availability of prey.

Terrestrial plants and animals used for traditional food, medicine and cultural practices are vulnerable to major ecosystem disturbances such as wildfire, drought, pests and invasive species.[13] Warmer temperatures, changing precipitation patterns and other disturbances are causing wildlife and birds to migrate farther north or to higher elevations in search of suitable habitat, potentially moving out of traditional tribal hunting grounds.[14] In the western United States, the fire season has lengthened in conjunction with higher summer temperatures and reduced snowpack.[15] Warmer summers, lower soil moisture and higher rates of evapotranspiration leave Pacific coastal forests more prone to fires than in the past.[16] For example, the 2015 Paradise Fire in the rainforests of the Queets River valley in Olympic National Park followed the driest May and June recorded in the Forks, Wash., area since records began in 1895.[17] Ultimately the fire consumed 2,800 acres of temperate rainforest.[18] Swiss needle cast, western spruce budworm, blister rust, and mountain pine beetle are all on the rise in Washington's forests because of climate change. The mild winters and wet springs and summers of the Pacific coast offer favorable conditions for the fungus that causes Swiss needle cast. In 2015, almost 350,000 acres of Douglas fir with Swiss needle cast symptoms were found in Washington state, with the most severely affected stands located near the coast and in the Grays Harbor area.[19]

NWIFC 2019

Quileute Tribe natural resources staff use a hydrodynamic sampler in the Bogachiel River to measure the fine sediment in the water. As flood flows increase and become more frequent, the amount of sediment transported by the stream increases, potentially burying and suffocating salmon eggs.[20]

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Climate Change Impacts the Pacific Coast and Tribal Traditional Practices

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2020 Puget Sound Regional Report

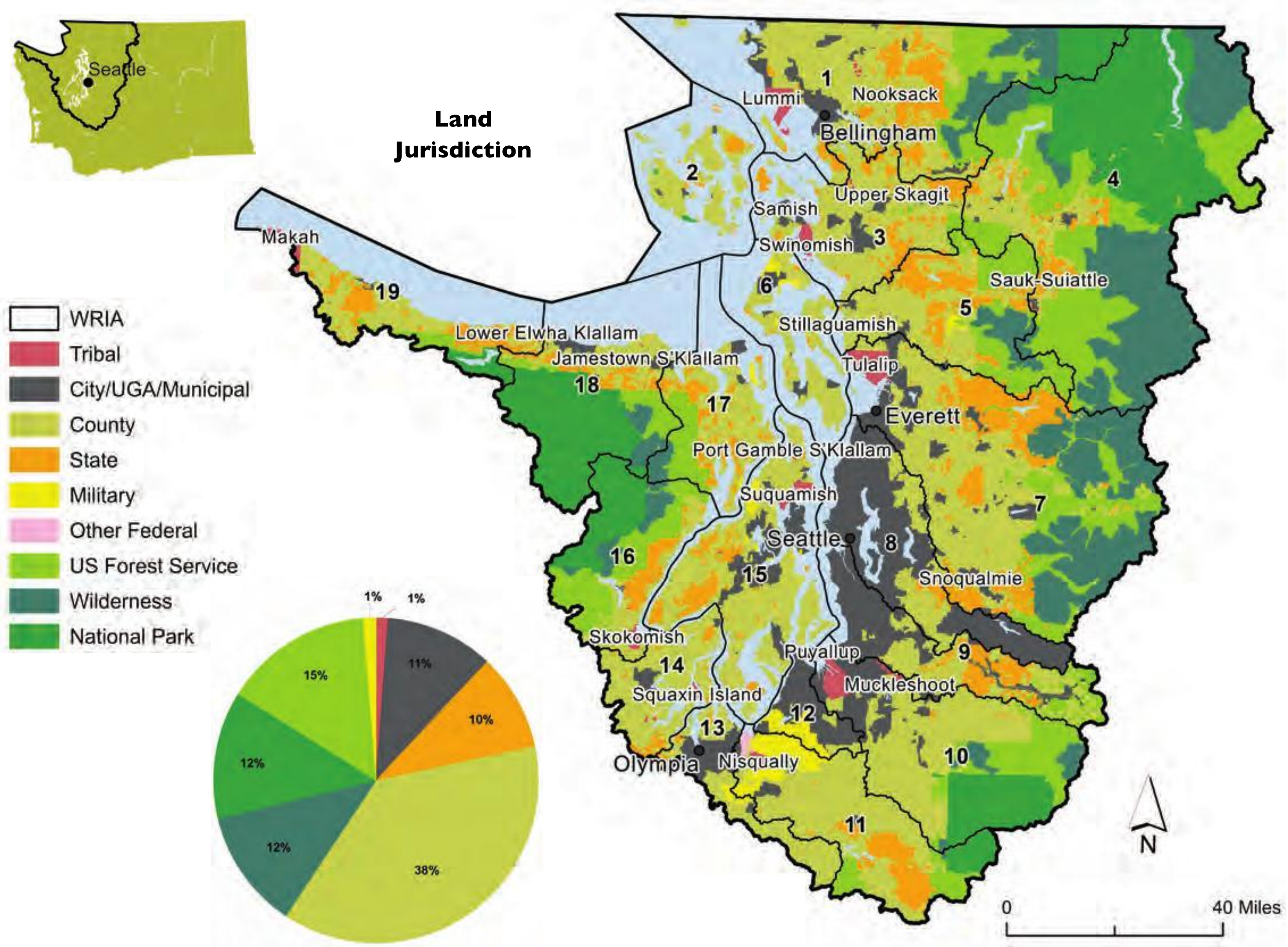
The Puget Sound Region (PSR) includes the second largest estuary in the United States covering approximately 16,575 square miles, consisting of a complex estuarine system of interconnected marine waterways and basins. The PSR has over 20 major river systems, from the Nooksack River along the Canadian border southwest to the Elwha River along the Strait of Juan de Fuca. Some of these watersheds originate in the steep high-elevation headwaters of the Cascade and Olympic Mountains with an elevation of over 14,000 feet at the glaciers of Mount Rainier. Rainfall ranges from about 16 inches annually at Sequim, Washington, to over 100 inches at Mount Rainier.[1]

The PSR is the traditional home to 19 federally recognized tribes, who have harvested and managed the natural resources of Puget Sound since time immemorial. Euro-Americans began settling the area in the 1850s primarily for the logging resources, along with opportunities in farming and mining. Lowland land clearing for agriculture began in earnest by the 1890s. By the early 1900s, denudation of the forested lowland areas was complete, and nearly all of the lower portions of the basins were converted from forest production. Historically and presently, land use has been dominated by physical geography.

The foothills and mountains are mainly used for wood products and outdoor recreation. The lowlands are primarily used for agriculture and rural residential development. Most of the urban and industrial land use is concentrated near the deltas and lower floodplains.

The PSR is home to two-thirds of the state's population, with a projected population increase to over six million by 2040.[2] The following pages look at the impacts of growth and its effects on the landscape and salmonids. Conditions such as increased impervious surface area, loss of floodplain connectivity, exempt well increases, forest cover loss, diminished riparian forest, culvert barriers and nearshore habitat impairment all negatively affect natural salmonid production. Sustainable natural salmonid production cannot increase unless the quality and quantity of habitat is increased. Natural production lost to habitat degradation and blocked passage must be mitigated by hatchery production to provide an opportunity for the tribes to exercise their treaty right to harvest salmon. Hatchery production cannot be reduced unless there is a commensurate increase in sustainable natural production and habitat recovery is required for that to happen.

The Puget Sound Region is home to eight different anadromous salmonid species, pink, chum, chinook, coho, sockeye, steelhead trout, bull trout and cutthroat trout. Chinook, Hood Canal summer chum, steelhead trout and bull trout are all listed as threatened species under the Endangered Species Act and have Salmonid Recovery Plans outlining strategies for recovering these populations.



Map Data Sources: USFWS 2018,[3] WADNR 2016,[4] WADNR 2018,[5] WADOT 2018,[6] WAECY 1994,[7] WAECY 2000,[8] WAECY 2018a,[9] WAECY 2018b[10]

Chapter Summary

The Northwest Indian Fisheries Commission member tribes have fished, hunted, gathered and practiced their cultural identities along the rivers, tributaries and waters of the Puget Sound since time immemorial. No one on this earth is more connected to the watersheds, its water, plants, fish and animals than the region's tribes. At the heart of that connection is salmon which has always been a primary source of life.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those watersheds.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org*.

For this status report of the Puget Sound, the tribes have focused on the issues that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Shoreline Armoring Continuing to Threaten Salmon and Forage Fish Spawning Habitat

Of the total 2,460 miles of shoreline within the Puget Sound Region, 715 miles (or 29%) is armored. Hydraulic project permits issued between 2015 and 2018 showed a net reduction of about 1 mile of armoring and an additional 6.7 miles of shoreline armoring replacement in the Puget Sound Region. While this reduction is a positive sign, the shoreline ecological functions have been severely impacted by past shoreline armoring and more restoration work needs to done. For example, the Puyallup watershed's marine shoreline is 92% impacted by armoring, resulting in lost foraging opportunities and reduced residence times for juvenile salmonids which in turn result in a decreased survival rate of these runs.

Impervious Surface Continues to Increase

Excluding federal lands, impervious surface area increased to about 7% in 2016, an increase of 1.2% since 2011. By 2040, the forecast population for Puget Sound will increase an additional 1,100,000 beyond 2016; with an associated increase to almost 8.5% impervious surface area. The Puget Sound Salmon Recovery Plan lists minimizing impervious surfaces as a key strategy for protecting habitat.

Forest Cover Loss Continues in Puget Sound Lowlands

From 2011 to 2016, an additional 243 square miles (2% net reduction) of forest cover was lost in the Puget Sound lowlands. The projected trend is to see continuing high rate of forest cover loss if protective actions are not taken. Minimizing forest cover removal will reduce the long-term impacts of forest cover loss and is key strategy for protecting and restoring habitat within Puget Sound.

Diminished Riparian Forest Cover

Diminishing riparian forests in the lowlands of western Washington continue to impair habitats critical to the recovery of the region's anadromous salmon. The number of 6th-level HUCs rated for properly functioning riparian forest cover shrank by 37.9% between 2011 and 2016. In 2011, NMFS identified for most of Puget Sound that degraded riparian areas are a limiting factor to the recovery of chinook salmon.

Blocking Culverts Impact Salmonid Survival

During the first six years of implementing the *U.S. v. Washington* culvert case injunction, the state of Washington has corrected 150 fish-blocking culverts. At the current rate, if additional support is not gained, the corrections of the remaining 799 culverts would be completed in 32 years in 2052.

Water Quality

In 2014 only 7% of the PSR stream miles were assessed for water quality, a total of ~3,867 miles. Of the assessed streams, 87% were determined to be impaired for one or more parameters and are listed in WA Ecology's 305b report to EPA. Of the 305b listed impaired streams, 56% are identified as salmonid bearing.

Groundwater Withdrawals Impact Surface Flows

Since 1980, over 67,000 wells have been developed in the Puget Sound Region. Of these, 5,815 were built between 2015-2019, a 40% increase in the number of wells built during the previous five years (2010-2014). This increasing rate of new well installations threatens groundwater availability, which has effects on instream flows and overall ecosystem health across the region.

European Green Crab Threaten Native Species

Between 2016 and 2019, over 360 European green crabs were captured in the Puget Sound Region by Washington Sea Grant, Washington State Department of Fish and Wildlife, tribes, U.S. Fish and Wildlife Service, and partners. Although European green crab occurrences in the Puget Sound Region have so far been relatively rare, the impacts of their populations in other parts of the world indicate the potential for widespread changes to Puget Sound's ecosystem if action is not taken to limit their spread. Green crab are outcompeting juvenile native Dungeness crab for space, increasing the threat to Dungeness crab from predators and decreasing food availability.

Commercial Shellfish Growing Conditions Remain a Concern in Puget Sound Region

Since 2014, there has been an increase of nearly 6,000 acres of approved or conditionally approved commercial shellfish growing areas in the Puget Sound Region due to improved water quality conditions. However, there remains a considerable amount of prohibited and restricted growing areas across the region. Of the over

280,000 total acres of growing areas in 2020, 34% (98,052 acres) had either prohibited or restricted status. This prompts concerns about water quality issues across the region.

Climate Change Impacts Puget Sound and Tribal Traditional Practices

Today, Puget Sound watersheds are experiencing the effects of a changing climate and it is predicted that these effects are going to continue or accelerate into the future. Tribal communities are on the front line of the climate crisis as their traditional practices are now threatened by broad-scale and far-reaching environmental changes. The harms caused by climate change are compounded by ongoing damage to the ecological integrity and resilience of our watersheds. In the Pacific Northwest (PNW), the observed and projected trends include warmer air temperatures; shrinking glaciers and snowpack; lower summer streamflows; higher winter flood flows; shifts in streamflow patterns and timing; higher stream temperatures; larger and more frequent wildfires; warmer ocean temperatures; rising sea levels; and changing ocean chemistry, including ocean acidification and low levels of dissolved oxygen.

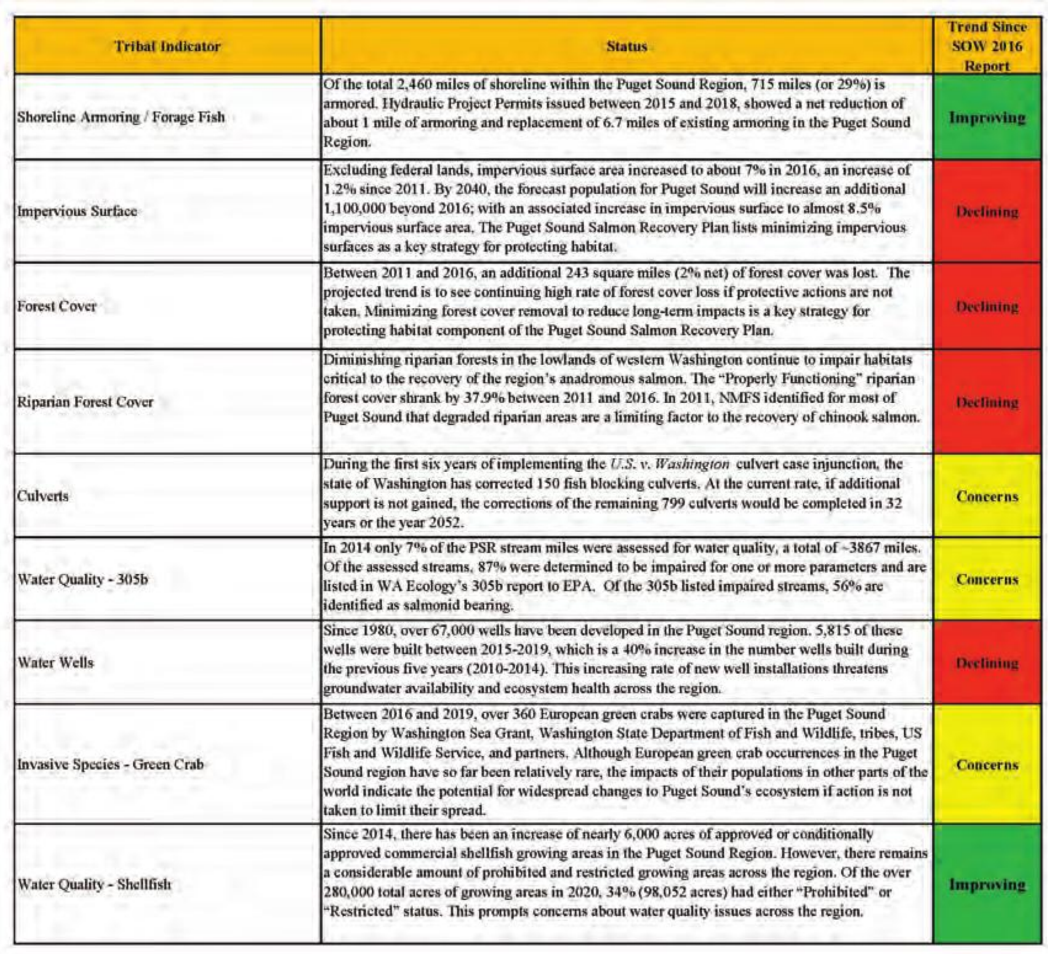
Conclusion

The tribes want to maintain and restore ecological processes that support natural ecosystem conditions that will sustain salmon productivity in all watersheds of Puget Sound in perpetuity. While habitat improvement is a major component to sustain salmon productivity, it is recognized that without protecting existing habitat functions, restoration activities cannot reverse the decline of salmon populations within Puget Sound. In this regard, conclusions on the State of Our Watersheds in 2020 are mixed.

There are clear strategies for recovery that are resulting in the acquisition and restoration of critical salmon habitat in Puget Sound. However, restoration is expensive and funding remains a challenge. As well, restoration requires the participation of willing political leaders and landowners, which is not always readily available. As restoration and acquisition projects continue, these two factors (political support and willing landowners) greatly affect the pace at which it occurs.

The legacy of European colonization on the landscape remains largely unchanged. Floodplain riparian forest cover is in poor condition, too much of the marine nearshore remains armored, and nonpoint pollution continues to threaten shellfish harvest. People continue to move into the Puget Sound Region, either reinforcing development patterns of the past, or bringing new development to previously undeveloped areas. Changing this legacy of land use is a long, slow and very contentious process. It requires adherence to the laws and regulations of federal, state and local governments. Implementation of those laws, which happens locally, is often left to the goodwill of landowners. Politically, this is most palatable, but it has proven inadequate for the needs of salmon habitat recovery. Moving forward, as more people move into the region, better enforcement of the existing regulatory framework or an overall shift in how we manage development will become even more necessary.

Review of the trends for these key environmental indicators since the 2016 State of Our Watersheds Report shows a decline for the indicators and a concern for whether the state of Washington will be able to repair the fish barriers per the court order:



Tribal Indicator	Status	Trend Since SOW 2016 Report
Shoreline Armoring / Forage Fish	Of the total 2,460 miles of shoreline within the Puget Sound Region, 715 miles (or 29%) is armored. Hydraulic Project Permits issued between 2015 and 2018, showed a net reduction of about 1 mile of armoring and replacement of 6.7 miles of existing armoring in the Puget Sound Region.	Improving
Impervious Surface	Excluding federal lands, impervious surface area increased to about 7% in 2016, an increase of 1.2% since 2011. By 2040, the forecast population for Puget Sound will increase an additional 1,100,000 beyond 2016; with an associated increase in impervious surface to almost 8.5% impervious surface area. The Puget Sound Salmon Recovery Plan lists minimizing impervious surfaces as a key strategy for protecting habitat.	Declining
Forest Cover	Between 2011 and 2016, an additional 243 square miles (2% net) of forest cover was lost. The projected trend is to see continuing high rate of forest cover loss if protective actions are not taken. Minimizing forest cover removal to reduce long-term impacts is a key strategy for protecting habitat component of the Puget Sound Salmon Recovery Plan.	Declining
Riparian Forest Cover	Diminishing riparian forests in the lowlands of western Washington continue to impair habitats critical to the recovery of the region's anadromous salmon. The "Properly Functioning" riparian forest cover shrank by 37.9% between 2011 and 2016. In 2011, NMFS identified for most of Puget Sound that degraded riparian areas are a limiting factor to the recovery of chinook salmon.	Declining
Culverts	During the first six years of implementing the *U.S. v. Washington* culvert case injunction, the state of Washington has corrected 150 fish blocking culverts. At the current rate, if additional support is not gained, the corrections of the remaining 799 culverts would be completed in 32 years or the year 2052.	Concerns
Water Quality - 305b	In 2014 only 7% of the PSR stream miles were assessed for water quality, a total of ~3867 miles. Of the assessed streams, 87% were determined to be impaired for one or more parameters and are listed in WA Ecology's 305b report to EPA. Of the 305b listed impaired streams, 56% are identified as salmonid bearing.	Concerns
Water Wells	Since 1980, over 67,000 wells have been developed in the Puget Sound region. 5,815 of these wells were built between 2015-2019, which is a 40% increase in the number wells built during the previous five years (2010-2014). This increasing rate of new well installations threatens groundwater availability and ecosystem health across the region.	Declining
Invasive Species - Green Crab	Between 2016 and 2019, over 360 European green crabs were captured in the Puget Sound Region by Washington Sea Grant, Washington State Department of Fish and Wildlife, tribes, US Fish and Wildlife Service, and partners. Although European green crab occurrences in the Puget Sound region have so far been relatively rare, the impacts of their populations in other parts of the world indicate the potential for widespread changes to Puget Sound's ecosystem if action is not taken to limit their spread.	Concerns
Water Quality - Shellfish	Since 2014, there has been an increase of nearly 6,000 acres of approved or conditionally approved commercial shellfish growing areas in the Puget Sound Region. However, there remains a considerable amount of prohibited and restricted growing areas across the region. Of the over 280,000 total acres of growing areas in 2020, 34% (98,052 acres) had either "Prohibited" or "Restricted" status. This prompts concerns about water quality issues across the region.	Improving

The tribes continue to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded and conducting research to understand the organisms and their interactions with the habitats they rely on for survival.

Looking Ahead

The increasing population of western Washington negatively impacts the landscape both physically and biologically. With population growth comes increased negative effects upon the landscape and the ecological process that sustain salmonids: developed impervious surfaces; forestland conversions for housing and infrastructure; pollution; water consumption; increased opportunity for invasive species; landscape modification (e.g., docks, piers, levees, culverts, bank hardening, channel modification); reduction in species diversity/density; loss of contiguous habitat (e.g., riparian, migration corridors); and related effects (e.g., sedimentation, mass wasting, climate change, diminished water quality, aquifer/groundwater depletion, native species endangerment/extirpation). While population growth is expected to continue, that growth needs to be managed to minimize its potential additional negative effects and ongoing and historic impacts must be mitigated and restored to ensure a resilient ecosystem for all species.

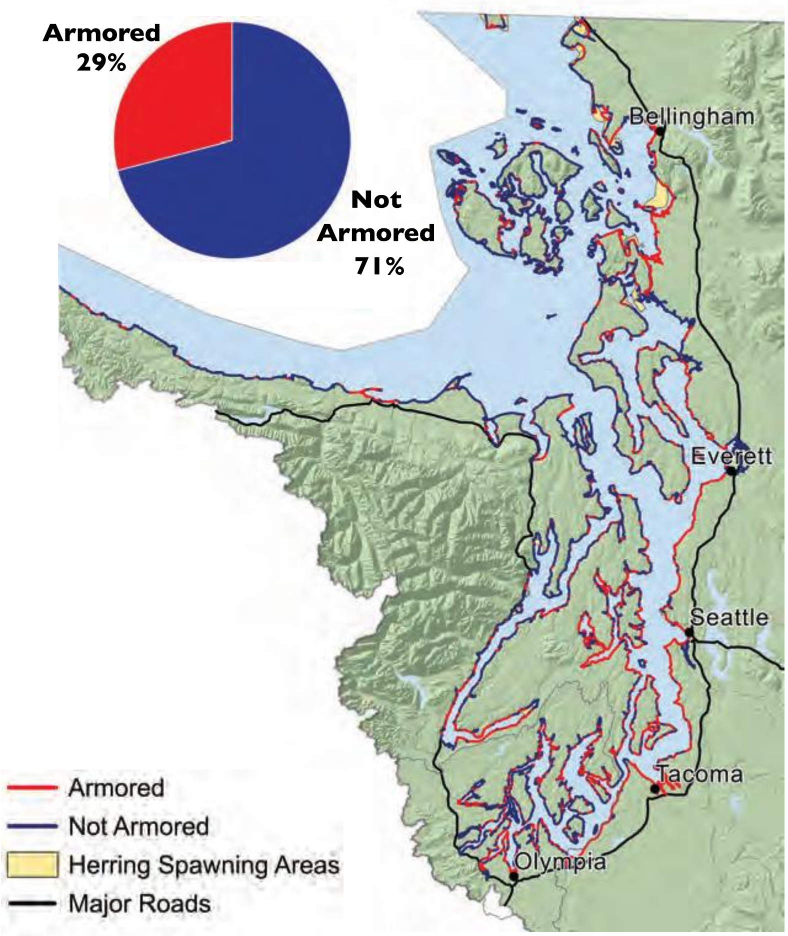
Among these impacts, impervious surfaces restrict groundwater recharge and contribute to increased pollution, both chemical and physical. Surface water withdrawals reduce streamflows and wetland volume downstream. Groundwater withdrawals, if not balanced by recharge, reduce streamflow, wetland volume and freshets into seawater. Larger and additional roads and railways increase the number of stream crossings with the potential to impact salmonid access to habitat and add additional impervious surfaces. Canopy cover is an important component of our hydrologic cycle; it supports life important to the salmonid life cycle. In the riparian zone, forests moderate temperature impacts, contribute woody debris, capture some pollutants otherwise released to the landscape, and reduce the potential for mass wasting events.

The increase in global average temperatures in the air and oceans contributes to the suite of climate change effects. Climate change occurs within the context of land and water use patterns that already have diminished the ecological integrity of our watersheds. These changes leave aquatic and terrestrial species increasingly vulnerable to changes in climate conditions in the Pacific Northwest region. The deep relationship between traditional tribal lifeways and the ecosystems of Puget Sound leave member tribes especially vulnerable to the effects of climate change. Critical tribal resources, including salmon, shellfish, traditional plants and wildlife, are already experiencing climate change related impacts. The tribes currently employ many strategies to protect natural resources but climate change could threaten the effectiveness of these strategies and the resilience of ecosystems in responding to historic and the ongoing impacts of land use and future development.

Shoreline Armoring Continuing to Threaten Salmon and Forage Fish Spawning Habitat

Of the total 2,460 miles of shoreline within the Puget Sound Region, 715 miles (or 29%) is armored.[1] Hydraulic project permits issued between 2015 and 2018 showed a net reduction of about 1 mile of armoring and replacement of 6.7 miles of existing armoring in the Puget Sound Region.[2]

Ala Spit before and after 160 feet of riprap and 400 feet of cement wall armor were removed in 2015.



Forage fish, such as Pacific herring (*Clupea pallasi*), surf smelt (*Hypomesus pretiosus*), and Pacific sand lance (*Ammodytes hexapterus*), spawn along intertidal and/or subtidal beaches composed of sand and gravel. Surf smelt and Pacific sand lance are a key link in the Puget Sound food web between zooplankton and larger predatory fish and wildlife, such as salmonids.[3,4]

It is widely understood that shoreline armor (also known as bulkheads or seawalls) negatively affects nearshore habitats. Armoring significantly degrades or eliminates a variety of vital nearshore ecological processes and habitats, including sediment input and transport, riparian fringe habitat quantity, estuarine connectivity and water quality.[5] A significant amount of herring, surf smelt and sand lance habitat has been impacted by armoring in the PSR,[6,7] posing a threat to their survival.

Of the total miles of shoreline in the Puget Sound Region (PSR), 29% is armored. The two counties in the region with the highest percentages of shoreline armored are King (55%) and Pierce (53%) counties. The lowest percentage armored are San Juan (6%) and Jefferson (14%) counties.

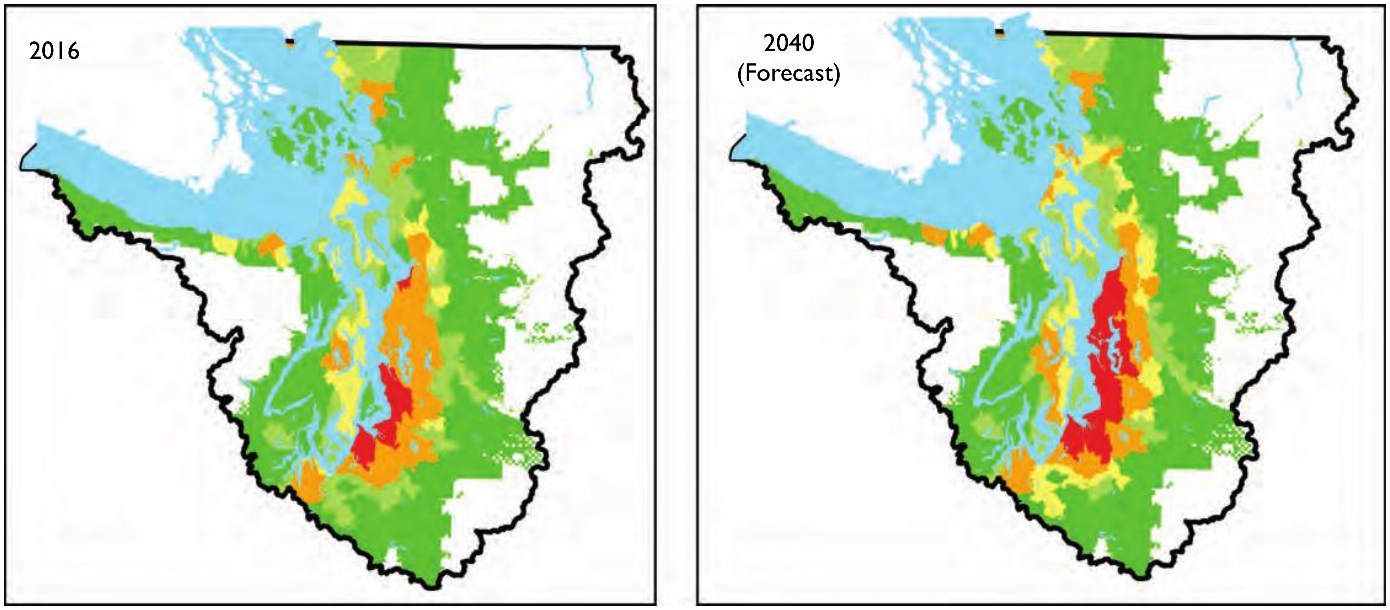
A modified and armored nearshore environment results in diminished protection from predators, reduced prey abundance and contaminated water, all of which is detrimental to achieving salmon recovery goals. Alternatively, natural shorelines form migratory pathways for juvenile salmon and forage fish, who rely on pocket estuaries for their abundant insect prey, freshwater input, and protective shallow waters.[8] Additionally, salmon fry feed on forage fish that spawn along natural shorelines.[9]

The Washington Department of Fish and Wildlife (WDFW) has been permitting shoreline armoring and modification activities through the Hydraulic Project Approval (HPA) program. Permitted projects from 2015-2018 included 421 HPAs within the PSR, resulting in 1.6 miles of new armor, 2.6 miles of removed armor and 6.7 miles of armor maintenance projects.[10] Although over a quarter mile of new armoring was established in 2018, this is 904 feet less than the amount of new armoring established in 2015 (which was nearly 0.5 miles). This decline in new armor construction within HPA projects offers some encouragement, though more research needs to be done into the long-term impacts of the armor maintenance projects that prolong the impacts of armoring on the shoreline and the species that rely on it.

Map Data Sources: CGS 2017,[11] WAECY 2018,[12] WADOT 2010,[13] WADOT 2018,[14] WDFW 2017,[15] WDFW 2014,[16] WDFW 2019,[17] SSHIAP 2004[18]

Impervious Surface Continues to Increase

Excluding federal lands, impervious surface area increased to about 7% in 2016, an increase of 1.2% since 2011. By 2040, the forecast population for Puget Sound will increase an additional 1,100,000 beyond 2016; with an associated increase to almost 8.5% impervious surface area. The Puget Sound Salmon Recovery Plan lists minimizing impervious surfaces as a key strategy for protecting habitat.[1]

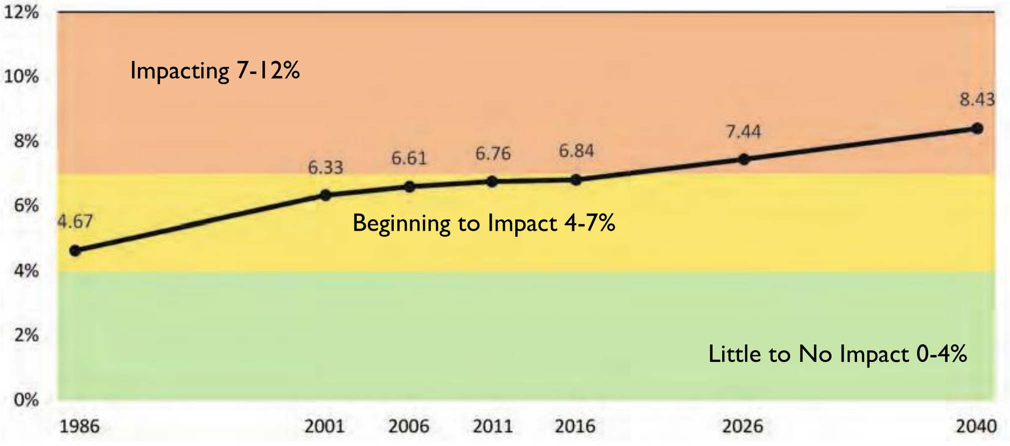


As impervious surface increases in a watershed, stream temperatures and sediment transport are likely to increase, along with a decrease in in-stream biodiversity by reducing the number of insect and fish species. It will also contribute to pollutants in stormwater runoff, which can contaminate local aquatic systems.[2] Contaminated runoff poses significant threats to freshwater, estuarine and marine species, including the Pacific Northwest's salmon and steelhead runs.[3] The addition of impervious surface reduces water infiltration and increases runoff, causing higher peak flows during wet times and lower dry weather flows due to lack of groundwater recharge.[4]

Between 2006 and 2016 the rate of annual impervious surface increase has decreased from the rate between 1986 and 2006. In correlation to population, the 2040 impervious surface forecast is based upon a continuation of the 2006-2016 behavior. If the population increases much more than forecast, or if an improving economy causes people to regress to 1986-2006 behavior, there is potential for an even greater increased impervious surface level. It is essential as we recover from the current 2020 budget crisis, that economic recovery does not take precedent over environmental resiliency, so we need to ensure that new infrastructure projects limit the amount of new impervious surfaces.

The Chinook Recovery Plan leans heavily on local planning, land-use policies, and provisions contained in the local watershed plans to protect federally designated habitat.[5] However, even with critical areas ordinances, planned development areas outside of the designated Urban Growth Areas will continue to contribute to increases in impervious surface area.

Puget Sound Impervious Surface
1986-2040 forecast, excluding NPS and USFS

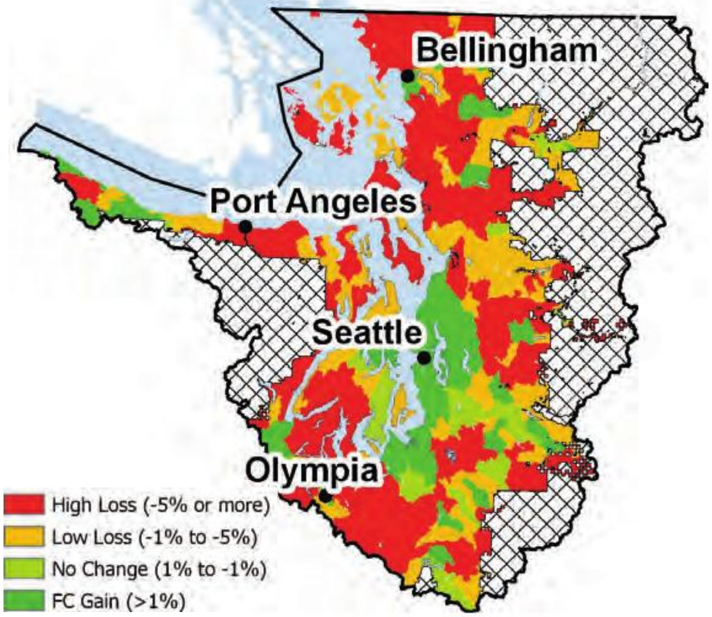


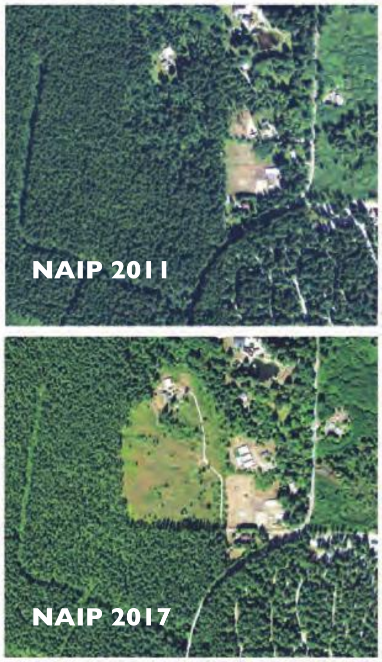
Map Data Sources: NLCD 2006,[6] NLCD 2011,[7] USGS 2014,[8] WAECY 1994,[9] WAECY 2000,[10] WAOFM 2017,[11] NLCD 2016[12]

Forest Cover Loss Continues in Puget Sound Lowlands

An additional 243 square miles (2% net) of forest cover was lost. The projected trend is to see a continuing high rate of forest cover loss if protective actions are not taken. Minimizing forest cover removal to reduce long-term impacts is a key strategy for protecting habitat in the Puget Sound Salmon Recovery Plan.[1]

2011-2016 Forest Cover Change by Basin





Example of forest cover loss to residential use that is not expected to be replaced along the Skykomish River.

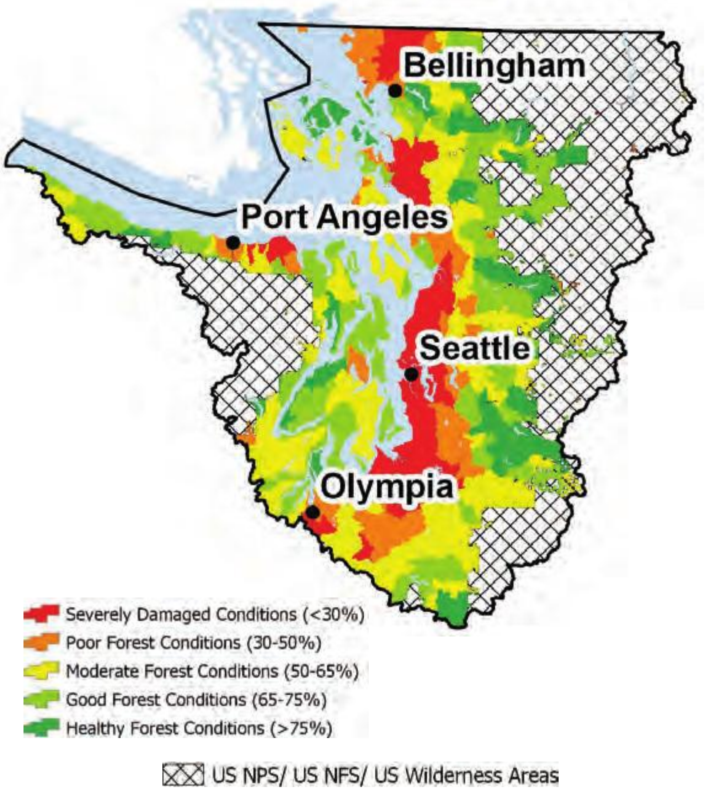
Within the Puget Sound Area (WRIAs 1-19) and outside of the National Park and Recreation areas, lies an area of approximately 11,950 square miles (excluding the marine waters). There was a decline in forested area between 2011 and 2016, of 243 square miles (net), due to timber harvesting and land conversions. While 651 square miles of forested land cover was lost, 408 square miles was gained through forest growth.

This forested area reduction of 243 square miles is an increased rate from the previous analysis period (2006-2011) of 153 square miles, which continues a trend in the rate of deforestation.

From 1988-2004, western Washington forestlands have declined by 25%. These losses (meaning conversion to other uses), were the result of changes in market conditions for wood products, changes in land ownership, impacts from competing land uses and the health of timber stock. Recent research from the University of Washington indicates that nearly 1 million more acres of private forestland are threatened with conversion. Across all of Washington, the potential risk of conversion is highest in the Puget Sound region.

This habitat loss is added to the existing background of land disturbance and development across Puget Sound. The numbers show a disturbing trend of continuing loss despite the state's adoption of some of the most aggressive land management tools in the nation, including the Shoreline Management Act (SMA), Growth Management Act (GMA), Critical Areas Regulations (CAR) and the Forests and Fish Agreement, which led to changes in the Forest Practices Act to protect salmon.[2]

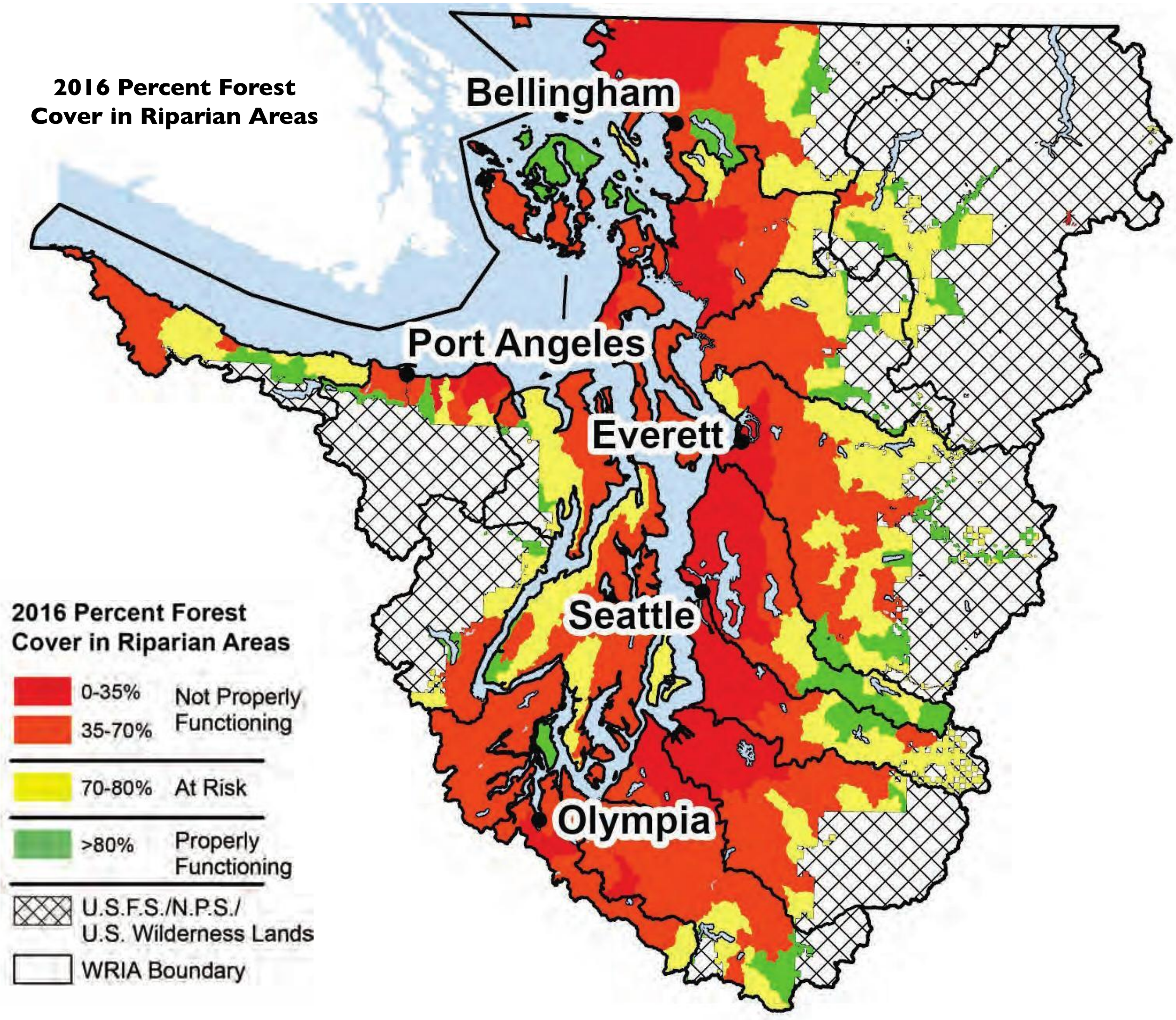
2016 Sub-Basin Assessment of Forest Cover



Map Data Sources: WADNR 2017,[3] NOAA 2016,[4] NOAA 2011,[5] NAIP 2017,[6] NAIP 2011[7]

Diminished Riparian Forest Cover

Diminishing riparian forests in the lowlands of western Washington continue to impair habitats critical to the recovery of the region's anadromous salmon. The number of 6th-level HUCs rated for properly functioning riparian forest cover shrank by 37.9% between 2011 and 2016. In 2011, NMFS identified for most of Puget Sound that degraded riparian areas are a limiting factor to the recovery of chinook salmon.[1]



Since statehood in 1889, Washington has lost an estimated 70% of its estuarine wetlands, 50% of its riparian habitat, and 90% of its old-growth forest.[2] Although focusing growth inside UGAs (Urban Growth Areas) is required by GMA (Growth Management Act), the protection of forest cover has not been met by existing regulatory tools. Growth pressures clear land in UGAs, even along riparian corridors and other areas important for salmon habitat.[3]

The Puget Sound Region consists of 425 6th-level Hydrologic Units (HUCs) from the U.S. side of the Salish Sea out to the mouth of the Strait of Juan de Fuca. Over 300 of these HUCs are partially or completely outside of USFS/NPS/Wilderness Areas. Of these identified HUCs, only 17% are rated as properly functioning riparian forest cover in 2016, down from 28% in 2011.

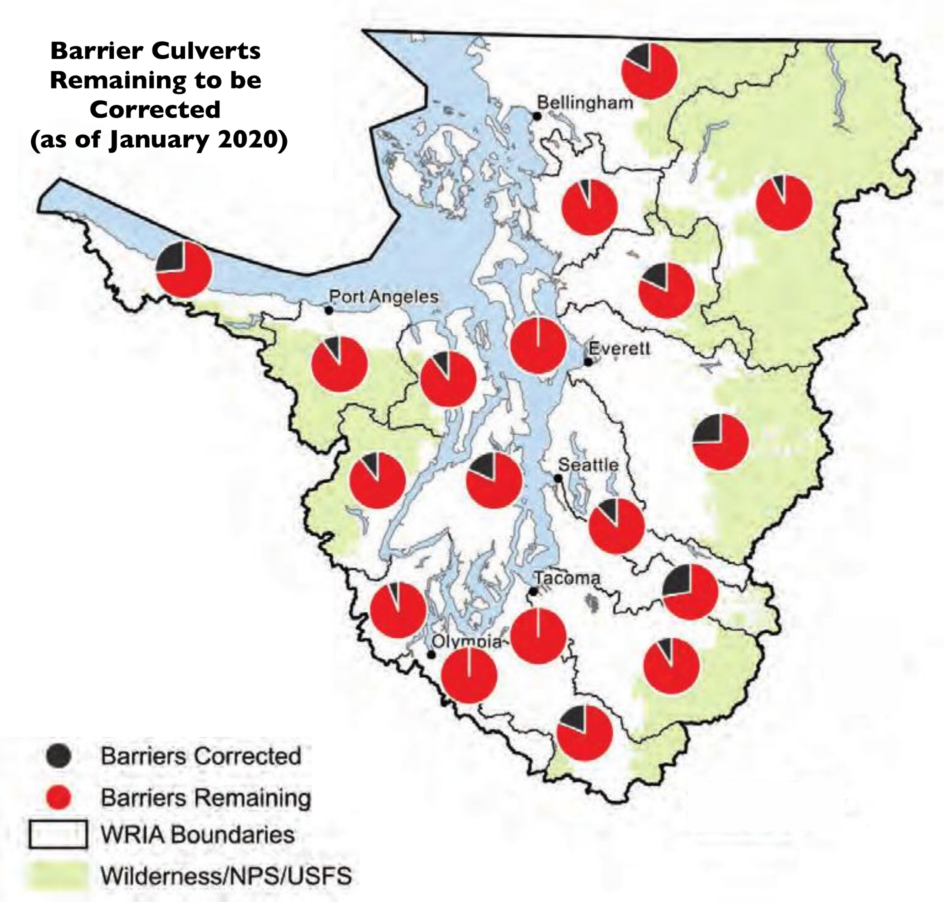
NMFS identified degraded riparian areas as a limiting factor important for recovery in the 2011 Implementation Status Assessment Final Report.[4] The assessed riparian zone is 300 feet from identified salmonid-bearing waters and 100 feet from all other fresh waters.

The diminished riparian function of most watersheds and marine shoreline results in decreased water quality, temperature regulation, cover, bank stability, LWD recruitment, increased sedimentation, detrital/nutrient input and impacts to other biotic and abiotic conditions for salmon and their supporting environment. As population growth continues throughout Puget Sound, effects in riparian areas must be managed to ensure recovery of this vital salmonid habitat limiting factor.

Map Data Sources: SSHIAP 2014,[5] WADNR 2015,[6] WADOT 2010,[7] WAECY 2000,[8] NOAA 2011,[9] NOAA 2016[10]

Blocking Culverts Impact Salmonid Survival

During the first six years of implementing the U.S. v. Washington *culvert case injunction, the state of Washington has corrected 150 fish-blocking culverts in the Puget Sound Region. At the current rate, if additional support is not gained, the corrections of the remaining 799 culverts would be completed in 32 years or the year 2052.*


Barrier Culverts Remaining to be Corrected (as of January 2020)

Usable habitat for Puget Sound salmon is a fraction of what it once was, and our ability to recover the salmon populations directly depends on the recovery of habitat.[1]

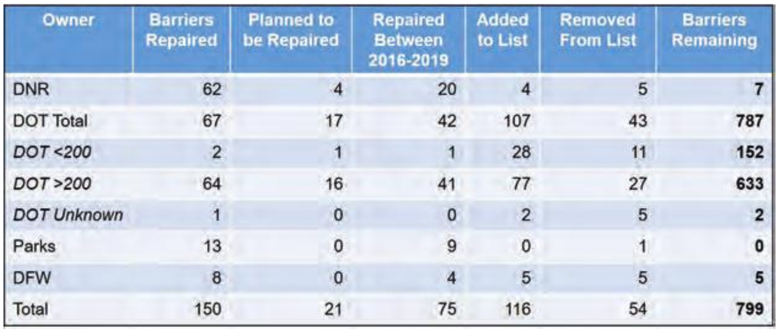
"Impaired fish access is one of the more significant factors limiting salmonid productivity in many watersheds."[2] In 2013, the U.S. District Court ruled that "the Tribes and their individual members have been harmed economically, socially, educationally, and culturally by the greatly reduced salmon harvests that have resulted from State created or State-maintained fish passage barriers."[3]

The Puget Sound Salmon Recovery Plan states that "the loss of rearing habitat quantity and quality is the primary factor affecting population performance," and that the status quo is unacceptable.[4] Not only do physical barriers limit fish passage and available habitat, they can also damage water quality and disrupt sediment deposition.[5]

Because of this damage, "In 2001, the United States and western Washington Tribes brought an action against the State of Washington for their failure to construct and maintain fish passage on state-owned culverts." In 2007, the Court ruled that the right of taking fish, as secured by the Treaties, means that the State must "refrain from building or operating culverts…that hinder fish passage."[6]

In March 2013, the U.S. District Court granted the permanent injunction requested by the Federal Government and Tribes, holding that the Tribes "have suffered irreparable injury in that their Treaty-based right of taking fish has been impermissibly infringed. The construction and operation of culverts that hinder free passage of fish has reduced the quantity and quality of salmon habitat, prevented access to spawning grounds, reduced salmon production in streams in the Case Area, and diminished the number of salmon available for harvest."[7]

Multiple state agencies were affected by this ruling. Washington State Parks and the Department of Fish and Wildlife were required by state law to fix injunction culverts by Oct. 31, 2016.[8] This deadline was nearly met, but because some barrier culverts have been identified since the 2016 deadline, a few corrections still need to be made. Some Department of Natural Resources' culverts have a longer timeline for correction.[9]



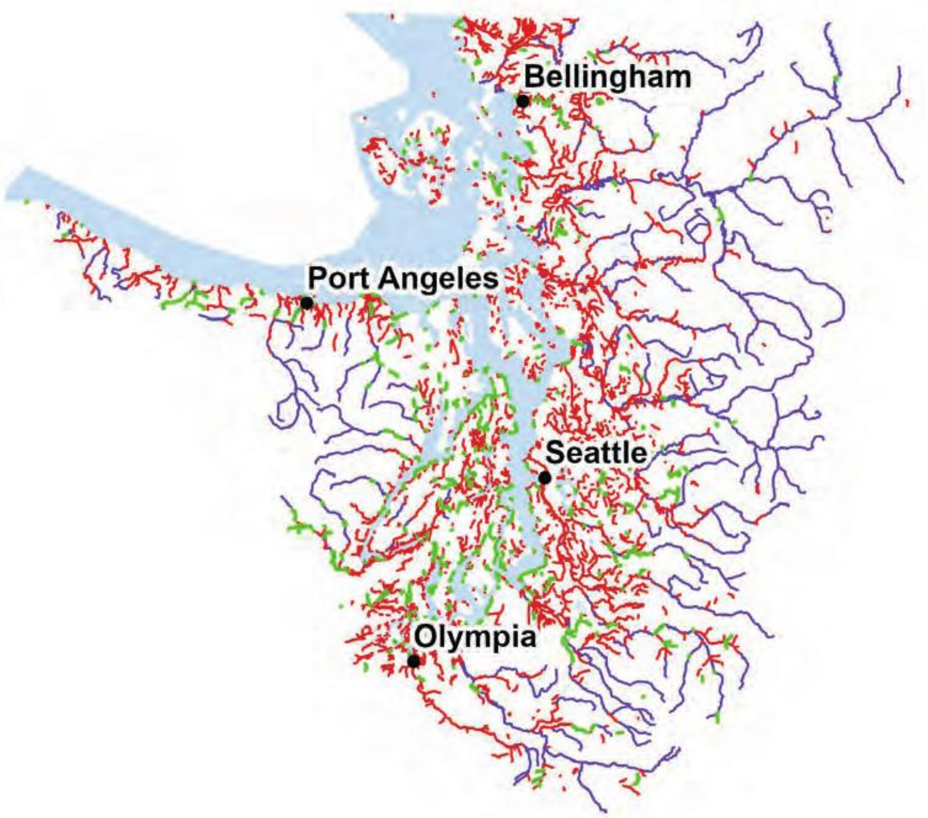
Owner	Barriers Repaired	Planned to be Repaired	Repaired Between 2016-2019	Added to List	Removed From List	Barriers Remaining
DNR	62	4	20	4	5	**7**
DOT Total	67	17	42	107	43	**787**
DOT <200	2	1	1	28	11	**152**
DOT >200	64	16	41	77	27	**633**
DOT Unknown	1	0	0	2	5	**2**
Parks	13	0	9	0	1	**0**
DFW	8	0	4	5	5	**5**
Total	150	21	75	116	54	**799**

Washington Department of Transportation (DOT) is required to fix culverts that block 200 meters or more of habitat by 2030. DOT culvert repair funding is less than 12% of where it needs to be to complete repairs by the court appointed deadline.[10] DOT still needs to fix over 600 barrier culverts (>200m of habitat) in the PSR region; 16 are planned for repair in the 2020-2021 construction season.

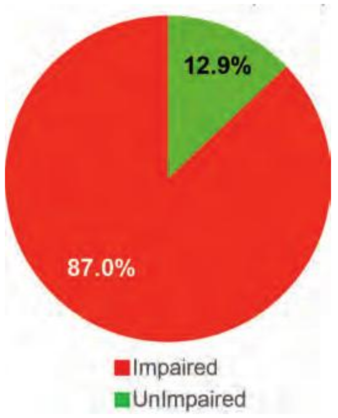
Map Data Sources: WDFW 2019,[11] WADNR 2019,[12] WADNR 2019b,[13] WADOT 2020,[14] WADOT 2019,[15] Curtis 2019,[16] WAECY 2000,[17] WASPS 2016[18]

Water Quality

In 2014 only 7% of Puget Sound Region stream miles were assessed for water quality, a total of ~3,867 miles. Of the assessed streams, 87% were determined to be impaired for one or more parameters and are listed in WA Ecology's 305b report to EPA. Of the 305b listed impaired streams, 56% are identified as salmonid bearing.

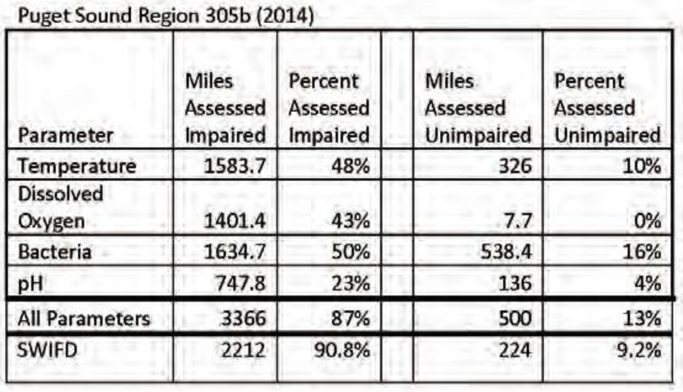


Assessed Waters (2016)



Water quality requirements for salmonid survival include cool temperatures, high dissolved oxygen, natural nutrient concentrations and low levels of pollutants.[1] If the values of these parameters exceed the desired ranges for a specific location and time of year, the ability of surface waters to sustain fish populations are impaired. WA Ecology's 305b[2] & 303d[3] reports to US EPA list waters that are too polluted to meet water quality standards (impaired). Ninety-three percent of freshwater lakes, streams and wetlands are unsampled for water quality and are of an unknown quality status. Due to the low level of sampling, the actual degree of water quality impairment could be higher than identified, especially when the unsampled aquatics are adjacent to known impaired waters.

Of the many parameters assessed in the Puget Sound Region (PSR) the four most prevalent are: Temperature, Dissolved Oxygen (DO), Bacteria, and pH. Comparing the 305b listed impaired stream segments to the Statewide Integrated Fish Distribution (SWIFD) data set,[4] 56% are identified as salmonid bearing. Of the WQ Assessed streams that are salmonid bearing, 91% are impaired for one or more parameters. The listed impairments negatively impact the ability of these streams to support a viable salmonid population.



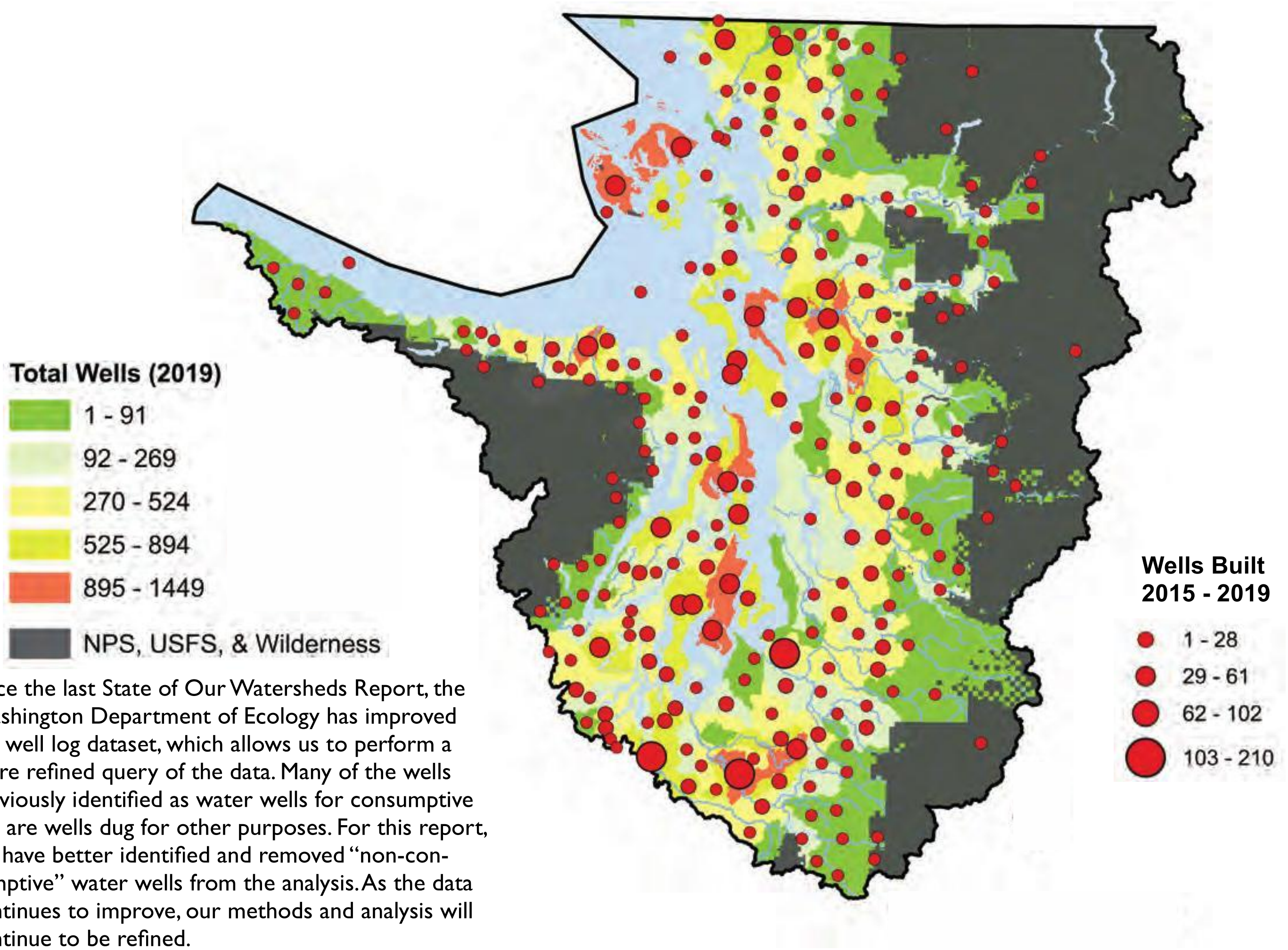
Puget Sound Region 305b (2014)

Parameter	Miles Assessed Impaired	Percent Assessed Impaired		Miles Assessed Unimpaired	Percent Assessed Unimpaired
Temperature	1583.7	48%		326	10%
Dissolved Oxygen	1401.4	43%		7.7	0%
Bacteria	1634.7	50%		538.4	16%
pH	747.8	23%		136	4%
All Parameters	3366	87%		500	13%
SWIFD	2212	90.8%		224	9.2%

Map Data Sources: WAECY 2014,[5] WAECY 2016,[6] WAECY 2016[7]

Groundwater Withdrawals Impact Surface Flows

Since 1980, over 67,000 wells have been developed in the Puget Sound Region. Of these, 5,815 wells were built between 2015-2019, which is a 40% increase in the number of wells built during the previous five years (2010-2014). This increasing rate of new well installations threatens groundwater availability and stream ecosystem health across the region.



Since the last State of Our Watersheds Report, the Washington Department of Ecology has improved the well log dataset, which allows us to perform a more refined query of the data. Many of the wells previously identified as water wells for consumptive use are wells dug for other purposes. For this report, we have better identified and removed "non-consumptive" water wells from the analysis. As the data continues to improve, our methods and analysis will continue to be refined.

Population growth within the Puget Sound Region, will continue to have increased demands on groundwater resources. Washington state instream flow rules allocate river flow for ecological requirements, but state law allows new wells to withdraw 5,000 gallons of groundwater per day without obtaining a permit that requires scientific evidence that water is legally available.[1] Groundwater withdrawals can cumulatively affect streamflows, especially in late summer when flows are naturally low.

An aquifer's natural outflow discharges into lakes, wetlands, streams and seawater through springs and seeps on the land surface and through groundwater. Adequate natural outflow is essential for sustaining stream base flows, maintaining lake levels, providing fresh water inputs to the nearshore and preventing seawater intrusion.

As development occurs and more groundwater is extracted than is being recharged, the natural outflow from groundwater subsequently decreases. This reduces the amount of fresh water available to lakes, wetlands, streams and the Puget Sound nearshore. Reduced freshwater inputs to the Puget Sound nearshore can have a negative impact on shellfish and out-migrating juvenile salmonids.

The reduced availability of surface water can have a negative impact on all stages of the salmonid life cycle. Water quality (e.g. temperature, flows) is affected by decreased inputs from groundwater. Lessened groundwater input concentrates pollutants, increases temperature, and diminishing dissolved oxygen. This is detrimental to salmonid migration, spawning and rearing.

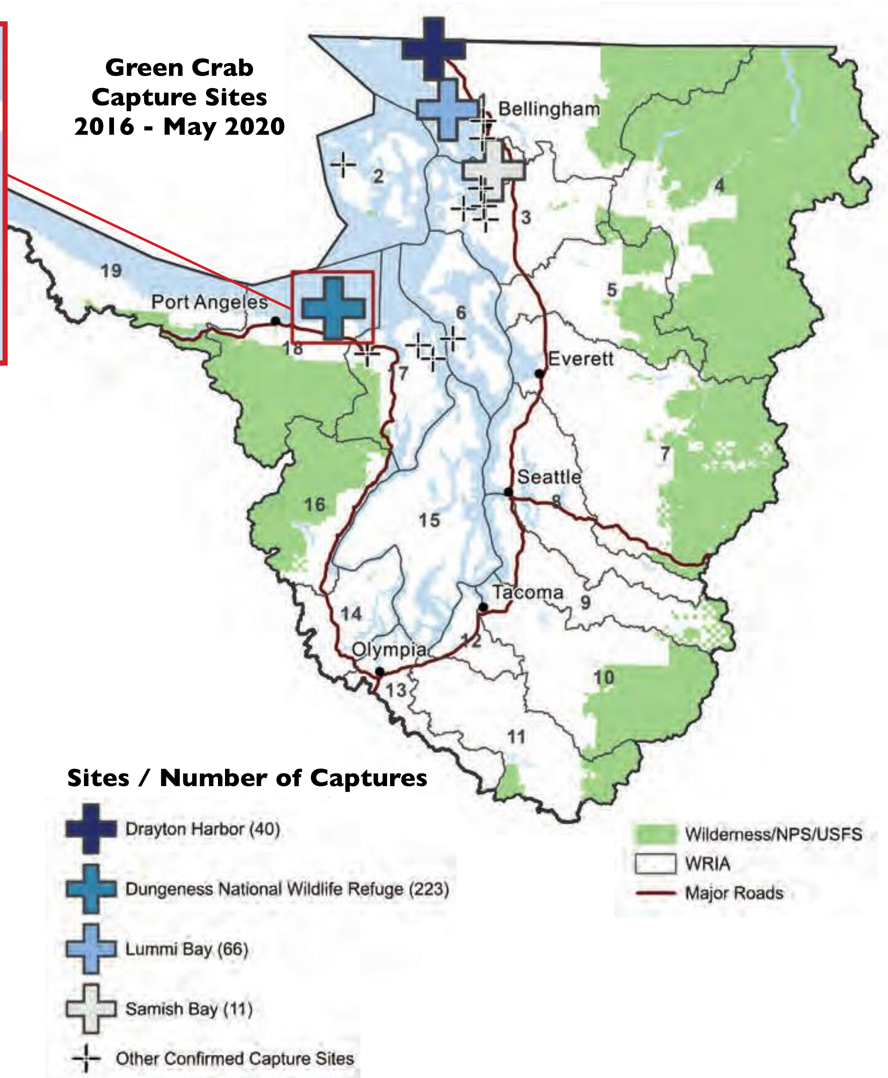
Wells are drilled without regard to aquifer sensitivity and stream recharge needs. As Puget Sound Region's freshwater demand increases, something has to change. Unchecked growth and its associated increased demand for groundwater must be addressed, if implementation of the Puget Sound Salmon Recovery plan is to successfully move forward.

Map Data Sources: USGS 2018,[2] WADNR 2016,[3] WAECY 2018,[4] WAECY 2019[5]

European Green Crab Threaten Native Species

Between 2016 and 2019, over 360 European green crabs were captured in the Puget Sound Region by Washington Sea Grant, Washington State Department of Fish and Wildlife, tribes, U.S. Fish and Wildlife Service, and partners. Although European green crab occurrences in the Puget Sound region have so far been relatively rare, the impacts of their populations in other parts of the world indicate the potential for widespread changes to Puget Sound's ecosystem if action is not taken to limit their spread.

Confirmed green crab captures in the Dungeness National Wildlife Refuge.



Jeff Adams, Washington Sea Grant

A European green crab captured in Washington's inland shorelines.

Although European green crab (*Carcinus maenas*) were first identified in Washington state in the late 1990s, their population has only recently expanded to Washington's inland shorelines. In 2016, the first confirmed European green crab within the inland marine waters of the state was captured in Westcott Bay on San Juan Island in 2016.[1] Since then, Washington Sea Grant, Washington State Department of Fish and Wildlife, tribes and partners have been monitoring green crab presence both on the coast and in the Puget Sound Region of the state.

Over 360 European green crabs were captured in the Puget Sound Region between 2016-2019. During that time, more than half of the total captures were in the Dungeness National Wildlife Refuge. Additionally, a large number of captures occurred within monitored sites in the Nooksack Watershed – namely in Samish Bay, Lummi Bay and Drayton Harbor.

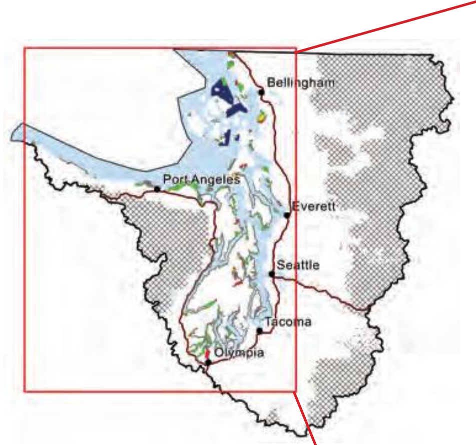
The increased numbers of European green crab in monitored sites has prompted concern of a potential inbound invasion of Puget Sound. Although green crab and Dungeness crab habitat are not thought to overlap in Washington, green crabs have been shown to have the potential to outcompete juvenile Dungeness crab for space and food in other parts of the world.[2] In addition to being a potential future threat to native crabs, the green crab is competing with native fish, bird, clam and oyster species for resources. The continued monitoring and subsequent trapping and removal of European green crab across the Puget Sound Region is essential to understand how quickly they are dispersing, which can provide insights into the best methods to limit their spread.

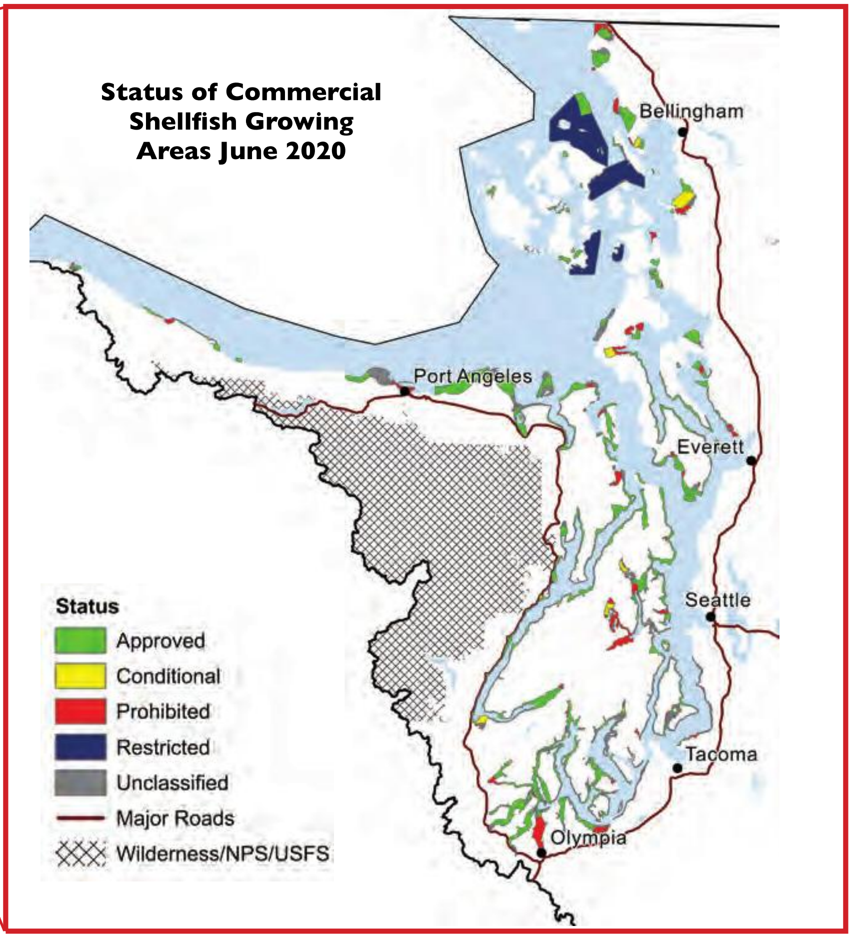
Map Data Sources: WSG 2020,[3] WADNR 2016,[4] WAECY 2018,[5] WAECY 2000,[6] WADOT 2010,[7] WADOT 2018[8]

PUGET SOUND REGION

Commercial Shellfish Growing Conditions Remain a Concern in Puget Sound Region

Since 2014, there has been an increase of nearly 6,000 acres of approved or conditionally approved commercial shellfish growing areas in the Puget Sound Region. However, there remains a considerable amount of prohibited and restricted growing areas across the region. Of the over 280,000 total acres of growing areas in 2020, 34% (98,052 acres) had either prohibited or restricted status. This prompts concerns about water quality issues across the region.

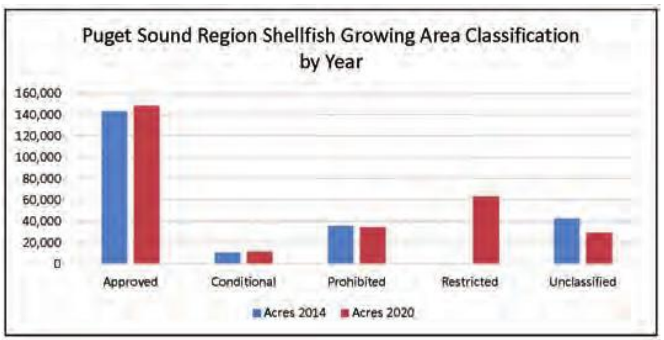



Status of Commercial Shellfish Growing Areas June 2020

Shellfish resources have long provided cultural, ecological and economic value to the Puget Sound Region. Washington State Department of Health (WADOH) conducts sanitary surveys in shellfish growing areas to determine harvest suitability, where they conduct water quality assessments and point-source pollution evaluations.

Since 2014, over 5,900 acres of commercial shellfish areas have gained approved or conditionally approved status across the PSR. Although almost 1,000 fewer acres are currently prohibited to commercial growing than were in 2014, nearly 35,000 acres remain classified as prohibited for shellfish growing. Additionally, since 2014, over 63,000 acres have been classified as restricted. A restricted status, according to WADOH, means the shellfish harvested from those areas cannot be marketed directly due to water quality issues.

Of the more than 280,000 total acres of growing areas in the PSR in 2020, 34% (98,052 acres) had either prohibited or restricted status. In 2014, 35,895 acres had either prohibited or restricted status, or 15% of the total. This large number of prohibited or restricted areas reflect a larger water quality issue across the Puget Sound Region that concerns not only shellfish growers, but also overall ecosystem health.

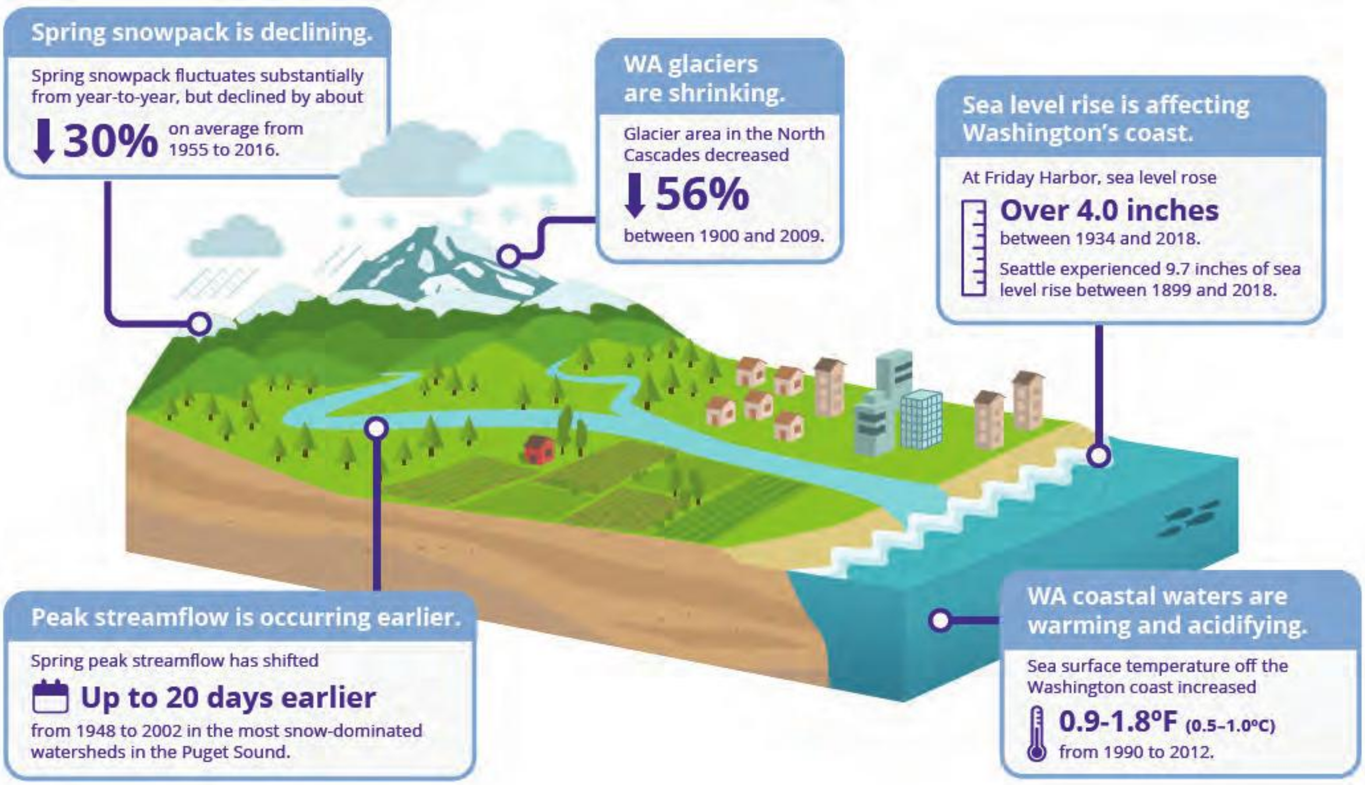


Map Data Sources: WADOH 2020,[1] WADOH 2014,[2] WADNR 2016,[3] WAECY 2018,[4] WADOT 2010,[5] WADOT 2018[6]

Climate Change Impacts Puget Sound and Tribal Traditional Practices

The watersheds of Puget Sound are experiencing the effects of a changing climate and these trends are projected to continue or accelerate into the future. Tribal communities are on the front line of the climate crisis as traditional practices that have been sustained since time immemorial are now threatened by broad-scale environmental changes. The harms caused by the climate crisis are compounded by ongoing damage to the ecological integrity and resilience of our watersheds as described in this report.

In the Pacific Northwest (PNW), the observed and projected trends include warmer air temperatures; shrinking glaciers and snowpack; lower summer streamflows; higher winter flood flows; shifts in streamflow patterns and timing; higher stream temperatures; larger and more frequent wildfires; warmer ocean temperatures; rising sea levels; and changing ocean chemistry, including ocean acidification and low levels of dissolved oxygen.



An overview of changes observed in the waters of Washington that are expected to continue or worsen in the future.[18]

Changing watershed processes pose a threat to salmon populations, which need adequate amounts of cool, clean water to survive. Overall, temperatures in PNW streams warmed by about 0.3°F (0.17°C) per decade from 1976 to 2015.[1] As stream temperatures increase, the length of time that rivers exceed salmon temperature limits for reproduction and survival grows longer. Loss of glaciers and snowpack contributes to lower summer streamflows, warmer waters, greater winter floods and more exposed sediment washing into rivers. In the North Cascade National Park, the loss of glacier area between 1984 and 2015 was 30% of total glacier volume.[2] From 1950 to 2010, summer streamflows decreased 33% in snow-dominated watersheds and 36% in mixed rain-snow watersheds in the PNW.[3] At the same time, winter flood risk is increasing since the top 1% of extreme rainfall events increased in frequency by 12% in the PNW during the 20th century.[4]

In addition to changes in streamflow and water temperatures, climate change leaves salmon and steelhead at risk from lower levels of dissolved oxygen, more sediment in streams, greater susceptibility to disease, competition from warm-water species, and changes to the type and availability of prey.

Terrestrial plants and animals used for traditional food, medicine and cultural practices are vulnerable to major ecosystem disturbances such as wildfire, drought, pests and invasive species.[5] Warmer temperatures, changing precipitation patterns and other disturbances are causing wildlife and birds to migrate farther north or to higher elevations in search of suitable habitat, potentially moving out of traditional tribal hunting grounds.[6] In the western United States, the fire season has lengthened in conjunction with higher summer temperatures and reduced snowpack.[7] Warmer summers, lower soil moisture and higher rates of evapotranspira-

(Continued on next page)

Tiffany Royal, NWIFC

Jamestown S'Klallam Tribe shellfish staff count eelgrass plants as part of the Washington Department of Natural Resources' Acidification Nearshore Monitoring Network (ANeMoNe), which seeks to measure changes in marine chemistry in order to evaluate potential impacts on marine organisms.[19]

(Continued from previous page)

tion leave Puget Sound forests more prone to fires than in the past.[8]

In marine and coastal ecosystems, changes to water chemistry and temperature can alter the range, distribution and abundance of fish, shellfish, waterfowl and other marine species important to the tribes.[9] For example, ocean acidification interferes with shell formation, and hence development and survival of a number of marine species, including crabs, clams and oysters. In addition, ocean acidification has the potential to alter marine food webs and change distribution of finfish, including Pacific salmon.[10] The marine waters of Washington have become 10-40% more acidified since 1800.[11]

Average annual sea surface temperatures are increasing globally and locally. Ocean temperatures can influence salmon migration routes. For example, the Fraser River sockeye and pink salmon that return from the ocean to their natal streams in Canada usually either go north around Vancouver Island, or they go south through the Strait of Juan de Fuca. When these fish divert to the north and out of U.S. waters, the tribes that fish these runs lose their access. In the past, northern diversion has been very strongly correlated with warmer water off Vancouver Island.[12] Unusually warm ocean conditions in 2015 may have spurred the Fraser runs toward the north and away from tribal fishing grounds, when the estimated northern diversion rates for sockeye and pink salmon were 99% and 91%, respectively.[13]

Low-lying tribal lands are susceptible to sea level rise (SLR), coastal flooding and erosion, which can reduce traditional tribal shellfish harvesting areas, damage culturally important sites, and threaten tribal communities and infrastructure. Global SLR is caused by the physical expansion of warmer water and the melting of ice sheets and glaciers, but locally, relative SLR includes the effects of vertical land movement. In western Washington vertical land movement is dominated by tectonic forces, so the amount of relative sea level rise varies over time and location.[14]

Tidal records show that relative SLR at Cherry Point near Bellingham has occurred at the equivalent of 1.6 inches per century, in Seattle it has been 8.2 inches per century, and in Olympia it has been 9.6 inches per century.[15,16] Due to ground uplift, tidal records in Neah Bay show a relative drop in sea level of the equivalent of 6.7 inches per century and a drop of 1.6 inches per century at Port Angeles.[17]

Kari Neumeyer, NWIFC

Nooksack Tribe water resources manager Oliver Grah (right) and contractor Andy Ingram set up monitoring equipment on the Sholes Glacier, Mount Baker.[20]

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2020 State of Our Watersheds Report
Hoh River Basin

> *At the headwaters of … the glaciers, that's where the Thunderbird lives…. There is power in that glacier. And Natives have always believed that if you go up there and you fast and you seek the spirit, you will get that spirit.*
>
> **- Viola Riebe**
> **Hoh Tribe**

Area of Interest

Hoh Tribe

Chalá·at: People of the Hoh River

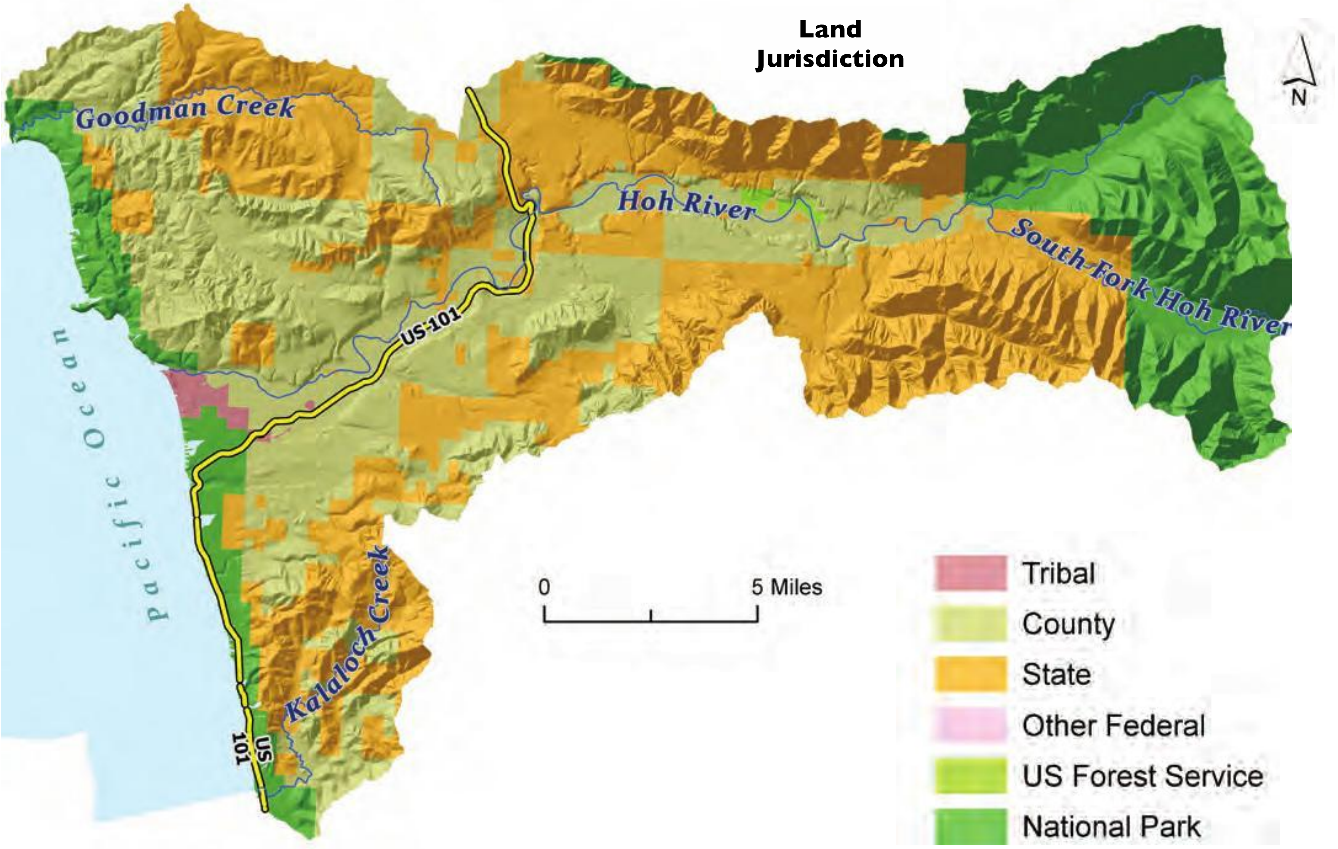
The Hoh River Indians are a federally recognized tribe located about 28 miles south of Forks and 80 miles north of Aberdeen on the west side of the Olympic Peninsula.

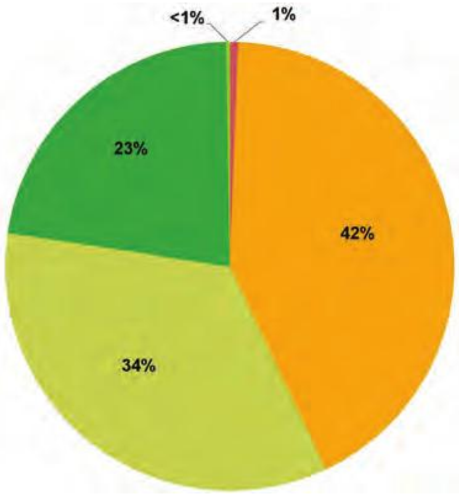
The original Hoh Indian Reservation was about 443 acres in size but through property acquisitions, the tribe now has a total of 908 acres in trust, and more than 162 acres in fee lands. The reservation has approximately one mile of beach front, running from the mouth of the Hoh River south toward Ruby Beach.

The Hoh Tribe is a river-based fishing community that is dependent on the fish, wildlife and other natural resources of the Hoh River watershed for their subsistence and commercial economy. Therefore, protection of the watershed's functions is key to meeting the cultural and economic needs of the tribe.

Hoh Tribe

Hoh River Watershed and Independent Tributaries





The Hoh Tribe's Area of Interest comprises portions of WRIAs 20 and 21 along the west side of the Olympic Peninsula, from Goodman Creek south to Kalaloch Creek. The largest basin in the area is the Hoh River which originates at the Hoh Glacier on Mount Olympus. From there, it flows westward through the Olympic National Park's temperate rainforest, then through foothills and a broad, flat floodplain before emptying into the Pacific Ocean at the Hoh Indian Reservation, the ancestral home of the Hoh people.

This Area of Interest is dominated by state and private forestlands and includes the Hoh Rain Forest, a large temperate area protected from major anthropogenic changes within the Olympic National Park. Although many pockets of forest remain, much of the forest has been logged within the last century.

Within the Park, the Hoh and South Fork Hoh rivers have some glacial input. The streams that discharge outside the Park are rainfall-dominated with a mean annual precipitation between 140 to 165 inches, the highest in Washington State. The Hoh drainage streamflow has considerable seasonal variation, with summer discharge averaging about a third of winter flows.

This basin supports all five species of Pacific salmon as well as cutthroat trout, and bull trout.[1,2,3] The Hoh River, some adjacent shoreline and tributaries, are designated critical habitat for bull trout.[4] There are lots of whitefish and several species of lamprey that are indigenous to the Hoh.

Smith[5] identified several factors limiting salmonid production in the basin downstream of the Park. These include fish access problems from culverts and cedar spalts, increased stream sedimentation, elevated stream temperatures, altered riparian areas, as well as scoured, incised channels with few spawning gravels and large woody debris. The WRIA 20 Watershed Plan[6] includes specific actions and management strategies for addressing these limiting factors.

Map Data Sources: SSHIAP 2004,[7] USFWS 2018,[8] WADNR 2016,[9] WADNR 2018,[10] WADOT 2018a,[11] WADOT 2018b,[12] WAECY 1994,[13] WAECY 2018a,[14] WAECY 2018b,[15]

Chapter Summary

The Hoh Tribe, the people of the Hoh River, from time immemorial, have lived near the mouth of the Hoh River. They are heavily dependent economically, culturally and spiritually on the natural resources found within its watershed for hunting, fishing and gathering. This basin supports all five species of Pacific salmon, cutthroat and bull trout, as well as many other fish and wildlife species.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org.*

It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Road Density

Since 2016, road density has increased and now all 7 watersheds outside the Olympic National Park, representing about 80% of the land area, may not be properly functioning because of high road density values that exceed 3 miles per square mile.

Road Crossings

Of the 299 culverts identified under the Road Maintenance and Abandonment Plan (RMAP) in the Hoh Area of Interest, 240 (or 80%) have been fixed while the other 59 (or 20%) remain barriers to fish passage. This suggests that the RMAP program appears to be working. However, there are 134 non-forestland barrier culverts, of which 67 (or 50%) are totally impassable to fish.

Timber Harvest

Since 2016, about 18.3 square miles of forestlands have either been harvested or will soon be harvested in the Hoh Tribe's Area of Interest with 6.1 square miles (or 33%) within state-owned lands and 12.2 square miles (or 67%) within private forestlands.

Between 2011 and 2015, a total of 62.4 square miles of forestlands were harvested with an overall harvest rate of 12.5 square miles per year, while the rate dropped to about 6.1 square miles per year since 2016.

Invasive Species

Invasive plant species continue to be present in the riparian zones of the Hoh Area of Interest. Knotweed is no longer as widely prevalent as in previous years, most likely a result of the control measures carried out by the Hoh Tribe and others. Instead, Scotch broom, reed canarygrass, herb Robert, tansy ragwort and Canada thistle are now more dominant and could threaten the relatively healthy wild salmon populations in the area.

Hoh River Streamflow

The Hoh River continues to experience increasing fluctuations in flow. Peak flow values show an increasing trend while low flows are decreasing. This is similar to the trends in the 2016 State of Our Watersheds Report. If both trends continue as anticipated under predicted climate change conditions, they may pose a significant impact to salmonid runs in the Hoh River.

Water Quality

Streams in the Hoh Area of Interest continue to be impaired by high water temperature with 14 water bodies placed on the list for water temperature pollution, 2 more than reported in the 2016 State of Our Watersheds Report. Also, eight of the nine streams monitored by the Hoh Tribe since 2006 have widespread maximum temperature exceedances that will likely have a negative impact on salmonid production in those watersheds. While there appears to be some improvement with respect to bacteria and pH pollution, water temperature continues to be a major problem.

Climate Change Impacts on Glaciers

Many of the glaciers in the Hoh watershed are retreating or going extinct. The rate retreat has accelerated recently as a result of climate change caused by carbon pollution, so that from 1981 to 2015, they shrunk by 40%. This will have a serious impact on streamflows, the year-round availability of clean, cold water, and healthy riparian forests on which fish depend for survival in the Hoh River watershed.

Ocean Conditions

The marine Areas of Interest for the Hoh Tribe have been heavily impacted by ocean warming, including marine heatwaves, hypoxia and harmful algal blooms. For instance, dissolved oxygen levels of up to 33% and 55% of the season have been recorded for north of the Hoh River and off Kalaloch Beach, respectively. These adverse marine conditions caused the tribe to declare a fisheries economic disaster for their 2015 fall coho fishery which had very poor returns. Also, razor clam harvest from the Kalaloch beach area has been limited in recent years.

Conclusion

There have been a number of restoration successes in the Hoh River and independent tributaries since the 2016 State of the Watershed report. Forest road barriers have been repaired to be benefit of landowners and salmon, forest cover has increased, Japanese knotweed infestation has been reduced, and restoration is occurring.

At the same time, the incremental decline in low flow conditions and increases in peak flow conditions raises concerns with the changing climate conditions. Although restoration is occurring, it is not enough to keep up with the impacts of a growing population and their resource demands from the watershed. People have to be held accountable to protecting, conserving and improving fish habitat in their land use decisions, and federal, state and local governments all have a role in that. Implementation includes education and voluntary action, but it also needs to include enforcement when those laws are broken. The future of tribal treaty rights in the Hoh River watershed depends on it.

Landscape-Scale Challenges Difficult to Address

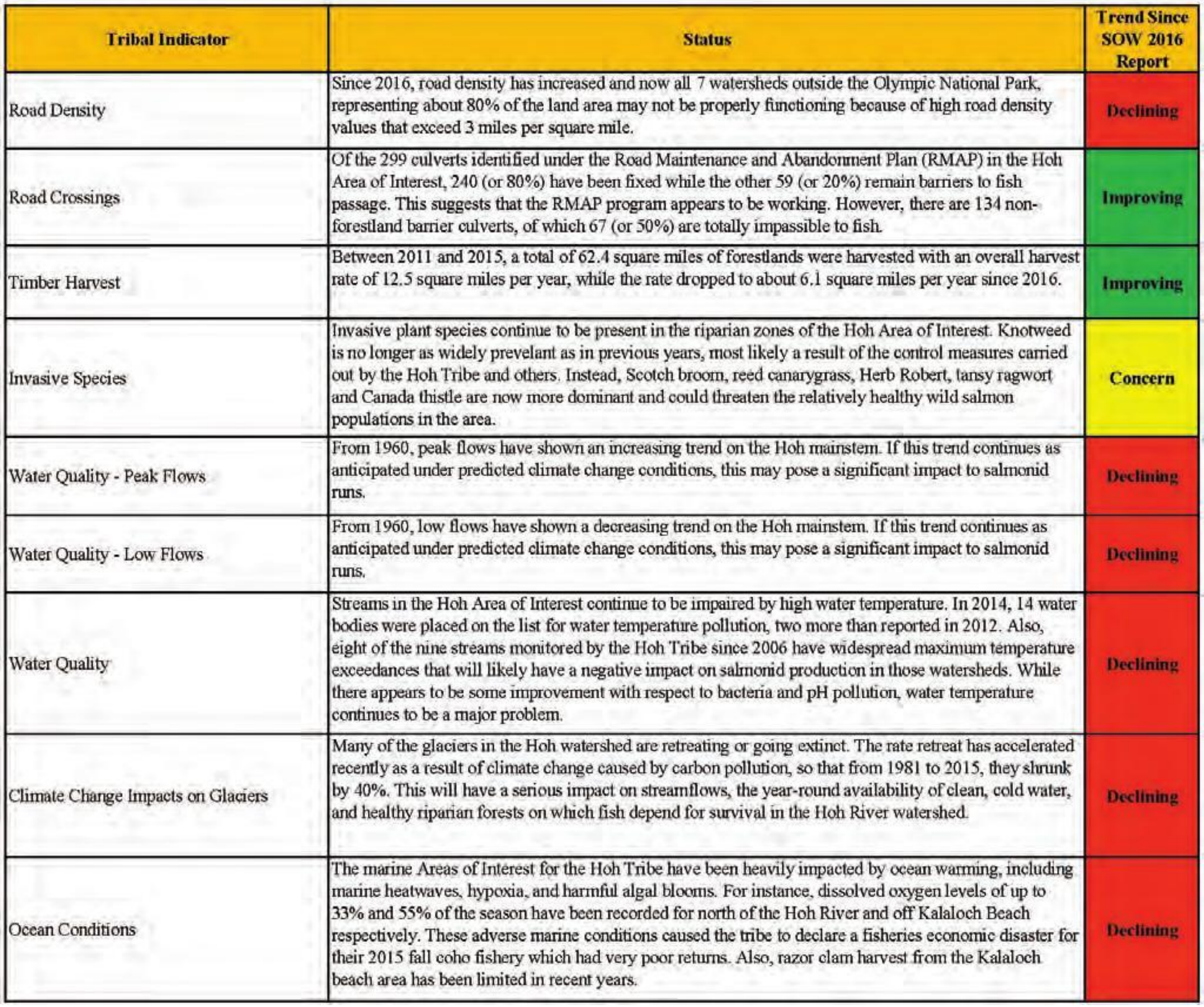
A review of key environmental indicators for the Hoh basin area shows a reduction in the number of forest practice applications, and the removal of forest road barriers and invasive species, but degradation of water quantity and quantity, climate and ocean conditions.

There is a misconception that the Hoh watershed is relatively pristine and its fish stocks are healthy, but the system has been heavily impacted by timber harvests, road construction, infrastructure protection and other anthropogenic influences.

In spite of efforts to improve fish access, current and past logging practices continue to degrade fish habitat, water quality, hydrologic function and other ecological processes.

In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trend for these key environmental indicators since the 2016 State of Our Watersheds Report shows improvement for some indicators, while there remains a steady loss for several landscape-scale indicators in habitat status:



Tribal Indicator	Status	Trend Since SOW 2016 Report
Road Density	Since 2016, road density has increased and now all 7 watersheds outside the Olympic National Park, representing about 80% of the land area may not be properly functioning because of high road density values that exceed 3 miles per square mile.	Declining
Road Crossings	Of the 299 culverts identified under the Road Maintenance and Abandonment Plan (RMAP) in the Hoh Area of Interest, 240 (or 80%) have been fixed while the other 59 (or 20%) remain barriers to fish passage. This suggests that the RMAP program appears to be working. However, there are 134 non-forestland barrier culverts, of which 67 (or 50%) are totally impassible to fish.	Improving
Timber Harvest	Between 2011 and 2015, a total of 62.4 square miles of forestlands were harvested with an overall harvest rate of 12.5 square miles per year, while the rate dropped to about 6.1 square miles per year since 2016.	Improving
Invasive Species	Invasive plant species continue to be present in the riparian zones of the Hoh Area of Interest. Knotweed is no longer as widely prevelant as in previous years, most likely a result of the control measures carried out by the Hoh Tribe and others. Instead, Scotch broom, reed canarygrass, Herb Robert, tansy ragwort and Canada thistle are now more dominant and could threaten the relatively healthy wild salmon populations in the area.	Concern
Water Quality - Peak Flows	From 1960, peak flows have shown an increasing trend on the Hoh mainstem. If this trend continues as anticipated under predicted climate change conditions, this may pose a significant impact to salmonid runs.	Declining
Water Quality - Low Flows	From 1960, low flows have shown a decreasing trend on the Hoh mainstem. If this trend continues as anticipated under predicted climate change conditions, this may pose a significant impact to salmonid runs.	Declining
Water Quality	Streams in the Hoh Area of Interest continue to be impaired by high water temperature. In 2014, 14 water bodies were placed on the list for water temperature pollution, two more than reported in 2012. Also, eight of the nine streams monitored by the Hoh Tribe since 2006 have widespread maximum temperature exceedances that will likely have a negative impact on salmonid production in those watersheds. While there appears to be some improvement with respect to bacteria and pH pollution, water temperature continues to be a major problem.	Declining
Climate Change Impacts on Glaciers	Many of the glaciers in the Hoh watershed are retreating or going extinct. The rate retreat has accelerated recently as a result of climate change caused by carbon pollution, so that from 1981 to 2015, they shrunk by 40%. This will have a serious impact on streamflows, the year-round availability of clean, cold water, and healthy riparian forests on which fish depend for survival in the Hoh River watershed.	Declining
Ocean Conditions	The marine Areas of Interest for the Hoh Tribe have been heavily impacted by ocean warming, including marine heatwaves, hypoxia, and harmful algal blooms. For instance, dissolved oxygen levels of up to 33% and 55% of the season have been recorded for north of the Hoh River and off Kalaloch Beach respectively. These adverse marine conditions caused the tribe to declare a fisheries economic disaster for their 2015 fall coho fishery which had very poor returns. Also, razor clam harvest from the Kalaloch beach area has been limited in recent years.	Declining

The Hoh Tribe continues to work toward the protection and restoration of healthy and functional watersheds and the ocean conditions, with a focus on protection while restoring critical habitat. The tribe also continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

Salmon need cool, clean and highly oxygenated water to survive. Even in an area as rural as the Hoh watershed, land management activities threaten salmon survival and the future of the Hoh people who depend on them culturally and economically.

Elevated stream temperature is one of the cumulative effects of land management activities, which have altered surface water runoff, groundwater recharge, streamside plant communities and in-channel structures such as logjams.

In all likelihood, continued land management activities will preclude many streams from a complete recovery of natural temperature conditions. What salmon need, people need too. To ensure a future for the next seven generations, land management rules already in place need enforcement and those that are not adequate to protect fish need to be adapted to do so.

The Hoh River basin continues to support native runs of salmonid species, but there are significant anthropogenic and natural habitat threats. In particular, land-use practices associated with forestry activities continue to alter watershed processes, resulting in stream-channel degradation. Streamflow changes and high water temperature values are affected by both forest activities and climate change. The protection and restoration of fish habitat is needed to ensure that the currently declining salmon runs return to a healthy status.

While the Hoh Tribe continues to advocate for increased resource protection, inadequate support from state and federal regulatory agencies is an ongoing hindrance.

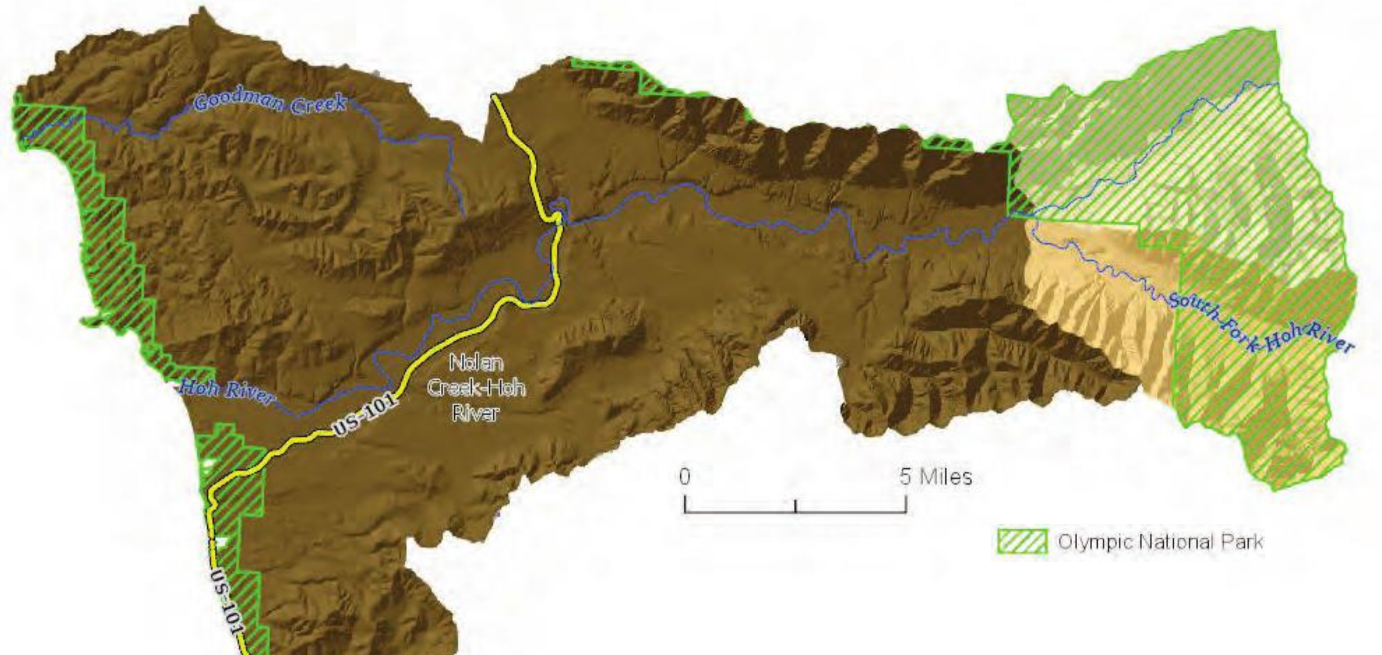
In an effort to address rapidly declining habitat conditions and severely impaired riverine processes, the Hoh Tribal Natural Resources Department is working with Jefferson County and several other local organizations on the development of a Hoh watershed restoration plan and a glacial geomorphic study. This plan will be used, in part, to seek funding for more environmentally compatible alternatives to common infrastructure protection techniques, such as riprap bank armoring. The Hoh Tribal Natural Resources Department also is in the process of planning and implementing habitat surveys in known degraded streams to develop a baseline for future stream and habitat health analysis.

Other efforts include implementation of the Hoh Water Adventure Camp which provides Hoh Tribal youth opportunities to learn about cultural and natural resources, as well as management concerns and strategies.

Hoh Tribe

Road Density

Since 2016, road density has increased and now all seven watersheds outside the Olympic National Park, representing about 80% of the land area, may not be properly functioning because of high road density values that exceed 3 miles per square mile.



Upper Hoh Road Washout

Joel Green, Hoh Tribe

If not properly constructed or maintained, forests roads can be a source of sediments to streams, degrading fish habitat and water quality.[1] Furniss et al.[2] concluded that the sediment contribution per unit area from roads is often much greater than all other forest activities combined. Stream crossings by roads can alter stream geomorphology and every intersection of a road with a fish-bearing stream represents a potential place with a barrier to fish passage.

Many studies have correlated road density or indices of roads to fish density or measures of fish diversity.[3] Cederholm et al.[4] found increases in fine sediment in fish spawning habitat when road density exceeded 2.5% of the Clearwater watershed. It has also been reported that the proper functioning of salmon bearing streams may be at risk when road densities exceed two miles of road per square mile of area and cease to function properly at densities over three miles per square mile.[5]

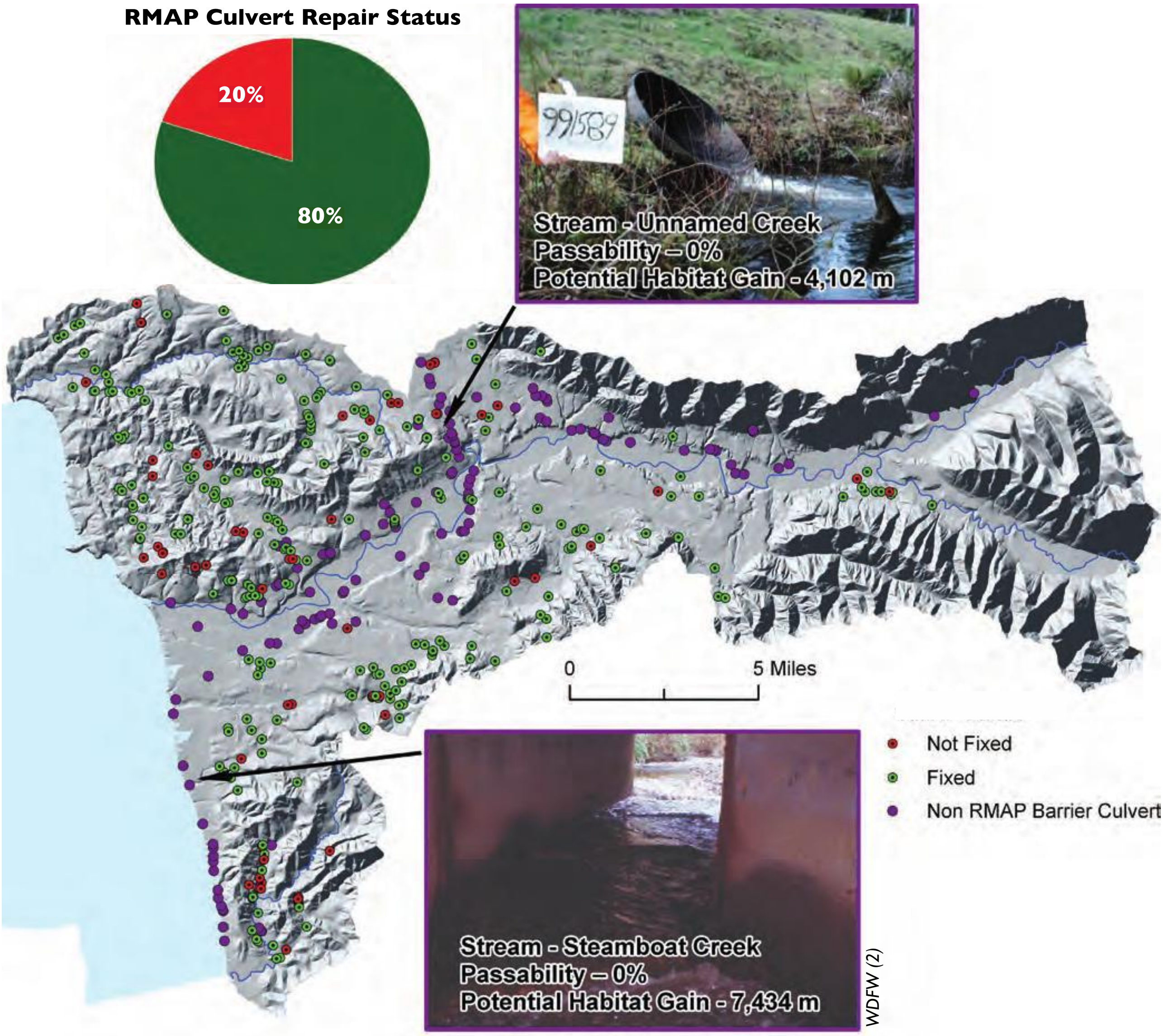
Road density values were over 3 miles per square mile in all watersheds outside the Olympic National Park where the values were less than 1 mile per square mile. A total of seven watersheds, representing about 80% of the land area may not be properly functioning because of high road density values that exceed 3 miles/square mile. In 2016, only six watersheds (or 72% of the land area) had such road densities. This is the direct result of the network of roads built notably for timber harvest. Road densities were highest in the Nolan Creek-Hoh River and Kalaloch Creek watersheds.

Map Data Sources: SSHIAP 2004,[6] WADNR 2016,[7] WADNR 2019,[8] WADOT 2018,[9] WAECY 2018[10]

HOH TRIBE

Road Crossings Impact Salmon

Of the 299 culverts identified under the Road Maintenance and Abandonment Plan (RMAP) in the Hoh Area of Interest, 240 (or 80%) have been fixed while the other 59 (or 20%) remain barriers to fish passage. This suggests that the RMAP program appears to be working. However, there are 134 non-RMAP barrier culverts of which 67 (or 50%) are totally impassable to fish.



WDFW (2)

In order to reduce the adverse effects of roads, Washington State Forest and Fish law requires most forest landowners to have a Road Maintenance and Abandonment Plan (RMAP). The RMAP is a method to evaluate forest roads, identify areas that do not meet forest practices rule standards, and schedule needed upgrades and/or repairs. Of the 299 culverts identified under the RMAP project in the Hoh Area of Interest, 240 (or 80%) have been fixed while the other 59 (or 20%) have yet to be repaired and remain barriers to fish passage. This suggests that road repairs on both state and private forestlands in this area are on schedule to be completed as mandated by the RMAP program. This will have a positive impact on fish habitat and water quality in the Hoh Area of Interest.

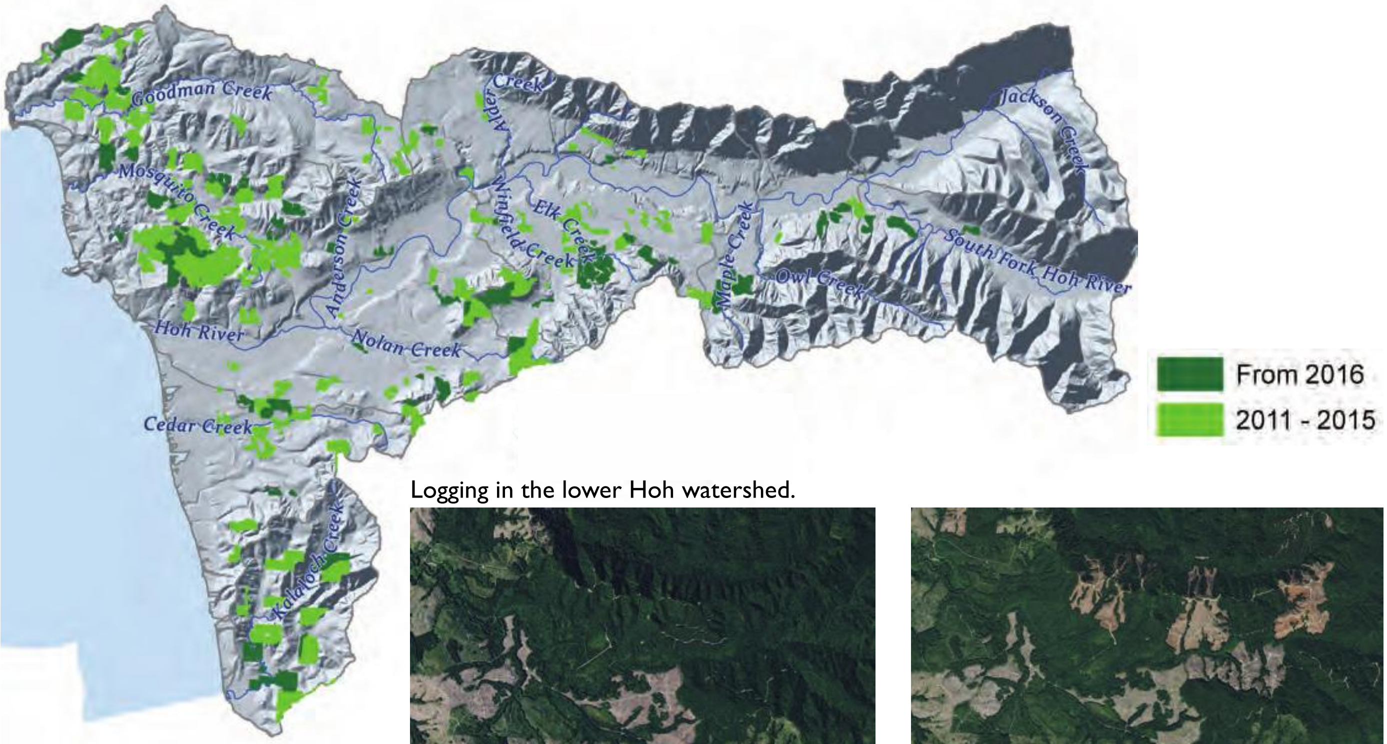
There are an additional 134 barrier culverts in the Hoh Area of Interest that are not part of the RMAP dataset but impede access to miles of stream suitable for salmon habitat. Of these, 67 (or 50%) are impassible to fish including one on Steamboat Creek which blocks 7,434 meters (4.6 miles) of potential coho and steelhead habitat.

Barrier culverts adversely impact fish migration, particularly on small streams because the water velocity is too high, flow is too shallow or there is a waterfall into or out of the culvert. Price et al.[1] reported one-third of culverts permitted under the hydraulic project approval (HPA) process for fish passage resulted in becoming a barrier to fish passage.

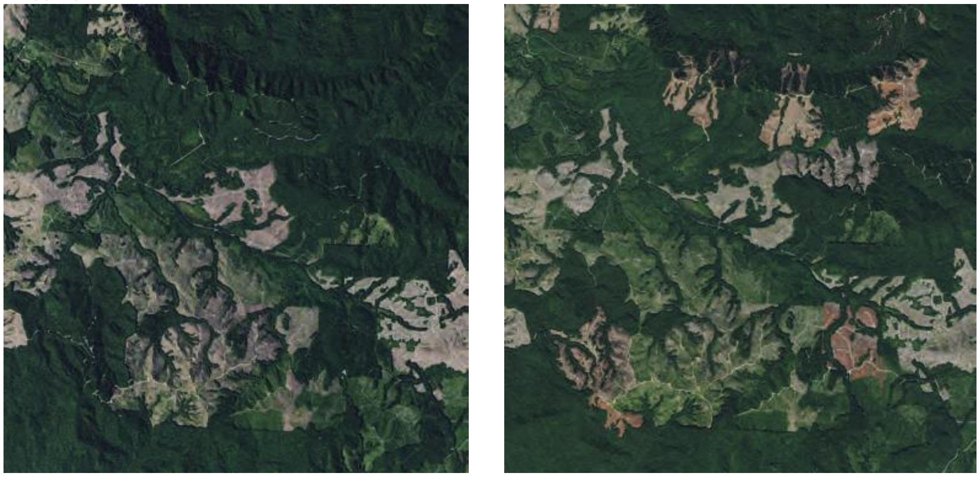
Map Data Sources: CSP 2019,[2] SSHIAP 2004,[3] WADFW 2019,[4] WADNR 2019,[5] WAECY 2018[6]

Timber Harvest Activities

Since 2016, about 18.3 square miles of forestlands have either been harvested or will soon be harvested in the Hoh Tribe's Area of Interest with 6.1 square miles (or 33%) within state-owned lands and 12.2 square miles (or 67%) within private forestlands. Between 2011 and 2015, a total of 62.4 square miles of forestlands were harvested with an overall harvest rate of 12.5 square miles per year, while the rate dropped to about 6.1 square miles per year since 2016.



Logging in the lower Hoh watershed.


2015

2017

NAIP (2)

Forest practice activities within the Hoh Tribe's Area of Interest directly influence watershed vegetation through creating access to, as well as removal and re-establishment of forest vegetation. The removal of vegetation has resulted in poor large woody debris and riparian conditions in the basin.

Debris flows are common and devastating, resulting in scoured, incised channels with little spawning gravel for salmon. The WRIA 20 Watershed Plan recognizes that the significant conversion of forests to other uses as a threat to watershed planning and management objectives.

Forest practice applications filed for the purposes of cutting or removal of commercial timber products show that since 2016, about 18.3 square miles of forestlands have either been harvested or will soon be harvested. That includes 6.1 square miles (or 33%) in state-owned lands and 12.2 square miles (or 67%) in private forestlands. A large proportion of these activities were in the upper areas of the Winfield Creek, Elk Creek, and Maple Creek watersheds, plus in the Mosquito Creek and Kalaloch watersheds.

In the period between 2011 and 2015, a total of 62.4 square miles of forestlands were harvested in this area with 5.1 square miles (or 8%) within state-owned lands and 57.3 square miles (or 92%) within private lands. Between 2011 and 2015, the overall harvest rate was about 12.5 square miles per year, while the rate dropped to about 6.1 square miles per year since 2016.

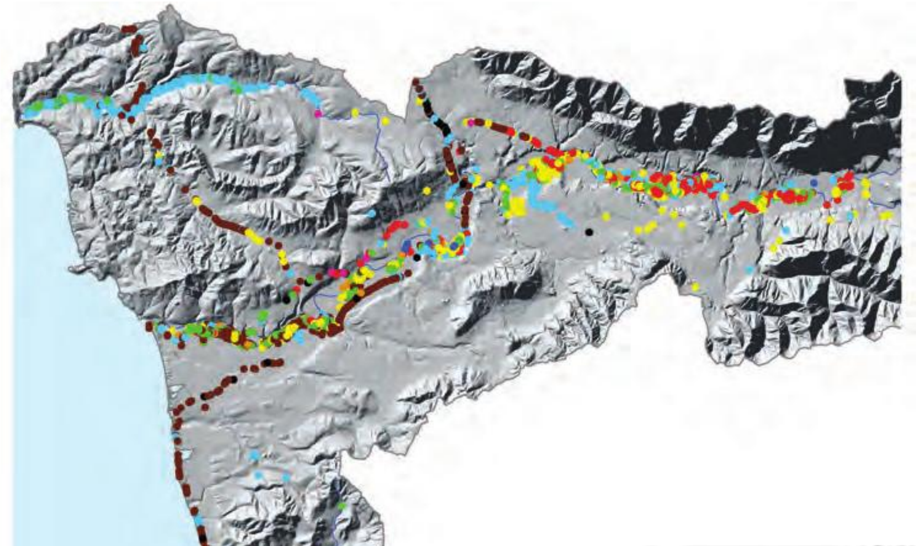
A study in the Hoh watershed revealed that timber harvesting significantly impacts peak and mean daily flow of streamflow at watershed, sub-basin and basin level. Similarly, reductions in hydrologic maturity with the resultant degradation of floodplain habitat and altered flow regime are significant habitat factors limiting salmonid production in this basin. These conditions may be improved by altering timber harvest rates. If sustained over a much longer period, the reduced timber harvest rate since 2016 may have a positive impact on fish habitat in the area.

Map Data Sources: SSHIAP 2004,[6] WADNR 2019,[7] WAECY 2018[8]

HOH TRIBE

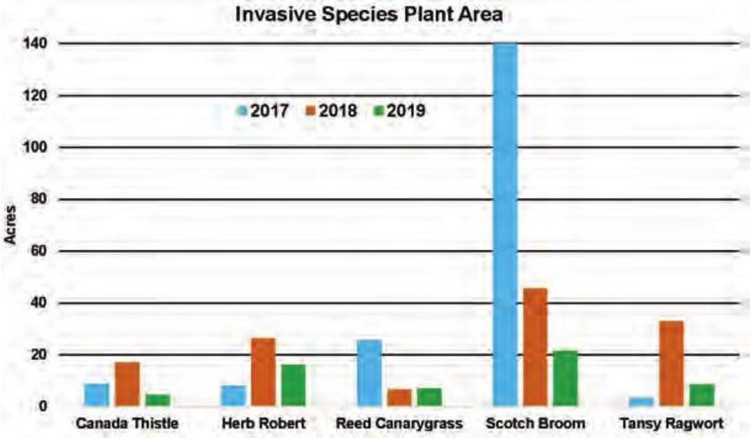
Invasive Species

Invasive plant species continue to be present in the riparian zones of the Hoh Area of Interest. Knotweed is no longer as widely distributed as in previous years, most likely a result of the control measures carried out by the Hoh Tribe and others. Instead, Scotch broom, reed canarygrass, Herb Robert, tansy ragwort, and Canada thistle are now more dominant and could threaten the relatively healthy wild salmon populations in the area.



Reed canarygrass

Jill Silver, 10,000 Years Institute



Since the last report, a more comprehensive inventorying and treatment of invasive species has been carried out in the Hoh Tribe's Area of Interest by the 10,000 Years Institute and their partners. As a result, the types and distribution of the invasive species differ significantly from previous reports in which the primary species of focus was knotweed (*Polygonum*).

Knotweed continues to be present in the riparian zone but its numbers have dropped and it is no longer as widely distributed, most likely a result of the control measures carried out by the Hoh Tribe and others in the watershed. In 2002, a multi-year effort was initiated by the tribe to completely eradicate these plants in nearly 30 river miles of the active Hoh River channel migration zone and adjacent terraces.[1] That effort resulted in the eradication of 99.5% of the plants.[2]

In terms of the areas occupied by invasive plant species, Scotch broom (*Cytisus scoparius*), reed canarygrass (*Phalaris arundinacea*), herb Robert (*Geranium robertianum*), tansy ragwort (*Jacobaea vulgaris*), and Canada thistle (*Cirsium arvense*) are now more dominant. Other species of note include St. John's Wort (*Hypericum perforatum*), Evergreen blackberry (*Rubus laciniatus*), Himalayan blackberry (*Rubus armeniacus*), and Smartweed (*Polygonum*). Although the period between 2017 and 2019 for which data from the new survey is limited, the trend seems to show a general reduction in the amount of area occupied by the plants.

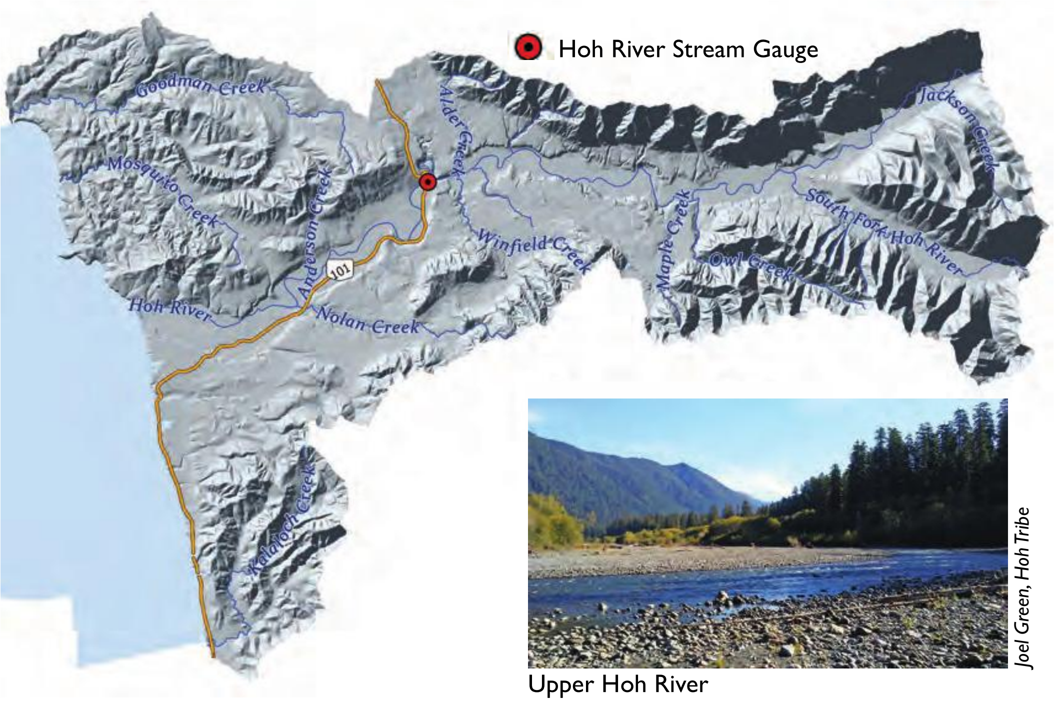
The Hoh River's support of relatively healthy wild salmon populations could be threatened by invasive plants that grow in the river's riparian zone. These plants are a problem because they are known to crowd out native species and alter riparian vegetative communities, disrupt nutrient cycling and reduce quality of litter inputs, and can cause long-term changes to the structure and functioning of the riparian forests and adjacent fish habitats.[3,4]

Map Data Sources: 10KYI 2019,[6] SSHIAP 2004,[7] WAECY 2018[8]

HOH TRIBE

Hoh River Streamflow

The Hoh River continues to experience increasing fluctuations in flow. Peak flow values show an increasing trend while low flows are decreasing. This is similar to the trends in the 2016 State of Our Watersheds Report. If both trends continue as anticipated under predicted climate change conditions, they may pose a significant impact to salmonid runs in the Hoh River.



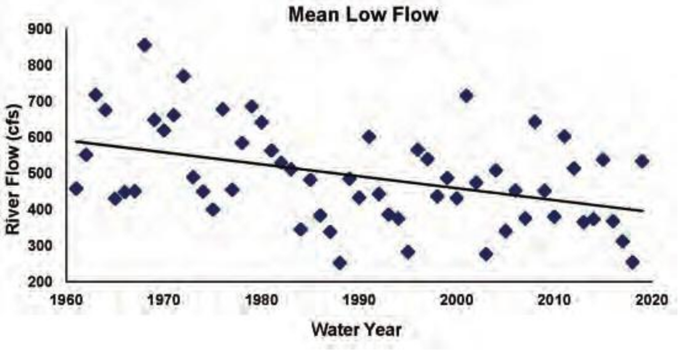
Upper Hoh River

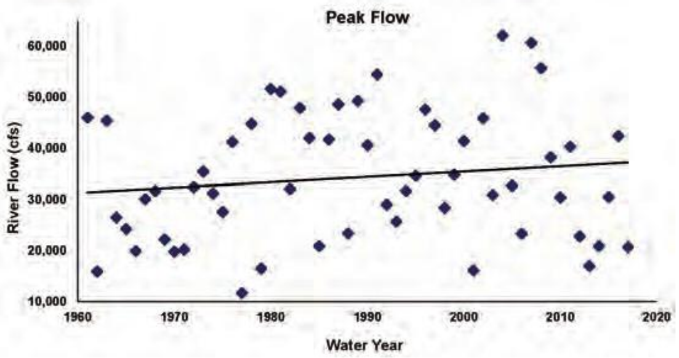
Over half a century of data from the Hoh River gauge at Highway 101 shows that the amount of the river's streamflow is changing. Peak flow values show increased winter streamflow while summer mean low flow values show a decreasing trend at precisely the time when streamflow is needed the most and when water temperatures are at their highest. This is similar to the trends in the 2016 State of Our Watersheds Report. Both trends have been predicted to occur because of climate change and this may indicate that salmon habitat and other aquatic ecosystem functions are not being adequately protected.

Lower flows and higher temperatures can be a limiting factor since they result in less suitable habitat for fish as well as impairment of upstream passage of salmon returning to spawn. Lower flows force adult fish to lay eggs in more exposed areas of the river channel, making the eggs more vulnerable to drying out and predation. Higher flows on the other hand, can scour eggs out of the gravel and create problems for emerging fry and juveniles.

A study[1] found that in a 40-year period, the seven-day minimum flow of the Hoh River decreased, on the average, at a rate of about 5 cubic feet per second (cfs) per year, although low flow data collected by the Hoh Tribe over a 14-year period for other streams shows no clear trend.

If the low flow trend continues as anticipated under predicted climate change conditions, this may pose a significant challenge to salmonid runs. A recent study[2] found that chinook salmon populations could be particularly vulnerable to such streamflow changes because spawning fish may show up when rivers are at their lowest levels. The WRIA 20 Watershed Plan[3] recommends that options for maintaining salmonid runs in the face of extended or recurring low flow periods be evaluated for all watersheds.



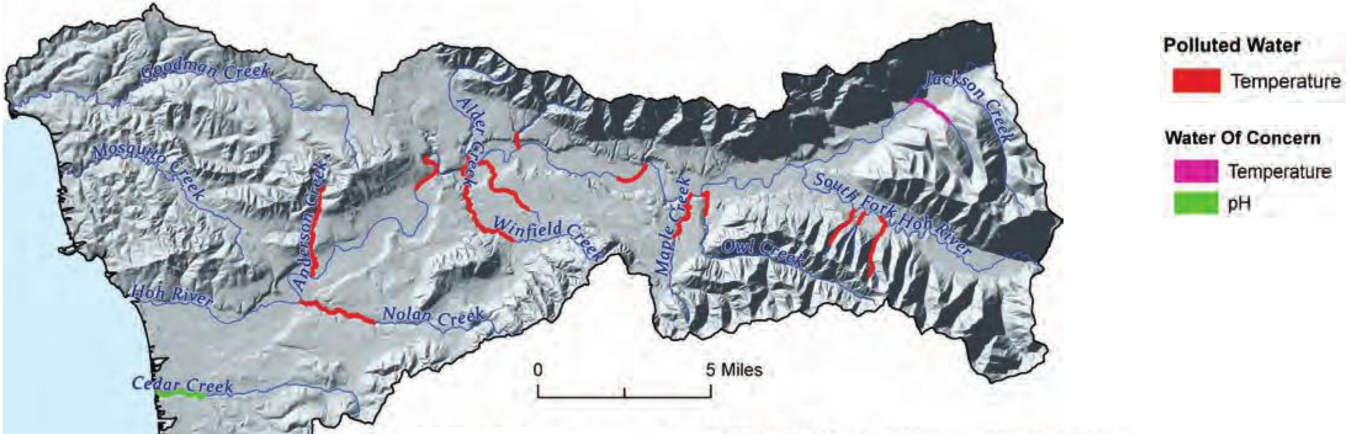


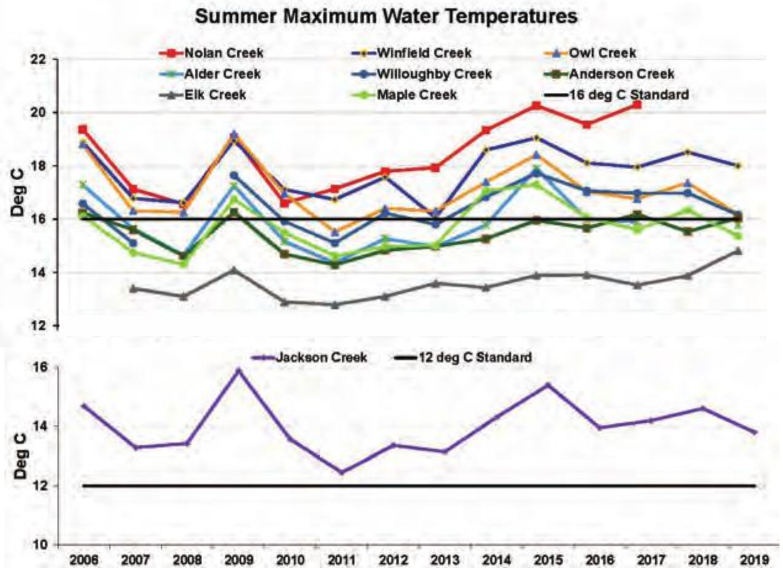
Map Data Sources: SSHIAP 2004,[4] USGS 2019,[5] WADOT 2018,[6] WAECY 2018[7]

HOH TRIBE

Water Quality is More Impaired

Streams in the Hoh Tribe's Area of Interest continue to be impaired by high water temperature, with 14 water bodies placed on the list for water temperature pollution, 2 more than reported in the 2016 State of Our Watersheds Report. Also, eight of the nine streams monitored by the Hoh Tribe since 2006 have widespread maximum temperature exceedances that will likely have a negative impact on salmonid production in those watersheds. While there appears to be some improvement with respect to bacteria and pH pollution, water temperature continues to be a major problem.





Joel Green, Hoh Tribe

Water quality technician Bernard Afterbuffalo measuring turbidity of a water sample at Owl Creek.

In the Hoh Area of Interest, 14 waterbodies are listed as impaired by water temperature pollution. In addition, 2 waterbodies are placed on the list of waters of concern for pH and 1 for temperature. In the 2016 State of Our Watersheds Report, there were 12 listings for water temperature pollution and 1 for bacteria while 4 waterbodies were placed on the list of concern for pH and another 2 for temperature. There appears to be some improvement with respect to bacteria and pH, but water temperature pollution continues to be a major problem.

Streams in the Hoh Tribe's Area of Interest were monitored by the Tribe for water temperature values between 2006 and 2019 to determine compliance with Washington State's water quality standards (Chapter 173-201A WAC).[1] The 7-day average of the daily maximum temperature (7-DADM) values for 8 of the 9 streams with long-term monitoring showed widespread exceedances and therefore potential violations of the standards.

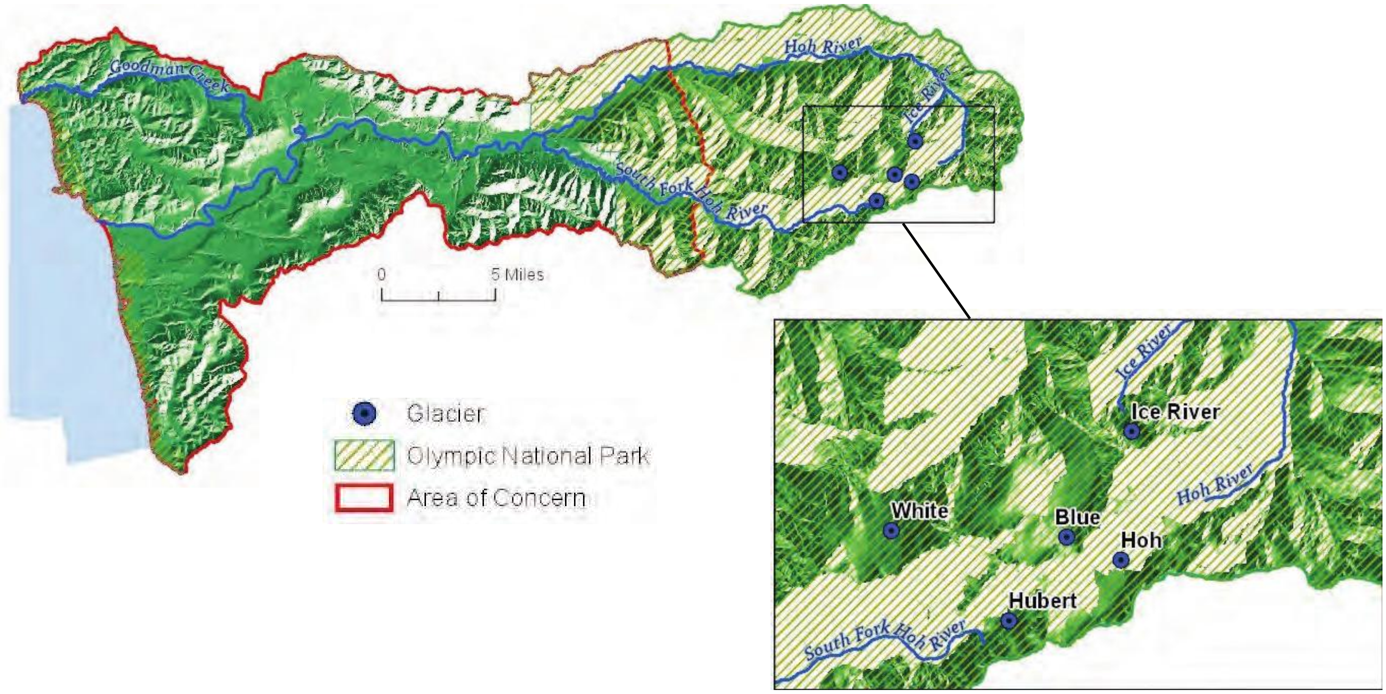
In all 13 years, Jackson Creek had 7-DADM values that exceeded the 12oC standard for "Char Spawning and Rearing". Similarly, Winfield Creek had values that failed the 16oC standard for and "Core Summer Salmonid Habitat" for all 13 years while the Nolan Creek values failed the standard for the 11 years for which data was available. Owl Creek had exceedances in all but one year while Willoughby Creek has failed the standard continuously in the last 6 years. The one notable exception to this general trend was Elk Creek whose relatively intact riparian vegetation may have helped to keep the water temperatures low.

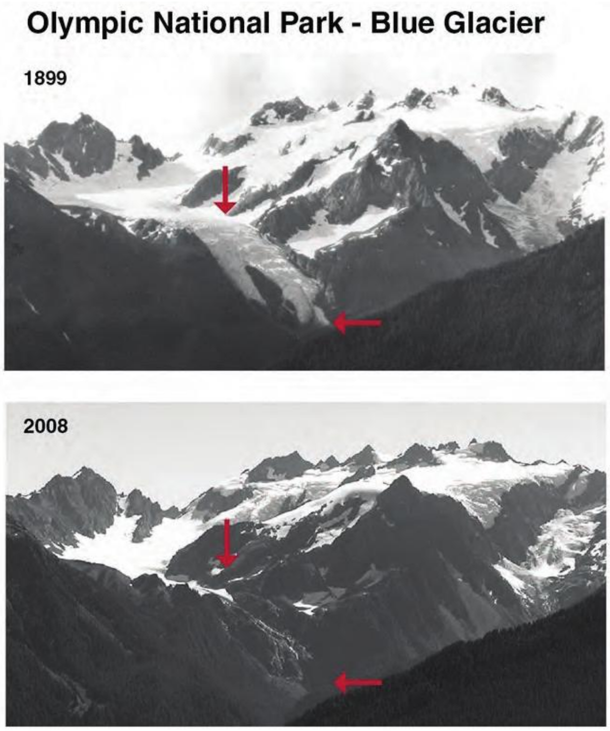
Generally, these exceedances were more common in the last five years. These water temperature impairments will likely have a significant negative impact of fish survival and production in these watersheds since salmonids require cool and well-oxygenated water.

Map Data Sources: Hoh 2020,[2] WAECY 2016,[3] SSHIAP 2004,[4] WAECY 2018[5]

Climate Change Impacts on Glaciers

Many of the glaciers in the Hoh watershed are retreating or going extinct. The rate of retreat has accelerated recently as a result of climate change caused by carbon pollution. From 1981 to 2015, they shrunk by 40%. This will have a serious impact on streamflows, the year-round availability of clean, cold water and healthy riparian forests on which fish depend for survival in the Hoh River watershed.





Jim Patterson, Olympic National Park

Comparison photographs show thinning and retreating of the Blue Glacier which contributes a significant amount of water to the Hoh River.

The glaciers of the Olympic Mountains helped sculpt the beautiful landscape of the Olympic National Park. About 66% of the glaciers in Olympic Mountains is found in the Hoh watershed[1] and help maintain the Hoh rainforest. They include the Hoh, Blue, Ice River and Hubert glaciers. Their cold water combines with snow to feed rivers and forests which salmon, bull trout and other species depend on. As a result of rising temperatures, some of these glaciers are retreating or going extinct.

Blue Glacier, one of the largest in the Olympic National Park, is a 2.6-mile long glacier that descends from the 7,980-foot Mount Olympus, the highest peak in the Olympic Mountains.[2] During the winter, most of the precipitation on Blue Glacier consists of snow. Because of its proximity to the Pacific Ocean in the spring and summer, the glacier receives a lot of rainfall in its upper reaches, therefore contributing a significant amount of cold, oxygenated water to the Hoh River.

But climate change is impacting this glacier. From 1948 to 1996, mean summer temperature increased 1° Celsius while the average January to March temperature at Blue Glacier increased by 3° celsius.[3]

It has been estimated that glaciers of the Olympic Mountains have shrunk by about 75% since 1900. The rate of glacier retreat has accelerated recently as a result of climate change caused by carbon pollution. From 1981 to 2015, they shrunk by 40%.[4] If the glaciers of the Olympic Mountains are all gone by the end of the century as predicted,[5] the impact on streamflows, the year-round availability of clean, cold water and healthy riparian forests in the Hoh River watershed will be dire. This will no doubt limit the productivity of salmon and steelhead in the watershed and threaten their ultimate survival.

Map Data Sources: SSHIAP 2004,[6] WAECY 2018[7]

HOH TRIBE

Ocean Conditions

The marine Areas of Interest for the Hoh Tribe have been heavily impacted by ocean warming, including marine heatwaves, hypoxia and harmful algal blooms. For instance, dissolved oxygen levels of up to 33% and 55% of the season have been recorded for north of the Hoh River and off Kalaloch Beach, respectively. These adverse marine conditions caused the tribe to declare a fisheries economic disaster for their 2015 fall coho fishery which had very poor returns. Razor clam harvest from the Kalaloch beach are also has been limited in recent years.

The marine Areas of Interest for the Hoh Tribe have been heavily impacted by ocean warming, including marine heatwaves (MHW), hypoxia and harmful algal blooms (HABs). In recent years, the California Current System (CCS) has experienced two major MHWs – the 2014-16 “Blob” and the 2019 event.

The 2014-16 MHW persisted for multiple years due to weak atmospheric circulation, and the presence of warm waters down to 300m deep. This MHW was aided by a strong El Nino event, which weakened upwelling and brought warm waters northward. The 2019 MHW coincided with a weak El Nino, and only lasted one year.

In 2015, the CCS experienced a prolonged, severe harmful algal bloom driven by the MHW. McCabe et al.[1] and McKibben et al.[2] have found that HABs in the CCS are strongly correlated with El Nino events, with the worst conditions occurring when southward winds drive upwelling of nutrient rich waters, followed by northward winds that drive downwelling and push these waters onshore, with the phytoplankton bloom that can accompany them.

Summertime hypoxia has been a growing concern on the Washington continental shelf, with more severe conditions to the south. Since 2006, Olympic Coast National Marine Sanctuary has deployed seasonal moorings off the Olympic Coast. Moorings to the north of Hoh River (off Teahwhit Head) recorded hypoxic conditions up to 33% of the season (average of 16%) and moorings to the south (off Kalaloch Beach) recorded hypoxic conditions up to 55% of the season (average of 28%).

Adverse marine conditions have caused the Hoh Tribe to declare a fisheries economic disaster[3] for their 2015 fall coho fishery, which had very poor returns.

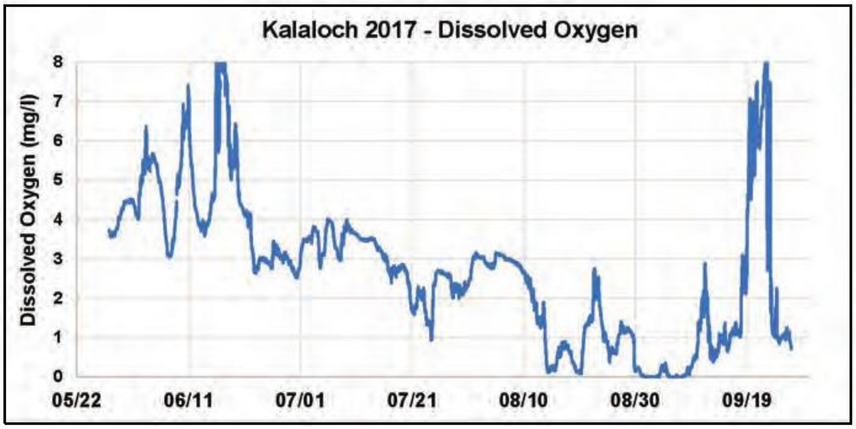
Tribal members have noted that they have been finding smaller razor clams than they have in the past. Razor clam harvest from the Kalaloch beach area has been limited in recent years due to a combination of HABs and limited numbers of adult clams, in spite of large numbers of juveniles being observed, indicating poor survival.

Tribal fishers have also noted that smelt are much harder to find now, however, no information is currently available for smelt populations on the Olympic Coast.

Lastly, the Hoh river channel has migrated to south over the past two years, limiting the amount of beach area for tribal use.

Debbie Preston, NWIFC

Dead fish on the Washington coast.



Map Data Sources: NOAA 2015,[3] NOAA 2018,[4] OCNMS 2020[5]

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4 Yale Climate Connections. 2020. Glaciers in the Olympic Mountains Could Vanish by End of This Century. Retrieved from https://www.yaleclimateconnections.org/2020/01/glaciers-in-the-olympic-mountains-could-vanish-by-end-of-this-century/

5 Yale Climate Connections. 2020. Glaciers in the Olympic

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6 SSHIAP. 2004. Hillshade derived from University of Washington Digital Elevation Model (OEM). Olympia, WA: Northwest Indian Fisheries Commission.

7 WAECY 2018. NHD Major Areas, Streams, and Waterbodies. 1:24000. From U.S. Geological Survey (in cooperation with others) National Hydrography Dataset. Olympia, WA: Washington Department of Ecology.

Ocean Conditions

1 McCabe, R. M., B. M. Hickey, R. M. Kudela, K. A. Lefebvre, N. G. Adams, B. D. Bill, F. M. D. Gulland, R. E. Thomson, W. P. Cochlan, and V. L. Trainer. 2016. An unprecedented coastwide toxic algal bloom linked to anomalous ocean conditions, Geophys. Res. Lett., 43, 10,366–10,376, doi:10.1002/2016GL070023.

2 McKibben, S.M., W. Peterson, A.M. Wood, V.L. Trainer, M. Hunter, A.E. White. 2017. Climatic regulation of the neurotoxin domoic acid, PNAS, 114 (2) 239-244; DOI: 10.1073/pnas.1606798114

3 NOAA. 2015. June 2015 Sea Surface Temperature anomaly. Retrieved from https://coastwatch.pfeg.noaa.gov/erddap/griddap/osu2SstAnom.graph and https://coastwatch.pfeg.noaa.gov/erddap/search/index.html?page=1&itemsPerPage=1000&searchFor=OSU%20MODIS%20Climatology

4 NOAA. 2018. Fishery Disaster Determinations. National Oceanic and Atmospheric Administration. https://www.fisheries.noaa.gov/national/funding-and-financial-services/fishery-disaster-determinations

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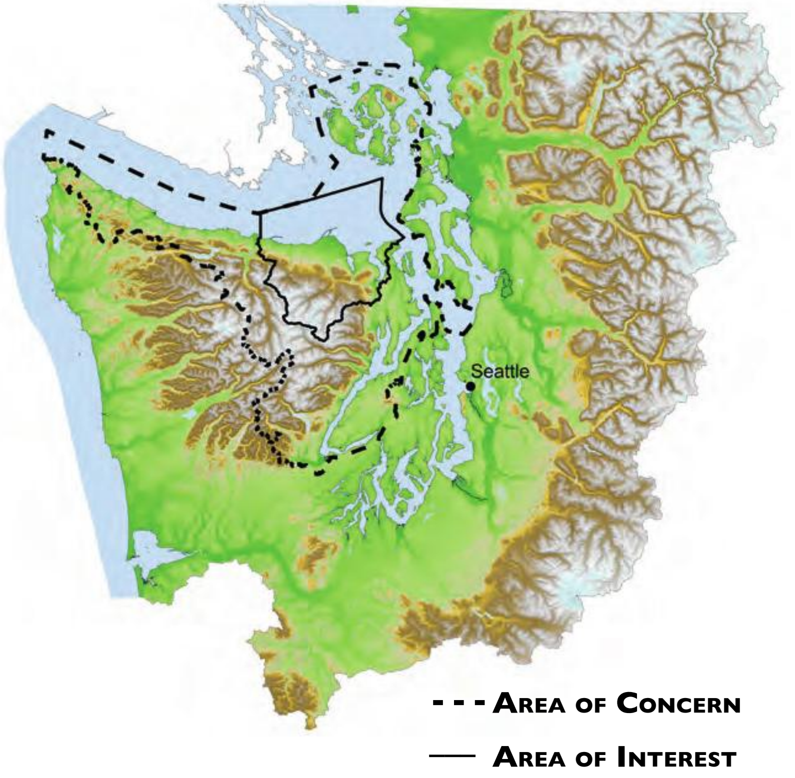
2020 State of Our Watersheds Report
Dungeness – Morse Watersheds

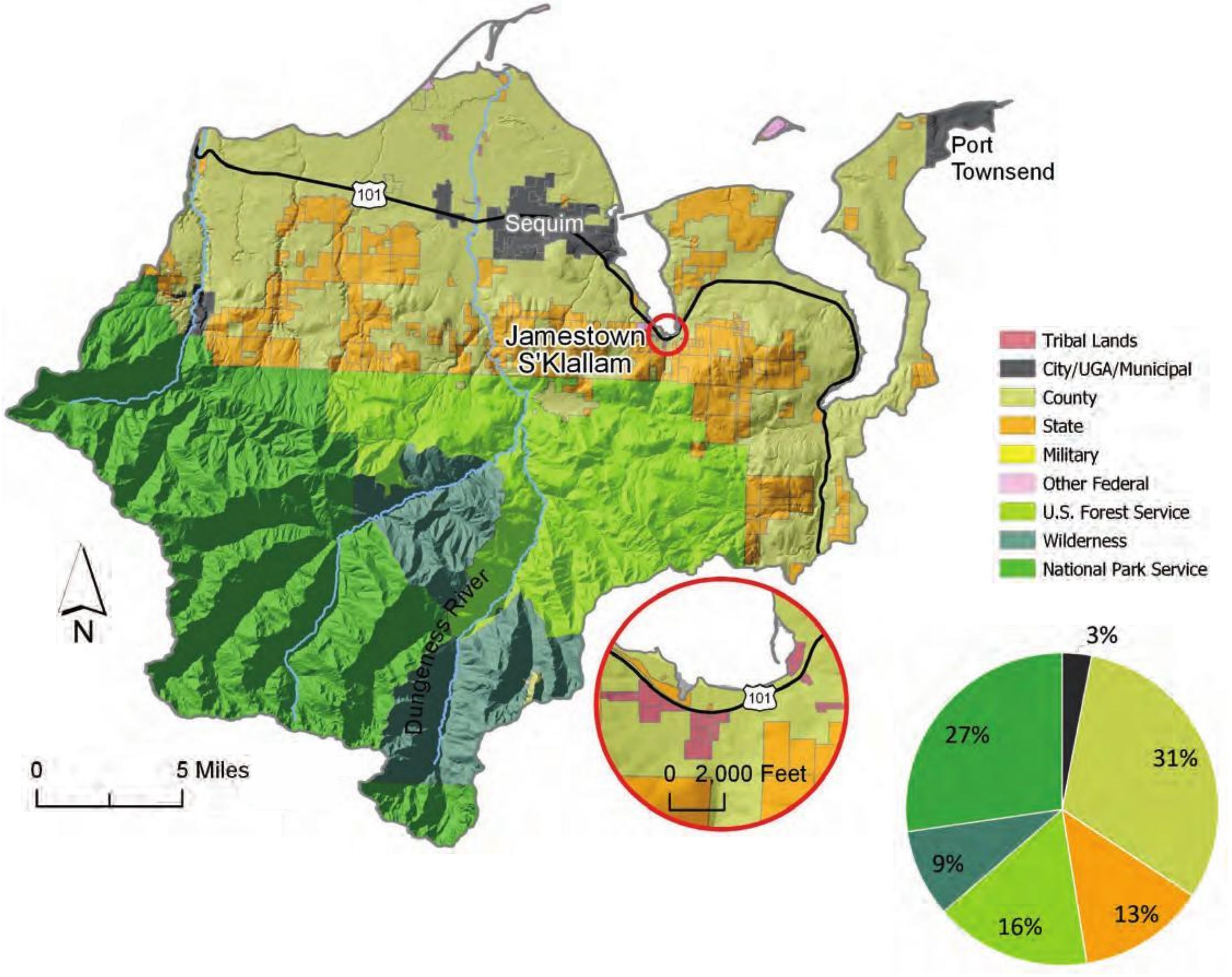
> *Are we worried and disappointed about climate change, water resources and the state of salmon habitat? Yes, we are, but we refuse to be discouraged. We'll keep at it because salmon will always be who we are.*
>
> **– W. Ron Allen**
> **Chairman**



Jamestown S'Klallam Tribe

The Jamestown S'Klallam people have been living in these areas since time immemorial in winter and summer communities along or near the shore of the Strait of Juan de Fuca and Hood Canal. As part of their way of life, the Jamestown S'Klallam people have fished and hunted in these areas for cultural, spiritual and economic reasons, and continue to do so today. These watersheds and coastal areas have been impacted by commercial forestry, agriculture, rural and urban development, which impacts important habitat for salmonids and steelhead, among other species. Development in the floodplain also has altered the hydrologic conditions of the floodplain to the detriment of salmonid production. The Jamestown S'Klallam are working hard toward recovery in this region since it is so critical.

Jamestown S'Klallam Tribe



The Jamestown S'Klallam Tribe's area of primary interest for this report is in the northeast corner of the Olympic Peninsula, including portions of the Quilcene-Snow and Dungeness-Elwha drainage areas, which reside in the rain shadow of the Olympic Mountains. These watersheds include the Dungeness River, whose headwaters are located in the Olympic National Park and U.S. Forest Service wilderness areas, plus other smaller independent drainages, all emptying into the Strait of Juan de Fuca.

The S'Klallam were the first human inhabitants in the eastern Strait region where they had villages and fishing camps along the shorelines and near the mouths of major streams, enjoying the benefits of the plentiful fish and shellfish resources.

With the signing of the Point No Point Treaty of 1855, the S'Klallam tribes retained the right to fish, hunt and gather in their Usual and Accustomed areas. These treaty-reserved rights were affirmed by Judge Boldt in the *U.S. v. Washington* ruling (the Boldt decision), in the 1994 ruling by Judge Rafeedie affirming tribal shellfish harvest, and several other court cases.

However, by 1855, Euro-Americans had begun settlements around sawmills in the region, logging old-growth timber that dominated the landscape and farming the lower Dungeness River floodplains.

Today, a plethora of human impacts have degraded Dungeness River salmon habitat, as well as habitat of other independent tributaries to the Strait and the accompanying nearshore environment.

These impacts include agricultural water withdrawals, shoreline bank armoring, riparian clearing and sediment impacts, and contribute greatly to the decline of Dungeness salmon and char.

While the tribe and other stakeholders are making significant gains in restoring our focus area of habitat, one of the direst impacts – the loss of floodplains – has mostly eluded correction. The tribe remains committed to salmon recovery, but has been increasingly reliant on shellfish harvests.

Map Data Sources: USFWS 2014,[3] WAECY 2011,[4] WAECY 2018,[5] WAECY 1994,[6] WADNR 2018,[7,8,9] WADOT 2018,[10]

Chapter Summary

The Jamestown S'Klallam Tribe has fished, hunted and gathered in their watersheds in western Washington since time immemorial and are leaders in the state's salmon recovery effort, especially in the Olympic Peninsula and Hood Canal regions. The S'Klallams, among other tribes, have taken a large role not only culturally, but also scientifically to understand these watersheds because of their significance to their people and their children's future. The tribe believes if salmon and shellfish are to survive, real gains in habitat protection and restoration must be achieved.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on this.

The 2020 State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (the Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the salmon resource. The goal of this report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun collectively by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org.*

For this report, the Jamestown S'Klallam Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss, degradation and water quality. This document is considered a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Nearshore Habitat Loss Continues due to Shoreline Armoring

Since the 2016 State of Our Watersheds Report, an additional 1.5 miles of armored shoreline has been identified in the tribe's Area of Interest. Docks, bulkheads, riprap and other forms of shoreline armoring severely affect the fish and other wildlife that depend on these areas for nursery, habitat and breeding grounds. With increasing populations, shoreline armoring is likely to increase as well. However, the tribe is working to preserve and protect the nearshore environment from developments that would armor it.

Forage Fish Habitat is on a Decreasing Trend

Sand lance, surf smelt, and Pacific herring are essential for the survival of many species in the sound including ESA-listed salmon stocks. The spawning grounds for these forage fish continues to dwindle due to shoreline armoring. Currently, 19.1% of their preferred spawning grounds are armored. This is a 5% increase relative to the total shoreline analyzed since the 2016 State of Our Watersheds Report.

Forest Cover Increases

Forest cover in the Area of Interest increased by 4.7 square miles since the 2016 State of Our Watersheds Report. Much of the area analyzed borders national park and wilderness land. Nearly 60 sub-watersheds in the area have moderate, poor or severely damaged forest cover. Clearcutting and land conversion to developed areas impairs the natural function of connected, healthy forests.

Impervious Surface Increases Slow

Within the tribe's Area of Interest, impervious surfaces have increased by only 0.23% since the 2016 State of Our Watersheds Report. Of the 104 sub-watersheds, 13 have degrading watershed health (12-40% impervious surface area).

Climate Change Models Predict Rising Seas

With sea level rise predictions ranging from 0.9 to 5.1 feet by the end of the century, the Jamestown S'Klallam are preparing for change. Climate change could negatively affect the tribe's resources, economy, infrastructure and health. The Jamestown Climate Vulnerability Assessment and Adaptation Plan analyzes the potential impacts of climate change and outlines measures that the tribe will implement to mitigate these impacts.

Dungeness Floodplain Restoration Continues

Before 1963, the Lower Dungeness floodplain was over 700 acres but in 2019, only 169 acres remain intact. Massive river dikes block the natural flow and processes of the river. The Jamestown S'Klallam Tribe has been working for more than 30 years to restore the floodplain. A properly functioning floodplain is essential for salmon habitat.

Biotoxins Remain Persistent in Sequim Bay

Harmful algal blooms make shellfish toxic for consumption. The tribe monitors these blooms and issues harvest closures when toxicity thresholds are exceeded. Long-term data collection will help to identify what causes these blooms. The tribe will conduct a pilot study in 2021 that adds phytoplankton and nutrient sampling to already existing WDFW zooplankton monitoring programs.

Conclusion

The biggest of success (and on-going need) is in the Dungeness River watershed and estuary. The tribe has been instrumental in coordinating with partners and restoring much of the area in and along the river and estuary. However, more work needs to be done so that the salmon and other critical fish and wildlife can return. Lack of funding and community education continues to hinder progress. Nearshore and riparian restoration has been implemented and been successful, and should be used as a model for other areas in the watershed. At the same time, the incremental decline in habitat conditions across the watershed in their Area of Interest has continued. Too much nearshore habitat remains armored, impervious surfaces continue to expand as populations increase, habitat conditions for forage fish and herring continue to decline, and harmful algal blooms are making shellfish toxic for consumption. Restoration is not enough to keep up with the impacts of a growing population and their land use in the watershed. People have to be held accountable to protecting, conserving and improving fish habitat in their land use decisions, and federal, state and local governments all have a role in that and are encouraged to work with the tribe. Land use and water laws that are in place and meant to protect critical areas and fish habitat need to be implemented. Implementation includes education and voluntary action, but it also needs to include enforcement when those laws are broken. The future of tribal treaty rights in this area depends on it. The tribe is working toward climate resilience, through monitoring and evaluation of impacts to their tribally owned land and the surrounding areas where they hunt and fish.

Key Indicators All Show Declining Habitat Conditions

At the 15-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Dungeness basin planning area shows that priority issues continue to be degradation of water quantity and quality, degradation of floodplain and riparian processes, and degradation of marine shoreline habitat conditions. In addition, there is a shortage of staff at all levels (e.g., federal, state, tribal and county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. Funding shortfalls for large-scale projects (e.g., Siebert Creek culvert replacement, Dungeness River floodplain restoration) contribute to the slow pace of progress.

Review of the status of these key environmental indicators since the 2016 State of Our Watersheds Report shows a steady loss in habitat status:

Tribal Indicator	Status	Trend Since SOW 2016 Report
Shoreline Modifications/Forage Fish Impacts	Since reported in 2016, the amount of armored marine shoreline has increased by 2% relative to the total coastal shoreline analyzed (501,500 feet). Since that time the total length of armored shoreline has increased by an additional 8,698 feet.	**Declining**
Forage Fish	Since reported in 2016, shoreline armoring within documented sand lance, surf smelt, and Pacific herring habitats has increased by 5% relative to the total shoreline analyzed (260,720 feet). The total length of affected habitat along this shoreline has increased to 8,140 feet.	**Declining**
Forestland Cover	Forest cover increased by 4.7 square miles from 2011-2016. However, of the 104 sub-watersheds in this area, those with moderate, poor, or severely damaged forest cover increased from 55 sub-watersheds in 2011 to 56 sub-watersheds in 2016. Thirty-seven sub-watersheds had an overall loss of forest cover from 2011 to 2016.	**Declining**
Impervious Surface	With the exception of northern part of the Jamestown Tribe's Focus Area, many of the watersheds show little increase in impervious surface area from 2011 to 2016. However, the total impervious surface area has increased by 0.23% across their area. Four of the 113 sub-watersheds have a 1% to 4% increase in impervious surface area. Thirteen sub-watersheds have degrading watershed health (12-40% impervious surface area).	**Declining**
Climate Change	The 2013 Jamestown Climate Vulnerability Assessment and Adaptation Plan provides an assessment of vulnerabilities of tribal resources to the negative impacts of climate change. The plan also identifies adaptation measures and the tribe is working to complete these measures. Sea level rise, ocean acidification and climate models show potential for increased risks to critical habitats, tribal infrastructure and tribal health.	**Concern**

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

As the Jamestown S'Klallam Tribe looks ahead, the issues and indicators discussed in this report will remain as priorities needing attention and monitoring. The tribe continues to prioritize Dungeness River floodplain recovery. Other important work remains, including reducing armor along all marine shorelines to improve herring and forage fish spawning habitat, and juvenile salmon migration habitat. Other priority issues include the decrease in forest cover and the increase of impervious surface in important habitat areas.

The tribe is on the forefront of addressing tribal vulnerabilities and initiating preparation for climate change. As one of the first tribes in western Washington to complete a climate adaptation plan and vulnerability assessment, they have identified and prioritized areas where the changing climate conditions (i.e., changing precipitation patterns, sea level rise, ocean acidification) will leave their resources, infrastructure, economy and health most vulnerable.[1] Sea level rise models designed for their Area of Interest show potential damage and vulnerability to critical beaches, tribal infrastructure, main roads and emergency services. Additional impacts to the tribe include increased occurrence of shellfish poisoning associated with harmful algal blooms (which warmer conditions may favor) and potentially diminished health and wellness of tribal members.

One of the main problems in the Dungeness watershed, both for fish and humans, is low streamflows, especially in late summer when the highest demand for irrigation water coincides with peak chinook spawning.

The tribe has worked for many years with the irrigation community, as well as the Clallam Conservation District and Washington Department of Ecology, to reduce the impacts of irrigation by implementation of water conservation projects and other improved irrigation system efficiencies. Over the past 15 years, the irrigators have reduced their withdrawal by over 45% with the development and implementation of the Water Conservation Plan.[2] Progress has been made, but Dungeness flows are still inadequate for sustaining ESA-listed salmon species.

Currently an agreement between the Water Users Association and Washington Department of Ecology (September 2012) details allowed water uses and mitigation activity for irrigation. The agreement binds the irrigators to withdraw no more than 50% of the river flow, while always leaving at least 60 cubic feet per second (cfs), and to reduce their adjudicated certificates to 93.5 cfs. Urban and residential growth in the watershed relies almost entirely on groundwater sources that are hydraulically linked with the Dungeness River. The tribe is hopeful that the irrigators and community will continue to prioritize water conservation and develop additional solutions, such as the Dungeness off-channel reservoir.

In spite of outward appearances, the Sequim/Dungeness watershed is still degraded. Hydrological modifications of the Dungeness River, including a 3-mile-long Army Corps of Engineers levee and five private levees, have caused such significant aggradation in the lower river that flooding is a constant threat.


PNPTC

Forest cover at Fort Warden State Park

The tribe is hoping to continue to obtain funding to include floodplain restoration. Funding from the Puget Sound Acquisition and Restoration Fund and the Floodplains by Design initiative has been allocated for restoration efforts in the lower Dungeness River floodplain to restore and improve nearshore, estuary and floodplain conditions while reducing downstream flood risk. The project funded in 2015 includes plans for levee setbacks and habitat restoration to reconnect 112 acres of floodplain that is expected to be completed within the next five years. The tribe will continue to lead efforts to plan and implement additional habitat restoration on the river.

Within the past 10 years, there has been a proliferation of commercial development and associated increase of impervious surfaces, leading to greater amounts of stormwater runoff. Stormwater runoff impacts fresh and marine waters and is a contributing factor to shellfish harvest area downgrades and salmon fatalities in local streams. Shellfish beds in both Dungeness and Sequim bays are subject to harvest closures due to either bacterial pollution or toxins associated with algal blooms. Except for the city of Sequim, the entire watershed is served by individual or community septic systems, many of which are likely contributors to marine bacterial pollution.[3] The tribe will continue to monitor and address impacts to water quality and shellfish.

Habitat is declining despite the assessment of the Puget Sound Chinook Recovery Plan that protecting existing habitat is the most important action needed.[4] Conditions in the Dungeness River floodplain that are harmful to both fish and humans have been described in the Dungeness Flood Control Plan (1990), Dungeness Comprehensive Flood Hazard Management Plan (2009) and several salmon recovery documents. A focused message is needed to foster community will and political support to protect remaining high-quality habitat.

JAMESTOWN S'KLALLAM TRIBE

Nearshore Habitat Loss in the Strait of Juan de Fuca from Morse Creek to Port Townsend

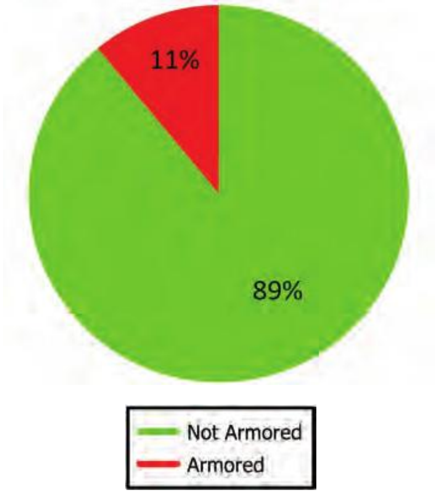
Since reported in 2016[1], the amount of armored marine shoreline has increased by 2% relative to the total coastal shoreline analyzed (501,500 feet). Since that time, the total length of armored shoreline has increased by an additional 8,698 feet within the tribe's Area of Interest. Armored shorelines diminish healthy habitats for fish and shellfish.

A. Natural Shoreline

B. Armored Shoreline

Washington Department of Ecology Coastal Atlas, 2006 (2)

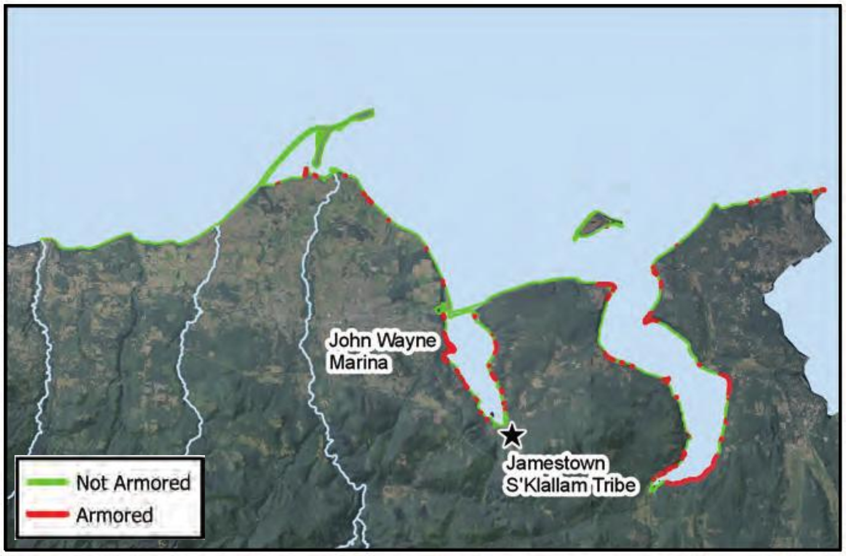
Figure 1: Shoreline Conditions 2017



As of 2017, data collected on shoreline conditions in this Area of Interest (AOI) shows that 11% is armored and 89% is not armored (Figure 1). New shoreline armoring was permitted in Jamestown's AOI from 2016 through 2018 (Figure 2).

Map Data Sources: SSHIAP 2004,[8] SSHIAP 2012,[9] NAIP,[10] CGS 2017[11]

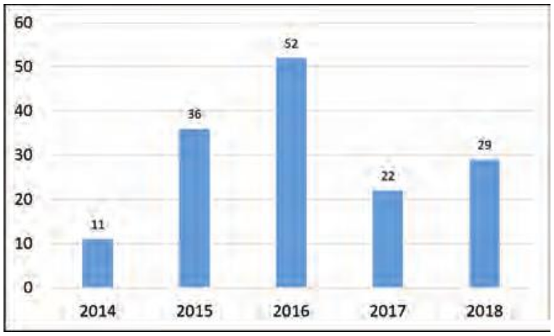
Marine Shoreline Conditions



The Strait of Juan de Fuca contains a rich array of marine habitats that support diverse populations of fish, marine mammals and other wildlife. The impacts of bulkheads, docks and other forms of armoring can reduce or eliminate productive beaches and shallow water habitats through filling or by alteration of sediment sources or sediment transport along the nearshore.[2] Furthermore, shoreline armoring associated with a single-family residence, which is exempt under local shoreline master plans, has substantially increased.[3] However, the nearshore coastline adjacent to the Jamestown S'Klallam reservation is largely forested and undeveloped, which is notable compared to the area near the northwestern shore of Sequim Bay (Photo B). This area by Washington Harbor has had a long history of occupancy by the tribe up until the time of non-Indian settlement.[4]

Today habitat function has been lost as a marina, dock, fill, parking lot and launch ramp have severely impacted the shoreline natural processes.[5] Shoreline alterations such as jetties and rock walls disrupt the flow of sediment on beaches. Docks and bulkheads cover beaches and reduce the productivity of plants and fish in these areas.[6] The tribe relies on these healthy habitats to sustain their way of life, including fishing and shellfishing, and the tribe is working toward preserving and restoring habitat in this region. Habitat alteration has been identified in the Action Agenda[7] as a threat and a priority for action in the Puget Sound and Strait of Juan de Fuca.

Figure 2: HPA Permits Issued by Year in Jamestown AOI



Spawning Conditions for Sand Lance, Surf Smelt and Herring Are Threatened

Since reported in 2016, shoreline armoring within documented sand lance, surf smelt and Pacific herring habitats has increased by 5% relative to the total shoreline analyzed (260,720 feet). The total length of affected habitat along this shoreline has increased to 8,140 feet. Shoreline armoring interrupts the movement of sediment and negatively affects spawning habitat. Herring stocks remain in critical status in Discovery Bay.

Forage fishes, such as sand lance and surf smelt, spawn on upper intertidal beaches made of sand and gravel. These fish are small schooling fishes that are important prey for larger predatory fish and wildlife in the marine food web.[1] Sand lance is recognized as being one of the key elements of a juvenile chinook's nearshore diet.[2]

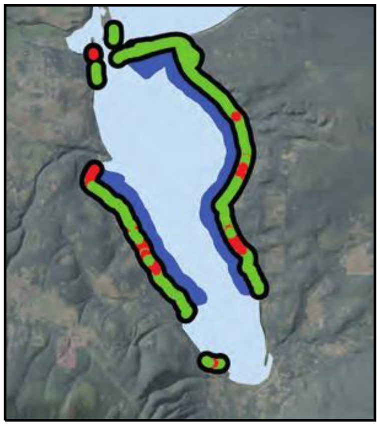
In the Strait of Juan de Fuca, bays have been altered in various ways by human activities, to the detriment of these species. Studies show that development on shorelines negatively affects their spawning sites.[3] This could be one of the main factors contributing to their continued decline.

Maintaining abundant herring, surf smelt and sand lance in Puget Sound is a conservation imperative, but current county regulations do not consider cumulative or off-site impacts of shoreline armoring and do not address likely future conditions such as climate change.[4,5]

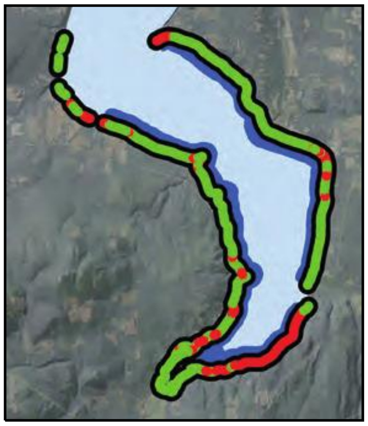
Shoreline Conditions of Surveyed Forage Fish and Herring Spawning Areas

🟩 Not-Armored
🟥 Armored
🟦 Herring Spawning Areas
⬛ Surveyed Areas

Sequim Bay Habitat Conditions



Discovery Bay Habitat Conditions



Dungeness Bay Habitat Conditions

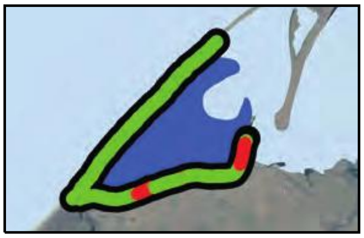
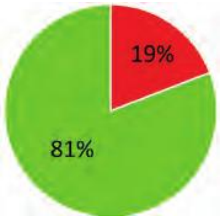


Figure 1: Forage Fish Habitat Shoreline Conditions



The shoreline conditions in known forage fish spawning areas by percentage. Not all shorelines have been surveyed.

Pacific herring are a valuable indicator of ecosystem health and they serve as important bait fish for tribal fishermen. In Discovery Bay, Pacific herring status is critical (Figure 2), which is one step away from disappearance. In Sequim Bay, the status in recent years has fluctuated between declining and critical. The estimated herring biomass in Discovery Bay and Sequim Bay combined continues to be low compared to the 1980s.[6]

Figure 2: WDFW Herring Status[7]

Year	Discovery Bay	Dungeness/Sequim Bay
1988	Unknown	Unknown
1992	Declining	Unknown
1996	Depressed	Unknown
2000	Critical	Increasing
2004	Critical	Declining
2008	Depressed	Critical
2012	Critical	Declining
2016	Critical	Declining

Map Data Sources: NAIP,[9] SSHIAP,[10] WDFW[10,11]


WDFW

Surf Smelt


USGS

Sand Lance

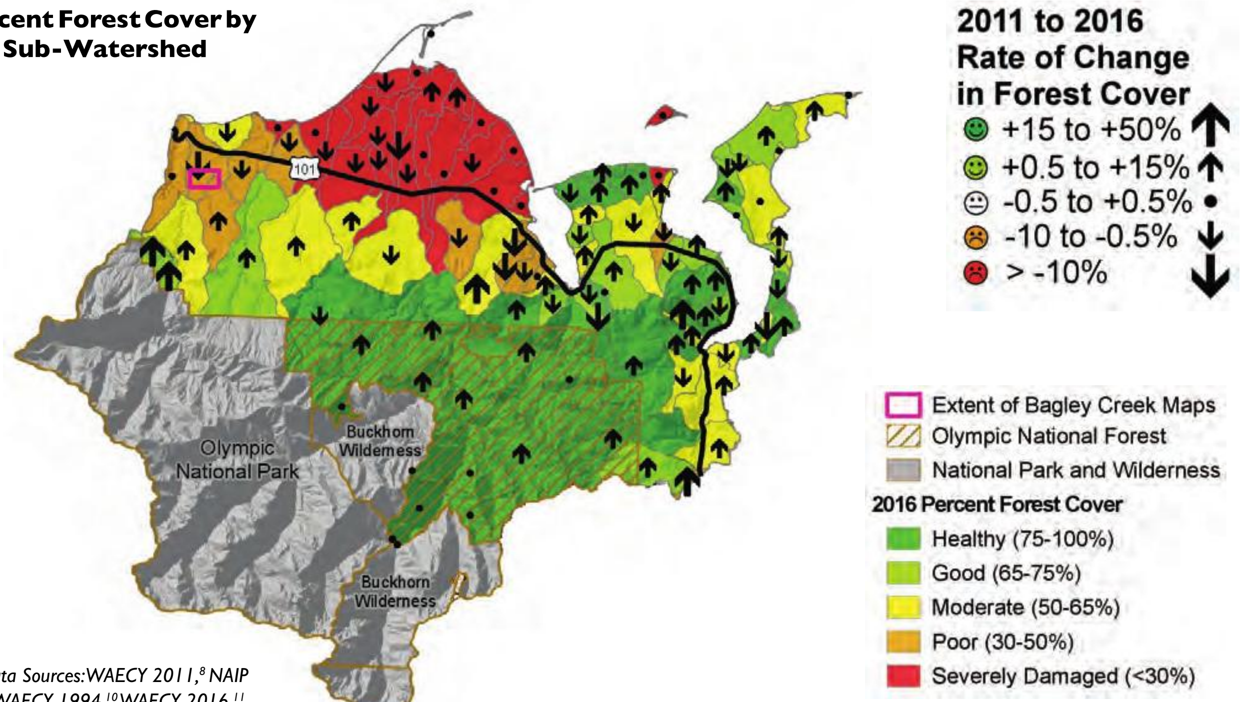

University of North Carolina

Herring

Forested Land Cover Critical for Watershed Health

Forest cover in the Jamestown S'Klallam Tribe's Area of Interest increased by 4.7 square miles from 2011-2016. However, of the 104 sub-watersheds in this area, those with moderate, poor, or severely damaged forest cover increased from 55 sub-watersheds in 2011 to 56 sub-watersheds in 2016. Thirty-seven sub-watersheds had an overall loss of forest cover from 2011 to 2016.

Percent Forest Cover by Sub-Watershed



Map Data Sources: WAECY 2011,[8] NAIP 2011,[9] WAECY 1994,[10] WAECY 2016,[11] NAIP 2017,[12] WAECY 2011,[13] WAECY 2018,[14] WADNR 2014,[15] WADNR 2014[16]

Forested land cover is a vital component of healthy stream ecosystems at both the watershed and riparian corridor scales.[1] The Hood Canal and Eastern Strait of Juan de Fuca Summer Chum Salmon Recovery Plan[2] states that the "removal and modification of native riparian forests increases water temperatures, reduces stability of floodplain landforms, and reduces large woody debris recruitment to stream channels."

Loss of forest cover degrades aquatic ecosystems even when the level of impervious surface is low.[3] The threshold for minimal to severe stream degradation is 65% forest cover;[4] however, any level of disturbance has an impact on stream ecology.[5] Restoring forest cover through vegetation planting in riparian and adjacent areas is vital to salmon habitat restoration efforts in the Dungeness River.[6] While some forest cover is regained through plantings in working forests, much more is lost as forest land is converted and developed. Within the Jamestown S'Klallam Area of Interest but outside of the Olympic National Park and Buckhorn Wilderness, forest cover decreased in 37 sub-watersheds, 12 of which had losses over 5%. However, 22 sub-watersheds had increases in forest cover over 5%, resulting in a net gain in forest cover across the Area of Interest of 1.5% (3,029 acres) from 2011 to 2016.

Clearcutting Timber Harvest Damages Working Forests


2011 Forest Cover

2016 Forest Cover

Between 2011 and 2016, 133 acres of timberland were clearcut near Bagley Creek. Clearcutting forests can increase water temperatures and stream sedimentation while decreasing streamflow, all of which are detrimental to salmon and other species.[7]

JAMESTOWN S'KLALLAM TRIBE

Impervious Surface Negatively Impacts Water Quality

With the exception of northern part of the Jamestown Tribe's Area of Interest, many of the watersheds show little increase in impervious surface area from 2011 to 2016. However, the total impervious surface area has increased by 0.23% across their AOI. Four of the 113 sub-watersheds have a 1% to 4% increase in impervious surface area. Thirteen sub-watersheds have degrading watershed health (12-40% impervious surface area).

Figure 1. Percent Impervious Surface Area by Sub-Watershed

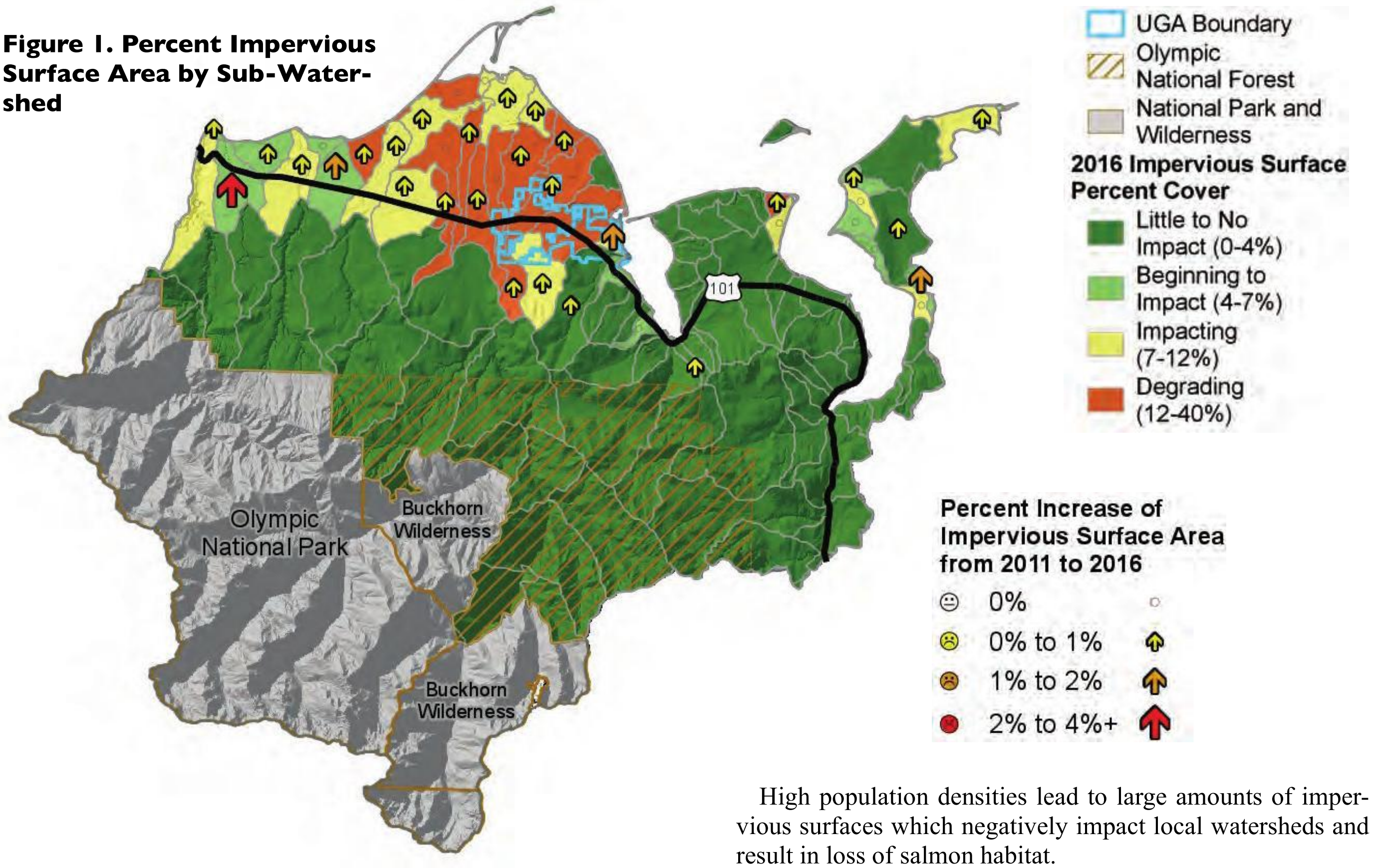
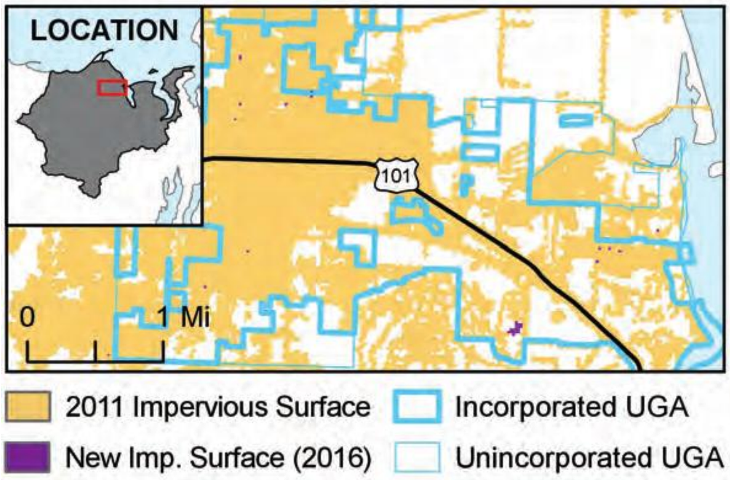


Figure 2. Impervious Surface Area in Sequim UGA



High population densities lead to large amounts of impervious surfaces which negatively impact local watersheds and result in loss of salmon habitat.

The Sequim-Dungeness area is predominantly rural, but any level of human disturbance impacts watershed processes. Impervious surface area is well documented as a coarse measure of human impact on watershed scale hydrology and biology.[1,2,3] Impervious surface area causes increases in stream temperatures, decreases in stream biodiversity, and contributes to pollutants in storm water run-off, which can contaminate local aquatic systems.[4]

The Hood Canal and Strait of Juan de Fuca Summer Chum Recovery Plan describes thresholds of 10% impervious surface area in a watershed at which sensitive stream habitat elements are lost, while 25% to 30% impervious surface area results in poor water quality.[5] Within the Area of Interest, watershed health is beginning to be impacted (4-7%) in eleven sub-watersheds, impacted (7-12%) in 15 subwatersheds, and degraded (12-40%) in 13 sub-watersheds (Figure 1).

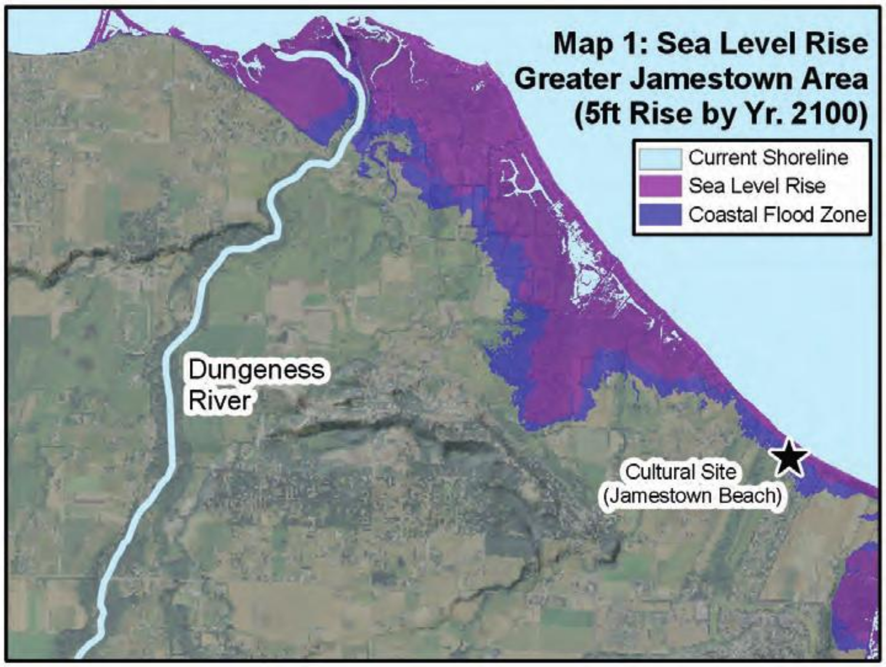
Each watershed has a different reaction to a given amount of impervious surface area: thresholds serve only to generalize the continuum of degradation that accrues as impervious surface area increases and forest cover is lost.[6]

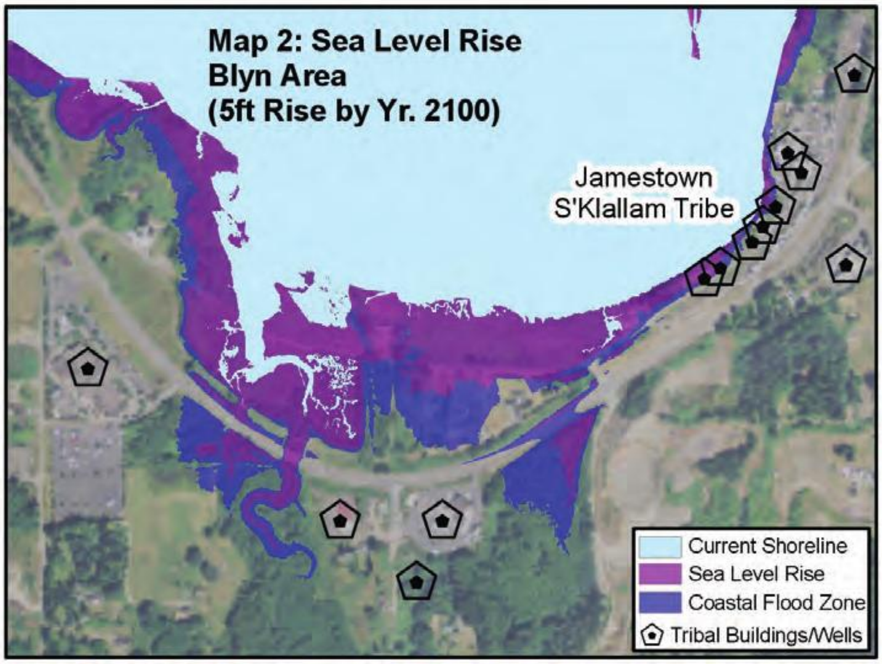
Impervious surface increases were minimal between 2011 and 2016 in the Area of Interest, with 21 sub-watersheds having less than 1% increases and only four sub-watersheds having increases of 1-4% (Figure 2).

Map Data Sources: WAECY 1994,[7] WAECY 2011,[8] WAECY 2013,[9] WADNR 2014,[10,11] NLCD 2019,[12,13] UW[14]

Vulnerability Assessment and Climate Change Adaptation Preparation

The Jamestown S'Klallam Tribe is on the forefront of addressing tribal vulnerabilities and preparing for climate change. The 2013 Jamestown Climate Vulnerability Assessment and Adaptation Plan provides an assessment of vulnerabilities of tribal resources to the negative impacts of climate change. The plan also identifies adaptation measures that the tribe is working to complete. Sea level rise, ocean acidification and climate models show potential for increased risks to critical habitats, tribal infrastructure and tribal health.





As one of the first tribes in western Washington to complete a climate adaptation plan and vulnerability assessment, the Jamestown S'Klallam Tribe has identified and prioritized areas where the changing climate conditions (i.e. changing precipitation patterns, sea level rise, ocean acidification) will leave tribal resources, infrastructure, economy and health most vulnerable.[1] Climate vulnerability depends largely on climate exposure, sensitivity and adaptive capacity.[2]

The tribe identified many vulnerabilities:

Impact to Salmon which is the foundation for almost all aspects of tribal cultural life and also serve as economic and nutritional resources for the tribe. Salmon will be impacted by the change in timing and amount of winter rains and flooding, scouring of egg redds (nests) during high flows, thermal stress from higher water temperature, and less water availability in the summer.

Oysters and clams also are highly vulnerable under expected conditions. Projected impacts include higher water temperatures and ocean acidification. There will also be an increased occurrence of shellfish poisoning associated with harmful algal blooms (which

(Continued on next page)

The maps (left) show flood conditions with a sea level rise model under the high severity scenario (Figure 1).[1] They show the potential inundation of a vital water source, closed roads, an important cultural site at Jamestown Beach (Map 1), and buildings on the tribal campus in Blyn (Map 2) where flood risk is projected to increase by the end of the century.[1]

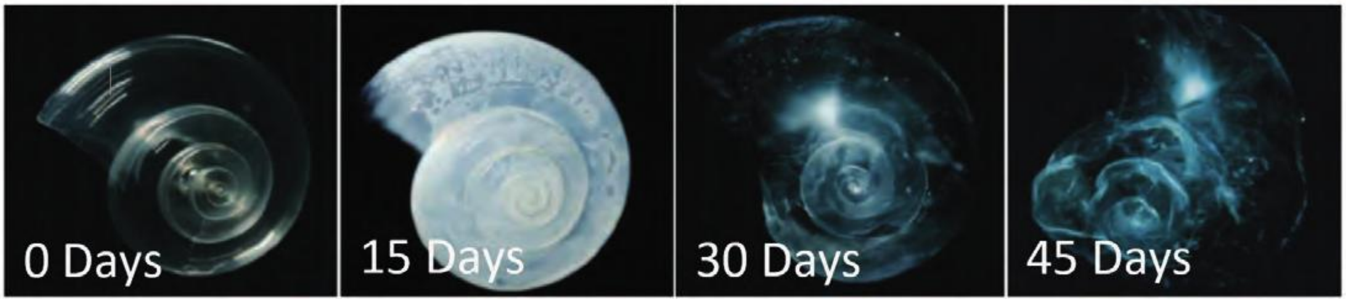
Map Data Sources: Adaptation International Climate Models 2013,[8] NAIP 2013,[9] WAECY 2011,[10] USGS 2019[11]

> *To ensure continued economic growth, promote long-term community vitality, and protect sensitive resources and assets, it is essential that we incorporate climate change preparedness into our planning efforts and operations.*
>
> *– W. Ron Allen, Jamestown S'Klallam Tribe Chairman*

(Continued from previous page)

warmer conditions may favor), diminished health and wellness, economic loss, and increased flooding of tribal buildings, sacred historical places and infrastructure.[3]

Traditional ways of life and health are extremely vulnerable. The loss or displacement of traditional plants necessary for food, and fibers needed for traditional practices is likely. There are potential impacts to Indian health from forest fire smoke and loss of important traditional agricultural food and natural resources.



NOAA[7]

Ocean acidification (decrease in ocean pH) will cause waters to become "corrosive to shell-forming organisms such as oyster larvae, clams, mussels and crabs," posing serious threats to the shellfish in the Strait of Juan de Fuca.[4] Pictured are the pteropod shells dissolving because of the decreasing ocean pH.[5]

Figure 1: Sea Level Rise Projections, Sequim Region

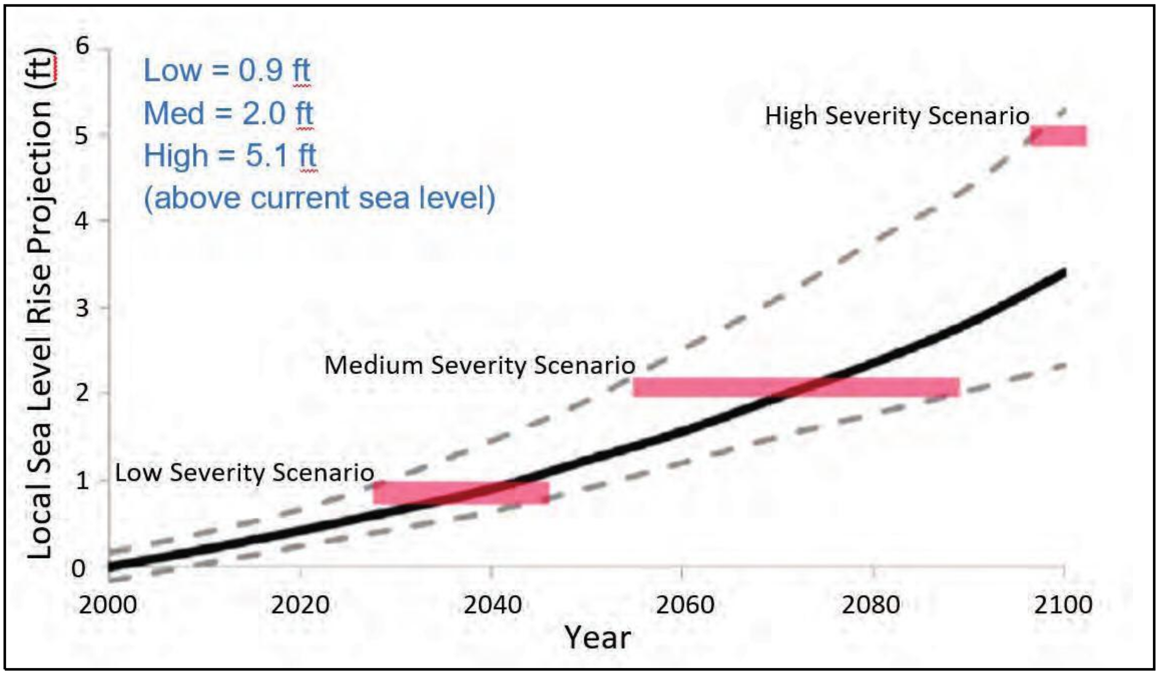


Figure 1 shows sea level rise in three scenarios (low, medium, high). This graph is from page 16 of the Jamestown Climate Vulnerability Assessment and Adaptation Plan.[6] The tribe has identified areas most susceptible to rising sea levels. The assessment has helped the tribe relocate several storage buildings that would have been otherwise affected.

JAMESTOWN S'KLALLAM TRIBE

Biotoxins Sampling for Public Health

Biotoxin monitoring in the Jamestown S'Klallam Tribe's Area of Interest ensures that only shellfish safe for human consumption are harvested. Long-term data will help us understand what factors increase harmful algal blooms in the Salish Sea.

The Jamestown S'Klallam Tribe has monitored phytoplankton as part of the SoundToxins program since 2008[1] (Figure 1). This monitoring identifies harmful algal blooms (HABs) that make shellfish tissue toxic for consumption or have negative impacts on fish and shellfish.

The tribe conducts phytoplankton net tows and collects water samples and ancillary oceanographic data weekly in the summer and biweekly in the winter (Photos 1 & 2). These samples are analyzed for species that can cause shellfish toxicity. In addition, the tribe takes shellfish tissue samples that are sent to Washington Department of Health for analysis. Shellfish testing is ramped up when toxic species are present and shellfish harvesting closures are issued when thresholds are exceeded (Figures 2 & 3).

There is concern that increased nutrient runoff into the Salish Sea may result in an increase of HABs and may be altering food webs.[2] In addition, some HABs can directly impact salmonid populations.

Phytoplankton monitoring helps understand what is in the water that may cause public health issues with shellfish. Over time, monitoring will discern what changes are happening in the Salish Sea as the waters acidify, warm and become more nutrient rich.[3]

The tribe is slated to do a pilot study in 2021 with Washington Department of Fish and Wildlife that will add phytoplankton and nutrient sampling to their existing zooplankton monitoring programs in Northern Hood Canal and Admiralty Inlet. This project is part of a larger effort from the Salish Sea Marine Survival Project, which aims to understand the factors affecting salmon survival in the Salish Sea.[4] By coupling these sampling efforts, the tribe will be able to understand the bottom up factors impacting salmon survival.

(Continued on next page)

Figure 1. Sequim Bay Biotoxin Sampling Sites

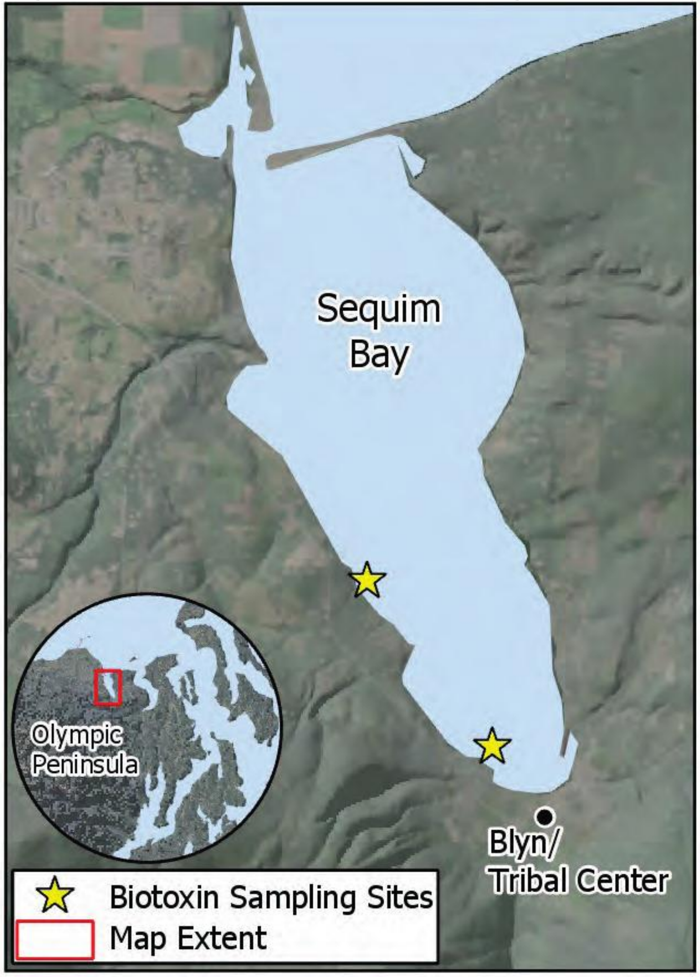


Photo 1. Water Sampling in Sequim Bay

Photo 2. Net Tow Sampling in Sequim Bay

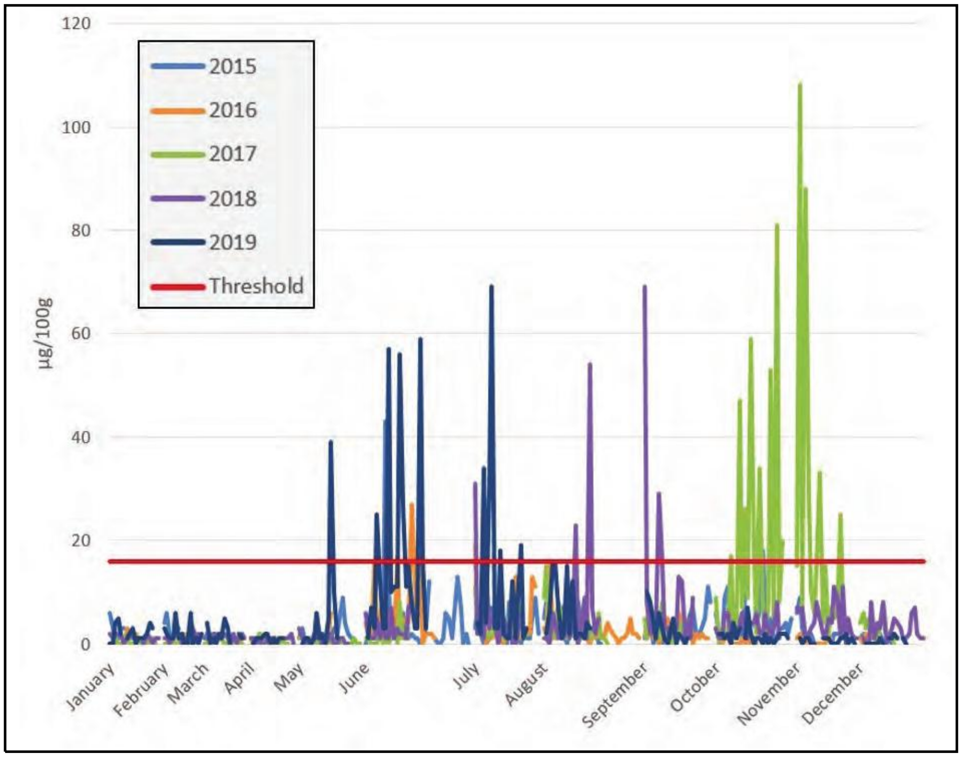
Tiffany Royal, NWIFC (2)

Map Data Sources: NAIP 2017,[7] WADNR 2014[8]

(Continued from previous page)

Figures 2 and 3 below show toxin threshold exceedances found in Sequim Bay. When PSP and DSP get to toxic levels, the shellfish harvesting areas are closed by the Washington State Department of Health, which greatly impacts the Jamestown S'Klallam Tribe's ability to harvest.

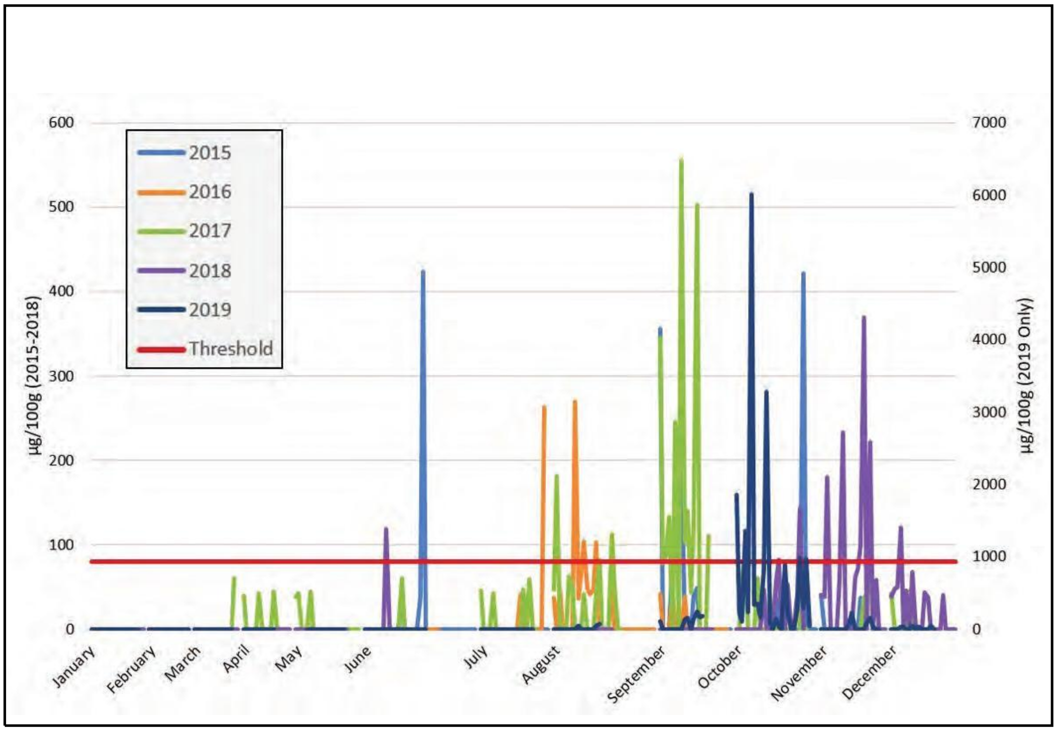
Figure 2. Diarrhetic Shellfish Toxins in Sequim Bay



Warning from Washington State Department of Health: "Paralytic Shellfish Poison (PSP) is a naturally occurring marine biotoxin that is produced by some species of microscopic algae. Shellfish eat these algae and can retain the toxin. People can become ill from eating shellfish contaminated with Paralytic Shellfish Poison. This biotoxin affects the nervous system and paralyzes muscles, thus the term "paralytic" shellfish poison. High levels of Paralytic Shellfish Poison can cause severe illness and death."[5]

There have been many threshold exceedances and corresponding shellfish harvest closures in recent years.

Figure 3. Paralytic Shellfish Toxins in Sequim Bay



Warning from Washington State Department of Health: "Diarrhetic Shellfish Poison (DSP) is a marine biotoxin toxin produced by the dinoflagellate *Dinophysis*, which is a type of naturally occurring microscopic algae. Shellfish eat these algae and can retain the toxin. People can become ill from eating shellfish contaminated with Diarrhetic Shellfish Poison."[6]

There have been many threshold exceedances and corresponding shellfish harvest closures in recent years.

JAMESTOWN S'KLALLAM TRIBE

Dungeness Floodplain Restoration Key to Salmon Recovery

Floodplains play an important ecological role in salmon recovery and creating healthy functioning habitat. The Jamestown S'Klallam Tribe has been actively working on projects to restore the Dungeness River for more than 30 years.

Figure 1. Dungeness River Floodplain

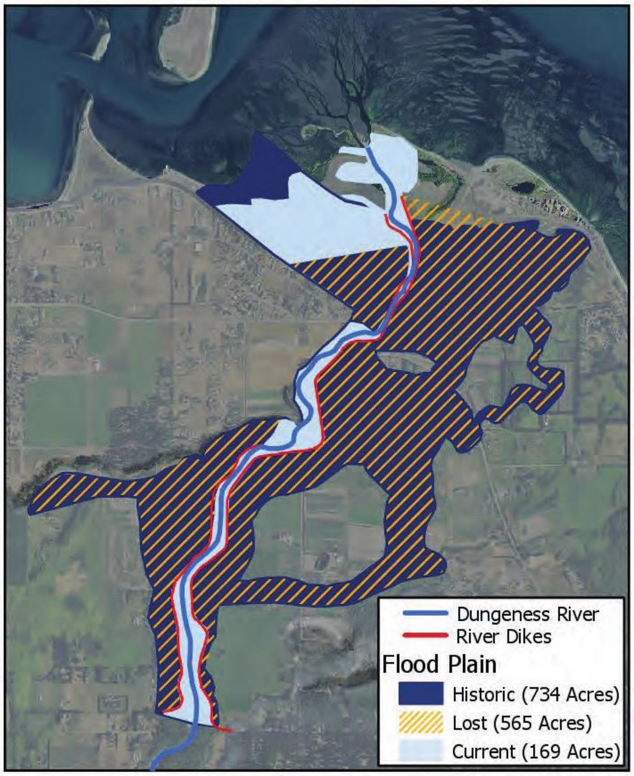
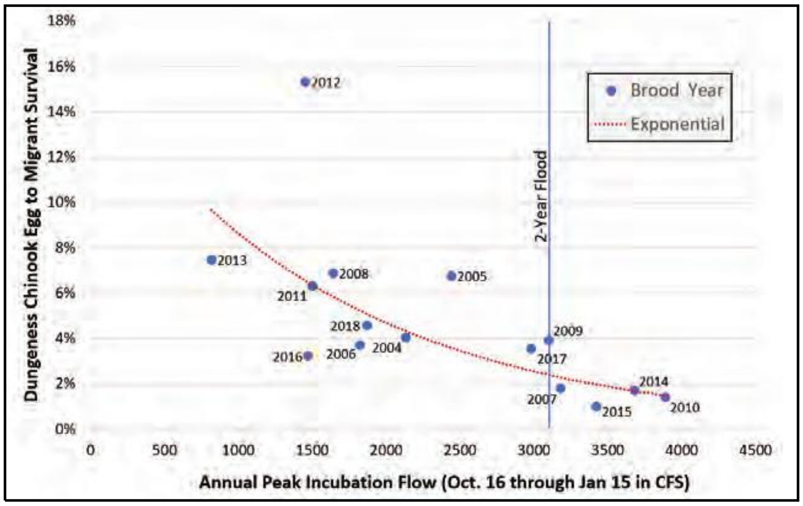


Figure 2. Impacts to Dungeness Chinook Egg-to-Smolt Survival



High water flows during chinook egg incubation period reduces the egg-to-smolt survival rate in the Dungeness River. The goal is to keep salmon survival rates high for healthy chinook populations and to support the tribe's invaluable resource.

Map Data Sources: NAIP 2017,[2] USGS 2018[3]

Figure 3. Dungeness River – Robinson Property

Before Restoration (March 2015)

After Restoration (January 2017)

The historic Dungeness floodplain was approximately 730 acres before 1963, but as a result of river diking, in 2019 only 169 acres remained intact[1] (Figure 1). These dikes eliminate natural river processes and greatly reduce the available habitat for salmon and other species (Figure 2). The Jamestown S'Klallam Tribe and their partners continue to work on major restoration projects in order to help preserve, protect and restore salmon habitat in the Dungeness watershed (Figure 3).

The Lower Dungeness River Floodplain Restoration Project goals are to:

(1) restore habitat-forming processes within two miles of the Dungeness River by eliminating a severe anthropogenic stressor (loss of floodplain processes due to river diking) by setting back the offending dike as near to the edge of the 100-year flood inundation area as possible.

(2) Remove a dike and restore 150 acres of former agricultural land to healthy floodplain. The coupling of these two activities with restoration creates a healthy, vibrant floodplain forest. Restoration of the floodplain included placement of large woody debris and reconnection of the river.

When the restoration is complete, the Lower Dungeness River will be approximately two miles of fully functioning river uninhibited by the river dikes. The river will be transformed and replete with high quality salmon habitat, functioning side channels and diverging channels that meander through a publicly owned, permanently protected floodplain forest on a trajectory to become old-growth forest.

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Dungeness Floodplain Restoration Key to Salmon Recovery

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2020 State of Our Watersheds Report
West WRIA 18 – WRIA 19
Morse Creek to Neah Bay

Seven years after the Elwha Dam and five years after the Glines Canyon Dam were removed, full Elwha River restoration is no longer just a possibility. It is now a certainty. Salmon, Dungeness crab, wildlife and vegetation are returning to historical habitats – some species faster than expected. The dreams of the Lower Elwha Klallam Tribe are becoming a reality.

Robert Elofson
Fisheries Manager
Tribal Member

Sonny Sampson

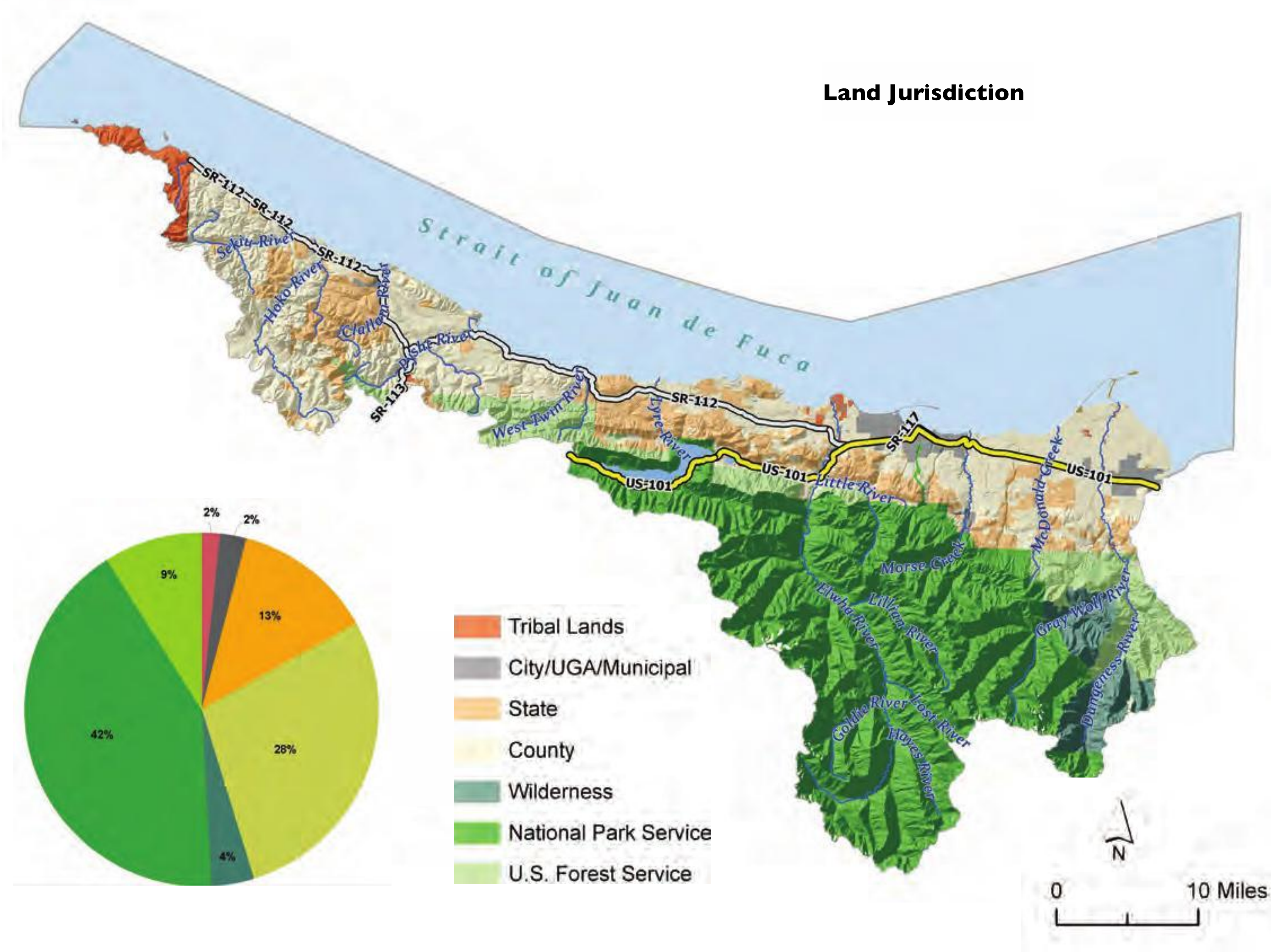
Area of Interest

Lower Elwha Klallam Tribe

The Lower Elwha Klallam Tribe is part of the Klallam Band of Indians that has resided throughout the Strait of Juan de Fuca, Hood Canal and Port Gamble Bay for generations. They are party to the Point No Point Treaty of 1855, when tribes ceded most their traditional lands to the U.S. government. The Elwha-Dungeness Basin (WRIA 18) and Lyre-Hoko (WRIA 19) have remained largely rural and forested with a natural resources-based economy focused on shellfish harvesting, commercial forestry, commercial fisheries, tourism and agriculture. Major land use impacts on salmon habitat have occurred from floodplain and shoreline development, road construction and past logging practices. This report will focus on the northwest portion of WRIA 18 basin and surrounding marine waters, which is only a portion of the area that the Lower Elwha Klallam Tribe co-manages.

Lower Elwha Klallam Tribe

Elwha-Dungeness and Lyre-Hoko Basins



The Lower Elwha Klallam Tribe's Area of Interest includes the Elwha-Dungeness (WRIA 18) and Lyre-Hoko (WRIA 19) basins. The area is located along the northeast portion of the Olympic Peninsula with its watersheds draining to the Strait of Juan de Fuca. The main watersheds include the Sekiu, Hoko, Clallam, Pysht, Lyre, Dungeness and Elwha rivers as well as Morse and McDonald creeks. The headwaters of the two largest basins, the Dungeness and Elwha, are found in the Olympic National Park and U.S. Forest Service wilderness areas, thus remaining in relatively pristine condition.

The topography and precipitation patterns of the area vary dramatically, from high mountain ridges with 240 inches of annual precipitation mostly as snow, to lowland valleys with 25 inches of annual precipitation predominantly as rain.

The Klallam were the first human inhabitants of the eastern Strait region, with villages and fishing camps most often associated with stream mouths and marine embayments where they could take advantage of plentiful fish and shellfish resources. With the Point No Point Treaty of 1855, the tribes ceded their lands to the U.S. government. However, by this time, Euro-Americans had already begun clearing and farming the floodplains and were soon cutting old-growth timber along the shorelines.

Much of the area remains rural and forested with about 42% within the Olympic National Park and another 13% within U.S. Forest Service land and wilderness areas. However, the city of Port Angeles, its main population center, has developed rapidly.

ESA-listed Puget Sound chinook and steelhead as well as Hood Canal summer chum reside in the basin, along with coho, fall chum, pink salmon, steelhead trout, rainbow trout and bull trout. Historically, the Elwha River was one of the most productive rivers for its size in the Pacific Northwest.[1]

Following the passage of the Elwha River Ecosystem and Fisheries Restoration Act by Congress, the Glines Canyon and Elwha dams, which were located along the lower mainstem of the Elwha River and had blocked all anadromous fish access to the majority of the watershed since the early 1900s, were removed in 2014. Dam removal opened the upper watershed to salmon for the first time in 102 years. Today, the Elwha River flows freely from its headwaters to the Strait of Juan de Fuca.

Map Data Sources: SSHIAP 2004,[2] USFWS 2018,[3] WADNR 2016,[4] WADNR 2018,[5] WADOT 2018a,[6] WADOT 2018b,[7] WAECY 1994,[8] WAECY 2018a,[9] WAECY 2018b[10]

Chapter Summary

The Lower Elwha Klallam Tribe's Area of Interest includes the Elwha-Dungeness (WRIA 18) and Lyre-Hoko (WRIA 19) basins. The tribe resides in the Lower Elwha River Valley and adjacent bluffs on the north coast of the Olympic Peninsula just west of Port Angeles. The Klallam were the first human inhabitants to the eastern Strait region, with villages and fishing camps most often associated with stream mouths where they could take advantage of plentiful fish and shellfish resources. With the Point No Point Treaty of 1855, the tribes ceded their lands to the U.S. government and by this time, Euro-Americans had already begun clearing and farming the floodplains and were soon cutting the old-growth timber along the shorelines. Much of the area remains rural and forested with about 42% within the Olympic National Park and another 13% within U.S. Forest Service land and wilderness areas. However, the city of Port Angeles, its main population center, has developed rapidly.

Following the passage by Congress of the Elwha River Ecosystem and Fisheries Restoration Act, the Glines Canyon and Elwha dams were removed in 2014. They were located along the lower mainstem of the Elwha River and had blocked all anadromous fish access to the majority of the watershed since the early 1900s. Dam removal opened the upper watershed to salmon for the first time in 102 years. Today, the Elwha River flows freely from its headwaters to the Strait of Juan de Fuca.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org.*

For this report, the Lower Elwha Klallam Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Shoreline Armoring and its Impact on Forage Fish Habitat

About 20% of the marine shoreline in the Lower Elwha Klallam Tribe's area of interest is armored. Since reported in 2016, the amount of armored shoreline has increased by 2% (13,360 feet) relative to the total coastal shoreline analyzed (718,832 feet). Over a longer period, the state of Washington's HPA database shows that between 2005 and 2018, there was 903 feet of new shoreline armor, 475 feet of replacement armor, and 4,802 feet of removal of existing armor, with a net reduction of 1,966 feet of shoreline.

Impervious Surface

About 91.5% of the Lower Elwha Area of Interest currently shows little to no impact from impervious surface conditions. The watersheds mostly impacted were around Port Angeles, Sequim and Neah Bay. Between 2011 and 2016, more than 99% of the Area of Interest showed little to no change in impervious surface conditions. However, in the 15-year period between 2001 and 2016, watersheds around Port Angeles and Sequim had increases in impervious surface conditions.

Water Wells

There are currently 4,603 wells in the Lower Elwha Klallam Tribe's Area of Interest mostly between Sequim and Port Angeles. Between 1980 and 2014, a total of 4,341 wells were completed, representing an average annual rate of about 124 new wells. Since 2015, an additional 262 wells have been added, at about 52 new wells per year. Although the cumulative number of wells has increased since 2015, the rate of increase has slowed.

Forest Cover Conditions

Current forest cover conditions are generally good to healthy in 71% of the Lower Elwha Area of Interest but severely damaged conditions exist in watersheds in areas around Sequim. In the period between 2011 and 2016, there was little to no change in the forest cover in most watersheds. However between 1992 and 2016, there were significant mostly negative changes in forest cover in many of the watersheds west of the Pysht River.

Invasive Species

Native species in the Lower Elwha Area of Interest are increasingly threatened by invading plants and animals. One recent arrival, the European green crab (*Carcinus maenas*) which poses a significant risk to the Dungeness crab, a culturally and economically important species to the tribe, is found mostly at the Dungeness Bay. Other invasive plant species are found mostly in the riparian areas of Lake Pleasant.

Morse Creek Floodplain Impairment

Since the 2010 restoration project that restored a significant meander and added 1,300 feet of habitat to the formerly channelized reach, there has been a dramatic 300% increase in juvenile fish abundance within the restored reach compared to an untreated control reach just upstream of the project. However, almost a quarter of accessible anadromous habitat of Morse Creek can be found in the reach downstream of the Highway 101 bridge crossing.

Elwha River Fisheries and Ecosystem Restoration

Conditions in the Elwha River watershed have been monitored by the Lower Elwha Klallam Tribe and their partners to gauge ecosystem response to the removal of the Elwha dams. Six years following dam removal, there have been positive responses for chinook, steelhead, coho, bull trout and Pacific lamprey but pink and chum salmon have yet to show a response. The return of sand lance and smelt, which are important prey items for juvenile salmonids, also have been observed. River otters and American dippers, closely tied to ecosystem health, are expected to be positively impacted by the return of salmon. It is estimated that, to date, more than 4 million cubic yards of sediment has been deposited in the Elwha delta since the removal of the dams.

Port Angeles Harbor Cleanup and Restoration

Over a century of industrial activities has exacted a heavy toll on natural systems within the Port Angeles Harbor resulting in the contamination of sediment and fish, heavily degraded shorelines, and the loss of critical nearshore and estuarine habitat used by salmon and their forage fish prey.

The tribe and other partners have carried out multiple shoreline restoration projects along the interior of Ediz Hook, the spit that created and shelters the harbor. They have restored 1,600 meters of hardened shoreline by removing former log rafting and offloading structures and associated armoring, replacing the shoreline with clean beach material and native beach vegetation. The tribe and its partners also salvaged and planted eelgrass plants to restore eelgrass beds in the harbor that provide critical nursery habitat for juvenile salmon and forage fishes.

Conclusion

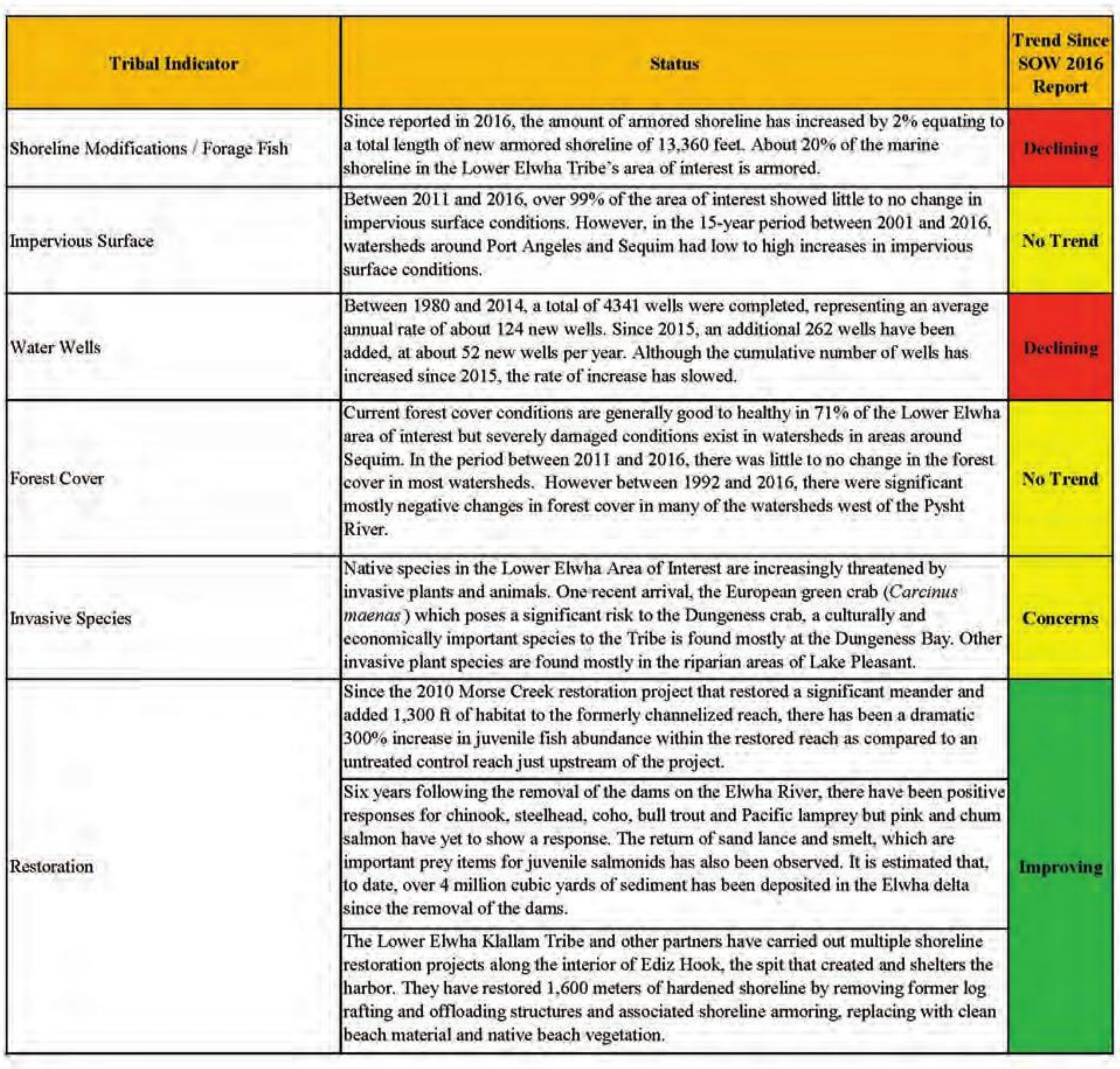
Since the removal of the two Elwha River dams, the watershed has started the process to recovery. The goals are to maintain and restore natural ecosystem conditions that sustain salmon productivity. While habitat improvement is a major component of the recovery strategy, it is recognized that without protecting existing habitat function, restoration activities cannot reverse the decline of salmon and steelhead populations within the watershed. In this regard, conclusions on the state of the watershed in 2020 is concerning.

The conditions of the watershed habitat are improving since the removal of the two dams on the lower Elwha River, but there are concerns with the increase in population in the lower watershed. The impacts which come from indiscriminate use of the limited resources is concerning. Over the past five years, the watershed has experienced an increase in shoreline armoring and water wells. Along with the increase in population comes the increase of impervious surface and forest cover. Even though restoration is occurring, it is not enough to keep up with the impacts of a growing population and their land use decisions. Land use and water laws that are in place and meant to protect critical areas and fish habitat need to be implemented. Implementation includes education and voluntary actions, but it also needs to include enforcement when those laws are broken. The future of treaty rights in the Elwha River basin depend on it.

Recovery Efforts Show Signs of Improvement But Still Lagging in Key Indicators

At the 15-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Lower Elwha area shows improvements for floodplain processes and restoration effort, but degradation of water quantity and no improvement in the reduction of impervious surface areas and an increase of forestland cover. In addition, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat, and to monitor and enforce compliance of existing regulations. Funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trends for these key environmental indicators since the 2016 State of Our Watersheds Report shows improvement for some indicators and a steady loss for others in habitat status:



Tribal Indicator	Status	Trend Since SOW 2016 Report
Shoreline Modifications / Forage Fish	Since reported in 2016, the amount of armored shoreline has increased by 2% equating to a total length of new armored shoreline of 13,360 feet. About 20% of the marine shoreline in the Lower Elwha Tribe's area of interest is armored.	Declining
Impervious Surface	Between 2011 and 2016, over 99% of the area of interest showed little to no change in impervious surface conditions. However, in the 15-year period between 2001 and 2016, watersheds around Port Angeles and Sequim had low to high increases in impervious surface conditions.	No Trend
Water Wells	Between 1980 and 2014, a total of 4341 wells were completed, representing an average annual rate of about 124 new wells. Since 2015, an additional 262 wells have been added, at about 52 new wells per year. Although the cumulative number of wells has increased since 2015, the rate of increase has slowed.	Declining
Forest Cover	Current forest cover conditions are generally good to healthy in 71% of the Lower Elwha area of interest but severely damaged conditions exist in watersheds in areas around Sequim. In the period between 2011 and 2016, there was little to no change in the forest cover in most watersheds. However between 1992 and 2016, there were significant mostly negative changes in forest cover in many of the watersheds west of the Pysht River.	No Trend
Invasive Species	Native species in the Lower Elwha Area of Interest are increasingly threatened by invasive plants and animals. One recent arrival, the European green crab (*Carcinus maenas*) which poses a significant risk to the Dungeness crab, a culturally and economically important species to the Tribe is found mostly at the Dungeness Bay. Other invasive plant species are found mostly in the riparian areas of Lake Pleasant.	Concerns
Restoration	Since the 2010 Morse Creek restoration project that restored a significant meander and added 1,300 ft of habitat to the formerly channelized reach, there has been a dramatic 300% increase in juvenile fish abundance within the restored reach as compared to an untreated control reach just upstream of the project.	Improving
	Six years following the removal of the dams on the Elwha River, there have been positive responses for chinook, steelhead, coho, bull trout and Pacific lamprey but pink and chum salmon have yet to show a response. The return of sand lance and smelt, which are important prey items for juvenile salmonids has also been observed. It is estimated that, to date, over 4 million cubic yards of sediment has been deposited in the Elwha delta since the removal of the dams.	
	The Lower Elwha Klallam Tribe and other partners have carried out multiple shoreline restoration projects along the interior of Ediz Hook, the spit that created and shelters the harbor. They have restored 1,600 meters of hardened shoreline by removing former log rafting and offloading structures and associated shoreline armoring, replacing with clean beach material and native beach vegetation.	

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

The Lower Elwha Klallam Tribe has been at the forefront of large, ecosystem scale, restoration and environmental cleanup projects on the north Olympic Peninsula. Elwha River restoration has become a template for an increasing number of successful dam removals across the United States, in a trend toward reversing decades of adverse impacts to ecosystem processes that affect both marine and freshwater systems. The tribe will continue its long-term monitoring of fish and wildlife communities within the Elwha River watershed with our state and federal partners, as we continue to observe positive trends in recovery. We will continue to promote restoration actions and low impact development activities that are complementary to the goals and objectives of ecosystem and fisheries restoration.

The Lower Elwha Klallam Tribe will continue to focus its efforts and resources on the restoration and protection of sensitive environments and critical habitats in floodplain, riparian, estuarine and nearshore systems on the North Central Olympic Peninsula. The tribe has restored many miles of floodplain and riparian habitat on the North Olympic Peninsula across numerous stream systems (Hoko, Pysht, Deep, Twin, Lyre, Elwha, Ennis, Morse and Seibert watersheds). The tribe will continue to pursue funding opportunities to monitor stream health and restore degraded systems throughout this region. The tribe also will continue to monitor the long-term recovery of the Elwha River ecosystem along with its state and federal partners as salmonid populations progress through 4 stages of recovery – preservation, recolonization, local adaptation and viable natural populations.[1]

We will continue to prioritize the restoration of marine shorelines within Port Angeles Harbor and elsewhere in the Strait of Juan de Fuca to encourage the recovery of sensitive and critical nearshore systems like eelgrass meadows and estuaries. The tribe has completed two eelgrass plantings along Ediz Hook with its Pacific Northwest National Laboratory partner in summer 2017 and 2020. Eelgrass salvaged from the 2017 salvage of eelgrass from beneath the U.S. Navy pier at the Port Angeles Coast Guard Base has been the source of eelgrass plant material for restoration efforts. Two test plots of approximately 3,500 eelgrass plants each were planted in 2017, while 7,000 plants were planted in June 2020. An additional planting is planned for early summer 2021 using the remaining eelgrass that is growing in the PNNL outdoor tanks. This effort will extend the eelgrass plantings further west along the interior of Ediz Hook and complement the shoreline restoration the tribe completed in recent years.

Despite the relatively low human population density across the North Olympic Peninsula, significant degradation of coastal systems and impairment of stream access have occurred in these watersheds. However, we still have an opportunity to learn from the adverse development impacts elsewhere in Puget Sound and use science-based, low impact development strategies in local planning efforts. The tribe will continue to work with local governments through the Shoreline Master Program, watershed planning, comprehensive plans and other regulatory processes to ensure that shoreline development practices minimize future impacts to nearshore environments. We will continue to advocate for limited shoreline development and the removal of shoreline armoring in favor of environmentally friendly shoreline protection methods similar to those the tribe has successfully employed along the interior of Ediz Hook.

(Continued on next page)

Kim Plummer Williams, Lower Elwha Klallam Tribe (2)

Eelgrass planting preparation involving staff from Lower Elwha Klallam Tribe and Pacific Northwest National Lab (PNNL), July 2020.

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Port Angeles Harbor with Ediz Hook lagoon, a tidal salt marsh that has significant ecological, cultural and historic value to the tribe.

The tribe has been actively involved in the cleanup and restoration of Port Angeles Harbor since 1999, when it entered into the three-party Deferral Agreement with the state Department of Ecology and federal Environmental Protection Agency. This agreement, the first nationally for an Indian Tribe, provided the tribe with concurrence on all major cleanup decisions. We expect to see significant progress in the cleanup of the western harbor and the Rayonier mill site and associated marine cleanup unit. We will continue to work with the Port Angeles Harbor Trustee Council to find solutions to compensate for injuries to natural resources within the harbor. The tribe will continue to advocate for a high quality cleanup that will expedite the recovery of marine and estuarine systems in Port Angeles Harbor, and ultimately culminate in the resumption of a healthy and productive fisheries.

Lower Elwha Klallam Tribe

Shoreline Armoring and its Impact on Forage Fish Habitat

Since reported in 2016, the amount of armored shoreline has increased by 2% equating to a total length of new armored shoreline of 13,360 feet. About 20% of the marine shoreline in the Lower Elwha Klallam Tribe's area of interest is armored.

Shoreline armoring involves the use of physical structures such as bulkheads, seawalls or riprap to protect marine shorelines in order to stabilize coastal land, prevent erosion, and protect residential and commercial infrastructure.

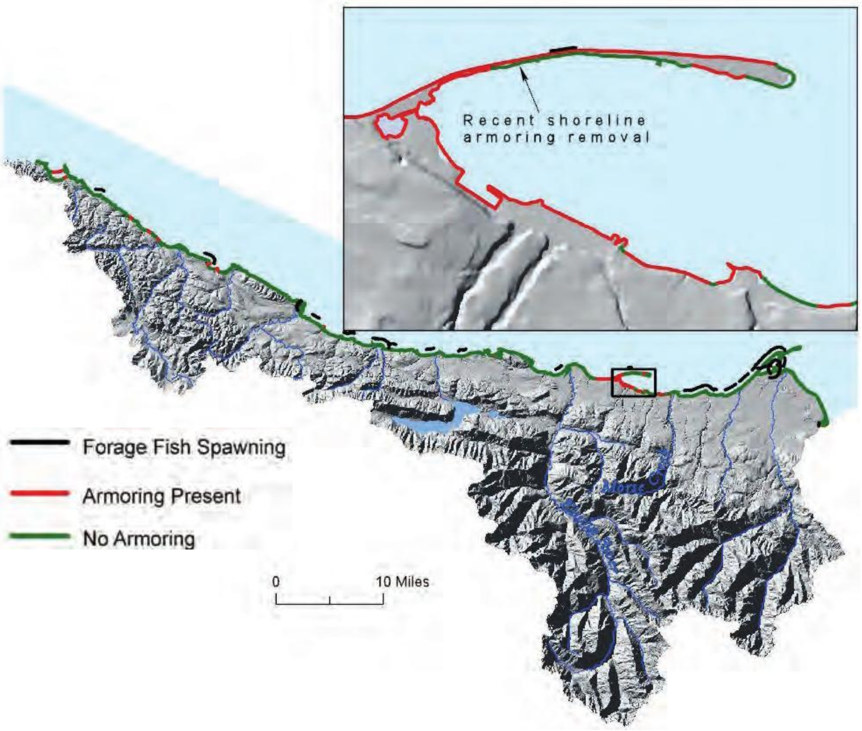
Shoreline armoring can alter the delivery, transport and accretion of sediment when sediment source bluffs become disconnected from their associated beaches and marine nearshore. This negatively affects the nearshore environment necessary for salmon survival, and severely limits forage fish habitat development and maintenance.

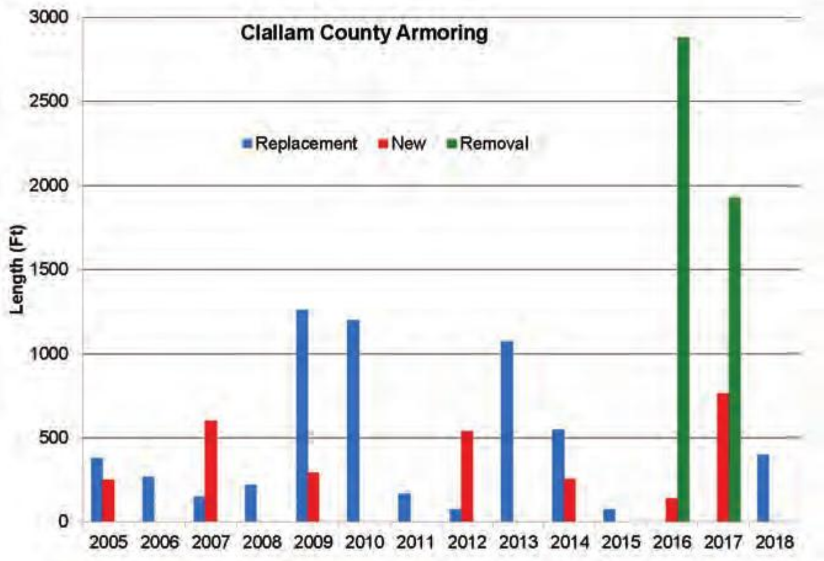
Shoreline armoring is widespread in Puget Sound shorelines, severely degrading shoreline currents, sediment processes, vegetative communities, vertebrate and invertebrate communities (salmonid food sources), and the protective habitat provided by natural shorelines.[1,2]

Sand lance and surf smelt, which make up a major portion of the diets of juvenile chinook salmon, spawn almost exclusively on sand and gravel beaches, making them especially vulnerable to the degrading effects of shoreline modification and armoring.

About 20% of the marine shoreline in the Lower Elwha Klallam Tribe's Area of Interest is armored. Since reported in 2016, the amount of armored shoreline has increased by 2% relative to the total coastal shoreline analyzed (718,832 feet). Since that time, the total length of armored shoreline has increased by 13,360 feet. About 73% of the total shoreline around Port Angeles, between the Elwha River and Morse Creek, is armored. This may explain the relative lack of surf melt and sand lance spawning presence in that area.

Data available for Clallam County from the Hydraulic Project Approvals (HPA) database[3,4] was used to identify the general trend in shoreline armoring in this area. Since reported in 2016, the number of shoreline armoring projects has increased by 10 to a total of 36. Since then, there has been a total of 903 feet of new shoreline armor, 475 feet of replacement armor, and 4,802 feet of removal of existing armor, much of which was undertaken by the tribe. As a result, there has been a net reduction of 1,966 feet of shoreline armor between 2005 and 2018 which may have a positive impact forage fish spawning.





The Washington State's HPA database shows for Clallam County, between 2005 and 2018, there was 903 feet of new shoreline armor, 475 feet of replacement armor, and 4,802 feet of removal of existing armor, with a net reduction of 1,966 feet of shoreline.

Map Data Sources: CGS 2017,[5] PSNERP,[6] SSHIAP 2004,[7] WAECY 2018[8]

Lower Elwha Klallam Tribe

Impervious Surface

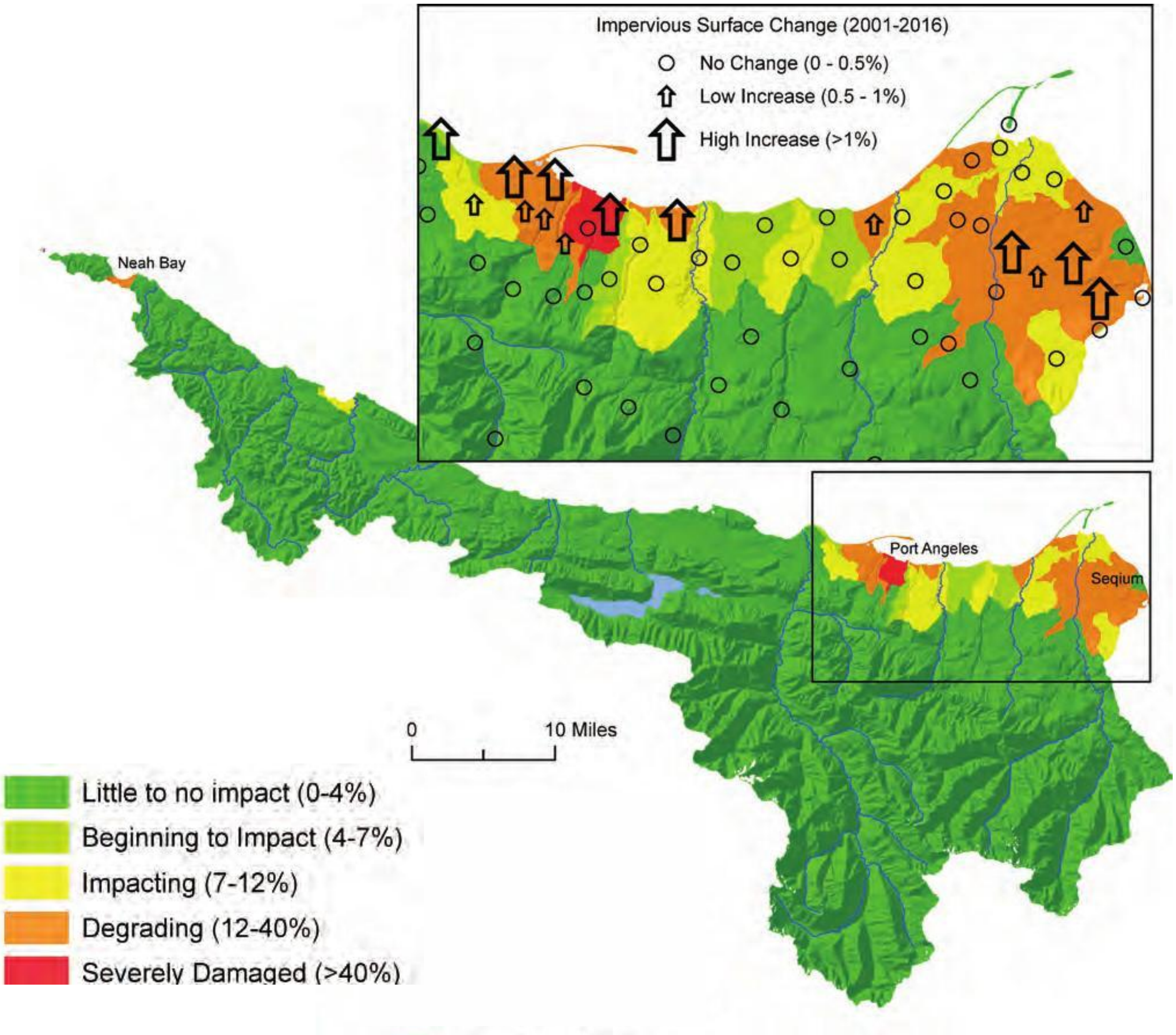
Between 2011 and 2016, more than 99% of the Area of Interest showed little to no change in impervious surface conditions. However, in the 15-year period between 2001 and 2016, watersheds around Port Angeles and Sequim had low to high increases in impervious surface conditions.

About 91.5% of the Lower Elwha Area of Interest currently shows little to no impact from impervious surface conditions. The watersheds mostly impacted are in the northeast corner of the Area of Interest with conditions ranging from beginning to impact at the low end, to severely damaged at the high end.

The most negatively impacted impervious surface conditions prevail in watersheds around Port Angeles, Sequim and Neah Bay. This is likely a result of urbanization which directly increases the percentage of land covered by impervious surfaces and reduces the area available for infiltration. A high percentage of impervious surface leads to increased runoff and higher stream peak flows, increased sediment and pollutant delivery, and decreases in stream biodiversity.[1,2]

Between 2011 and 2016, more than 99% of the Area of Interest showed no change in impervious surface conditions, with values ranging from 0 to 0.5% increase, which may be an indication of the low rate of change in urbanization in the area within that period.

However, between 2001 and 2016, watersheds around Port Angeles and Sequim showed low to high increases in impervious surface conditions with values as high as 3% increase. This was likely caused by changes to population, urbanization and road construction over the much longer period. Combined population estimates for WRIA 18 and 19 by the state Office of Financial Management[3,4] show a 2.4% change in population between 2011 and 2016 but a 13.9% change from 2001 to 2016. It appears that the higher population change and subsequent increase in urbanization over the 15-year period produced higher increases in impervious surface conditions in the urban growth areas of Port Angeles and Sequim.



Map Data Sources: SSHIAP 2004,[5] NLCD 2006,[6] NLCD 2011,[7] NLCD 2016,[8] WAECY 2011,[9] WAECY 2018[10]

Water Wells

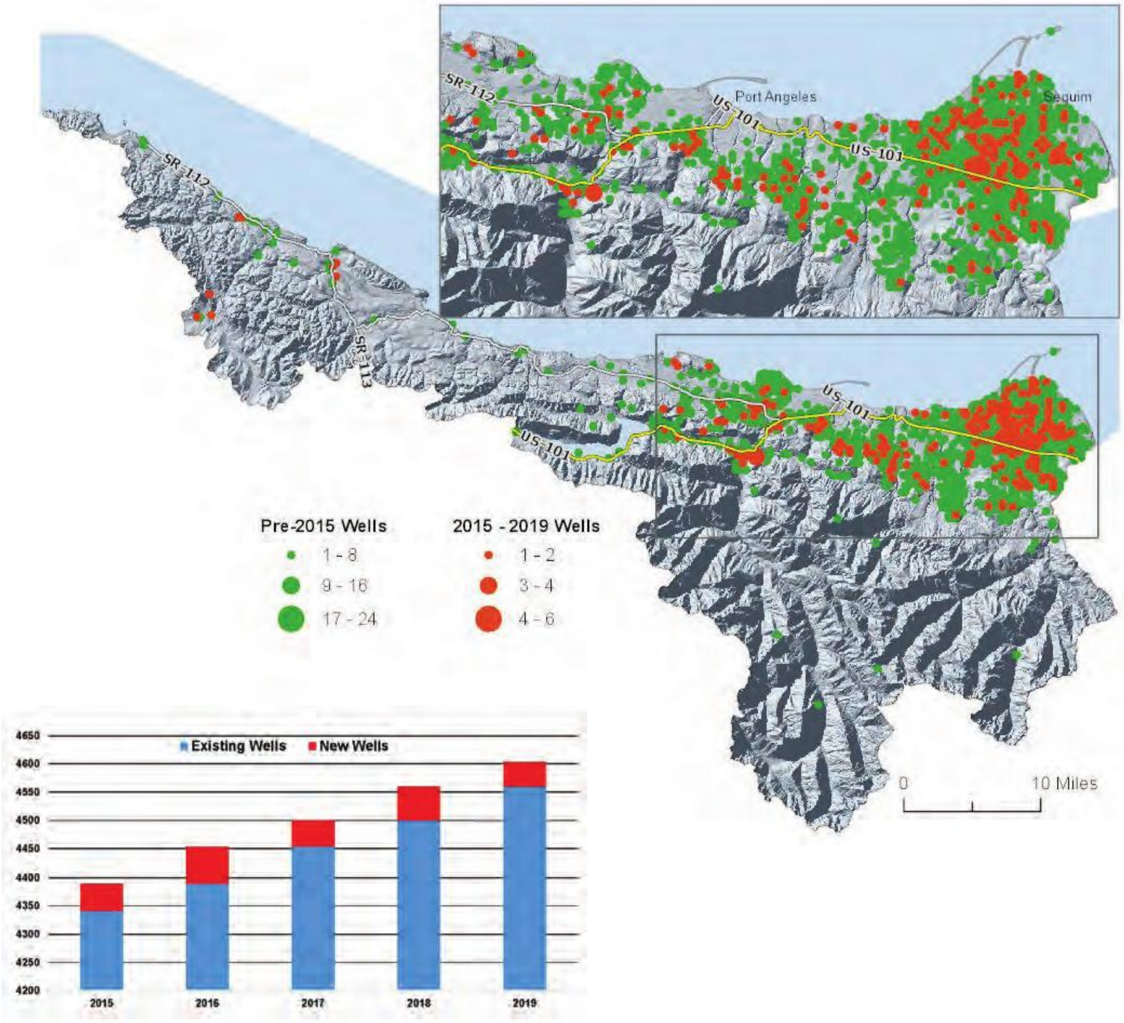
Between 1980 and 2014, a total of 4,341 wells were completed, representing an average annual rate of about 124 new wells. Since 2015, an additional 262 wells have been added, at about 52 new wells per year. Although the cumulative number of wells has increased since 2015, the rate of increase has slowed.

Water wells represent a source of water for many landowners. Under state law, landowners with permit-exempt wells are allowed to withdraw water for domestic purposes without obtaining a water right. Water withdrawals through these wells affect groundwater supply. Because of the hydraulic connections between groundwater and surface water, these groundwater withdrawals may reduce instream flows of surface water, and negatively impact water quantity and quality as well freshwater and marine habitat for salmon, shellfish and related species.

There are currently 4,603 wells in the Lower Elwha Klallam Tribe's Area of Interest. Most of these wells are concentrated between Sequim and Port Angeles. Between 1980 and 2014, a total of 4,341 wells were completed in the Area of Interest, representing an average rate of about 124 new wells per year. Since 2015, an additional 262 wells have been added, representing a rate of about 52 new wells per year. Although the cumulative number of wells has increased since 2015, the rate of increase has slowed.

In January 2018, the Washington State Legislature passed a law intended to restore streamflows to levels necessary to support salmon populations and provide water for homes. The law directs local planning groups to develop watershed plans that offset impacts from new domestic permit-exempt wells and achieve a net ecological benefit within the watershed.[1] The law was in response to the Hirst decision, a ruling made by the state Supreme Court in October 2016 that limited a landowner's ability to get a building permit for a new home when the proposed source of water was a permit-exempt well.[2]

In the Lower Elwha Area of Interest, the Elwha-Dungeness watershed has an existing instream flow rule that regulates permit-exempt uses. No further action is required by this new law but the rest of the Area of Interest is not regulated by an instream flow rule, and permit-exempt wells are regulated by the old law. No new rules apply there.



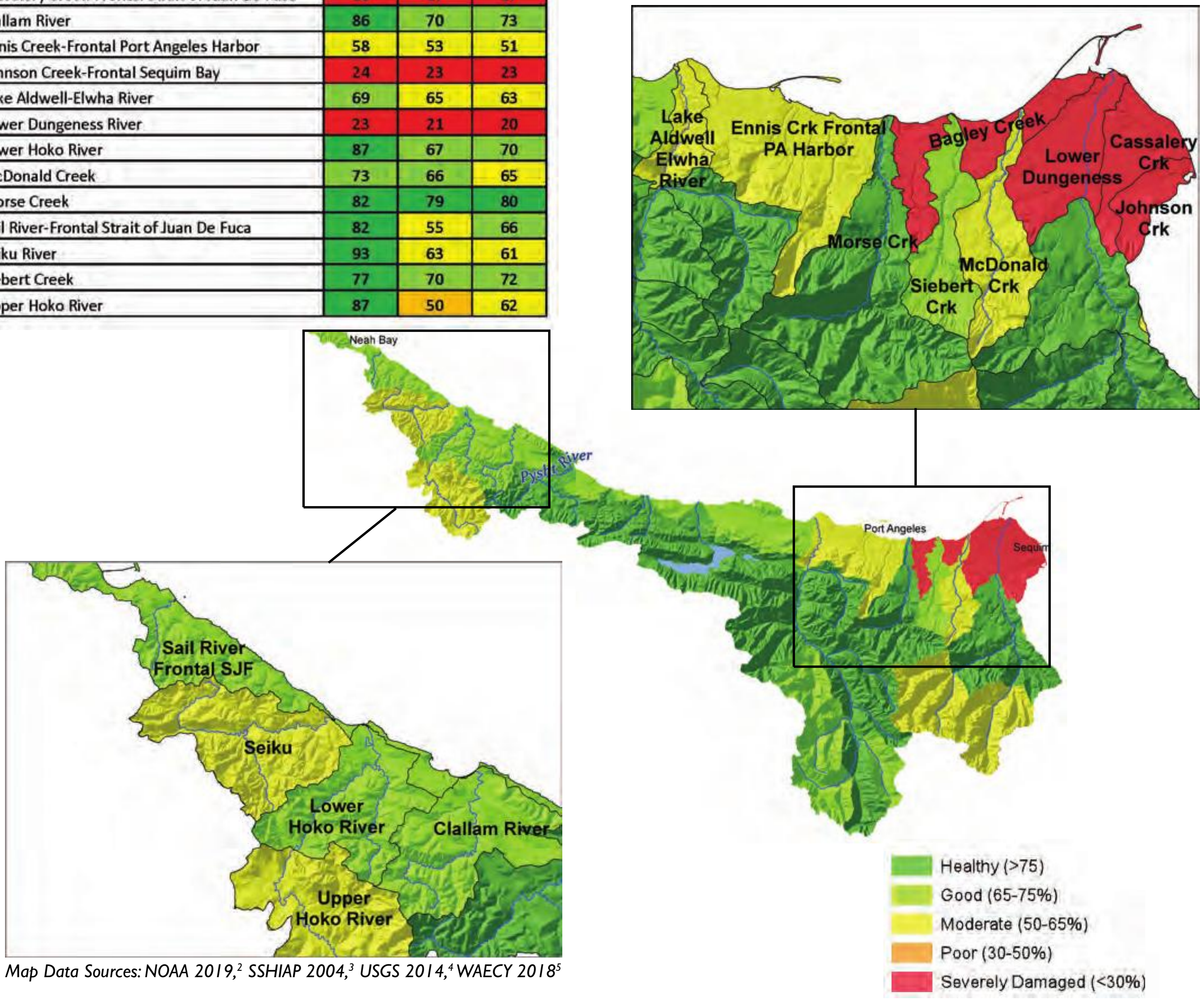
Map Data Sources: SSHIAP 2004,[3] WADNR 2018,[4] WAECY 2018,[5] WAECY 2019c[6]

Lower Elwha Klallam Tribe

Forest Cover Conditions

Current forest cover conditions are generally good to healthy in 71% of the Lower Elwha Area of Interest but severely damaged conditions exist in watersheds in areas around Sequim. In the period between 2011 and 2016, there was little to no change in the forest cover in most watersheds. However between 1992 and 2016, there were significant mostly negative changes in forest cover in many of the watersheds west of the Pysht River.

	Percent Forest Cover		
Watershed	1992	2011	2016
Bagley Creek-Frontal Strait of Juan De Fuca	37	28	27
Cassalery Creek-Frontal Strait of Juan De Fuca	18	17	17
Clallam River	86	70	73
Ennis Creek-Frontal Port Angeles Harbor	58	53	51
Johnson Creek-Frontal Sequim Bay	24	23	23
Lake Aldwell-Elwha River	69	65	63
Lower Dungeness River	23	21	20
Lower Hoko River	87	67	70
McDonald Creek	73	66	65
Morse Creek	82	79	80
Sail River-Frontal Strait of Juan De Fuca	82	55	66
Seiku River	93	63	61
Siebert Creek	77	70	72
Upper Hoko River	87	50	62



Map Data Sources: NOAA 2019,[2] SSHIAP 2004,[3] USGS 2014,[4] WAECY 2018[5]

About 71% of the Lower Elwha area of interest is in good to healthy forest cover conditions, which means that those areas have at least 65% forest cover. A large proportion of the area is in the Olympic National Park which is federally protected from anthropogenic disturbances.

Severely damaged forest conditions with less than 30% forest cover exist in watershed units in the urban and suburban areas around Sequim.

In the 5-year period between 2011 and 2016, there was little to no change in the forest cover in most watersheds. However in the longer 24-year period between 1992 and 2016, there were significant changes in forest cover in many of the watersheds.

Most of the forest cover losses were found in watersheds west of the Pysht River towards Neah Bay and to a lesser extent, the watersheds east of the Elwha River, between Port Angeles and Sequim. Between 1992 and 2016, the highest forest cover loss was 32% and 25% in the Seiku River and Upper Hoko River watersheds, respectively.

Given the location of where they occurred, it appears the most significant changes in forest cover were mainly caused by the removal of trees for commercial and non-commercial purposes. Other factors may have been the development of new impervious surface or other permanent structures and other human-induced changes such as temporary dirt roads.

Reduced forest cover can lead to degradation of the soil and alter watershed processes that are critical to the development and maintenance of good water quality and habitats favorable to salmonids.[1]

Invasive Species

*Native species in the Lower Elwha Area of Interest are increasingly threatened by invasive plants and animals. One recent arrival, the European green crab (*Carcinus maenas*) which poses a significant risk to the Dungeness crab, a culturally and economically important species to the tribe is found in the highly productive Dungeness Bay. Other invasive plant species are found mostly in the riparian areas of Lake Pleasant.*

Native species in the Lower Elwha Area of Interest are increasingly threatened by invasive plants and animals. One recent arrival is the European green crab (*Carcinus maenas*) which poses a threat to native shellfish resources, critical fish and wildlife habitat, and critically important native estuarine ecosystems.

In the Lower Elwha Area of Interest, a new population of green crab was first discovered at the Dungeness Spit near Sequim in 2017.[1] One unique feature of this initial find of the green crab population in the Dungeness Spit was that multiple crabs were being found at the same site over successive days of trapping. That was an indicator that the individuals could find and mate with each other and the population, if not controlled, could explode rapidly. Experts responded to this initial find with a rapid-response trapping and removal effort.[2] Since then, a total of 223 crabs have been caught in the highly productive Dungeness Bay between 2017 and 2019.

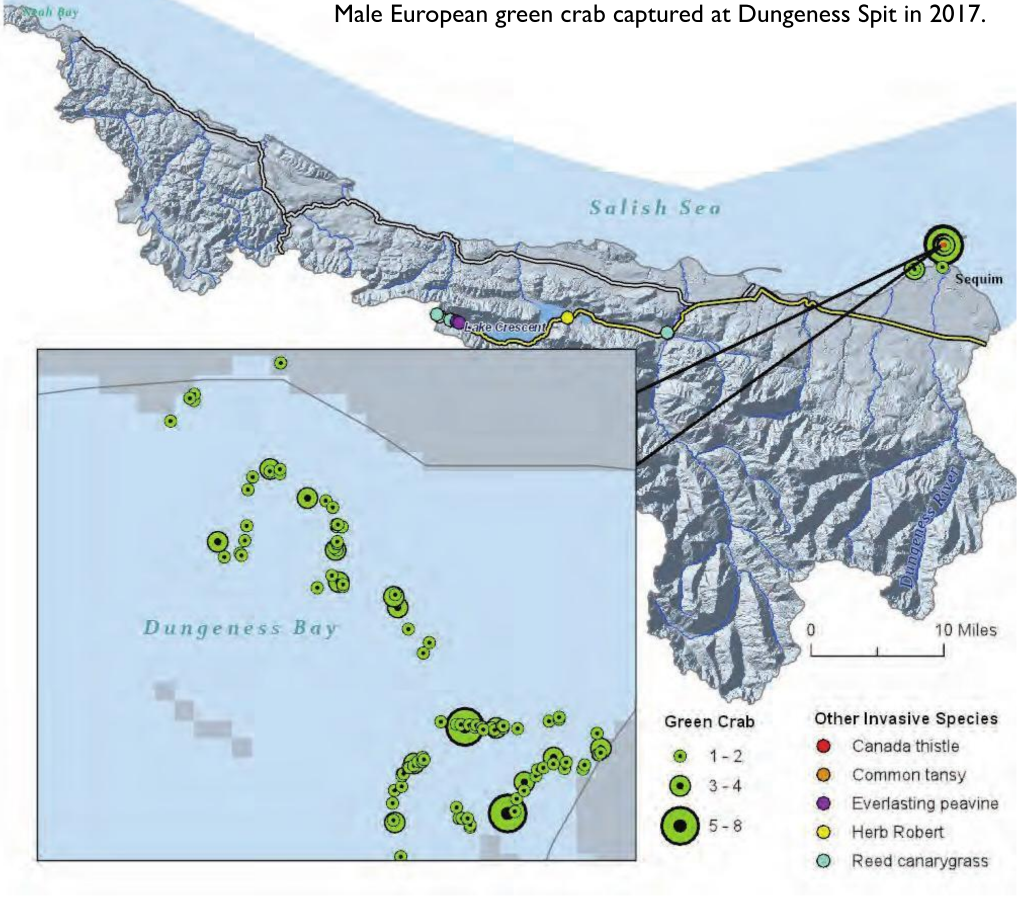
The green crab is considered a proficient colonizer that is able to establish and flourish in new environments. Their larvae can survive as plankton for up to 80 days, are dispersed by ocean currents along the coast, and swept by tides and currents into coastal waters where they molt and settle as juvenile crabs in the upper intertidal zone.[3]

The European green crab also is an efficient predator that preys on bivalves and other crustaceans, such as soft-shell clams and scallops and could damage eelgrass beds.[4] The tasty Dungeness crab, *Cancer magister*, is culturally and economically important to the Lower Elwha Klallam Tribe. But green crabs pose a significant risk to juvenile Dungeness crabs which suffer high mortality rates due to green crab predation.[5,6] This may reduce recruitment of these individuals to the adult populations. Green crab can also outcompete Dungeness crab for food and shelter.

Other invasive species include reed canarygrass (*Phalaris arundinacea*), herb Robert (*Geranium robertianum*), Canada thistle (*Cirsium arvense*), common tansy (*Tanacetum vulgare*), and everlasting peavine (*Lathyrus latifolius*) which are found mostly in the riparian areas of Lake Pleasant. A management strategy needs to be established for the prevention, control and eradication of these invasive species.

Allen Pleus, WDFW

Male European green crab captured at Dungeness Spit in 2017.



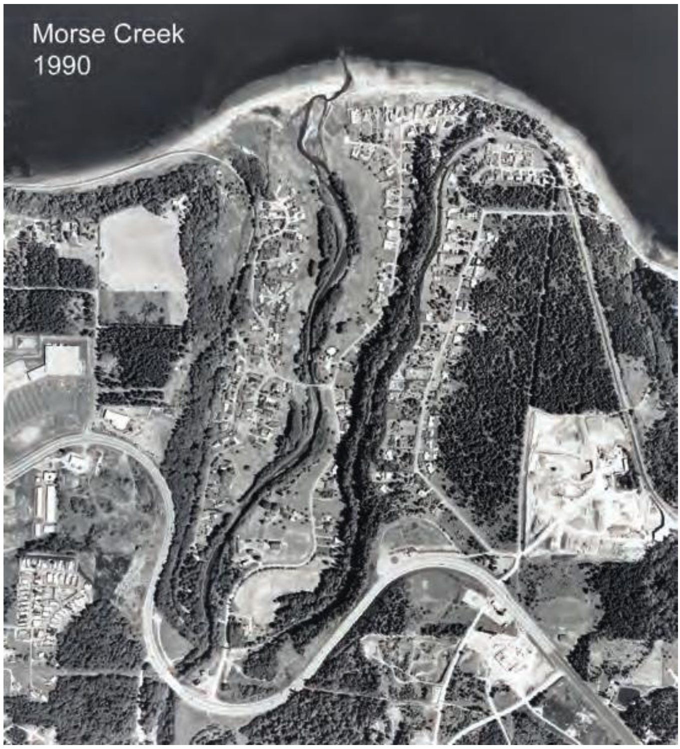
Map Data Sources: 10KYI 2019,[7] SSHIAP 2004,[8] WADOT 2018,[9] WAECY 2018,[10] WDFW 2019,[11] WSG 2020[12]

Lower Elwha Klallam Tribe

Morse Creek Floodplain Improvements Increase Fish Production

Since the 2010 restoration project that restored a significant meander and added 1,300 feet of habitat to the formerly channelized reach, there has been a dramatic 300% increase in juvenile fish abundance within the restored reach as compared to an untreated control reach just upstream of the project.

Morse Creek Before Channelization



Morse Creek After Channelization

Washington Department of Natural Resources (2)

Morse Creek is known to have historically produced a high diversity of salmon, including chinook, coho, chum and pink salmon, steelhead and searun cutthroat trout.[1] The diversity of stocks was likely the result of snowmelt hydrology as Morse Creek drains high elevation landforms of the Olympic National Park. Unfortunately, the spring chinook salmon stock has been extirpated and other stocks including pink, chum, coho and steelhead have declined to extremely low levels.

Historically, Morse Creek is perhaps the most significant salmon stream in the Eastern Strait sub-region, with the exception of the Elwha and Dungeness rivers.[2] The lower reaches of Morse Creek were unconfined and meandering with multiple channels. The sediment supply was sufficient to produce a pronounced spit with a secondary tidal creek outlet.

As humans moved into the watershed, the Morse Creek floodplain has been seriously impaired with 37% being zoned for development from utility right of ways to single-family homes. Downstream of Highway 101, 49% of the floodplain has been zoned for similar development[3] and below the anadromous barrier at river mile 4, the floodplain has been affected by a combination of land development, channelization, diking and armoring, road and other floodplain constrictions, and riparian vegetation removal.[4] Tributary watersheds, platted for urban development "will likely result in additional significant stormwater impacts."[5] What was once a wide productive floodplain has been modified to the extent that only the topography is recognizable.

Morse Creek is at risk from potential future development. "Both the Mining Creek and Frog Creek sub-watersheds are platted for future urban development. Both sub-watershed are located in the rain-on-snow zone in the Morse Creek watershed. Even if existing Critical Area Ordinances are enforced, new development will likely result in additional significant stormwater impacts to Morse Creek (Joel Freudenthal, pers. comm., 2001)."[6]

Large scale floodplain restoration is necessary to restore habitat and fish populations on Morse Creek. The first such project was recently completed south of the Highway 101 bridge crossing on property acquired by Washington Department of Fish and Wildlife for conservation. This parcel of land was historically cleared and used for hay production. Historic air photographs show that the channel was relocated by bulldozer along the west side of the river valley. In 2010, the North Olympic Salmon Coalition, the Lower Elwha Klallam Tribe and Jamestown S'Klallam Tribe obtained funding from the Salmon Recov-

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Map Data Sources: ESRI 2020,[7] FEMA 1996,[8] WAECY 2018[9]

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Mike McHenry, Lower Elwha Klallam Tribe

An undersized Highway 101 bridge opening on Morse Creek.

ery Funding Board to reconnect Morse Creek to its former location. The project restored a significant meander and added 1,300 feet of habitat to the formerly channelized reach. The project also included construction of side channels, additions of large wood, removal of dikes and restoration of floodplain forests. Monitoring has shown a dramatic increase (300%) in juvenile fish abundance within the restored reach as compared to an untreated control reach just upstream of the project.

This project demonstrates the type of approach that is necessary to recover Morse Creek habitat and ultimately salmon populations. A similar approach could be developed for the channelized and degraded portions of Morse Creek below Highway 101. Unfortunately efforts to advance restoration in lower Morse Creek have been resisted by a homeowners association who seem to prefer the maintenance of a straight, channelized river with a golf course that encroaches upon it. Without significant restoration in the reach below Highway 101, it is unlikely that Morse Creek will be able to recover its historic populations of Pacific salmon.

Mike McHenry, Lower Elwha Klallam Tribe

Housing encroachment on Morse Creek channel.

Lower Elwha Klallam Tribe

Elwha River Fisheries and Ecosystem Restoration

Conditions in the Elwha River watershed have been monitored by the Lower Elwha Klallam Tribe and their partners to gauge ecosystem response to the removal of the Elwha dams. Six years following dam removal, there have been positive responses for chinook, steelhead, coho, bull trout and Pacific lamprey but pink and chum salmon have yet to show a response. The return of sand lance and smelt, which are important prey items for juvenile salmonids has also been observed. River otters and American dippers, closely tied to ecosystem health, are expected to be positively impacted by the return of salmon. It is estimated that, to date, over 4 million cubic yards of sediment has been deposited in the Elwha delta since the removal of the dams.

On Aug. 26, 2014, detonation of explosives at the former Glines Canyon Dam site obliterated the final remnants of that structure and re-opened the upper watershed of the Elwha River to salmon for the first time in 102 years. On Sept. 2, one week later, the first chinook salmon were observed migrating beyond this site into more than 40 miles of pristine habitat now available to them within Olympic National Park. This was the culmination of 22 years of planning and 3 years of deconstruction associated with the removal of the 33 meter Elwha Dam (RM 4.9) and the 66 meter Glines Canyon Dam (RM 13.6).

Researchers from the Lower Elwha Klallam Tribe and their partners with Olympic National Park, United States Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), University of Washington, Sea Grant and other entities have been actively monitoring a multitude of biological and physical conditions in the Elwha River watershed to gauge ecosystem response to the removal of the Elwha dams. This work includes water quality monitoring, sediment transport and deposition monitoring, beach and delta topographic studies, numerous studies to assess adult and juvenile salmonid population responses, wildlife population response, estuarine fish and invertebrate studies, vegetation sampling, intertidal sampling, and subtidal SCUBA surveys.

Mike McHenry, Lower Elwha Klallam Tribe

A smolt trap on Little River (one of three within the Elwha River valley).

Tiffany Royal, NWIFC

Setting up SONAR camera for enumeration of adults.

Monitoring of Salmon Response

The tribe is conducting long-term population level monitoring of the response of salmon to dam removal. These efforts were initiated in the mid-2000s and the tribe is using a fish in-fish out model to monitor populations before, during and after dam removal. This life history approach requires enumeration of returning adults, juvenile abundance and smolt out-migrants.

Because Elwha restoration involved the release of large amounts of sediment that had accumulated over 100 years in two reservoirs, there also has been an emphasis on how that sediment impacted habitat over time. Six years after dam removal, the story is still unfolding as the river recovers and fish access different habitats that have not been occupied in more than a century. The overall goal of the project is to recover all salmon populations to naturally sustainable, fishable levels.

Only six years following dam removal, the tribe has seen positive responses for chinook, steelhead, coho, bull trout and Pacific lamprey. Populations that were at very low levels when the project began, such as pink and chum salmon, have yet to show a response.

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Monitoring of Wildlife Response

In connection with removal of the Elwha dams, the tribe's wildlife division is collecting baseline data on select species of river-dependent wildlife.

Specifically, river otters and American dippers are closely tied to ecosystem health and are expected to be positively impacted by the return of salmon and their associated marine-derived nutrients to the Elwha ecosystem.

The primary objective is to collect information on how otters and dippers use the river to meet their spatial, habitat and dietary needs. To fulfill this objective, the tribe is capturing and tagging otters and dippers, and collecting biological samples to conduct stable-isotope analysis of marine-derived nutrients.

Mike McHenry, Lower Elwha Klallam Tribe

Tagging juvenile fish.

Subtidal SCUBA Surveys

Tribal biologists have been assisting in USGS led subtidal dive (SCUBA) surveys along the Elwha nearshore from Freshwater bay to the base of Ediz Hook since 2011.

This study, initiated in 2008, involves monitoring sediment-related changes to subtidal habitats that may be associated with the removal of the Elwha dams. The USGS has estimated that, to date, more than 4 million cubic yards of sediment have been deposited in the Elwha delta since the removal of the dams. This represents approximately 15% of the sediment estimated to have been stored behind the Elwha dams.

The dive team identifies algae, macroinvertebrates and fish along 40 meter transects at depths of 20 to 60 feet. In addition, physical characteristics such as grain size, slope and light penetration at the sea floor also are recorded.

Interestingly, the physical presence of the large sediment plume created by the release of fine sediment from the former Elwha River reservoirs appeared to have a more pronounced effect on habitat during the first two years after dam removal than actual deposition along the sea floor at most study sites. The lack of light penetration through the sediment plume prevented or delayed the regeneration of large, dense kelp "forests" once observed at most of the subtidal dive sites.

As expected, the monitoring sites in closest proximity to the mouth of the river have received the greatest contribution of fine sediment. Of the 15 established Elwha nearshore monitoring sites, all have had some degree of fine sediment deposition from behind the former dams. Five of these subtidal sites have been completely buried, resulting in a marked transition from a heavily cobbled to a sandy substrate that is more conducive to bivalves and other soft substrate inhabitants. The tribe also has noted the return of sand lance and smelt, which are important prey items for juvenile salmonids. The site nearest the river mouth is now buried in more than 10 meters of fine sediment.

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Ian Miller, Washington Sea Grant

Newly constructed engineered logjams in the lower Elwha River. The structures are designed to split flows, activate new side channels, create pools and sort gravel.

Floodplain Restoration

While scientific research has dominated early headlines emerging from dam removals on the Elwha, the tribe also has been conducting comprehensive floodplain restoration actions in the lower river, downstream of former Elwha Dam site.

Prior to dam removal, the 5-mile lower Elwha River reach provided the only available habitat for Pacific salmon following construction of the Elwha Dam in 1913. This habitat became increasingly degraded over time as sediment and wood necessary to support habitat-forming processes was blocked by the dam. Habitat was further degraded over time by human activities including floodplain logging, removal of logjams, and channelization.

Indeed, prior to dam removal, the lower Elwha had lost almost all of its spawning habitat, had very few side-channels for a river of its size, had lost most of its historic estuary, and supported limited natural salmon populations.

Beginning in the late 1990s, before it was even clear that dam removal would occur, the tribe began efforts to restore floodplain habitat in the lower river.

The restoration strategy involved four tools: 1) the removal of abandoned flood control dikes in the floodplain, 2) the insertion of engineered log jams in the mainstem, 3) addition of free wood in side-channels and 4) floodplain revegetation. Over time and with increasing experience conducting restoration in a large river, the project grew in scale and complexity. While initial restoration actions were focused on simply providing salmon with a refuge while awaiting the possibility of dam removal, later restoration efforts focused on design that would be complementary to dam removal and the expected changes to follow in the lower river.

In 2014, both dams had been removed and the Elwha was restored to a free flowing river. A 15-year lower river floodplain restoration effort had resulted in the construction of 50 engineered logjams, the removal of four floodplain dikes, three side channels loaded with large wood, and the planting of 400,000 native trees and shrubs.

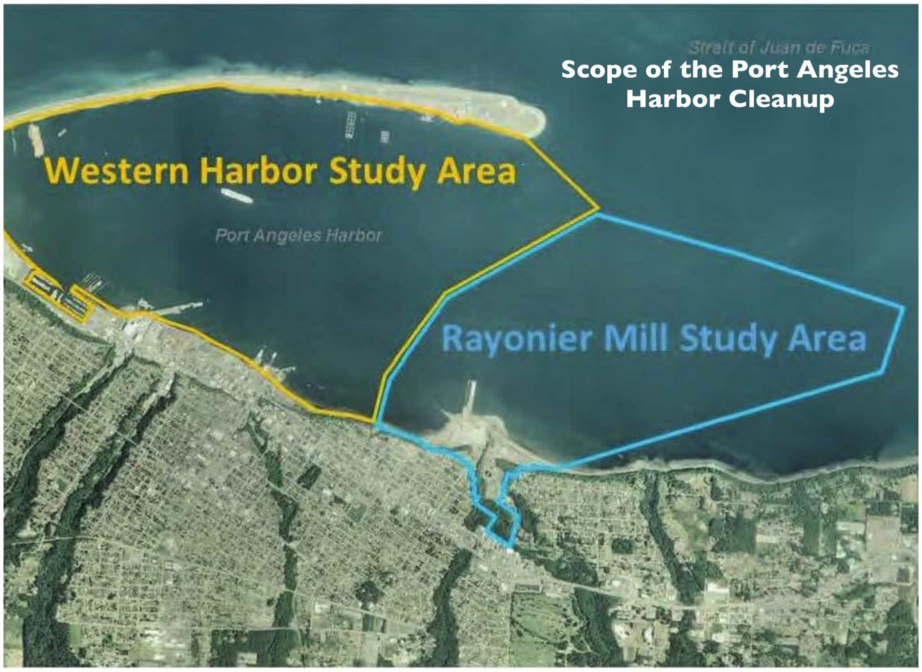
In 2021, an additional 24 logjams will be constructed in a 0.5 mile reach of the river.

Port Angeles Harbor Cleanup and Restoration

Over a century of industrial activities has exacted a heavy toll on natural systems within the Port Angeles Harbor, resulting in the contamination of sediments and fish, heavily degraded shorelines, and the loss of critical nearshore and estuarine habitat used by salmon and their forage fish prey.

The Lower Elwha Klallam Tribe and other partners have carried out multiple shoreline restoration projects along the interior of Ediz Hook, the spit that created and shelters the harbor, restoring 1,600 meters of hardened shoreline by removing former log rafting and offloading structures and associated shoreline armoring, and replacing with clean beach material and native beach vegetation.

To restore eelgrass beds in the harbor that provide critical nursery habitat for juvenile salmon and forage fishes, the tribe and its partners also salvaged and planted eelgrass plants.



Washington Department of Ecology


Matt Beirne, Lower Elwha Klallam Tribe

Eelgrass planted by the tribe in 2017.

Introduction and Background

Port Angeles Harbor is the largest natural deep water harbor on the west coast of the United States. It was created during the Holocene when feeder bluffs within the Elwha River drift cell to the west formed the long, protective eastward projecting sand spit (Ediz Hook).

Port Angeles Harbor has a long, rich history of cultural importance to the Klallam Indians. Three Klallam village sites were found along the southern shoreline of the harbor. Tse-Whit-Zen (western harbor) and Y'innis (Ennis Creek, eastern harbor) were large prominent villages, the former dating at least 2,500 years. The damming of the Elwha River (1912), coupled with armoring of the feeder bluffs reduced the sediment supply by 88%, resulting in the subsequent armoring of the outer Ediz Hook shoreline in the 1970s.

The 1,325-acre harbor is a typical Northwest "working harbor" with uses that include industrial, commercial, municipal, marine trades, recreation, tourism and natural resources. Over a century of industrial activities has exacted a heavy toll on natural systems within the harbor due to contaminants, extensive shoreline armoring and in-water structures. This has resulted in contamination of sediments and fish, heavily degraded shorelines, and the loss of critical nearshore and estuarine habitat used by salmon and their forage fish prey. A fish consumption

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Doug Wilson, NARA

Historical photo of log rafts showing the origins of legacy wood waste in the Port Angeles Harbor.

advisory is currently in effect by the Department of Health as well as a moratorium on commercial fishing in the harbor by the tribe and Washington Department of Fish and Wildlife.

Elwha Tribe Restoration Efforts

The tribe is deeply committed to restoring Port Angeles Harbor to a healthy, functioning ecosystem that will allow for the resumption of tribal and public access to healthy fish and shellfish resources. This will require significant efforts: 1) to remove and/or isolate existing contamination from biological pathways (a process often referred to as remediation or cleanup) and 2) to restore degraded nearshore and estuarine habitats along the harbor shoreline (a process referred to as restoration or "natural resources damages" or NRD, under such laws as the federal Comprehensive Environmental Response, Compensation and Liability Act, CERCLA or Superfund law). Legal mechanisms exist to promote and enforce these and other efforts, and the tribe is optimistic that the cleanup and NRD processes will result in significant improvements to the harbor ecosystem within the next several years.

While complicated chemical cleanup processes are ongoing in Port Angeles Harbor, there are also significant habitat impacts that must be dealt with, resulting from over a century of industrial uses. Those impacts include shoreline filling, armoring and overwater structures that have encroached on the majority of the harbor's natural shoreline. The only remnant natural shorelines remaining in Port Angeles Harbor are located east of the Rayonier Mill site and on the south shore of Ediz Hook. Hardened shorelines affect sediment transport and deposition processes and reduce spawning habitat for forage fish such as sand lance and smelt, the favored prey of Pacific salmon.

The tribe has spearheaded multiple shoreline restoration efforts along the interior of Ediz Hook, the spit that created and shelters the harbor. The tribe has restored over 2,100 meters of shoreline along the interior (southern shore) of Ediz Hook. This included cooperative projects with state DNR and federal Environmental Protection Agency to remove overwater structures and multiple shoreline restoration projects involving rock removal and placement of beach nourishment and large wood. Two additional segments of shoreline remain to be restored along Ediz Hook at the former Cooke Aquaculture upland site and the site of the Port Angeles rowing club. There is considerable opportunity for restoration of shoreline habitat along the south shore of Port Angeles Harbor in the industrialized and marine trades areas to reduce shoreline hardening and remove derelict structures.

Eelgrass Habitat Restoration

Decades of log rafting activities and shoreline hardening have adversely impacted eelgrass beds in Port Angeles Harbor that provide critical nursery habitat for juvenile salmon and forage fishes. In 2018, the U.S. Navy installed a large transit protection system (TPS) pier at the US Coast Guard Base along the eastern end of Ediz Hook to accommodate the paired blocker vessels that escort naval submarines through the Strait. This project included several mitigation actions, including the salvage of eelgrass beds located under the pier's large footprint. The tribe partnered with Pacific Northwest National Laboratory (PNNL) and Sea Grant to harvest eelgrass plants (turions) from the site using divers and a shore team. Approximately half of the 8,000 eelgrass turions harvested from the site were then planted on plots along the central shore of Ediz Hook. The remaining plants were transported to PNNL and planted in outdoor tanks for later plantings along the Ediz Hook shorelines. Eelgrass plantings from this stock, which has increased to approximately 15,000 turions, took place in July 2020 with more expected in summer 2021. The two eelgrass test plots planted in June 2017 responded well to transplanting and continue to provide vibrant, healthy eelgrass habitat functions. This shallow subtidal restoration work complements the shoreline beach restoration work that the tribe has completed and continues to pursue throughout Port Angeles Harbor.

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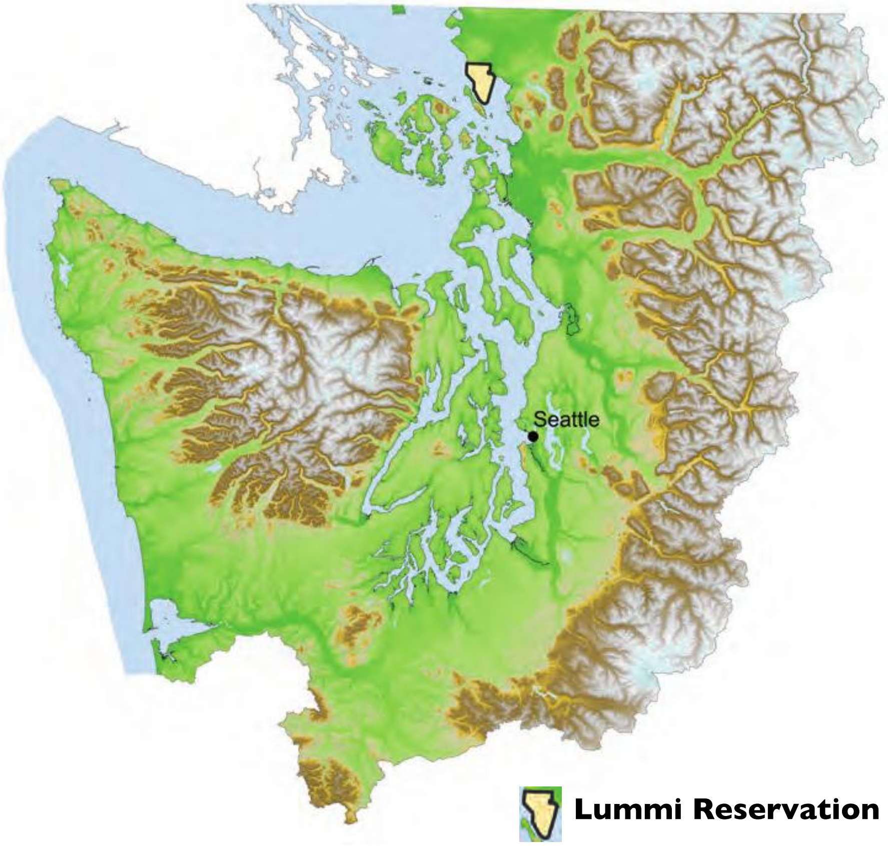
2020 State of Our Watersheds Report
Lummi Watershed

Randy Kinley Sr.

> *Our elders used to tell us salmon is good medicine. It's part of our* Sche Lang en' *– our way of life. Now the salmon is in trouble, so our way of life is in trouble.*
>
> – **Merle Jefferson Sr.**
> **Lummi Nation**

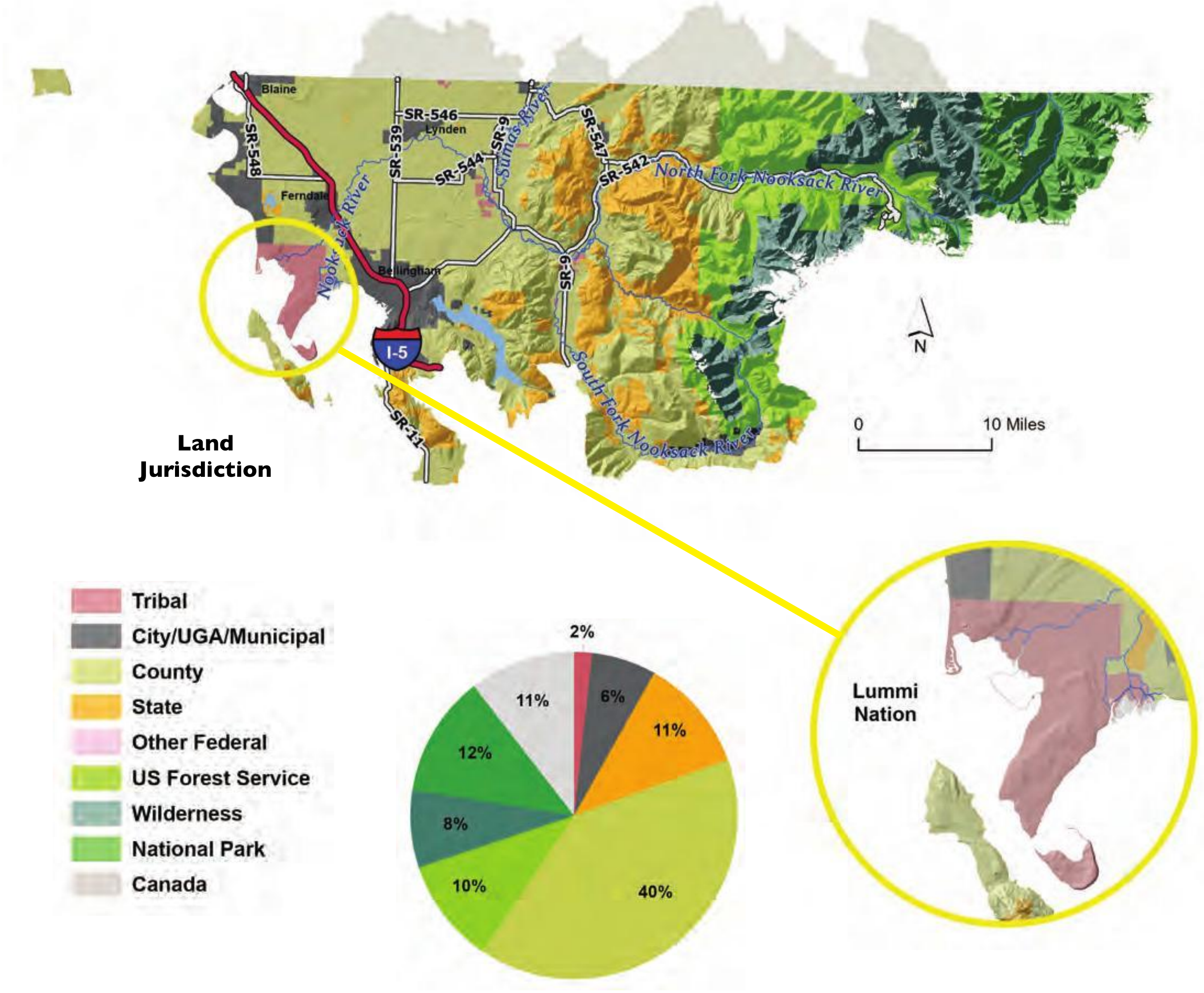


Lummi Nation

The Lummi people were among the original inhabitants of what is now Washington's northernmost coast and southern British Columbia. For thousands of years, they have worked, struggled and celebrated life on the shores and waters of Puget Sound. The Lummi Nation is a self-governing sovereign nation within the United States and one of the largest tribes in Washington state with more than 5,000 members. The Lummi Nation has the largest fishing fleet of all tribal nations in the United States.

Lummi Nation

WRIA 1: Mountains to the Sea



The Nooksack River watershed is 832 square miles, the largest drainage in WRIA 1, and the fourth largest drainage in the Puget Sound. It has three main forks: the North, Middle and South that originate in the steep high-elevation headwaters of the North Cascades and flow westerly descending into flats of the Puget lowlands. The North and Middle forks are glacial rivers and originate from Mount Baker. The South Fork is a snow- and rain-fed river and originates from the non-glaciated slope of the Twin Sisters peaks. The Middle Fork flows into the North Fork upstream of where the North Fork confluences with the South Fork to form the mainstem Nooksack River. The mainstem then flows as a low-gradient, low-elevation river until flowing into Bellingham Bay. Historically, the Nooksack River alternated between flowing into Bellingham Bay, and flowing through the Lummi River, and into Lummi Bay.

The Lummi are an aboriginal people who have fished, hunted and gathered throughout their usual and accustomed grounds and stations and their traditional territory since time immemorial. Living in a region with many resources, the Lummis developed vibrant communities and a rich culture. Most of the nearly 5,500 Lummi tribal members continue to live on or near the over 20,000-acre Lummi Indian Reservation.

Euro-Americans began settling the area in the 1850s primarily for the logging resources, with some arriving for opportunities in prairie farming and mining. Lowland clearing for agriculture began in earnest by the 1890s and by 1925, nearly all of the lower mainstem and delta forests had been converted to agricultural land.[1,2] Since 1950 land-use conversion has primarily been for commercial, residential, urban and industrial development.[3]

The Nooksack River and independent watersheds (WRIA 1) have five species of anadromous salmon: pink, chum, chinook, coho and sockeye; and three of anadromous trout: steelhead, cutthroat and bull trout.[4,5]

Map Data Sources: USFWS 2018,[6] WAECY 2018,[7] WAECY 2018,[8] WAECY 1994,[9] WADNR 2014c,[10] WADNR 2014d,[11] WADOT 2013,[12] SSHIAP 2004[13]

Chapter Summary

Natural resources such as salmon, shellfish, wildlife and traditional plants are all important cultural resources critical to the traditional way of life (*Sche Lang en'*) of the Lummi people, and Lummi's fishing, hunting and gathering rights as retained in the Point Elliott Treaty are viewed as an inherent right endowed by the Creator and protected and passed through the wisdom of Lummi elders. The Lummi people identify as the *L'aqtemish*, or people of the sea, and the most defining characteristic of the Lummi Nation is that since time immemorial, they have been a fishing people. In 1855 Lummi Nation, among other tribes, signed the Point Elliott Treaty ceding lands to the United States government in exchange for reservation lands and guarantees to retain the rights to hunt, fish and gather at usual and accustomed grounds and stations and traditional territories. Lummi Nation currently has the largest tribal commercial fishing fleet in the United States and has exercised these rights since time immemorial and intends to maintain these rights into perpetuity.

In order for those treaty promises to be fulfilled, there must be a sustainable supply of fish, shellfish, game and plants to harvest and gather, and ample access to those natural resources to meet the cultural and subsistence needs and a moderate living from fishing. In addition to naturally produced fish, hatchery-produced fish are also treaty fish and provide the necessary mitigation for the significant losses to returning harvestable salmon incurred through historic and ongoing habitat degradation.

While Lummi Nation did not create the problems that have led to the decline of salmon and the subsequent Endangered Species Act (ESA) listing of Nooksack early chinook, the tribe has consistently worked towards recovering salmon. The ESA is viewed by Lummi as a sign of poor natural resources management, and the act has been applied more stringently toward harvest and hatchery management as compared with protecting habitat and water resources.

To work toward recovery, in the late 1970s, Lummi Nation voluntarily closed its culturally important spring chinook fishery, and Lummi has more recently worked with the state and tribal co-managers and NOAA Fisheries to develop and implement a hatchery program at Lummi Nation's Skookum Creek Hatchery to preserve and recover South Fork Nooksack early chinook. A recovery program for North Fork/Middle Fork spring chinook was initiated at WDFW's Kendall Creek Hatchery in the early 1980s and continues today to prevent extinction of this chinook population in partnership with Lummi Nation. The success of these hatchery programs has provided a small number of early chinook for the community's First Salmon Ceremony and Stommish celebrations for several years. In 2020 favorable natural-origin abundance forecasts coinciding with surplus hatchery-origin from both recovery programs provided a limited subsistence fishery by community members for the first time since 2011.

Despite Lummi Nation's efforts to restore habitat, reduced harvest and overall declines to hatchery production in the Nooksack watershed and all of Puget Sound, the long-term average return of harvestable surplus salmon remains static with no net abundance increase or continues to decline. The primary limiting factors to salmon recovery are the quantity and quality of properly functioning habitat in the watersheds where salmon begin and end their lives, and habitat restoration efforts must continue the focus of increasing freshwater capacity for both spawners and juvenile salmonids.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the salmon resource.

The Lummi Nation chapter is narrowly focused on a few highlighted issues within the watershed related to habitat and water quality and quantity, and is not considered a comprehensive view of issues that Lummi Nation deems as important to protect and preserve the Lummi *Sche Lang en'* and Treaty Rights.

Principal Findings

Lummi Nation Is Improving Habitat by Protecting and Restoring Tidal Wetlands in the Nooksack River Delta

Wetland enhancement activities in the Nooksack delta pursuant to implementation of Phase 1A of the Lummi Nation Wetland and Habitat Mitigation Bank over the 2011-2019 period included over 80 acres of reed canary grass control though willow plantings and over 100 acres of deciduous forest enhancement through conifer underplanting.

Portage Bay Shellfish Growing Area Showed Some Improvement but Partial Conditional Closure Remains

In 2019 for the Portage Bay Commercial Shellfish Growing Area, the Lummi Nation and Washington State Department of Health (DOH) reopened spring harvest (April-June) in the conditionally closed portion of the growing area. Unfortunately, poor water quality persists during the fall season (October-December) and the affected 820-acre area of Portage Bay remains closed to commercial, ceremonial and subsistence shellfish harvest during this time.

Exempt Well Development Expands in WRIA 1 While Instream Flow Rules Continue to be Violated

Between 2015 and 2019, an estimated 647 new water wells were drilled in WRIA 1 and 85% of those are estimated to be permit-exempt water wells.

Forest Road Maintenance and Abandonment on Schedule to Be Completed in the Upper Nooksack Watershed by 2021

The Washington State Forest Road Maintenance and Abandonment Plan (RMAP) has led to the repair and/or abandonment of the majority of 1,426 total miles of private and state-owned forest roads in the Upper Nooksack River watershed. RMAP has also resulted in the repair or removal of 45 of 58 culverts. The remaining culvert repair is scheduled to be done for four Sierra Pacific culverts by 2021 and for nine state or privately owned culverts at the end of the "life of the pipe."

Floodplain Wetland Restoration Still Needed on Agricultural Lands

There has been little change in floodplain wetland area since the late 1900s.

Engineered Logjams and Long-Term Commitment to Healthy Riparian Forests Key to Restoring Wood to the Nooksack River

Since 2016, there have been 18 new large woody debris or engineered logjam (ELJ) projects in the Nooksack River watershed. Two projects are in a proposal phase, five projects are actively progressing and 11 projects have been completed.

Invasion of European Green Crab

The invasive European green crab, *Carcinus maenas*, threatens to disrupt nearshore habitats and balanced ecosystems wherever it is introduced. The Lummi Nation has considerable tidelands and marshlands on its reservation, providing ample suitable habitat for the invasive species. In the fall of 2019, the European green crab was detected in Lummi Bay for the first time since the species colonized the NE Pacific coast. Since then, the Lummi Natural Resources Department has provided a nonstop response to this environmental threat.

Conclusion

Lummi Nation is actively working with partners throughout the Nooksack watershed to restore critical chinook habitat. Habitat restoration objectives are most often monitored and assessed at the project level and with time are expected to have landscape level impacts. However, with severely limited funding and capacity for effectiveness monitoring it is difficult to determine whether salmon recovery projects will successfully provide the harvestable salmon Lummi relies on to practice its treaty-protected fishing rights.

Habitat restoration alone is too slow to address the critical state of the resource. Implementation of the WRIA 1 Salmonid Recovery Plan is lagging behind the pace originally anticipated during plan development. Restoration work has progressed with capital projects focused on restoring fish habitat and passage, however, WRIA 1 has faced significant funding shortages for restoration projects, limiting implementation progress.

Progress also has lagged on implementing the regulatory and incentive programs to protect and restore salmonid habitat and habitat forming processes. One small success is the completion of the RMAP process, but with habitat being lost faster than it is being restored and the severely lagging pace of high-priority restoration actions, it is not anticipated that restoration will fully restore the necessary sustainable supply of harvestable salmon in the foreseeable future.

In addition to volunteer restoration, the current regulatory framework needs to be better enforced. For example, Portage Bay will only be fully opened to year-round tribal shellfish harvest after landowners in the Nooksack watershed begin to plant and maintain riparian buffers, better manage dairy operations to protect water quality, properly manage waste from pets and non-dairy livestock, and maintain their septic systems. Furthermore, Lummi Nation is working toward increasing the number of harvestable salmon by implementing its 10-year co-manager agreed hatchery production plan to provide harvestable fish for the Lummi people.

Recovery Efforts Show Signs of Improvement but Still Lagging in Key Indicators

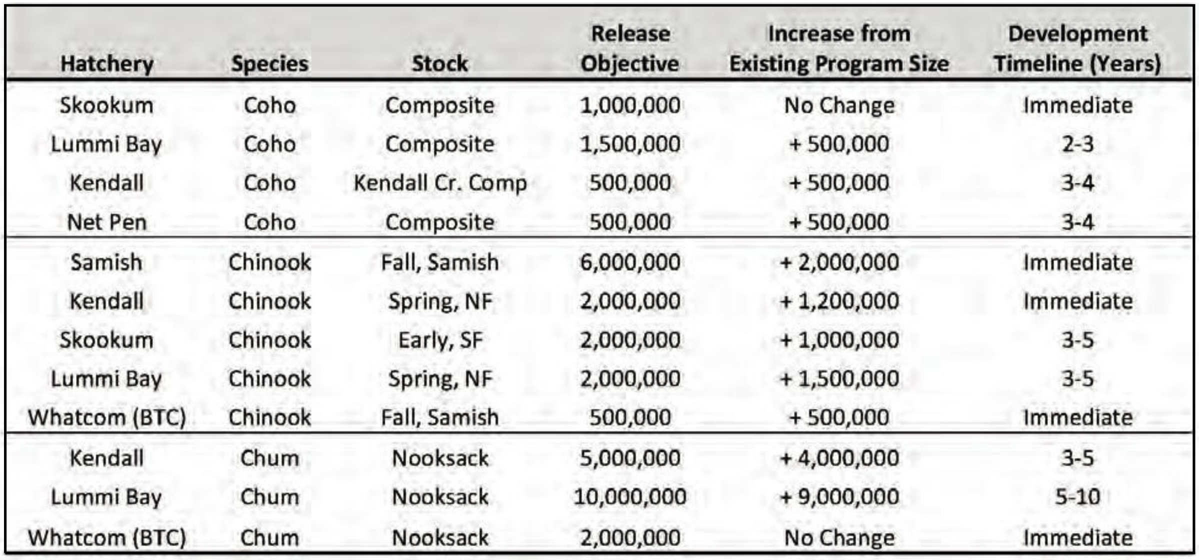
At the 15-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Nooksack basin shows improvements for forest fish passage barrier removals and construction of engineered logjams. There is still a declining trend to the quantity of water wells being drilled and no trends when one looks at improvement in floodplain wetlands and estuary habitat. There are mixed trends related to water quality. In general, there is a shortage of agency staff at all levels (e.g., federal, state, tribal, county, cities) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

A review of the trend for these key environmental indicators since the 2016 State of Our Watersheds Report shows improvement for some indicators in habitat status:

Tribal Indicator	**Status**	**Trend Since SOW 2016 Report**
Restoration - Estuary	The Lummi Nation has been working since the 1990s to improve estuarine habitat in the Nooksack River and Lummi River deltas. The Lummi Nation's Wetland and Habitat Mitigation Bank, which is the first tribal wetland mitigation bank in the United States, became operational in 2012. The mitigation bank is located immediately adjacent to a large restoration project known as the Smugglers Slough Restoration Project. Together, these two projects will permanently protect and restore nearly 3,000 acres of estuarine habitat in the Nooksack and Lummi River deltas.	**Improving**
Water Quality - Shellfish	In September 2014, in order to protect public health and safety, the Lummi Nation, in consultation with the Washington State Department of Health (DOH), voluntarily closed 335 acres of shellfish growing area in Portage Bay when the National Shellfish Sanitation Program (NSSP) fecal coliform standards were not achieved at two water quality monitoring stations. After poor water quality affected additional stations in November 2014 and April 2016, the Lummi Nation and DOH reclassified a total of 820 acres from approved to conditionally approved. The conditional closure classification prohibited shellfish harvest from affected areas from April 1 through June 30 and from October 1 through December 31. Following water quality improvements during the spring season, all of Portage Bay was reopened to shellfish harvest from April 1 through June 30 beginning in 2019. Poor water quality persists during the fall season and the affected 820-acre area of Portage Bay remains closed to commercial, ceremonial, and subsistence shellfish harvest from October 1 through December 31 annually.	**Concerns/ Improving, but still poor**
Water Wells	Between 2015 and April 2019, an estimated 647 new water wells were drilled in WRIA 1, and 85% of those are estimated to be permit-exempt water wells. Approximately 72% of all wells in WRIA1 are in basins either seasonally closed or closed year-round to water withdrawal due to instream flow levels that are less than the minimum flows established in 1985.	**Concerns**
Forest Roads	About 90% (1,277 miles out of 1,426 total miles) of private and state-owned forest roads have been repaired or abandoned in the Upper Nooksack River watershed. About 77% (45 of 58 culverts) on private and state-owned forest roads have been repaired or abandoned.	**Improving**
Floodplain - Wetlands	The WRIA1 Salmonid Recovery Plan recommends a return to historical wetland conditions in the lower mainstem floodplain of the Nooksack River. Based on the most recent comprehensive wetland study of the lower mainstem floodplain of the Nooksack River, in 1880 there were 4,754 acres of wetlands within the Nooksack River floodplain, and by 1998 wetlands had been reduced to less than 10% of that historical area. There has been little change in floodplain wetland area since the late 1990s. There was an estimated 1.5% loss of wetland area in the floodplain between 1996 and 2006, and no further loss between 2006 and 2011.	**Declining**
Restoration - ELJ	Engineered logjams are being consistently funded, placed and monitored throughout the North, Middle and South forks of the Nooksack River. This has resulted in an increase in density of instream wood since 2005.	**Improving**
European Green Crab	The invasive European green crab, *Carcinus maenas* , threatens to disrupt nearshore habitats and balanced ecosystems wherever it is introduced. The Lummi Nation has considerable tidelands and marshlands on its reservation, providing ample suitable habitat for the invasive species. In the fall of 2019, the European green crab was detected in Lummi Bay for the first time since the species colonized the NE Pacific coast. Since then, the Lummi Natural Resources Department has provided a nonstop response to this environmental threat.	**Concerns**

Looking Ahead

Lummi Nation's goal is to ensure for a sustainable supply of salmon and shellfish for ceremonial, subsistence and commercial harvests and to preserve Lummi's *Sche Lang en'*, or way of life, which is interwoven with the right to harvest natural resources retained in the Point Elliott Treaty of 1855. Specifically for salmon, per Lummi Indian Business Council's resolution 2015-42, Lummi Nation has set an interim goal of an average mid-1980s salmon harvest level, and to achieve this goal Lummi developed a co-manager agreed 10 year hatchery production plan to increase the return of harvestable salmon (Table 1).



Hatchery	Species	Stock	Release Objective	Increase from Existing Program Size	Development Timeline (Years)
Skookum	Coho	Composite	1,000,000	No Change	Immediate
Lummi Bay	Coho	Composite	1,500,000	+ 500,000	2-3
Kendall	Coho	Kendall Cr. Comp	500,000	+ 500,000	3-4
Net Pen	Coho	Composite	500,000	+ 500,000	3-4
Samish	Chinook	Fall, Samish	6,000,000	+ 2,000,000	Immediate
Kendall	Chinook	Spring, NF	2,000,000	+ 1,200,000	Immediate
Skookum	Chinook	Early, SF	2,000,000	+ 1,000,000	3-5
Lummi Bay	Chinook	Spring, NF	2,000,000	+ 1,500,000	3-5
Whatcom (BTC)	Chinook	Fall, Samish	500,000	+ 500,000	Immediate
Kendall	Chum	Nooksack	5,000,000	+ 4,000,000	3-5
Lummi Bay	Chum	Nooksack	10,000,000	+ 9,000,000	5-10
Whatcom (BTC)	Chum	Nooksack	2,000,000	No Change	Immediate

For shellfish, the Lummi have a saying – "When the tide is out, the table is set" and Lummi will be working with local, state and federal jurisdictions to reopen shellfish beds and ensure for sustainable and safe harvest of shellfish resources that have been lost and degraded.

The Nation is taking a coordinated technical, legal and policy approach to ensure that the salmon, shellfish, game and plant resources that are a critically important part of Lummi's identity and culture are available in perpetuity. The health of the watershed, the marine environments of the Lummi Usual and Accustomed Areas, and shellfish beds are key in ensuring Lummi's long-term goal of providing tribal members a moderate living, stable economy, food security, sovereignty and overall self-reliance.

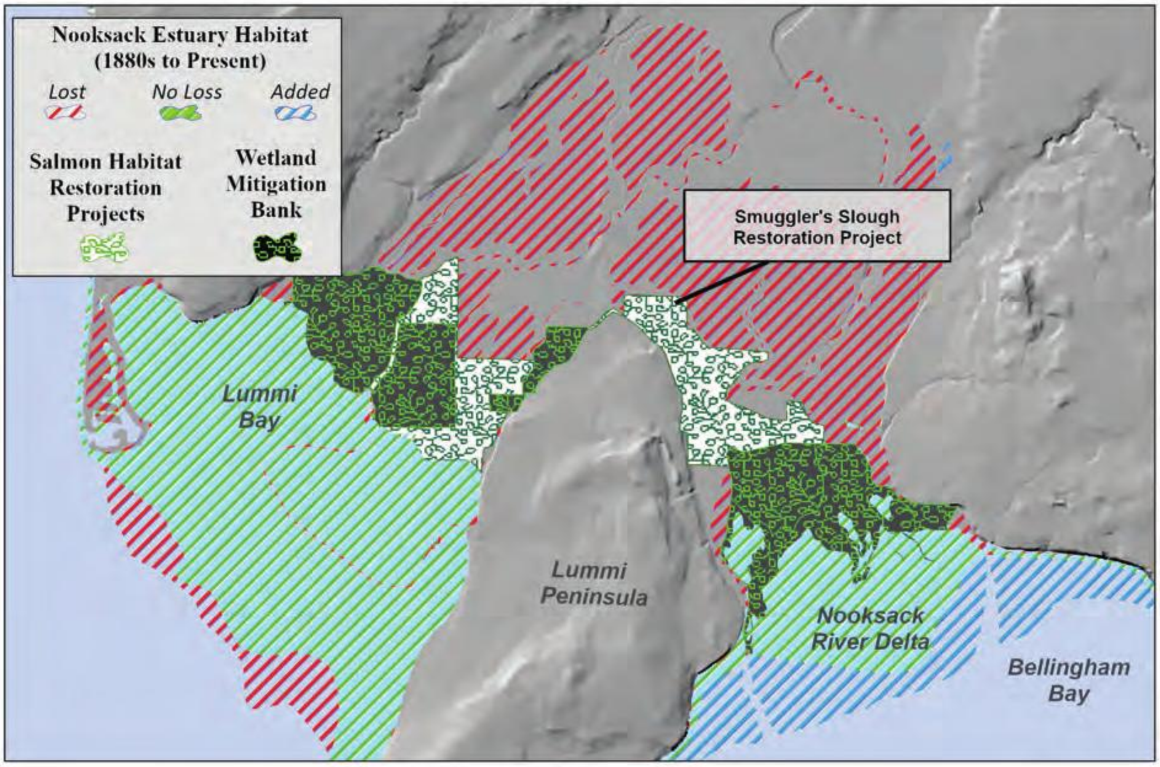
WRIA 1 and Whatcom County have seen great economic progress since the late 19th century, but not without environmental costs and subsequent damage to Lummi Nation's treaty-protected natural and cultural resources. Water quality and quantity continue to decline, the large-scale loss of floodplain forest associated with flood protection for municipalities and agriculture persists, and the quality and quantity of fish and wildlife habitat continue to be degraded. The end result is a lack of sustainable fisheries, damage to Lummi's treaty rights, and subsequent suffering of the Lummi people whose culture, economy and health have been damaged. To change these trends will require more than just site-scale restoration of fish and wildlife habitat; it will require a full integration of environmental costs into future land use and economic planning. For site-scale habitat restoration to succeed, overall watershed health must also be restored – everything is connected.

The regulatory approach within WRIA 1 varies among jurisdictions, but overall the goal is to implement, adapt and enforce compliance of existing regulations for the protection and restoration of salmonid and shellfish habitat. It is recognized that integrating incentives and other non-regulatory approaches within existing regulatory programs may improve compliance (i.e., use incentives to promote protection and restoration, apply penalties to discourage degradation). For this approach to be successful, the accompanying regulatory framework must protect the existing habitat from degradation as improvements in habitat quality and quantity are realized through voluntary effort and directed capital enhancement projects. This is not occurring within WRIA 1 as salmon and shellfish habitat quality and quantity continue to decline due to a general lack of a credible compliance enforcement presence within the watershed. Regulatory reform is required as the current framework clearly is not providing adequate protection.

Regardless of poor management by state and local governments, the Lummi Nation continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat. These efforts include, but are not limited to, protecting instream flows for fish, improving water quality, and restoring and protecting salmon and shellfish habitat. As one example, instream flows are discussed in more detail below.

Lummi Nation Is Improving Habitat by Protecting and Restoring Tidal Wetlands in the Nooksack River Delta

Recent mapping of the Nooksack delta found tidal wetland habitat increased by 64 acres between 2008 and 2013.[1] The increase in habitat area and change in habitat type has resulted in an increase in carrying capacity in the tidal delta for chinook salmon, thus providing more area for the fish to occupy.[2]



While historic tidal wetland areas have been lost in the Lummi River delta, the Nooksack delta area and associated estuary continue to grow. Through a large-scale salmon habitat restoration project and the wetland and habitat mitigation bank, the Lummi Nation is protecting and restoring large tracts of estuarine wetlands.

Over the 1926-1934 period, a sea wall was constructed along Lummi Bay, a levee constructed along the Lummi River and the west side of the Nooksack River, and drainage installed to develop agricultural lands on the Lummi Indian Reservation. This reclamation project significantly reduced historic sub-aerial estuarine habitat.[3] Since then, sediment deposition throughout the Nooksack River delta has expanded historic intertidal estuarine habitat along Bellingham Bay.

The Lummi Nation has been working since the 1990s to improve estuarine habitat in the Nooksack River and Lummi River deltas and to make up for the loss since. The Lummi Nation's Wetland and Habitat Mitigation Bank, which is the first tribal wetland mitigation bank in the United States, became operational in 2011. The protection provided by the mitigation bank allows for natural processes to continue in the delta and improve habitat for chinook. Immediately adjacent to the mitigation bank is a large Lummi Nation restoration project known as the Smuggler's Slough Restoration Project.

The Smuggler's Slough Restoration Project is primarily responsible for increase in habitat area from 2008 to 2013. As habitat area has increased through restoration, natural processes in the delta have changed and improved habitat type. Together, the mitigation bank and Smuggler's Slough have directly increased and improved tidal habitat area for chinook salmon in the Nooksack River delta.

Lummi Natural Resources

Large woody debris and floodplain forests inside the Lummi Nation Wetland and Habitat Mitigation Bank.

Map Data Sources: LIBC 2012,[4] PSNERP 2008,[5] SSHIAP 2004[6]

Fecal Coliform Pollution Forces Partial Closure of Portage Bay Shellfish Growing Area

Following recent water quality improvements during the spring season, all of Portage Bay was reopened to shellfish harvest from April 1 through June 30 beginning in 2019.[1] However, poor water quality persists during the fall season and the affected 820-acre area of Portage Bay remains closed to commercial, ceremonial and subsistence shellfish harvest from October 1 through December 31 annually.

In September 2014, in order to protect public health and safety, the Lummi Nation, in consultation with the Washington State Department of Health (DOH), voluntarily closed 335 acres of shellfish growing area in Portage Bay when the National Shellfish Sanitation Program (NSSP) standards were not achieved at two water quality monitoring stations.[2] After poor water quality affected additional stations in November 2014 and April 2016, the Lummi Nation and DOH reclassified a total of 820 acres from approved to conditionally approved.[3] The conditional closure classification prohibited shellfish harvest from affected areas from April 1 through June 30 and from October 1 through December 31. Beginning in 2019, Lummi Nation and DOH reopened spring harvest (April-June) in the conditionally closed portion of the growing area. Unfortunately, poor water quality persists during the fall season (October-December) and the affected 820-acre area of Portage Bay remains closed to commercial, ceremonial and subsistence shellfish harvest during this time.

Manure from dairy farms, non-dairy livestock operations, and pet and wildlife waste discharged from municipalities and failing septic systems in the Nooksack River watershed have pushed fecal coliform pollution levels in substantial portions of Portage Bay beyond federally accepted levels for safe shellfish harvest and consumption. The Portage Bay closure has a devastating impact on the livelihoods of over 200 Lummi Nation families who earn a portion of their annual income from the commercial harvest of Portage Bay shellfish. Additionally, the more than 5,000 Lummi Nation tribal members who have a treaty right to ceremonial and subsistence shellfish harvest also are impacted or damaged by this closure. Degraded water quality in the Nooksack River watershed has substantially reduced the shellfish available for Lummi to harvest and their ability to exercise their treaty rights to harvest shellfish throughout their Usual and Accustomed grounds and stations.

Portage Bay Shellfish Growing Area

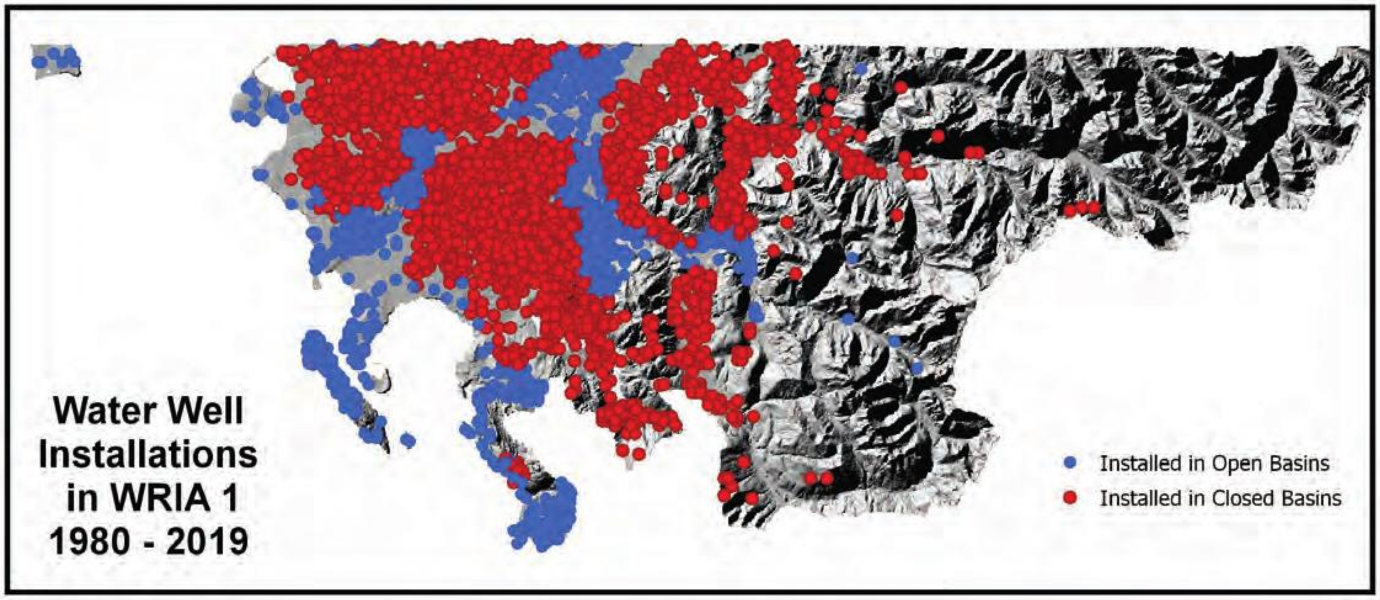
Map Data Sources: LNR 2016,[4]

A Lummi tribal member harvests shellfish in Portage Bay prior to the downgrade of the harvest area.

NWIFC

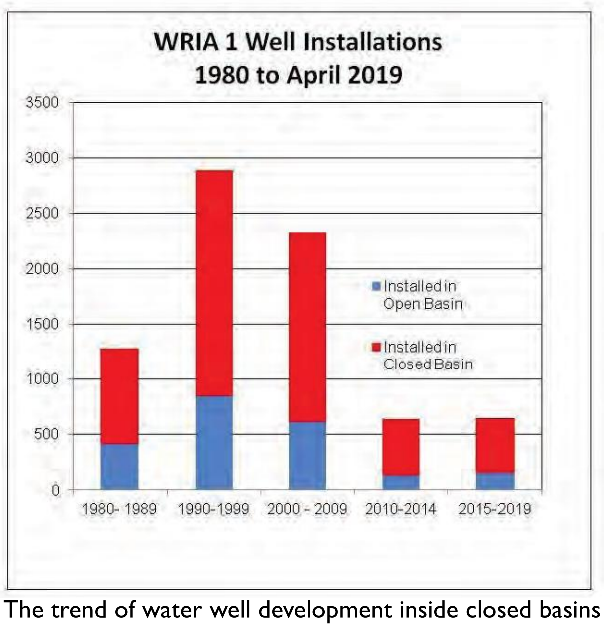
Exempt Well Development Expands in WRIA 1 While Instream Flow Rules Continue to be Violated

Between 2015 and 2019, an estimated 647 new water wells were drilled in WRIA 1, and 85% of those are estimated to be permit-exempt water wells.[1,2] *Approximately 72% of all wells in WRIA 1 are in basins either seasonally closed or closed year-round to water withdrawal due to instream flow levels that are less than the minimum flows established in 1985.*[3]



According to the WRIA 1 Salmonid Recovery Plan, not meeting instream low flows results in loss of habitat connectivity, reduced habitat volume, stranding of juvenile salmon, higher stream temperature and general decrease in water quality. The WRIA 1 watershed instream flow rules were set in 1985 to "protect and preserve" instream resources from low flow exceedance.

As displayed in the map and table above, permit-exempt wells have continued to be developed in WRIA 1 since 1986. While legal under state water law, continued exempt well development in basins targeted for limited or no additional withdrawal under the 1985 instream flow rule is in direct conflict with the guidance of the Salmonid Recovery Plan, which recommends reducing out of stream uses in sub-basins impacted by low instream flows.



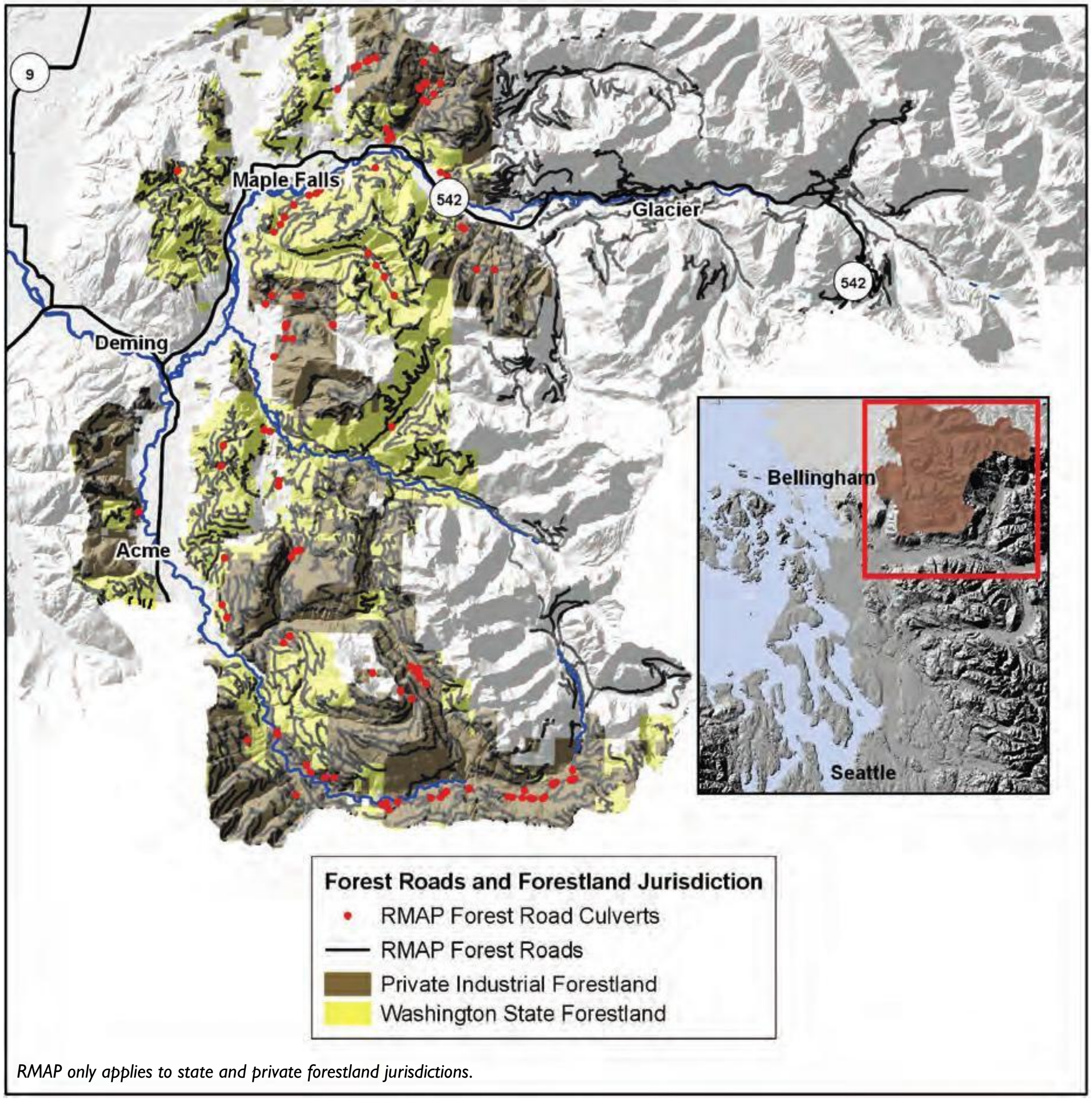
The trend of water well development inside closed basins in WRIA 1 has continued from 2015 to 2019.

Map Data Sources: WAECY 2019b,[6] *NWIFC 2015,*[7] *Whatcom Co. 1998,*[8] *WAC 173-501*[9]

LUMMI NATION

Forest Road Maintenance and Abandonment on Schedule to Be Completed in the Upper Nooksack Watershed by 2021

The Washington State Forest Road Maintenance and Abandonment Plan (RMAP) has led to the repair and/or abandonment of the majority of 1,426 total miles of private and state-owned forest roads in the Upper Nooksack River watershed.[1] RMAP has also resulted in the repair or removal of 45 of 58 (78%) culverts on private and state-owned forest roads. The remaining culvert repair is scheduled for four Sierra Pacific owned culverts by 2021, and for nine state and private forestland culverts at some point in the future if they fail and need replacement.[2]



RMAP only applies to state and private forestland jurisdictions.

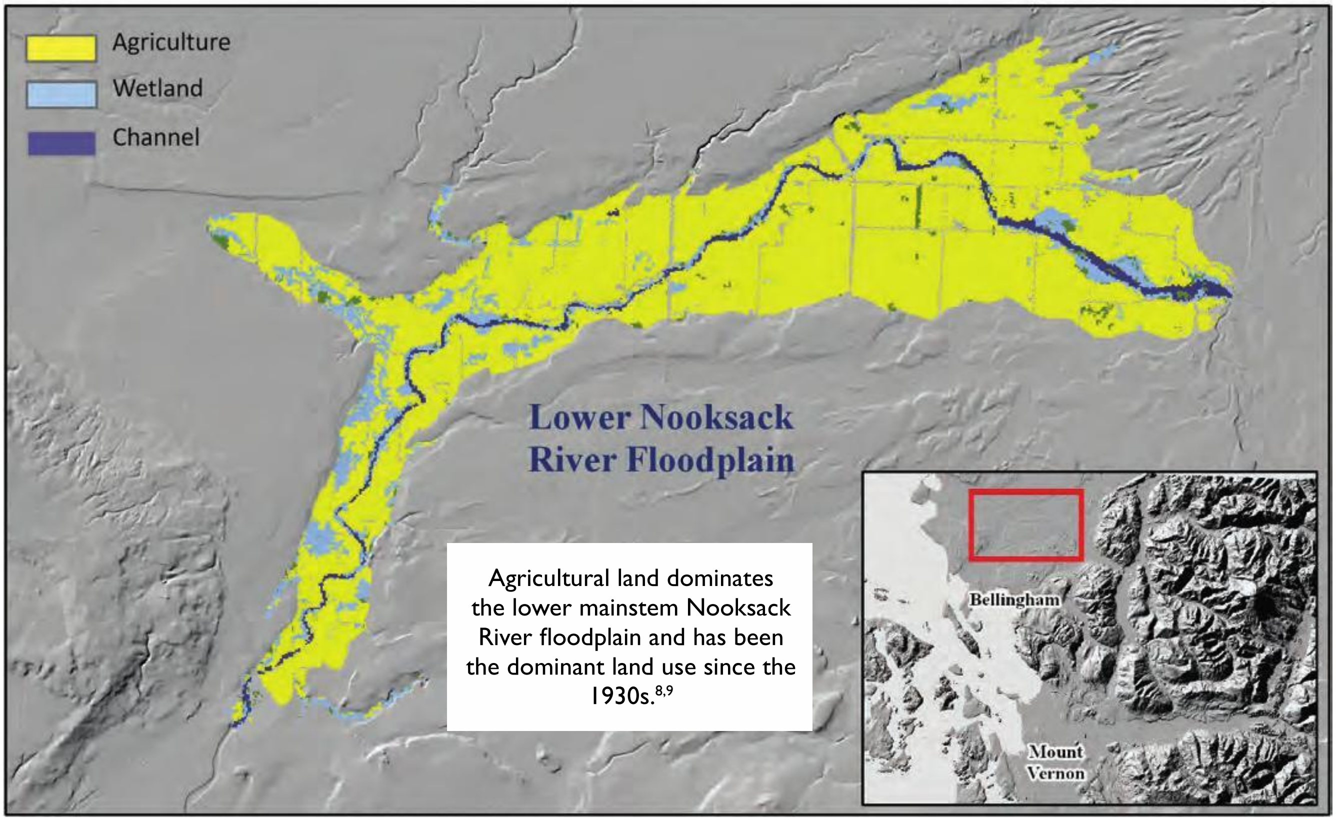
No alteration of the human landscape has a greater and more far-reaching effect on aquatic habitat than roads. The majority of forest roads in the Upper Nooksack basin are on private industrial and state lands and fall under the RMAP mandate. Considering the role that improved water quality plays in chinook habitat, the current status of RMAP being almost complete in the Upper Nooksack watershed is good news to salmon recovery.

While forest road density has increased in the Upper Nooksack basin since 2005,[4] it is expected that RMAP road repairs and abandonment may offset some of the water quality problems associated with higher forest road densities. Small-forest landowners were not required to develop an RMAP, and instead are expected to bring their roads up to standard and repair fish-passage barriers as the roads are used for forest practices activities. Since no plans are in place, there remains a great deal of uncertainty about the condition of the non-RMAP roads in the watershed.

Map Data Sources: Skagit Co. 2010,[5] Whatcom Co. 2011b,[6] WADNR 2014d,[7] WADNR 2014c[8]

Wetland Restoration Needed on Agricultural Lands in the Lower Nooksack River Floodplain

There has been little change in floodplain wetland area since the late 1990s.



Agricultural land dominates the lower mainstem Nooksack River floodplain and has been the dominant land use since the 1930s.[8,9]

The WRIA 1 Salmonid Recovery Plan recommends a return to historical wetland conditions in the lower mainstem floodplain of the Nooksack River.[1] Based on the most recent comprehensive wetland study, in 1880 there were approximately 4,754 acres of wetlands within the Nooksack River floodplain; by 1998, the floodplain wetlands had been reduced to less than 10% of that historical area.[2] There has been little change in floodplain wetland area since the late 1990s. There was an estimated 1.5% loss of wetland area in the floodplain between 1996 and 2006, and no further loss between 2006 and 2011.[3,4,5]

The lower mainstem of the Nooksack River historically meandered through a complex of wetlands and beaver dams. Now, the lower mainstem floodplain is a single threaded river through cropland (raspberries, blueberries, silage corn, and potatoes), hay fields and small municipalities.

The lower mainstem has suffered the greatest loss of habitat area and function from historical conditions, and the losses have been especially costly for rearing juvenile chinook salmon. In addition, the productivity of pre-spawning migrant, and over-winter and over-summer rearing life stages are all limited by the loss of historic off-channel wetland habitat in the lower mainstem.[6] While not the most limiting factor to chinook recovery, all Nooksack stocks of chinook are affected by conditions in the lower mainstem. Restoration of floodplain wetland conditions in the lower mainstem toward historic conditions remains a long-term goal of the WRIA 1 Salmonid Recovery Plan.[7]

Anderson 2015

The Nooksack River flows through the agricultural landscape of the lower Nooksack mainstem floodplain.[10]

Map Data Sources: SSHIAP 2004,[8] NOAA 2019[9]

Lummi Nation

Engineered Logjams and Long-Term Commitment to Healthy Riparian Forests Key to Restoring Wood to the Nooksack River

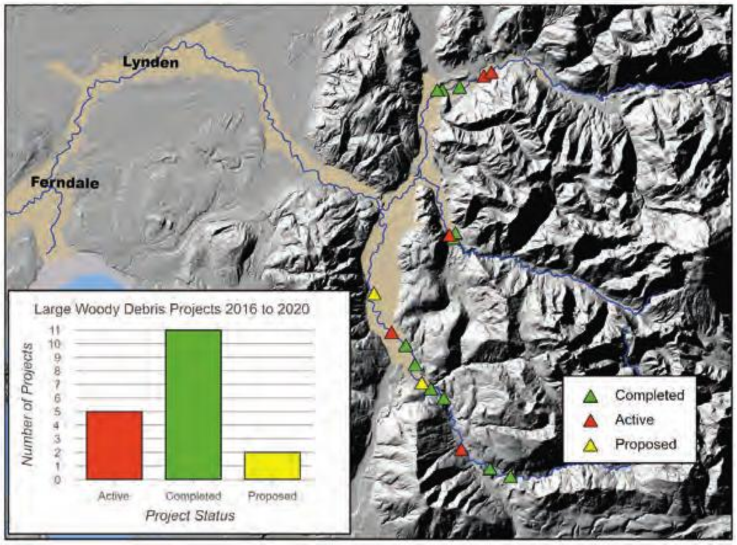
Since 2016, there have been 18 new large woody debris or engineered logjam (ELJ) projects in the Nooksack River watershed.[1,2] Two projects are in a proposal phase, five projects are actively progressing and 11 projects have been completed.

According to the WRIA 1 Salmonid Recovery Plan, instream wood has a role in channel stability, habitat diversity and overall habitat quantity and quality.[3] Archival data suggest that instream wood was historically very abundant in Puget Sound river systems, including the Nooksack River.[4] Settlers' descriptions from the 1800s of logjams 3/4 of a mile long are not uncommon.[5] The combination of land-clearing, riparian forest logging, splash damming, and instream wood removal for navigation have all combined to leave the Nooksack River with a relatively low abundance of instream wood.

Temperature is a limiting factor for salmonid production in the South Fork Nooksack during the hot, low flow summer and early fall months.[6] The South Fork Nooksack Temperature TMDL[7] and Qualitative Assessment[8] found that the most important actions to ameliorate the impacts of climate change in the South Fork watershed are riparian restoration, floodplain reconnection, wetland restoration, and placement of logjams. They recommend continuing and increasing the pace of instream restoration projects in high-priority reaches of the South Fork that create cold-water refuges, increase effective shading, promote hyporheic exchange, reconnect floodplain channels, reduce redd scour and create flood refuge habitat.

As a short-term strategy, engineered logjams are being consistently funded, placed and monitored throughout the North Fork, Middle Fork and South Fork of the Nooksack River. This has resulted in increasing densities of instream wood since 2005 and continuing up to the present.[9] As a long-term strategy, riparian restoration has to occur to provide a sustainable source of large woody debris.

The lower mainstem continues to be managed for flood control and navigation. There is little to no accumulation of instream wood between Lynden, WA, and the delta of the river. In contrast, large logs have accumulated in the delta and a logjam that started to form in 2005 is now over 2/3 of a mile long and completely blocks what was the primary distributary channel of the Nooksack River. These logjams in the Nooksack River delta have substantially impaired navigation in the delta area and as a result, have interfered with the riverine fisheries of the Lummi Nation. The upper mainstem and the forks have a relative abundance of instream wood, but still very low compared to historic levels. The relatively higher level of wood instream in the upper watershed is in part attributable to the engineering and construction of logjams. Since riparian forests are still dominated by young, small diameter trees, active logjam construction remains necessary to improve instream wood abundances in the Nooksack River system.[10]



Since 2016, 18 instream wood projects or engineered logjam projects have been proposed, are active or have been completed to increase instream wood densities in the North, Middle and South forks of the Nooksack River system.

Until riparian forests are mature enough to deliver key logjam-anchoring pieces of instream wood to the Nooksack River, engineered logjams remain essential to the salmon habitat restoration throughout the system.[11]

Map Data Sources: NNR 2015,[12] SSHIAP 2004,[13] WAECY 2011a,[14] HWS 2020,[15] RCO 2020[16]

Lummi Nation

European Green Crab Inside the Salish Sea

The invasive European green crab, Carcinus maenas*, threatens to disrupt nearshore habitats and balanced ecosystems wherever it is introduced. The Lummi Nation has considerable tidelands and marshlands on its reservation, providing ample suitable habitat for the invasive species. In the fall of 2019, the European green crab was detected in Lummi Bay for the first time since the species colonized the NE Pacific coast. Since then, the Lummi Natural Resources Department has provided a nonstop response to this environmental threat.*

In late September 2019, the discovery of live, European green crab (EGC) in Drayton Harbor, an embayment along the U.S.-Canada boundary to the north of the Lummi Nation, prompted Lummi Natural Resources Department (LNR) staff to mobilize and to perform a rapid trapping response on Lummi Reservation tidelands.

In early October 2019, LNR began trapping at several locations within Lummi and Portage bays. Indeed, by early November 2019, EGC were detected at two locations within Lummi Bay: the Lummi Sea Pond and Sandy Point Heights. Forty-one EGC were collected from inside of the Lummi Sea Pond, whereas 23 EGC were sampled outside of the tide gates at Sandy Point Heights. By the end of fall 2019, a total of 64 invasive EGC, 32 females and 32 males, were captured after 180 trap nights within Lummi Bay.

Aerial view of Lummi Bay showing locations (orange circles) of high-density European green crab catches at Sandy Point Heights and Lummi Sea Pond.

Map Data Sources: NNR 2015,[6] SSHIAP 2004,[7] WAECY 2011a,[8] HWS 2020[9]

These findings are concerning to local natural resources authorities for a variety of reasons, but mostly because once established inside of the Salish Sea, a population like that found in Lummi Bay might act as a seed source, ultimately expanding the distribution of EGC to neighboring marine areas where the crustacean predator could impact juvenile clam and oyster populations, cause substantial habitat destruction via excessive excavation or burrowing of marshy banks, and uproot eelgrass beds. Furthermore, EGC might outcompete native species for resources within the intertidal zone. For example, the Dungeness crab, *Metacarcinus magister*, which is of substantial economic and cultural importance to the Lummi people, might compete with EGC during its early life stages when the two species utilize the same resources in nearshore, estuarine habitats.

Hence, during winter 2019-2020, LNR staff worked with the governing body of the Lummi Nation, the Lummi Indian Business Council, to declare EGC a serious environmental threat to the tribe. With this official declaration, LNR was well-poised to continue leading the response effort for the tribe, and wherever appropriate and if possible, to collaborate with nontribal entities having EGC expertise.

Continuing its response, during January to March 2020, LNR staff conducted a pilot study to test the effectiveness of four different types of sampling gear to capture adult-size, egg-bearing female EGC in the Lummi Sea Pond. Consistent with findings from other wintertime studies of EGC elsewhere, no EGC were captured during this trapping effort.

Finally, during early spring 2020, LNR joined forces with the Washington State Department of Fish and Wildlife to secure resources for the tribe to continue its emergency response to EGC. As a result, on April 1, 2020, despite restrictive challenges brought on by the global COVID-19 pandemic, LNR staff again returned to intensive trapping and removal of EGC on Lummi Reservation tidelands. By September, LNR staff had captured and removed nearly 400 EGC from Lummi Bay. LNR will continue its response to EGC through 2020 and beyond.

Megan Hintz

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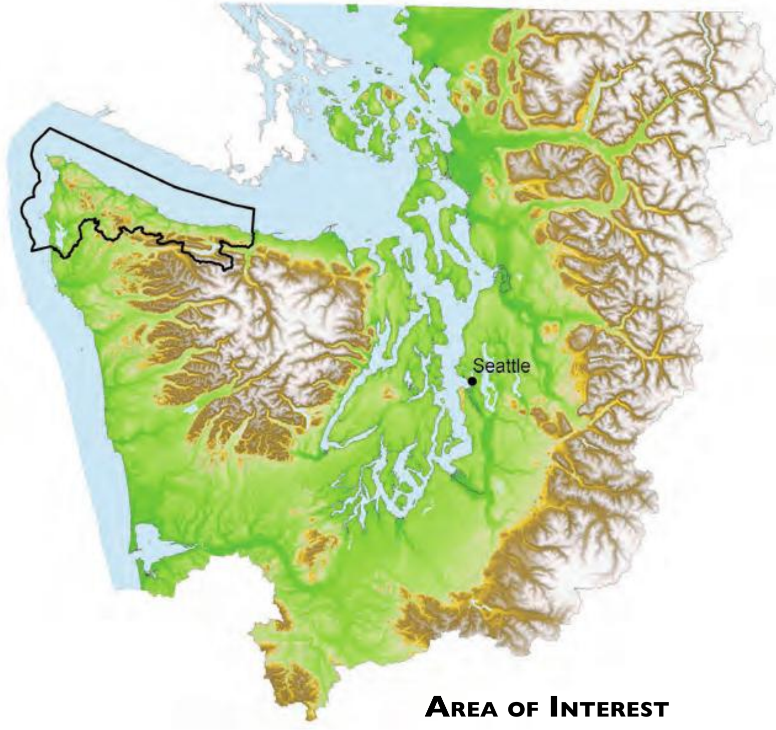
2020 State of Our Watersheds Report
Northwest Olympic Peninsula

We are indigenous to our land and sea. Through our Creator's design we have been given the responsibility as natural caretakers to our surrounding environments. Within these environments, we support an ecosystem based management approach to all things. This strategy is essential if we are to maintain a way of life that is rich in its connection to the many environments and its resources for which we depend.

Take care of them and they will take care of you.

Russ Svec
Fisheries Director



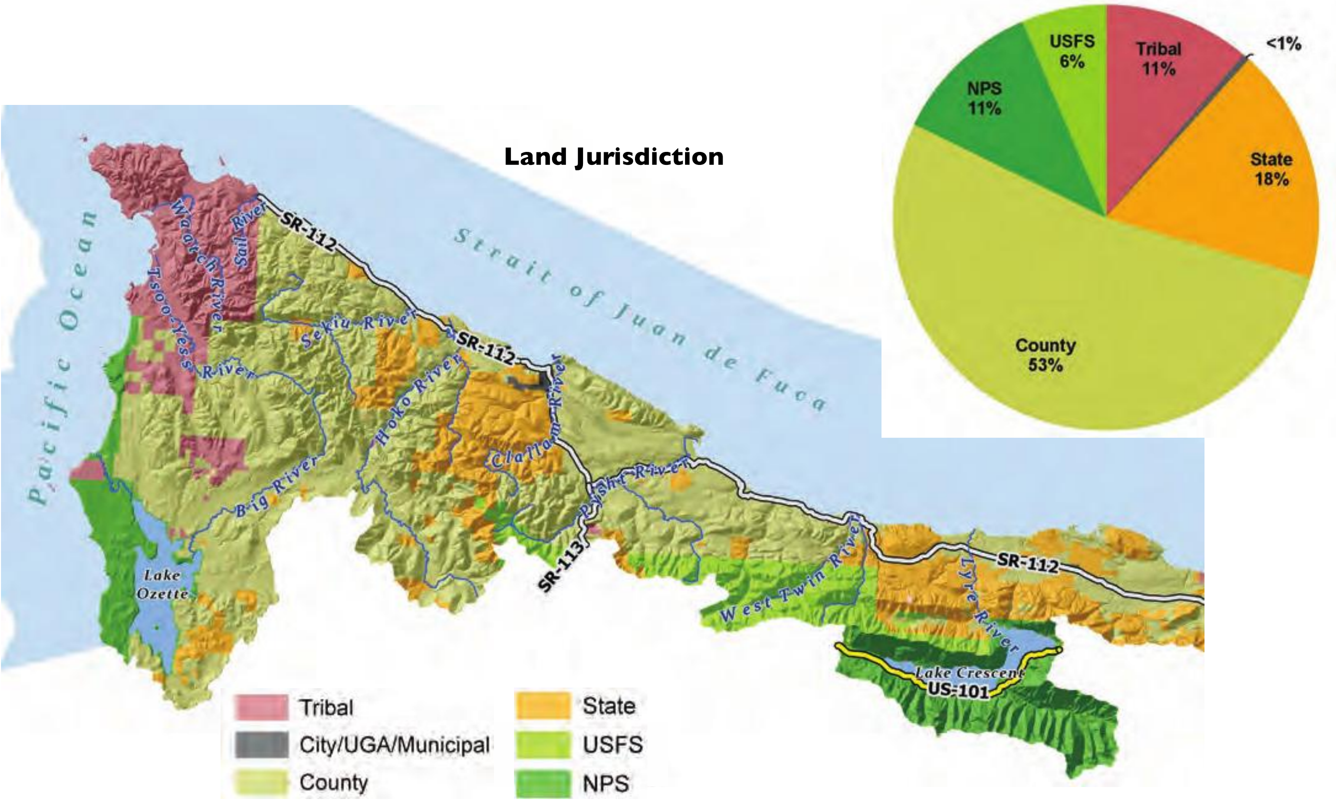
Area of Interest

Makah Tribe

Located on the northwest tip of the lower 48 states, the Makah always have utilized the bounty of the sea and the forests. From seals to salmon to whales, the sea was – and still is – a large part of the livelihood of the Makah. Within their territory, the Makah had many summer and permanent villages. The five permanent villages – the Wa'atch, Tsoo-Yess, Diaht, Ozette and Ba'adah – are located on the shoreline. This territory has been home to the Makahs for thousands of years. The Makah are highly skilled mariners, coming from a long line of ancestors who used sophisticated navigational and maritime skills to travel the rough waters of the Pacific Ocean and the Strait of Juan de Fuca to hunt whales and seals as well as travel. In 1855, the Makah, represented by 42 tribal dignitaries, negotiated and signed the Treaty of Neah Bay with the United States, retaining their inherent right to whale, fish, hunt and gather. The Makah Treaty of Neah Bay was the only treaty in the state that was associated with a single tribe. Tribal headquarters are located in Neah Bay, Wash.

Makah Tribe

WRIA 19 and portions of WRIA 20



Located on the northwest corner of the Olympic Peninsula, the Makah's Area of Interest includes many independent streams that flow from the foothills of the northern Olympic Mountains and enter the shores of the Strait of Juan de Fuca, The Makah Tribe is a predominately ocean-fishing tribe, therefore most of the tribe's fishing usual and accustomed areas are in the marine setting extending as far east as Tongue Point and as far west as 40 miles offshore. The tribe also historically hunted whales and other non-fish species as far out as 100 miles off-shore. However as a tribe that fishes pre-terminal fisheries, the health of all species that occur or migrate through, Makah Territory are of concern. For hunting, gathering and cultural resources, Makah rely upon a significant portion of the Olympic Peninsula landscape and have a vested interest in protection of these areas and their treaty reserved resources. The tribe's Area of Concern also extends seaward to the international boundary with Canada and all of the exclusive economic zone to the mouth of the Columbia River as many of the resources that migrate to Makah territory have a larger web of impact.

The largest watersheds in the Area of Interest are the Sekiu, Hoko, Clallam, Pysht, Tsoo-Yess, Ozette and Lyre rivers. Weathered sedimentary rock, sandstones and siltstones of the Twin River Formation occur in the western watersheds from, and including, the Pysht. Streams east of the Pysht have a mixed geology, including less erodible basalt from the Crescent Formation in headwaters, glacial outwash in the lower plain, and siltstones of the Twin River Formation to the west. The stream channels in the region change quickly to variations in flow and sediment inputs.

Chinook, coho, chum, sockeye, cutthroat and winter steelhead reside in the area's watersheds, with the Lake Ozette sockeye being listed as threatened under the Endangered Species Act.

Traditionally flourishing off the land and sea, the Makah Tribe had villages and fishing camps most often associated with stream mouths where they could take advantage of plentiful fish and shellfish resources. With the Point No Point and Makah treaties of 1854-55, the tribes agreed to cede their lands to the U.S. government in exchange for retaining their rights to hunt, fish and gather in their traditional territories.

About 11% of the Area of Interest is tribal land, 36% is public land and 53% is private land predominantly owned by timber companies. The Washington Department of Natural Resources has been engaged in the exchange of state trust lands with land held by private timber companies within this area. The tribe is concerned these exchanges may affect tribal treaty reserved rights by limiting tribal access to critical treaty reserved resources.

Beginning in the late 1800s, the Strait region has been heavily logged, with severe consequences to the health of its watersheds and salmon habitat. Today the region is predominantly rural, though industrial forest land use is widespread.

Map Data Sources: SSHIAP 2004,[1] USFWS 2018,[2] WADNR 2016,[3] WADNR 2018,[4] WADOT 2018a,[5] WADOT 2018b,[6] WAECY 1994,[7] WAECY 2018a,[8] WAECY 2018b[9]

Chapter Summary

Located on the northwest corner of the Olympic Peninsula, the Makah Tribe's Area of Interest includes many independent streams that flow from the foothills of the northern Olympic Mountains and enter the shores of the Strait of Juan de Fuca. The tribe's Area of Concern extends seaward to the international boundary with Canada and all of the exclusive economic zone to the mouth of the Columbia River.

The largest watersheds in the Area of Interest are the Sekiu, Hoko, Clallam, Pysht, Tsoo Yess, Ozette and Lyre rivers. Chinook, coho, chum, sockeye, cutthroat and winter steelhead occur in the area's watersheds, with the Ozette sockeye being listed as threatened under the Endangered Species Act.

Flourishing off of the land and sea, the Makah Tribe has villages and fishing camps most often associated with stream mouths where they can take advantage of plentiful fish and shellfish resources.

With the Point No Point and Makah treaties of 1854-55, the tribes agreed to cede their lands to the government of the United States in exchange for retaining their rights to hunt, fish and gather in their usual and accustomed areas. The Makah Tribe also explicitly reserved their right to whale within the Treaty of Neah Bay.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable fish returning to Washington waters every year and established the tribes as co-managers of the resource.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org.*

It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Forest Cover Conditions

Twenty watersheds (81.2% by land area) have healthy (over 75%) or good (65-75%) forest cover conditions in the Makah Area of Interest. This is an improvement over the 2011 forest cover conditions when 18 watersheds had healthy or good conditions (65.4% by land area) but a decline from 1992 when all watersheds had healthy or good conditions.

Culverts

There are currently 782 culverts on fish bearing streams in the Makah Area of Interest made up of 550 Road Maintenance and Abandonment Plan (RMAP) culverts and 232 non-RMAP culverts. About 81% of the RMAP culverts are not fish barriers, which represents an improvement over 67% since the 2016 State of Our Watershed report. However, barrier culverts still represent an important problem because many of the non-RMAP fish culverts which are predominantly on private, federal and county land continue to create significant barriers that will need a substantial amount of money to address. More than half of these culverts are totally impassible to fish and funding is needed to fix them.

Roads as a Limiting Factor

A total of 19 watersheds, representing 83% of the land area in the Makah Area of Interest had road densities above 3 miles per square mile, same as in the last report. These watersheds may not be properly functioning because such road densities can become a source of sediment to streams which degrade fish habitat and limit salmon production.

Water Quality

In the Makah Area of Interest, 40 waterbodies were placed on the 303(d) list for water pollution, an increase of 8 since the 2016 State of Our Watersheds Report. Water temperature remains by far the most common pollutant, although the proportion of stream length impaired by temperature dropped to 79% from 86% followed by dissolved oxygen which has the proportion of stream length impaired increase to 17% from 7% since the 2016 State of Our Watersheds Report. The Big River is the single most polluted waterbody by total length with 16.1 miles impaired by water temperature, dissolved oxygen, and pH.

Hoko River Flow

Streamflow data have been collected for almost six decades in the Hoko River. Winter peak flow values continue to show an increasing trend while summer mean low flow values continue to show a decreasing trend. Both trends have been predicted to occur because of climate change. Data from the other stations in the Makah Area of Interest have not been collected consistently over a long period but it is likely the patterns are similar. These trends may indicate that salmon habitat and other aquatic ecosystem functions may not be adequately protected in these watersheds.

European Green Crab Invasion

The European green crab (*Carcinus maenas*) is a relatively recent invasive species in the Makah Area of Interest. The tribe has embarked on a rapid and aggressive trapping effort to assess the extent of the invasive crab infestation. More than 2,500 crabs have been caught between 2017 and 2019. If left unchecked, these crabs will continue to reproduce and disperse throughout the area, threatening fish and shellfish habitat and species as well as the tribe's treaty-reserved rights.

Ocean Conditions

Ocean conditions in the Makah Tribe's Area of Interest have been heavily impacted by warming oceans, including marine heatwaves, and harmful algal blooms. This has severely limited salmon returns and led to the widespread closure of beaches accessed by tribal fishers due to high levels of the toxin responsible for paralytic shellfish poisoning.

Conclusion

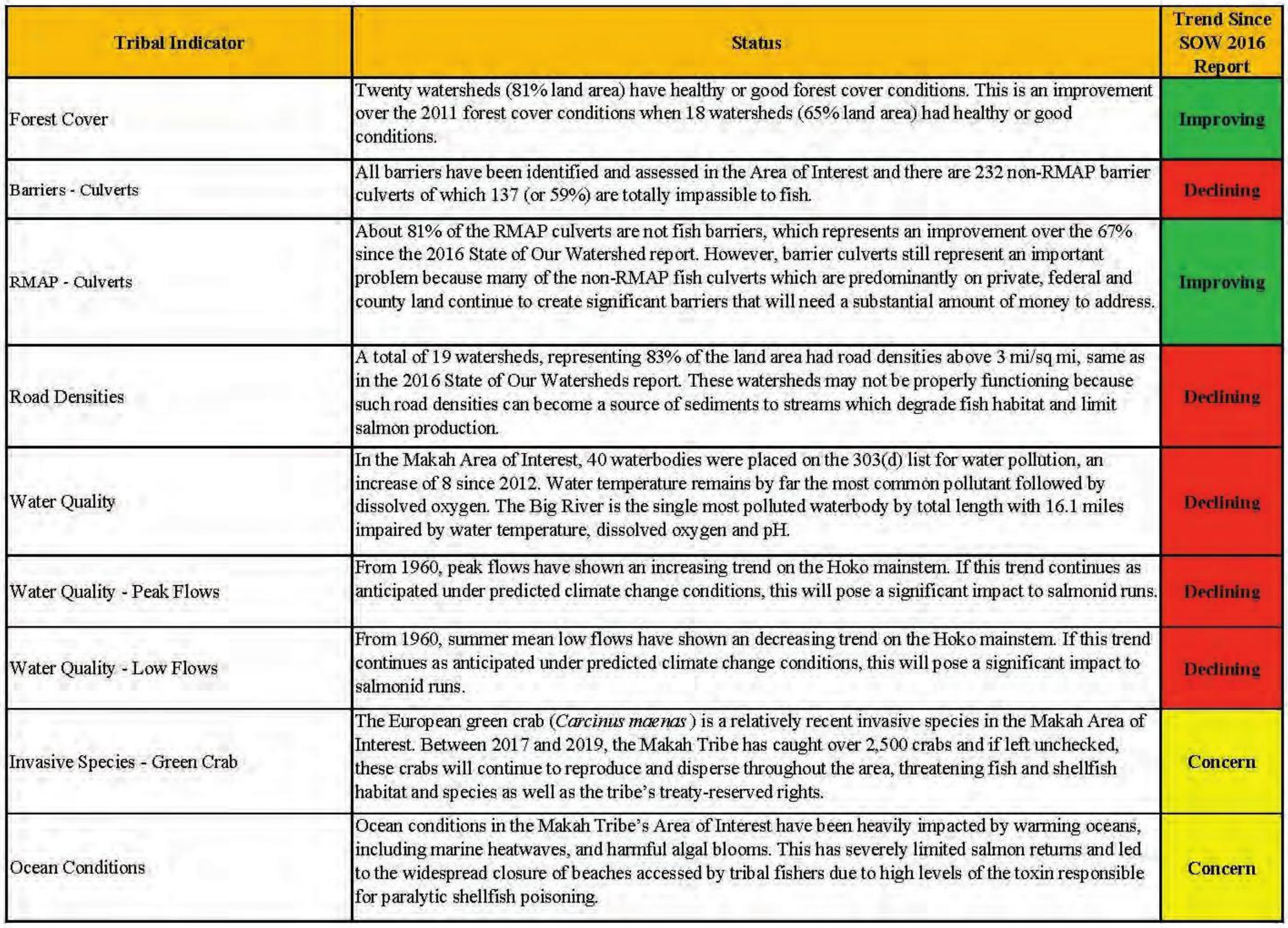
In the Makah's Area of Interest, there has been an improvement in habitat conditions with the continued growth of forest cover and a reduction of fish passage barriers through the RMAP program, but other habitat indicators are still declining. Over the past five years, there has been a decline in habitat conditions with the increase in road density, continued increase in peak flows and decrease in low flows and the decline in water quality conditions. At the same time, there has been an increase in the population of the European green crab, an invasive species that will threaten local fish and shellfish populations.

Although restoration is occurring, not enough is being done to keep up with the impacts of a growing population and their resource demands from the watershed. People have to be held accountable to protecting, conserving and improving fish habitat in their land use decisions, and federal, state and local governments all have a role in that. Implementation includes education and voluntary action but it also needs to include enforcement when those laws are broken. The future of tribal treaty rights of the Makah people depends on it.

Recovery Efforts Show Signs of Improvement But Still Lagging in Key Indicators

A review of key environmental indicators for the Makah area shows improvements in the removal of forest road barriers and forest cover, but degradation of water quality, road densities and non-forest fish barrier culverts. In general, there is a need to increase staff at all levels (e.g., federal, state, tribal, county) to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trend for these key environmental indicators since the 2016 State of Our Watersheds Report shows improvements for forest tree cover and forest landowners repairs to culverts, but a steady loss for others in habitat status:



Tribal Indicator	Status	Trend Since SOW 2016 Report
Forest Cover	Twenty watersheds (81% land area) have healthy or good forest cover conditions. This is an improvement over the 2011 forest cover conditions when 18 watersheds (65% land area) had healthy or good conditions.	Improving
Barriers - Culverts	All barriers have been identified and assessed in the Area of Interest and there are 232 non-RMAP barrier culverts of which 137 (or 59%) are totally impassible to fish.	Declining
RMAP - Culverts	About 81% of the RMAP culverts are not fish barriers, which represents an improvement over the 67% since the 2016 State of Our Watershed report. However, barrier culverts still represent an important problem because many of the non-RMAP fish culverts which are predominantly on private, federal and county land continue to create significant barriers that will need a substantial amount of money to address.	Improving
Road Densities	A total of 19 watersheds, representing 83% of the land area had road densities above 3 mi/sq mi, same as in the 2016 State of Our Watersheds report. These watersheds may not be properly functioning because such road densities can become a source of sediments to streams which degrade fish habitat and limit salmon production.	Declining
Water Quality	In the Makah Area of Interest, 40 waterbodies were placed on the 303(d) list for water pollution, an increase of 8 since 2012. Water temperature remains by far the most common pollutant followed by dissolved oxygen. The Big River is the single most polluted waterbody by total length with 16.1 miles impaired by water temperature, dissolved oxygen and pH.	Declining
Water Quality - Peak Flows	From 1960, peak flows have shown an increasing trend on the Hoko mainstem. If this trend continues as anticipated under predicted climate change conditions, this will pose a significant impact to salmonid runs.	Declining
Water Quality - Low Flows	From 1960, summer mean low flows have shown an decreasing trend on the Hoko mainstem. If this trend continues as anticipated under predicted climate change conditions, this will pose a significant impact to salmonid runs.	Declining
Invasive Species - Green Crab	The European green crab (*Carcinus maenas*) is a relatively recent invasive species in the Makah Area of Interest. Between 2017 and 2019, the Makah Tribe has caught over 2,500 crabs and if left unchecked, these crabs will continue to reproduce and disperse throughout the area, threatening fish and shellfish habitat and species as well as the tribe's treaty-reserved rights.	Concern
Ocean Conditions	Ocean conditions in the Makah Tribe's Area of Interest have been heavily impacted by warming oceans, including marine heatwaves, and harmful algal blooms. This has severely limited salmon returns and led to the widespread closure of beaches accessed by tribal fishers due to high levels of the toxin responsible for paralytic shellfish poisoning.	Concern

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

When the Makah Tribe negotiated the Treaty of Neah Bay, our ancestors understood that we were tied to the land and sea and that the resources that we rely upon are necessary for our survival, both physically and spiritually. In the last 165 years, we have had to witness and battle against systematic efforts to not only destroy and change who we are as a people, but also to destroy the resources that we rely upon, both directly and indirectly. The Makah Tribe will never concede to that battle. Even today, we have to protect ourselves from the State of Washington's efforts to minimize and diminish tribal hunting and gathering rights.

We are a tribe that understands the need to manage for multiple uses. As one of the most remote tribes in Washington, majority of our economy is derived from natural resources and we understand the delicate relationships between utilization and conservation. We are taught that everything is connected and that this landscape will provide for us, as long as we take care of it.

When we speak upon an issue as co-managers, it not only represents the concerns on behalf of the tribe, but on behalf of the resource as a whole. Thus the actions we take as co-managers, not only benefits the needs of the tribe, but also others who rely upon the resource. The conversation and approach to sustainable management has to include adequate consideration of cumulative impacts.

When we look forward into not only what the future holds for us but for how we should proceed with sustainable management, it is important to acknowledge that nature is resilient and adaptable. But the strength of that resiliency is a reflection of how much existing stress the resource is currently under. A condition representative of not only the current pressures, but also the legacy impacts from which it is still healing from.

Much of the Makah traditional territory has not succumbed to significant land conversion and urbanization, a condition that many other tribes have had to deal with. However that does not mean that our issues that we face are any less severe. The legacy of managing solely for single economic goals, and not true ecosystem-based management, has plagued our territory significantly. In fact, many would argue that the legacy impacts of the historic land management regime in our territory has had the equivalent impact as urbanization, however those impacts are not obvious to the open eye.

The Makah traditional territory has provided for us since time immemorial but we fear for the future of those resources. It has become apparent that the cumulative impacts of current management, in addition to legacy impacts, has created a situation that jeopardizes the resiliency of not only our resources and our natural resource economies, but also our treaty rights. The cumulative impacts include depletion and extirpation (localized extinction) of salmon stocks, degradation of habitat quality, and policy decisions that destroy habitat and remove the tribe's ability to exercise our rights.

The future will hold some very blunt and hard conversations and decisions in order to truly achieve sustainable management. It is important for policy makers to realize that when tribes fight for their treaty rights, they are fighting for the resource in perpetuity. Where would the state of Washington be if it were not for the tribes and their lengthy and persistent legal effort to address barrier culverts? It would still be blocking the passage of fish unapologetically for economic benefit, detrimental not only to the ability for tribes to harvest, but also for the non-tribal interests. It should not take legal action between co-managers to do what is right.

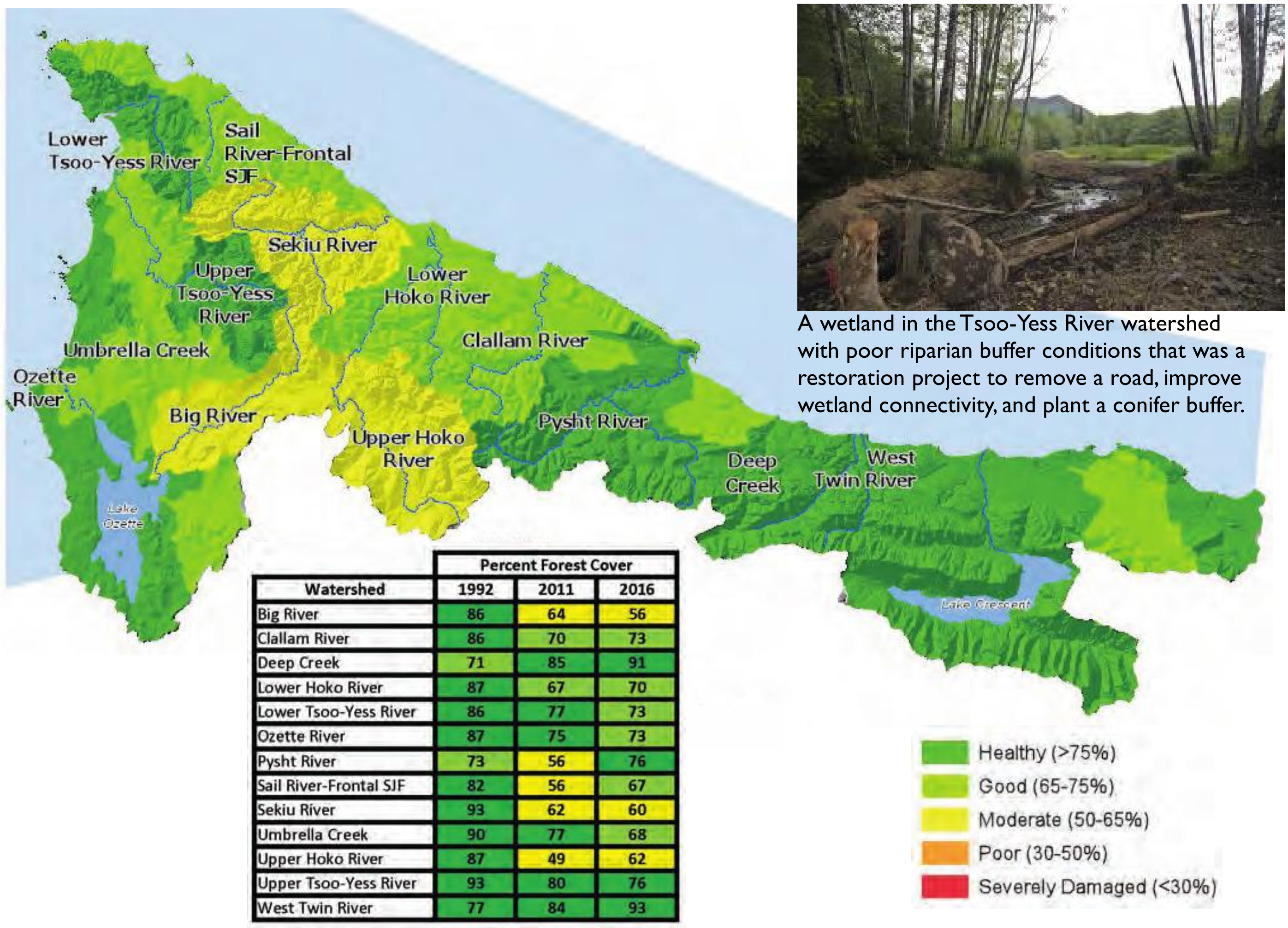
We need to improve our mindset and use an ecosystem-based approach to management of resources. All components of an ecosystem are connected, and if we are negligent in the context of one piece of the ecological framework, the foundations for all of them can come tumbling down. Currently we live in a paradigm where we only act upon an issue, such as the abundance of a species, after it reaches a threshold in which recovery and restoration may not be feasible. We need to acknowledge that many issues are not isolated and they are indeed indicative of a larger problem. Even before the conversation of climate change, our resources were struggling. Now in the face of climate change, the fear of loss of our resources is more dire as the legacy impacts have decreased their resiliency.

It is important that resource managers and policy makers value the right of the resource to exist higher than economic interests. But it is apparent that what exists as policy to protect the resource and what is instituted on the ground can vary significantly. Numerous policies and goals appear to be sound on paper, however implementation and investment is lacking, such as water availability, no-net-loss and Lake Ozette sockeye recovery. In order for written policy to achieve its goals, there has to be adequate investment financially and through capacity and infrastructure. Unfortunately Makah's traditional territory typically doesn't receive its equal share of sufficient resources. This has to change.

MAKAH TRIBE

Forest Cover Conditions

Twenty watersheds (81.2% by land area) have healthy (more than 75%) or good (65-75%) forest cover conditions in the Makah Area of Interest. This is an improvement over the 2011 forest cover conditions when 18 watersheds had healthy or good conditions (65.4% by land area) but a decline from 1992 when all watersheds had healthy or good conditions.



	Percent Forest Cover		
Watershed	1992	2011	2016
Big River	86	64	56
Clallam River	86	70	73
Deep Creek	71	85	91
Lower Hoko River	87	67	70
Lower Tsoo-Yess River	86	77	73
Ozette River	87	75	73
Pysht River	73	56	76
Sail River-Frontal SJF	82	56	67
Sekiu River	93	62	60
Umbrella Creek	90	77	68
Upper Hoko River	87	49	62
Upper Tsoo-Yess River	93	80	76
West Twin River	77	84	93

Debbie Preston, NWIFC

A wetland in the Tsoo-Yess River watershed with poor riparian buffer conditions that was a restoration project to remove a road, improve wetland connectivity, and plant a conifer buffer.

The current forest cover conditions of watersheds in the Makah Area of Interest are mostly healthy to good with 20 watersheds (81.2% by land area) having healthy (over 75%) or good (65-75%) forest cover conditions. This is an improvement compared to the 2011 forest cover conditions when 18 watersheds (65.4% by land area) had healthy or good conditions. However, a different picture in forest cover emerges over the longer period between 1992 and 2016. In 1992, all 23 watersheds (100% by land area) had a healthy to good forest cover as opposed to 20 watersheds in 2016. It is important to note that because the rotation length of many of the industrial timberland owners has shortened significantly, the resulting forest stands are not reaching an age where they are capable of providing full habitat functionality. The long term impact of this is that the entire area becomes severely damaged because the basins repeatedly never reach the ability to achieve a functioning habitat, and thus become less resilient.

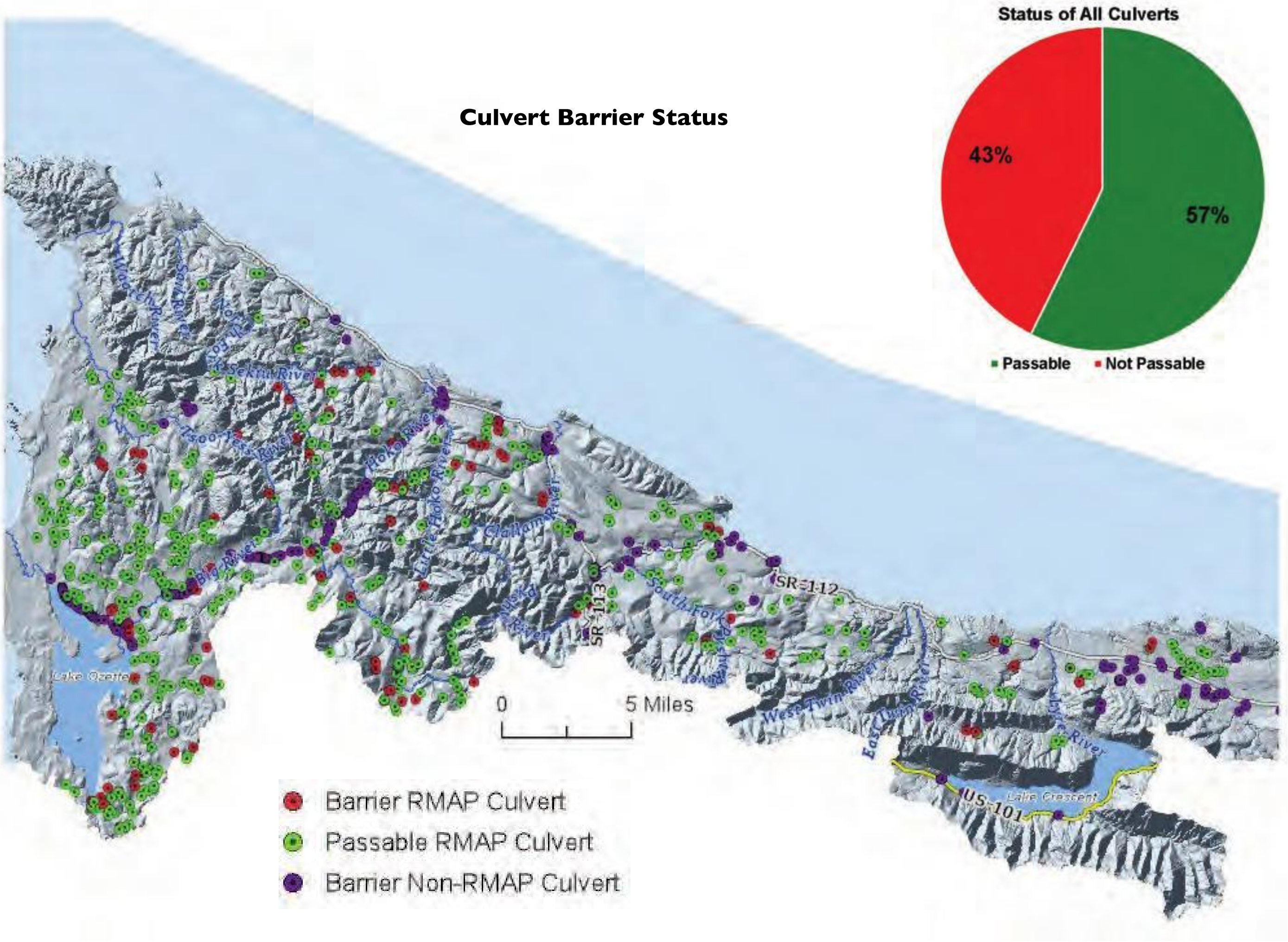
Between 2011 and 2016, a few watersheds like Umbrella Creek had a significant decline in forest cover but the overall trend was an increase in forest cover including an increase from 56% to 76% in the Pysht River watershed. In the longer period between 1992 and 2016, there were some gains in forest cover in some watersheds like West Twin River (which increased from 77% to 93%) and Deep Creek (71% to 91%). However, the general trend was a decrease in forest cover in various watersheds with the largest reductions in Big River (which decreased from 86% to 56%), Upper Hoko River (87% to 62%), and Umbrella Creek (90% to 68%).

Forest cover conditions have a tremendous impact on watershed processes and thus on salmonid habitat. Changes in forest cover can affect the rate of solar radiation reaching the stream surface, the delivery of water, large woody debris (LWD), sediment and nutrients to stream channels, as well as bank and channel stability. For the Sekiu River, Smith[1] lists extensive sedimentation problems, lack of LWD, extensive riparian areas dominated by hardwoods, and the reduced age of the surrounding forests as important habitat limiting factors. According to Smith,[2] excess sedimentation and a lack of LWD are primary factors which affect channel stability, impact incubating salmon eggs, and therefore limit salmon production in the Hoko River watershed.

Map Data Sources: SSHIAP 2004,[3] USGS 2014,[4] NOAA 2019,[5] WAECY 2018[6]

Culvert Barriers

There are currently 782 culverts on fish-bearing streams in the Makah Area of Interest made up of 550 Road Maintenance and Abandonment Plan (RMAP) culverts and 232 non-RMAP culverts. About 81% of the RMAP culverts are not fish barriers, which represents an improvement over the 67% since the 2016 State of Our Watershed report. However, barrier culverts still represent an important problem because many of the non-RMAP fish culverts which are predominantly on private, federal and county land continue to create significant barriers that will need a substantial amount of money to address. More than half of these culverts are totally impassible to fish and funding is needed to fix them.



There are currently 782 culverts on fish bearing streams in the Makah Area of Interest. Of these, 550 are culverts that fall under the Forest and Fish Agreement for state and private timberlands. Under the Washington State Forest and Fish Law, most forest landowners are required to have a Road Maintenance and Abandonment Plan (RMAP), which is a schedule for any repair work needed to up-grade road systems at stream crossings and address aquatic habitat and fish passage issues.

The RMAP data for the Makah Area of Interest shows that of the identified 550 culverts in fish bearing streams 102 (or 19%) were yet to be fixed, meaning that 81% are not barriers to fish. This represents an improvement over the last report where an analysis of similar data showed that about 67% of culverts were not fish barriers. This continues a positive trend in the fish barrier status of RMAP culverts that should have an overall positive impact on fish habitat in the Makah Area of Interest.

(Continued on next page)


North Olympic Salmon Coalition

Removal of this culvert on Johnson Creek, a tributary of the Hoko River and construction of a replacement bridge restored 6.2 miles of in-stream fish habitat.

Map Data Sources: CSP 2019,[2] SSHIAP 2004,[3] WADFW 2019,[4] WADNR 2019,[5] WAECY 2018,[6]

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The other 232 culverts are not part of the RMAP dataset and do not have a schedule for repair or maintenance but at varying degrees, impede access to miles of stream suitable for salmon habitat. Of these, 137 (or 59%) are totally impassible to fish. Predominantly on private, federal and county land, these culverts create significant barriers and will need a substantial amount of money to fix. Some of the identified barriers are on Washington state highways but there is no timetable for when the state will seek to address them as they are considered low priority based upon the amount of habitat gain.

Many of these culverts constitute fish barriers and adversely impact fish migration particularly on small streams because the water velocity is too high, or flow is too shallow, or has a waterfall into or out of the culvert. Price et al.[1] found that a third of culverts permitted under Washington state's hydraulic project approval (HPA) process for fish passage were, in fact, barriers.

With the assistance of the local salmon recovery stakeholders, Clallam County was able to acquire a baseline culvert inventory of majority of the Makah Area of Interest which was a first and important step toward addressing the problem of these barrier culverts. There has been significant momentum the last few years to help the county tackle this issue. With the assistance of regional salmon recovery partners, grant funding has been secured to help the county and some landowners address this problem. It is hoped that this partnership will continue as long as funding is available to ensure that the partners can assist the county in dealing with these costly and difficult barriers. There is a need to improve capacity funds for the region as there are many projects in the region that need technical assistance but the region doesn't have enough capacity to address all of the project needs in a timely manner.

Debbie Preston, NWIFC

Ray Colby, Assistant Director Makah Fisheries (left) and other Makah Tribe staff move fish downstream prior to the replacement of the fish-blocking culvert on Grimes Creek in the Tsoo-Yess River watershed.

Roads as a Limiting Factor

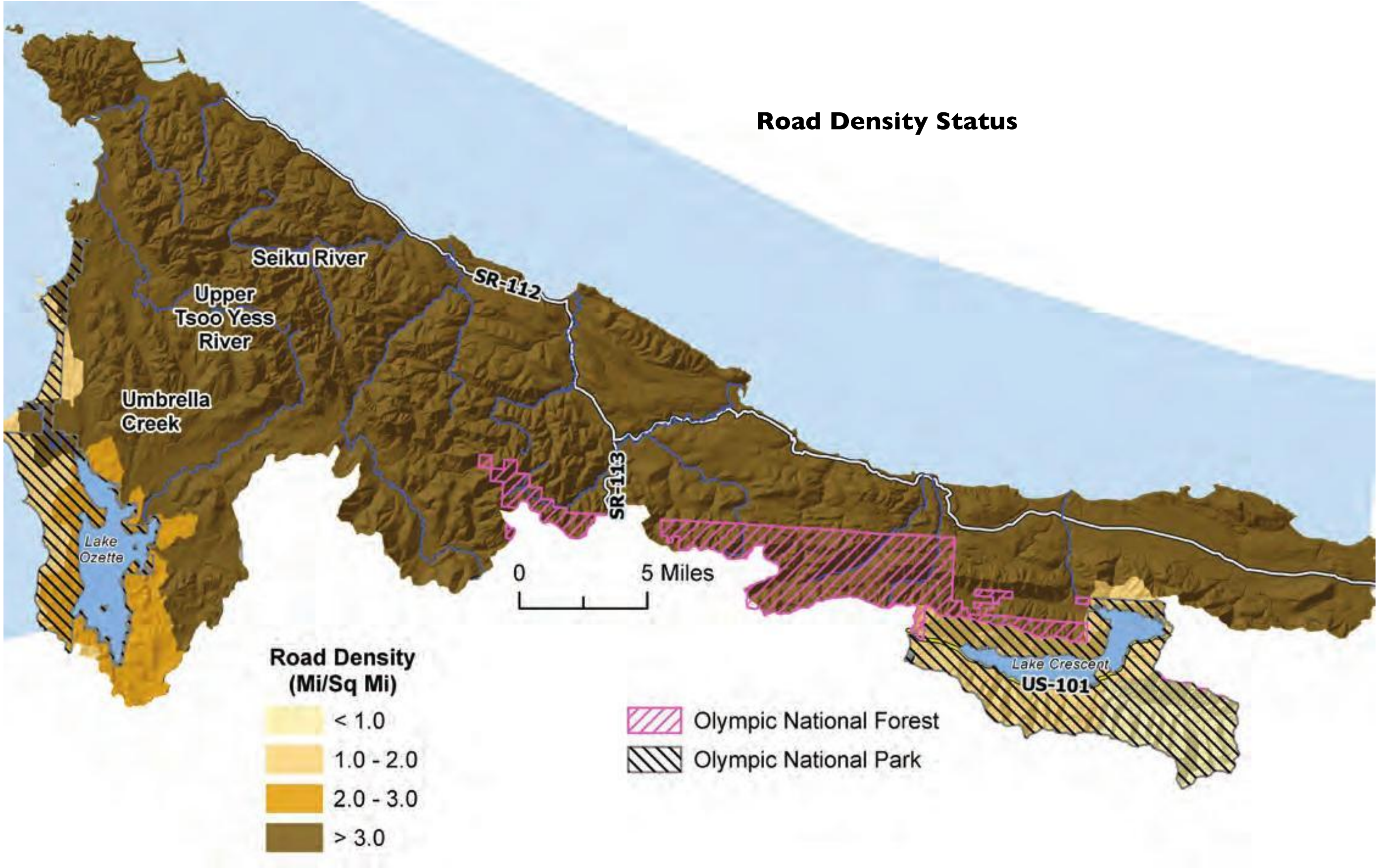
A total of 19 watersheds, representing 83% of the land area in the Makah Area of Interest had road densities above 3 miles per square mile, same as in the 2016 State of Our Watersheds Report. These watersheds may not be properly functioning because such road densities can become a source of sediment to streams which degrade fish habitat and limit salmon production.

Forests roads serve many important functions. They provide access for timber harvesting and management, fish and wildlife habitat enhancement, and a variety of recreational activities like fishing, hunting, hiking, camping and bird watching. If not properly constructed or maintained, they can become a source of fine sediments to streams which degrade fish habitat and water quality.[1] Furniss et al.[2] concluded that the sediment contribution per unit area from roads is often much greater than all other forest activities combined. Also, many culverts at forest road crossings may constitute fish barriers.

Cederholm et al.[3] found that fine sediment in salmon spawning gravels increased by 2.6 – 4.3 times in watersheds with more than 4.1 miles per square mile of land area. The National Marine Fisheries Service[4] guidelines for salmon habitat characterize watersheds with road densities greater than 3 miles per square mile of watershed area as "not properly functioning." Watersheds were classified as "properly functioning condition" when road densities were less than 2 miles per square mile and "at risk" when values were 2-3 miles per square mile.

A total of 19 watersheds representing 83% of the land area had road densities above 3 miles per square mile, same as in the last report. The Umbrella Creek, Upper Tsoo Yess and Sekiu River watersheds had the highest road densities of over 6 miles per square mile while the lowest values were in watersheds in the Olympic National Forest.

Extensive sedimentation resulting from high road densities and landslides was reported for many watersheds in the area by Smith[5] and the current road densities could be a major limiting factor on salmonid production.

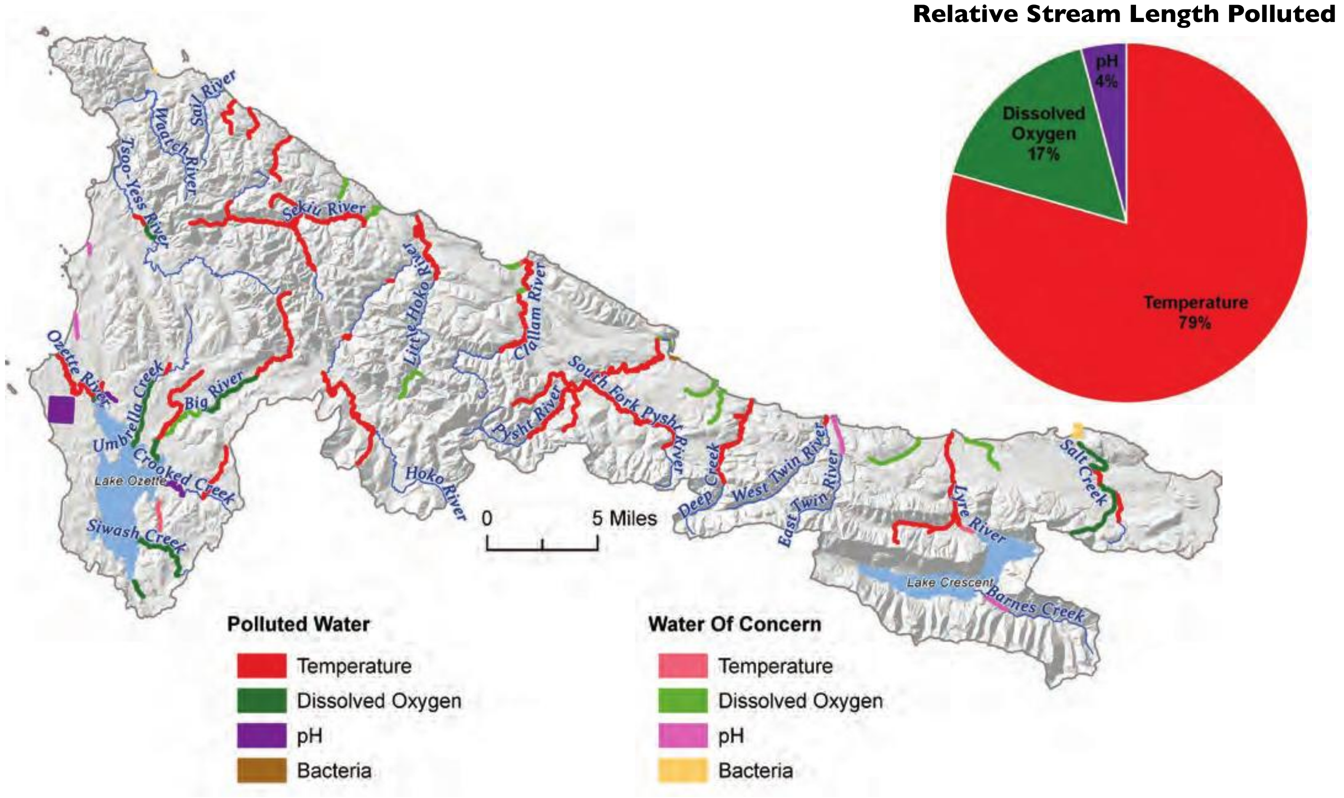


Map Data Sources: SSHIAP 2004,[6] WADNR 2019,[7] WAECY 2018[8]

MAKAH TRIBE

Water Quality

In the Makah Area of Interest, 40 waterbodies were placed on the 303(d) list for water pollution, an increase of 8 since 2012. Water temperature remains by far the most common pollutant although the proportion of stream length impaired by temperature dropped to 79% from 86% followed by dissolved oxygen which has the proportion of stream length impaired increase to 17% from 7% in the last report. Big River is the single most polluted waterbody by total length with 16.1 miles impaired by water temperature, dissolved oxygen and pH.



Map Data Sources: SSHIAP 2004,[3] WAECY 2016,[4] WAECY 2018[5]

The federal Clean Water Act requires states to monitor and report water pollution on waters that have been assessed. Waters that do not meet water quality standards because they are too polluted are called impaired. They are placed on a list for future actions to reduce the pollution. The 303(d) list comprises those waters that are in the polluted water category, for which beneficial uses such as drinking, recreation, aquatic habitat, and industrial use are not being met.

Water quality requirements for salmonids include cool temperatures, high dissolved oxygen, natural nutrient concentrations and low level of pollutants.[1] If the values of these factors exceed the desired range for a specific location and time of year, the ability of surface waters to sustain these fish populations is impaired.

In the Makah Area of Interest, 40 waterbodies were placed on the 303(d) list for water pollution, an increase of 8 (25%) since 2012. Water temperature remains by far the most common pollutant and is listed in 33 waterbodies. However, the proportion of stream length impaired by temperature dropped from 86% in the last report to 79% now.

The second most common pollutant is dissolved oxygen which is listed in 11 waterbodies and has the proportion of stream length impaired increase to 17% from 7% in the last report. Other pollutants were pH and bacteria.

An additional 31 waterbodies in the Area of Interest were listed as waters of concern for the same parameters in the 303(d) list. These are waterbody segments where there is some evidence of a water quality problem but not enough to be placed on the list for a pollution control plan.

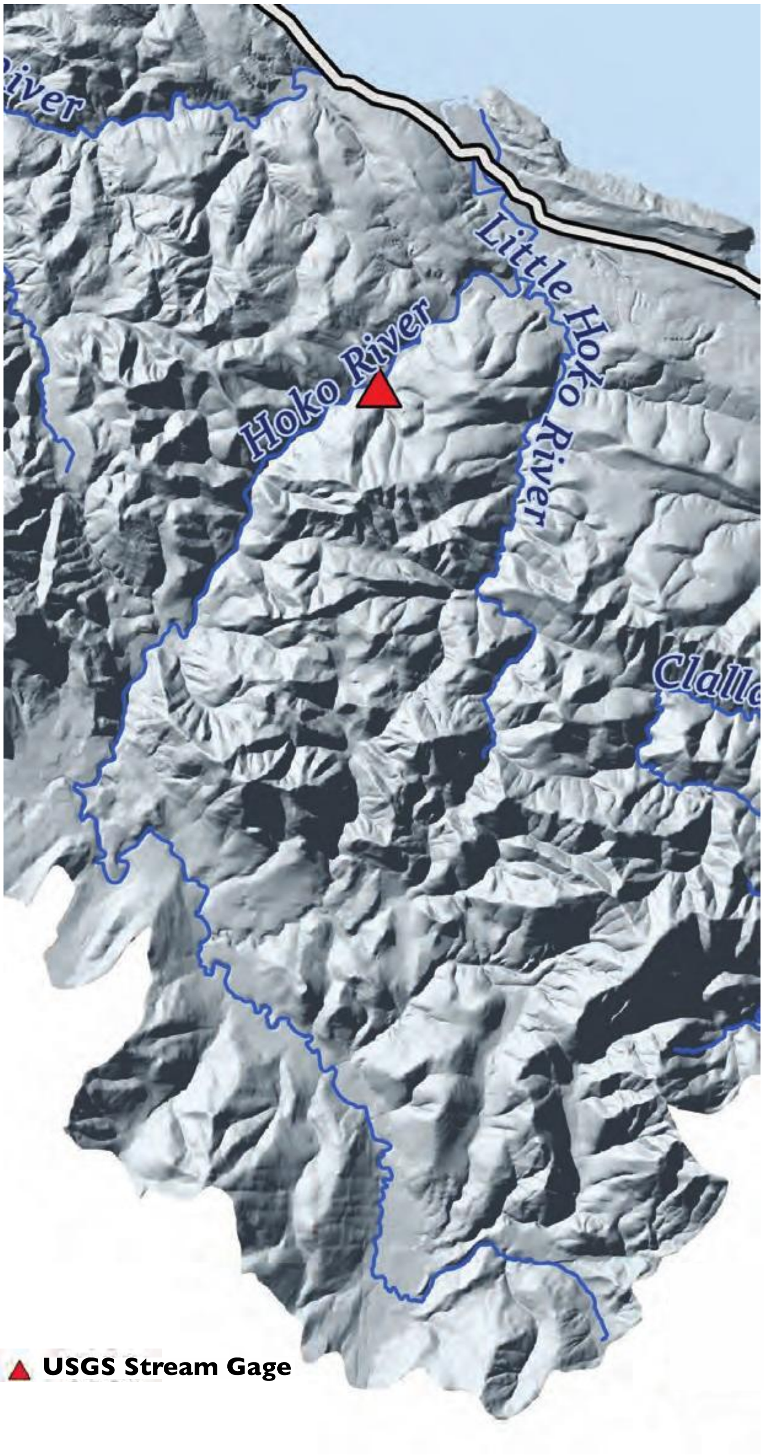
Big River is the single most polluted waterbody by total length with 16.1 miles impaired by water temperature, dissolved oxygen and pH. The Pysht River and South Fork Pysht River are polluted by water temperature with total segment lengths of 11.9 miles and 7.1 miles, respectively, while 10.3 miles of the Hoko River is impaired by water temperature which is similar to the last report.

Elevated stream water temperatures are associated with one or more causes, notably the loss of mature riparian vegetation along stream corridors, reduced instream flows in summer, and reduced water depth as a result of sedimentation. Low stream flows can also lead to a decrease in the amount of available oxygen and a concentration of toxins. These conditions have been reported for many of the rivers in the Makah Area of Interest including Deep Creek, as well as Clallam, Pysht, Sekiu and Hoko rivers.[2] These water quality impairments are indicative of the baseline condition of these watersheds and unless they are remedied, the watersheds will not be healthy enough to fully support salmon and other species. Restoration efforts to vegetate open riparian areas with conifers will contribute to stream shade and large woody debris in the long term.

Makah Tribe

Hoko River Flow

Streamflow data have been collected for almost six decades in the Hoko River. Median peak flow values continue to show an increasing trend while summer median low flow values continue to show a decreasing trend. Both trends have been predicted to occur because of climate change. Data from the other stations in the Makah Area of Interest have not been collected consistently over a long period but it is likely the patterns are similar. These trends may indicate that salmon habitat and other aquatic ecosystem functions may not be adequately protected in these watersheds.



Map Data Sources: SSHIAP 2004,[4] USGS 2019,[5] WADOT 2018,[6] WAECY 2018[7]

The magnitude, timing and variability of low streamflows and the magnitude and frequency of high streamflows are critical to salmonid survival and production. In the Makah Area of Interest, the streamflow values are collected from two gauges maintained by the United States Geological Survey (USGS) and five by the Washington Department of Ecology. At least two of the Ecology monitoring stations are funded by the Makah Tribe.

Streamflow data has been collected for the Hoko River near Sekiu by the USGS since 1963, although there were gaps during that period. The data shows that over time, median peak flow values have increased by 18.4% between 1965 and 2019. Summer median low flow values showed a decreasing trend at precisely the time when streamflow is needed the most and when water temperatures are at their highest. Both trends have been predicted to occur because of climate change and now are a reality in the Hoko.

Because of its low elevation and dependence on precipitation, the Hoko River basin is naturally susceptible to low water flows in the summer and early winter like the other rain dominant watersheds in the region. However, human factors seem to be contributing to the problems of low and peak flows. One of these factors is water withdrawals for municipal water use.[1] Another factor is forestry land-use practices and the alteration of the age and composition of the surrounding forest cover. The relatively younger tree stands are believed to be associated with an increased frequency and severity of peak flows.

Low flows contribute to high water temperatures and limit the spawning distribution of fall chinook to less stable areas of the mainstem, possibly increasing the likelihood of scour of redds during peak flow events.[2] The timing of these flows also can be a problem for coho salmon.[3]

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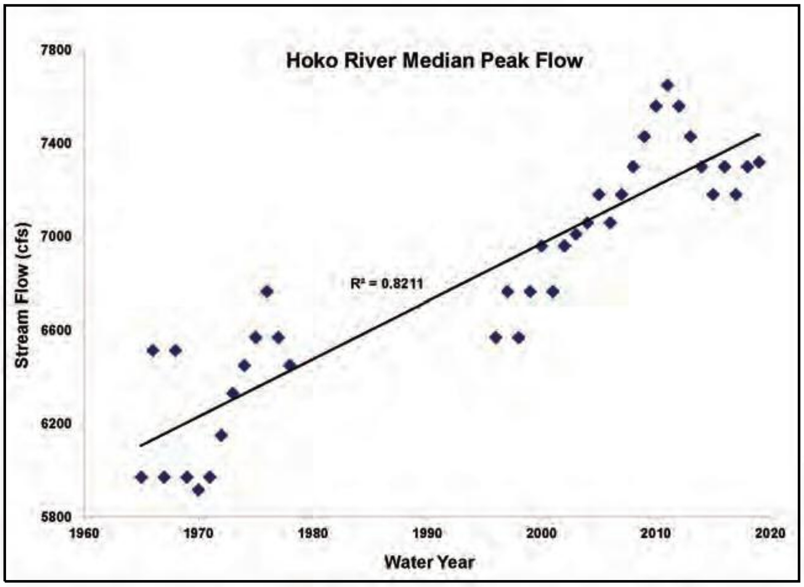
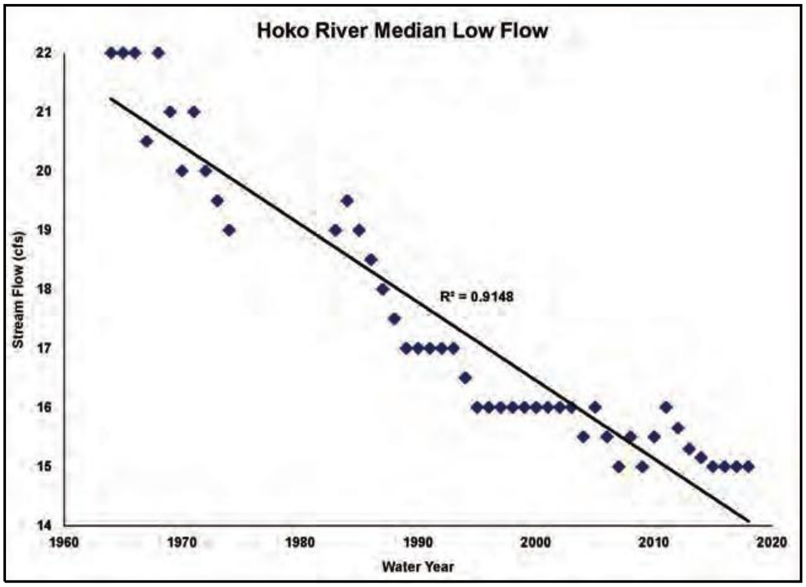
Streamflow data from the other monitoring stations in the Makah Area of Interest have not been collected consistently over a long period similar to the Hoko River but it is likely the patterns are similar. These trends may indicate that salmon habitat and other aquatic ecosystem functions may not be adequately protected in these watersheds under the current management regime.





Makah Tribe

European Green Crab Invasion

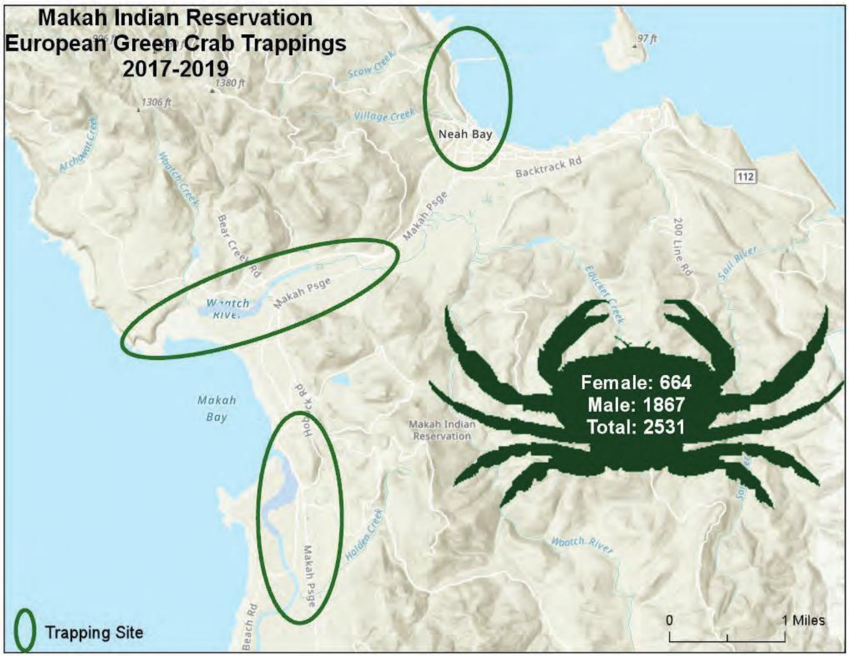
*The European green crab (*Carcinus maenas*) is a relatively recent invasive species in the Makah Area of Interest. The tribe has embarked on a rapid and aggressive trapping effort to assess the extent of the infestation. More than 2,500 crabs have been caught between 2017 and 2019. If left unchecked, these crabs will continue to reproduce and disperse throughout the area, threatening fish and shellfish habitat and species as well as the tribe's treaty-reserved rights.*

Adrianne Akmajian, Makah Tribe

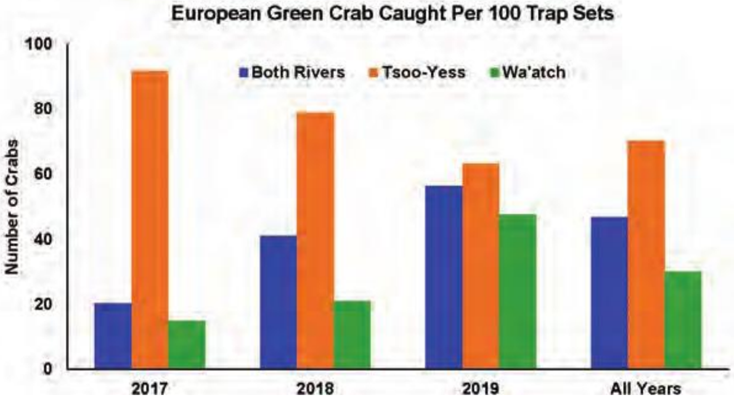
European green crab caught on the Makah Reservation.

The European green crab (*Carcinus maenas*) is a relatively recent invasive species in the Makah Area of Interest. The crab is considered a proficient colonizer that is able to establish and flourish in new environments. Their larvae can survive as plankton for up to 80 days, are dispersed by ocean currents along the coast, and swept by tides and currents into coastal waters where they molt and settle as juvenile crabs in the upper intertidal zone.[1]

The European green crab also is an efficient predator that preys on bivalves and other crustaceans, such as soft-shell clams and scallops, and could damage eelgrass beds.[2]



Map Data Sources: ESRI 2020,[4] Makah Tribe 2020,[5] WDFW 2019[6]



The European green crab was first found and reported by a beachwalker in the Area of Interest in the intertidal near the Wa'atch River mouth in August 2017. Makah tribal staff, input from federal and state agencies, then embarked on a rapid and aggressive effort in October 2017 to assess the extent of the invasive crab infestation on the reservation. Traps were set in areas thought to be the crab's preferred habitat – side channels off the main river with soft mud bottoms, undercut banks and salt water exposure – in the Wa'atch and Tsoo-Yess river valleys. This initial trapping effort yielded crabs that ranged in size about 1-3 inches, indicating that the crabs were most likely from the 2016 and 2017 brood classes and that larger individuals could reproduce. More intense crab trapping efforts were conducted by the tribe in 2018 and 2019 in the coastal estuaries as well as in Neah Bay.[3] The results show an increased number of captures in each subsequent year in the Area of Interest. From 35 crabs in 2017, the numbers rose to 1,056 in 2018 and 1,441 in 2019. In 2019, the tribe tested traps in new habitats, including deeper parts of the main river channels, and new traps types, including using recreational-style shrimp traps. These efforts are likely responsible for the greater number of crabs caught in 2019 compared to 2018. The shrimp traps in particular had a catch rate of approximately 6 crabs per trap set compared to the standard traps used; minnow traps caught just 0.2 crabs per trap and Fukui (crayfish) traps caught 0.5 crabs per trap.

Makah tribal members have historically relied on the subsistence harvest of coastal seafood, including fish and shellfish, which provide sustenance and a connection to their culture. But European green crab could pose a threat to native species. Their habitat overlap with some juvenile Dungeness crab which may result in a competition for resources.

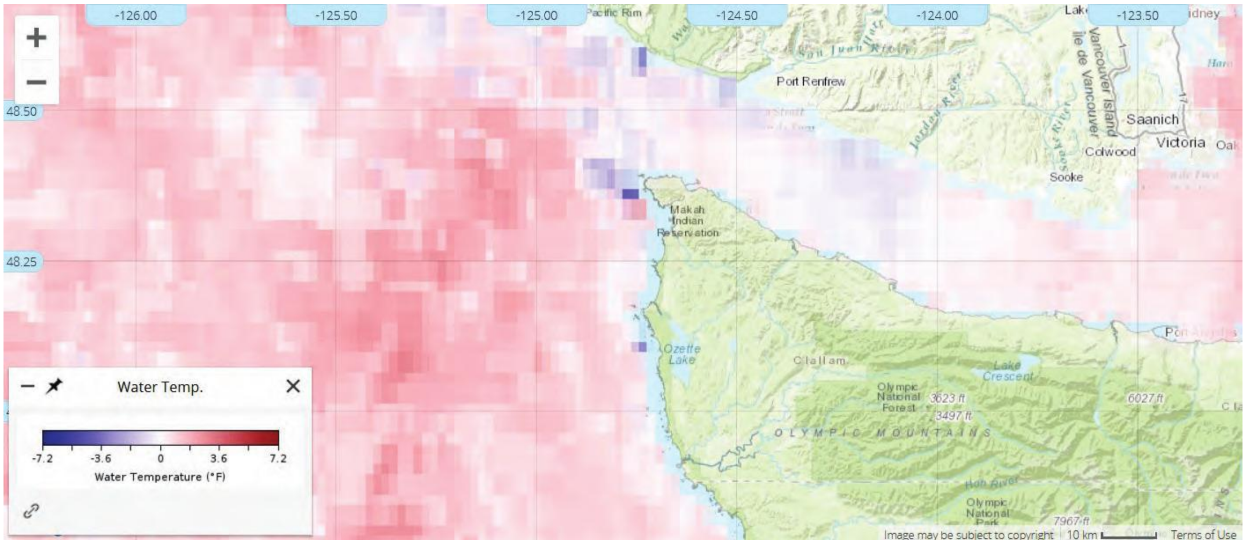
Without long-term aggressive trapping, monitoring and control measures, these European green crab will continue to reproduce and disperse throughout the Area of Interest, threatening fish and shellfish habitat and the tribe's treaty-reserved rights.

Makah Tribe

Ocean Conditions

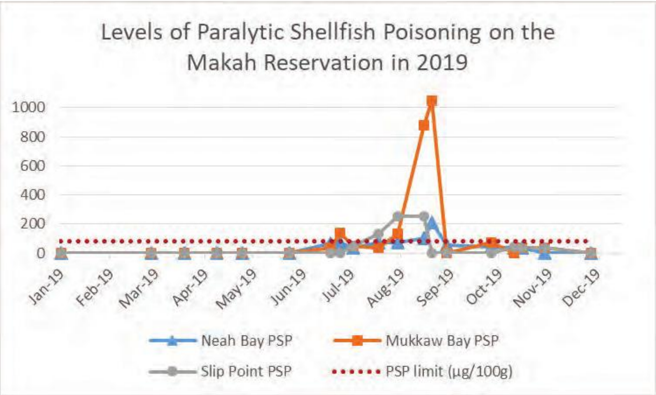
Ocean conditions in the Makah Tribe's Area of Interest have been heavily impacted by warming oceans, including marine heat waves and harmful algal blooms. This has severely limited salmon returns and led to the widespread closure of beaches accessed by tribal fishers due to high levels of the toxin responsible for paralytic shellfish poisoning (PSP).

June 2015 Sea Surface Temperature Anomaly



In recent years, ocean conditions in the Makah Tribe's Area of Interest have been heavily impacted by warming oceans, including marine heat waves (MHW) and harmful algal blooms (HABs). Ocean conditions here are driven by flow out of the Strait of Juan de Fuca, circulation within the Juan de Fuca eddy, and the California Current System (CCS). In 2014-16 and in 2019, the CCS experienced two major MHWs. The 2014-16 MHW (i.e. "the Blob") persisted for multiple years due to weak atmospheric circulation and the presence of warm waters down to 300 meters depth. This MHW was aided by a strong El Nino event which weakened upwelling and brought warm waters northward. The 2019 MHW coincided with a weak El Nino and only lasted one year. In 2015, the CCS experienced a prolonged, severe harmful algal bloom driven by the MHW. McCabe et al.[1] and McKibben et al.[2] found that HABs in the CCS are strongly correlated with El Nino events, with the worst conditions occurring when southward winds drive upwelling of nutrient rich waters, followed by northward winds that drive downwelling and push these waters onshore (and the phytoplankton bloom that can accompany them). The 2015 HAB event in Washington caused toxic build ups in numerous shellfish species, at least one sea lion death, and detectable concentrations of toxins in whales, dolphins and other marine mammals. The Blob and concurrent El Nino severely impacted 2016 coho and chinook salmon returns, leading to a disaster declaration with the tribe reporting a total economic impact to their 2016 ocean troll fishery of $4,026,269.[3]

Due to the outflow of warm, nutrient water from the Strait of Juan de Fuca, the tribe's Area of Interest also is highly susceptible to seasonal HABs, as is evidenced by the widespread closure of beaches accessed by tribal fishers due to high levels of the toxin responsible for paralytic shellfish poisoning (PSP) caused by blooms of *Alexandrium sp*. In the summer of 2019, shellfish harvesting was closed on the Makah Reservation after shellfish samples from the Strait of Juan de Fuca and Makah Bay were found to contain high levels of the toxin.



High levels of the toxin that causes paralytic shellfish poisoning (PSP), caused by blooms of *Alexandrium sp,* caused widespread closures of shellfish harvesting beaches between July and September 2019.

Makah Tribe

Riley Smith, Makah water quality specialist, looks in the microscope to identify any toxic algae that might produce domoic acid poisoning or paralytic shellfish poisoning.

Map Data Sources: OCNMS 2020[4]

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Roads as a Limiting Factor

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2020 State of Our Watersheds Report
Green-Duwamish River, White-Puyallup River and Lake Washington Basins

> *We are the salmon people. For generations, salmon have sustained our way of life. Now we must sustain the life of the salmon.*
>
> – **Phil Hamilton**
> **Muckleshoot Fish Commission**

Muckleshoot Indian Tribe

The Muckleshoot Indian Tribe is a federally recognized Indian tribe whose membership is composed of descendants of the Duwamish and Upper Puyallup people who inhabited Central Puget Sound for thousands of years before non-Indian settlement.

The tribe's name is derived from the native name for the prairie on which the Muckleshoot Reservation was established. Following the reservation's establishment in 1857, the tribe and its members came to be known as Muckleshoot, rather than by the historic tribal names of their Duwamish and Upper Puyallup ancestors.

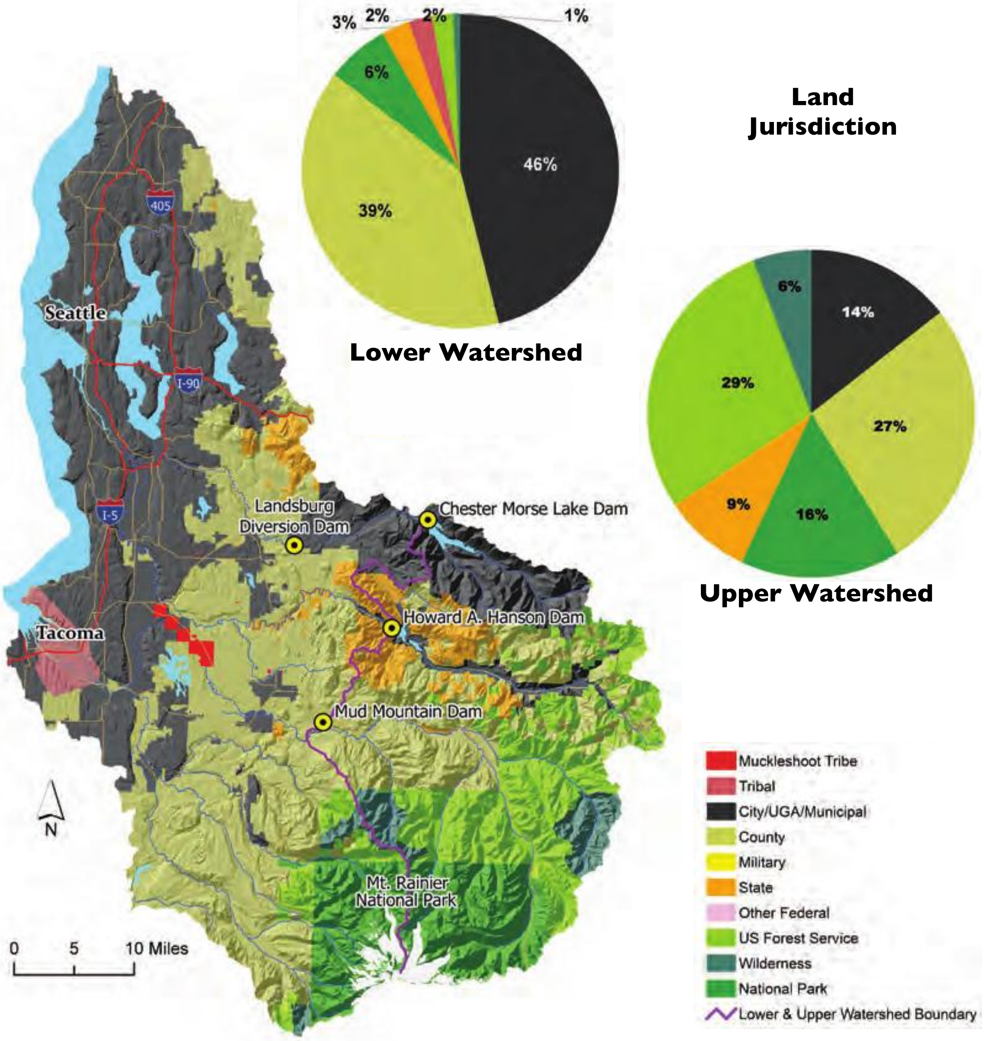
Today, the United States recognizes the Muckleshoot Tribe as a tribal successor to the Duwamish and Upper Puyallup bands from which the tribe's membership descends. Like all native people of western Washington, Muckleshoot ancestors depended on fish, animal and plant resources and traveled widely to harvest these resources. Village groups were linked by ties of marriage, joint feasting, ceremonies, commerce and use of common territory. Downriver people intermarried with other groups along the sound, while people on the upper reaches of the drainages also intermarried with groups east of the Cascade Mountains. This network of kinship tied together ancestral Muckleshoot villages within the Duwamish watershed, extended across watersheds and the Cascade crest, giving Muckleshoot ancestors access to fishing, hunting and gathering sites throughout a broad area extending from the west side of Puget Sound across the Cascade crest.

Area of Interest

Areas depicted do not necessarily correspond to Muckleshoot Usual & Accustomed fishing grounds and stations.

Muckleshoot Indian Tribe

Lake Washington, Green-Duwamish & White-Puyallup River Basins



Areas depicted do not necessarily correspond to Muckleshoot Usual & Accustomed fishing grounds and stations.

The Muckleshoot Indian Tribe's geographic Area of Interest includes all of WRIAs 8, 9 and 10. In this chapter, the tribe's focus is on Lake Washington (WRIA 8), the Green-Duwamish rivers (WRIA 9) and the White-Puyallup River basin (WRIA 10). Anadromous salmonids in this area include chinook, coho, sockeye, chum and pink salmon, and steelhead and bull trout.

The Green-Duwamish River basin was historically 1,736 square miles and included the White and Cedar rivers. The Cedar and White rivers were diverted in the early 1900s, reducing the basin area to 556 square miles. The Green River flow regime is altered by flood control and storage at Howard Hanson Dam and by water withdrawals. The U.S. Army Corps' dam was constructed in the 1960s without fish-passage facilities. Approximately 98% of historic intertidal marsh and flats have been replaced with commercial and industrial development. The basin supports an estimated 637,034 people (up 6.4% from 2014) and about 30% lies within Urban Growth Area boundaries.[1]

The 686-square-mile Lake Washington basin includes the Cedar and Sammamish rivers and the lakes of Sammamish, Union and Washington. Major alterations include channelization of the Sammamish River, and the construction of the Lake Washington Ship Canal and the Ballard Locks. The basin is heavily urbanized, leading to highly modified stream hydrology and shorelines. With 25 cities and an estimated 1.75 million people (up 13.8% from 2014), Lake Washington is the most populated basin in Puget Sound with 55% of its land area inside Urban Growth Area boundaries.[2]

The White River drains 494 square miles and originates on Mount Tacoma (Rainier) glaciers. The river flows 68 miles from its origin to its confluence with the Puyallup River at Sumner. Most of the upper White River is managed for timber production and has been intensively logged since 1945, leading to slope stability problems and increased sediment loads in non-glacial tributaries.[3] The U.S. Army Corps' Mud Mountain Dam blocks adult fish migration and the river's flow and sediment regime are heavily altered by flood control activities at the dam. From 1911 until 2004, Puget Sound Energy diverted up to 2,000 cfs from the White River into the Lake Tapps reservoir, depleting river flows on the Muckleshoot Indian Reservation and devastating salmon and steelhead populations. A 1986 settlement with the Muckleshoot Tribe required that the diversion meet a minimum instream flow. Hydropower diversion ceased in 2004, and in 2007 an agreement was reached with the Cascade Water Alliance that further limits water diversion to Lake Tapps. The basin includes Commencement Bay, which is highly altered and contaminated with industrial discharges and urban runoff. This basin saw an estimated 6.6% increase in population since 2014.[4]

Land development along with hydrologic and channel modification have severely diminished the potential for natural salmon production in these basins. Much of the habitat loss and degradation is not likely to be reversed, and new growth continues to add impacts. As a result, hatcheries continue to play a crucial role in providing salmon for tribal treaty and other harvest, and in maintaining the abundance of naturally spawning fish. Nonetheless, habitat protection and restoration remain essential in order to sustain future salmon populations regardless of hatchery or natural origin.

Map Data Sources: SSHIAP 2004,[5] USFWS 2018,[6] USGS 2012,[7] WADNR 2016,[8] WADNR 2018,[9] WADOT 2018a,[10] WADOT 2018b,[11] WAECY 1994,[12] WAECY 2018a,[13] WAECY 2018b,[14]

Chapter Summary

The Muckleshoot Indian Tribe is a federally recognized Indian tribe whose membership is composed of descendants of the Duwamish and Upper Puyallup people who inhabited Central Puget Sound for thousands of years before non-Indian settlement. The tribe's name is derived from the native name for the prairie on which the Muckleshoot Reservation was established. Following the reservation's establishment in 1857, the tribe and its members came to be known as Muckleshoot. Like all native people of western Washington, Muckleshoot ancestors depended on fish, animal and plant resources and traveled widely to harvest these resources. The Muckleshoot Tribe are leaders in the region's salmon recovery effort. No other people know these watersheds as well as the tribes and none has a greater stake in their future. The tribes believe that if salmon are to survive, real gains in habitat protection and restoration must be achieved.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on improving the quality and quantity of habitat.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org*.

For this report, the Muckleshoot Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Impervious Surface Continues to Increase

From 2011-2016, the Lake Washington, Green-Duwamish and Puyallup-White lower basins continued to gain impervious surface area. Though the gain in this time was small, (.5%) of combined lower basin area, the trend is for further development and additional impervious land cover.

Narrowing Down Stormwater Runoff Mortality Factors Connected with Coho Pre-Spawning Mortality (PSM)

Based on NOAA's latest 2017 model, 471 stream miles of known coho distribution in the Green-Duwamish and Lake Washington basins are predicted to have a PSM rate of 5% or more, with 147 miles predicted to have 35-100% PSM. Researchers are still trying to determine which chemicals in stormwater are contributing to the deaths of large numbers of coho salmon in Puget Sound.

Water Quality Continues to Require Corrective Actions

The Washington State Department of Ecology 2014 Water Quality Assessment lists approximately 190 miles of stream in WRIAs 8, 9 and 10 as "impaired waters." An additional 42 miles in WRIAs 8 and 9 are assumed to exceed water temperature standards for fish based on adjacent impairments or other data.

Summer-Fall Flows Decreasing as Water Resource Development Continues

From 2015-2019, 398 new water wells (7% increase) were added to the Lake Washington and Green-Duwamish basins, while the Puyallup-White basin saw an increase of 462 new water wells (18% increase). 482 miles of streams in the Lake Washington and Green-Duwamish basins are identified as having low streamflow problems, while in the Puyallup-White basin there are 122 miles of low flow concerns. In the future, the rate of declining stream flow levels will likely increase, as population growth and reduced snowpack continue to put more stress on this finite resource.

Overwater Structures Impact Lakeshore Habitat in Lake Washington

Along Lake Washington alone, there are about 3,000 residential piers and marinas. The number of new docks since 2016 is minimal as most homes already have docks and there is no more room for further development. An estimated 82% of Lake Washington's shoreline remains heavily modified with bulkhead and riprap.

Streams Still Lack Large Wood and Natural Habitat Features

Wood counts in the lower Cedar and Green rivers continue to have less than 5% of the expected key piece quantities. There is an urgent need for controlled field experiments and long-term studies that focus on the protection of existing large woody debris in stream channels and the recruitment of new debris from the surrounding forest.

Riverbank and Shoreline Modifications Limit Fish Habitat in Fresh and Marine Waters

From 2015-2018, marine shoreline conditions in King County have continued to change very little. During this time, 750 feet of armoring was removed, while 235 feet of new armoring was constructed. Almost 1 mile of armoring was replaced. A total of 125 miles of artificial shoreline negatively affect nearshore and fresh water habitat for salmon.

Conclusion

The Muckleshoot Tribe's watersheds have seen very few successes to the recovery of habitat over the past decade while other habitat indicators have stayed the same or worsened. The Green-Duwamish, Puyallup-White and Lake Washington basins in Central Puget Sound continue to support important salmon and steelhead runs despite dramatic habitat alteration and ecosystem decline. These watersheds are the most developed in all of Washington state. Their populations are continuing to grow rapidly which will undoubtedly continue to affect salmon populations in a negative way.

From 2011-2016, the Lake Washington, Green-Duwamish and Puyallup-White lower basins continued to gain impervious surface area. Though the gain in this time was small, (.5%) of combined lower basin area, the trend is for further development and additional impervious land cover. Based on NOAA's latest 2017 model, 471 stream miles of known coho distribution in the Green-Duwamish and Lake Washington basins are predicted to have a PSM rate of 5% or more, with 147 miles predicted to have 35-100% PSM. The Washington State Department of Ecology 2014 Water Quality Assessment lists approximately 190 miles of stream in WRIAs 8, 9 and 10 as impaired waters. An additional 42 miles in WRIAs 8 and 9 are assumed to exceed water temperature standards for fish based on adjacent impairments or other data. From 2015-2019, 398 new water wells (7% increase) were added to the Lake Washington and Green-Duwamish basins, while the Puyallup-White basin saw an increase of 462 new water wells (18% increase). A total of 482 miles of streams in the Lake Washington and Green-Duwamish basins are identified as having low streamflow problems, while in the Puyallup-White basin there are 122 miles of low flow concerns.

Along Lake Washington alone, there are about 3,000 residential piers and marinas. The number of new docks since 2016 is minimal as most homes already have docks and there is no more room for further development. An estimated 82% of Lake Washington's shoreline remains heavily modified with bulkhead and riprap. Wood counts in the lower Cedar and Green rivers continue to have less than 5% of the expected key piece quantities.

From 2015-2018, marine shoreline conditions in King County have continued to change very little. During this time, 750 feet of armoring was removed, while 235 feet of new armoring was constructed. Almost 1 mile of armoring was replaced. A total of 125 miles of artificial shoreline negatively affect nearshore and fresh water habitat for salmon. Even though restoration is occurring, it is not enough to keep up with the impacts of a growing population and their land-use decisions. Land use and water laws that are in place and meant to protect critical areas and fish habitat need to be implemented. Implementation includes education and voluntary actions, but it also needs to include enforcement when those laws are broken. The future of the Muckleshoot Tribe's exercising its treaty rights depends on it.

Recovery Efforts Show Improvement But Still Lagging in Key Indicators

At the 15-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators reveals negative results in progress toward the recovery plan's goals and objectives. Priority issues continue to be the degradation of water quantity and quality and the floodplain and riparian processes. There has been progress in the reduction of shoreline armoring, but concerns still exist with the large amount of shoreline armor replacement. In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat, and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trend for these key environmental indicators since the 2016 State of Our Watersheds Report shows a steady loss, except improvements in the reduction of shoreline armoring in habitat status:

Tribal Indicator	Status	Trend Since SOW 2016 Report
Impervious Surface	From 2011-2016, the Lake Washington, Green-Duwamish and Puyallup-White lower basins continued to gain impervious surface area. Though the gain was small, (.5 percent) of lower basin area, the trend is for further development and additional impervious land cover.	**Declining**
Coho Pre-Spawn Mortality	Based on NOAA's latest 2017 model, 471 stream miles of known coho distribution in the Green-Duwamish and Lake Washington basins are predicted to have a PSM rate of 5% or more, with 147 miles predicted to have 35-100% PSM. In the 2016 State of Our Watersheds Report, these estimates were 269 miles and 141 miles respectively.	**Declining**
Water Quality	The Washington State Department of Ecology 2014 Water Quality Assessment lists approximately 190 miles of stream in WRIA's 8, 9 and 10 as "impaired waters". An additional 42 miles in WRIA's 8 and 9 are assumed to exceed water temperature standards for fish based on adjacent impairments or other data.	**Declining**
Water Wells	From 2015-2019, 398 new water wells (7% increase) were added to the Lake Washington and Green-Duwamish basins, while the Puyallup-White basin saw an increase of 462 new water wells (18% increase). A total of 482 miles of streams in the Lake Washington and Green-Duwamish basins are identified as having low streamflow problems, while in the Puyallup-White basin there are 122 miles of low flow concerns.	**Declining**
Overwater Structures	Along Lake Washington alone, there are about 3,000 residential piers and marinas.1 The number of new docks since 2016 is minimal as most homes already have docks and there is no more room for further development. An estimated 82% of Lake Washington's shoreline remains heavily modified with bulkhead and riprap.	**Declining**
Large Woody Debris	Wood counts in the lower Cedar and Green Rivers continue to have less than 5% of the expected key piece quantities.	**Concerns**
Shoreline Modifications/Forage Fish Impacts	From 2015-2018, marine shoreline conditions in King County have continued to change very little. During this time, 750 feet of armoring was removed, while 235 feet of new armoring was constructed. Almost one mile of armoring was replaced. A total of 125 miles of artificial shoreline negatively affect nearshore and fresh water habitat for salmon.	**Marginally Improving**

The tribe continues to work toward the protection and restoration of water quality, streamflows, nearshore, estuarine and river habitat, and to conduct research to understand the organisms and the habitats they occupy.

Looking Ahead

Salmon returns and treaty harvest opportunities continue to deteriorate in Central and South Puget Sound. The long-term outlook for the Muckleshoot Indian Tribe is challenging given degraded habitat functions and degraded water quality, rising human population, unstable marine conditions and other effects associated with climate change. Dramatic improvements are required, along with a flexible approach to rebuilding salmon and steelhead populations to harvestable levels.

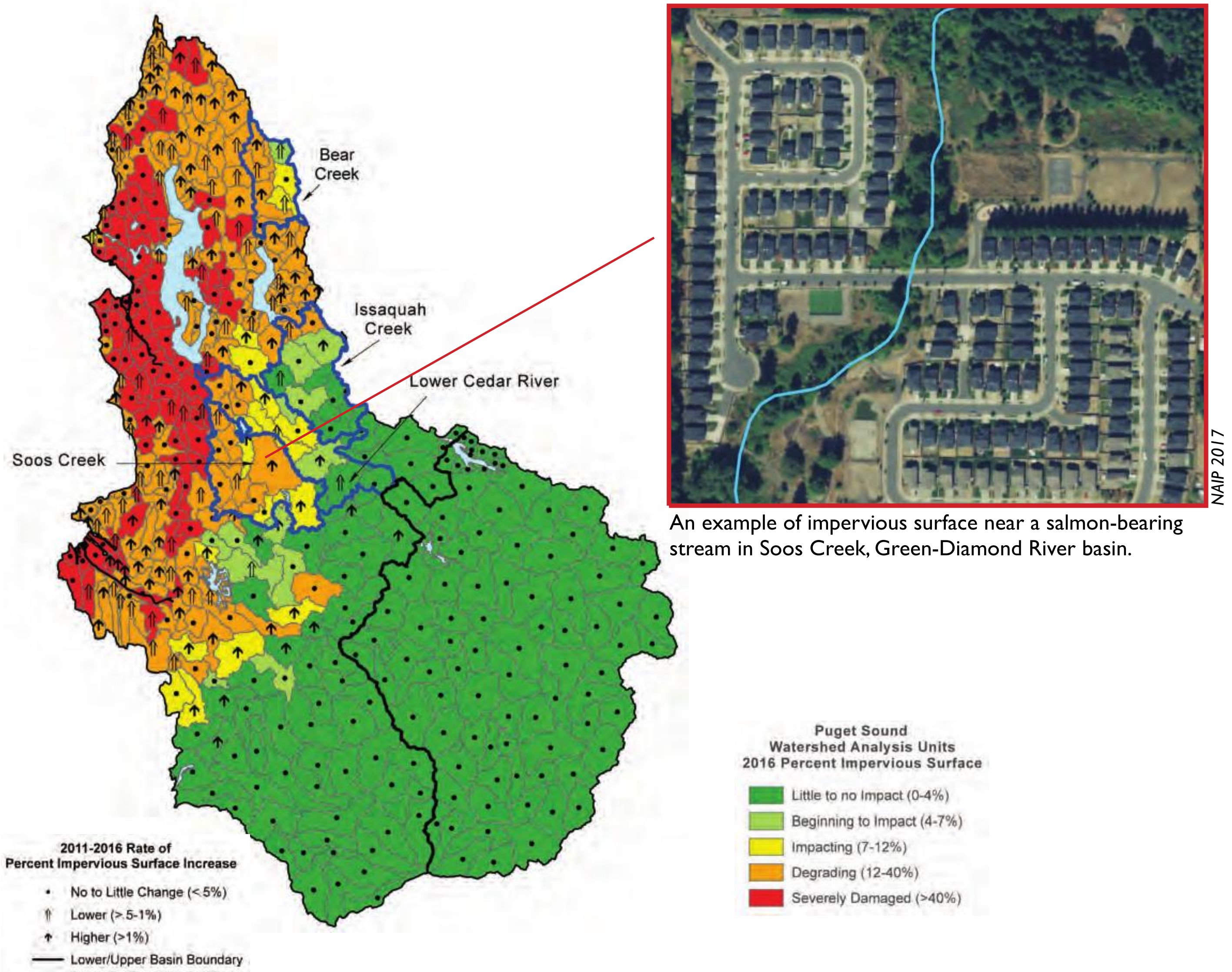
Over the next five years, the Muckleshoot Indian Tribe will continue to work with WDFW to implement the Co-Managers' Urban Salmon Strategy. This strategy is designed to optimize hatchery production and bypass bottlenecks affecting survival in the urban environment. The Lake Washington basin will be a priority as salmonids entering and exiting this basin encounter passage problems, marine mammal predation and thermal blockages at the Ballard Locks and Ship Canal, miles of docks, bulkheads, riprap and light pollution outlining the basin, warm water, and the many native and exotic fish predators favored by those degraded conditions. The co-managers will also continue working to restore Lake Washington sockeye to harvestable levels by implementing and evaluating delayed release strategies designed to increase survival and will also continue working to secure that Seattle's mitigation obligations for the Landsburg Dam blockage are achieved.

Habitat priorities for the next five years include establishing a riparian shade corridor along the Green River (including 20 miles through Kent and Tukwila) to address unhealthy water temperatures and comply with Washington water quality standards. To accomplish this, a new level of support from local, state and federal agencies will be demanded regarding permit approvals and mitigation for levee construction and repairs. Reducing lethal temperatures in the Lake Washington Ship Canal and the Sammamish River is another priority. The quality and quantity of instream wood in the Green and Cedar rivers continue to be extremely low compared to natural conditions, due to land use and river management. The amount of existing instream wood in the Green and Cedar Rivers was estimated to be 89% to 95% less than NMFS criteria required for properly functioning conditions for salmon habitat.[1] Long-awaited fish passage improvements at the U.S. Army Corps' Mud Mountain Dam are scheduled for completion at the end of 2020 followed by several years of monitoring the expected increased survival. Also, renewal of ESA consultation for the U.S. Army Corps operation of the Ballard Locks is overdue and must address marine mammal predation on listed salmonids passing through the facility. Finally, state and tribal hatchery water supplies need to be secured against the degradation of water quality and quantity caused by the impacts of upstream development and groundwater withdrawals.

Population growth and development will continue to challenge salmon rebuilding efforts in the urban environment. Trends indicate that we'll lose habitat even as restoration projects are implemented. Increasing implementation of priority restoration efforts and enforcing or revising regulations that are supposed to protect salmon habitat must occur if salmon populations are to be sustained into the future. Natural salmon production alone will not support fisheries; more hatchery supplementation is essential to restore fishing opportunity for tribal members and to fulfill treaty fishing rights. For the past century, the tribe has relied on hatcheries for harvest and will continue to depend on hatchery production for years to come.

Impervious Surface Continues to Increase

From 2011-2016, the Lake Washington, Green-Duwamish and Puyallup-White lower basins continued to gain impervious surface area. Though the gain was small, (.5 percent) of lower basin area, the trend is for further development and additional impervious land cover.[1,2]



An example of impervious surface near a salmon-bearing stream in Soos Creek, Green-Diamond River basin.

The Green/Duwamish and Central Puget Sound watersheds are among the most densely populated and developed in the state, resulting in many sub-watershed areas having high amounts of impervious surface areas. The detrimental effect of stormwater runoff from impervious surfaces on salmon habitat is well documented; this nonpoint source pollution is among the least regulated. Salmonid populations are adversely affected by increased peak flows that scour out salmon redds and displace fry; increased low flows resulting from reduced infiltration and groundwater recharge; by the contaminants carried by water running across impervious surfaces; and by sedimentation and habitat simplification caused by excessive runoff. Salmon survival is critically linked to landscape cover and the management of surface water and stormwater runoff. Stormwater discharges from impervious surfaces also are the primary way in which pollutants are conveyed to the marine waters of Puget Sound.[3]

The growing northwest population will continue to impact the quality and quantity of surface water in local streams and lakes as well as the quantity of groundwater available. Pollutants such as oil, metals, pesticides and herbicides are washed off developed surfaces and enter our waterways. Impervious surfaces, like roads and buildings, prevent water from being filtered by the soil and cause a greater volume of runoff than natural conditions, causing flooding and erosion.[4] Though the increase in impervious surface from 2011-2016 was minimal, according to the Washington State Office of Financial Management, WRIA 8 saw an 8.8% increase in population from 2011-2016, while WRIA 9 saw a 5.8% increase and WRIA 10 increased by 5.7%. This continuing growth in population will bring about a continued increase in impervious surface, a trend that needs to stop if salmon populations stand any chance of recovering.

Map Data Sources: NLCD 2011,[5] NLCD 2016,[6] WAECY 2008b,[7] WADNR 2006[8]

MUCKLESHOOT INDIAN TRIBE

Stormwater Runoff Increases Coho Pre-Spawning Mortality

Based on NOAA's latest 2017 model, 471 stream miles of known coho distribution in the Green-Duwamish and Lake Washington basins are predicted to have a PSM rate of 5% or more, with 147 miles predicted to have 35-100% PSM.[1] In the 2016 State of Our Watersheds Report, these estimates were 269 miles and 141 miles respectively.[2]

Puget Soundkeeper

A coho salmon in Longfellow creek exhibits signs of stress.

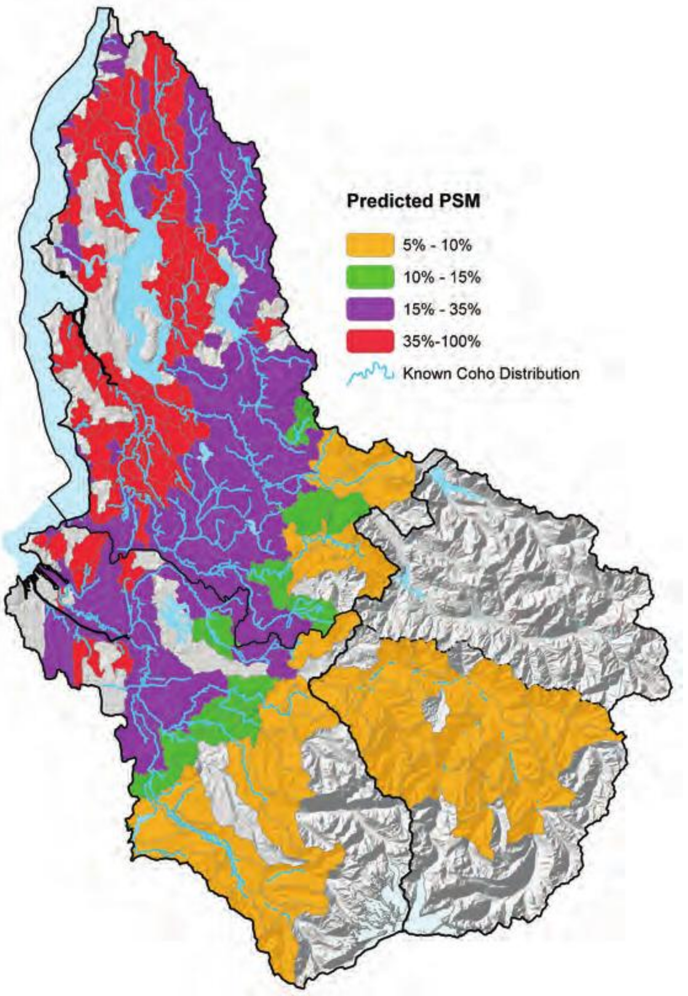
Researchers are trying to determine which chemicals in stormwater are contributing to the deaths of large numbers of coho salmon in Puget Sound. Stormwater may be Puget Sound's most well-known pollutant, and at the same time its least known. While the state has called stormwater Puget Sound's largest source of toxic contaminants, scientists are still having a tough time answering two basic questions about it: What is stormwater, exactly, and what does it do?[3]

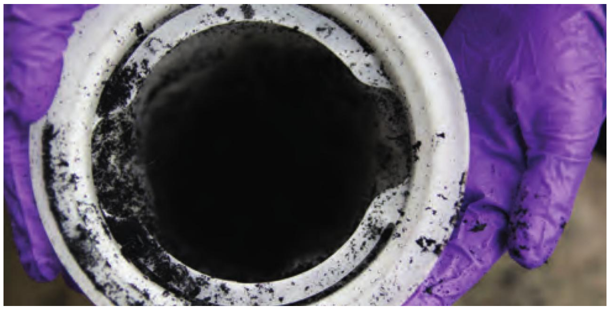
Every year, the Puget Sound region receives up to 40 inches of precipitation, most of it as rain. In the past, which is to say before the I-5 corridor became the bustling urban matrix it is today, much of that rain seeped into the soil or collected on leaves and grass and then evaporated back into the atmosphere; less than 1% was thereafter left to trickle into the sound as surface runoff. Now, with more than 350,000 acres of impervious surfaces – streets, roads, highways, parking lots, building roofs and so on – between 20-30% of precipitation turns into surface runoff. This translates into more than 370 billion gallons of stormwater per year pouring into Puget Sound. As modern stormwater sluices downhill, it gathers whatever is in its path. By the time it becomes sound water, it is a formidable toxic stew.[4]

So which of the potentially thousands of chemical compounds found in stormwater might be killing the coho? Among the biggest suspects are the millions of cars that pass nearby, shedding potentially toxic substances such as synthetic rubber from tires, motor oil, windshield washer fluid, transmission fluid, brake dust and automobile exhaust.

Scientists who have identified possible toxics are testing those and other substances, but their precise origin remains as murky as the stormwater itself, at least in the published literature. Scientists were able to reduce the runoff's toxicity simply by running it through a vertical soil treatment column: essentially, a barrel full of sand, shredded bark and compost. After that, the coho were fine.

Scientists are also testing different lengths of swale for the extra removal of metals, running gallons of stormwater over a mix of Dutch clover and red fescue. The goal is to learn what a minimum effective length of swale might be, so Washington Department of Transportation engineers will know how much to plant next to roads. Once everyone has a better idea of the contaminants in stormwater, people can start to recommend changes in a policy sphere.[5]





Tiffany Royal, NWIFC

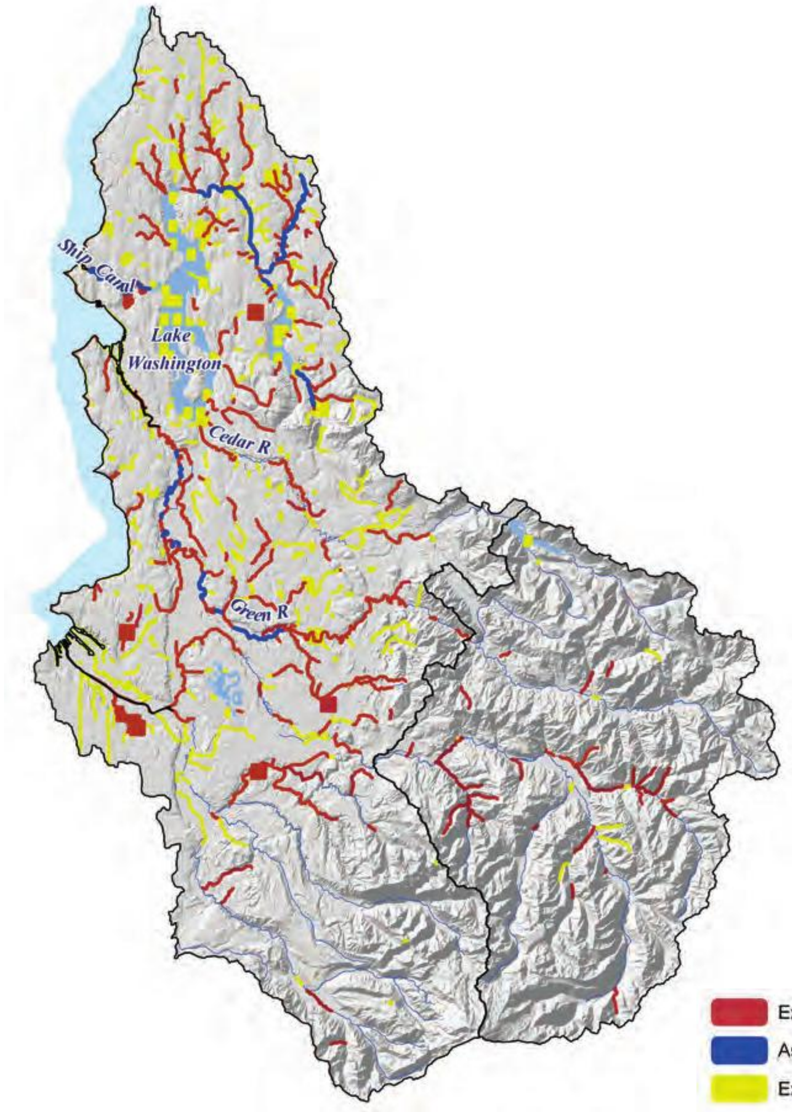
After six years of learning how coho and chum salmon are affected by runoff from urban streets, scientists are narrowing down which pollutant is killing fish. This year, they focused on how tire residue in water affects juvenile and adult coho and chum salmon.

Map Data Sources: PSM Predictions 2017,[6] SSHIAP 2004,[7] SWIFD 2019,[8] WAECY 2000,[9] WAECY 2018b[10]

MUCKLESHOOT INDIAN TRIBE

Water Quality Requires Corrective Actions

The Washington State Department of Ecology 2014 Water Quality Assessment lists approximately 190 miles of stream in WRIAs 8, 9 and 10 as impaired waters.[1] An additional 42 miles in WRIAs 8 and 9 are assumed to exceed water temperature standards for fish based on adjacent impairments or other data.



NAIP 2017

The lower Green River between Auburn and Tukwila has severe shade deficits along each side of the river, elevating water temperatures to levels known to cause disease outbreaks and pre-spawning mortality in migrating salmon and trout.

Water temperature and dissolved oxygen are known to be significant limiting factors for both juvenile and adult salmon.[2] The Lake Washington Ship Canal, the sole migration route for salmon to and from Lake Washington, routinely reaches temperatures of 21-23˚+ Celsius by July each year. These high temperatures are believed to have contributed to disease leading to the pre-spawn mortality of approximately 40% of the Cedar River sockeye run in both 2014 and 2015. The Green-Duwamish river watershed is home to salmonid species listed under the federal Endangered Species Act (ESA). Summer temperatures in the Lower Green River typically reach 7-day average daily maximums greater than 21˚C. In 2015, July river temperatures reached as high as 24˚C. Many streams and rivers throughout King County exceed the 16˚C standard established for the protection of core summer salmonid habitat, with the exception of a few streams found in rural areas and streams within the urban growth boundary dominated by cold groundwater inputs and/or intact riparian cover.[3] A major cause is poor riparian conditions. With over 190 miles of impaired stream in WRIAs 8, 9 and 10 and an additional 42 miles in WRIAs 8 and 9 assumed to exceed temperature standards for fish, it is critical that more action be taken before any further degradation takes place. The lack of tall native trees along the banks of the Green River and its tributaries causes unhealthy and sometimes lethal conditions for chinook and other salmon. Shade levels generally range from zero to 20% of natural system potential.[4]

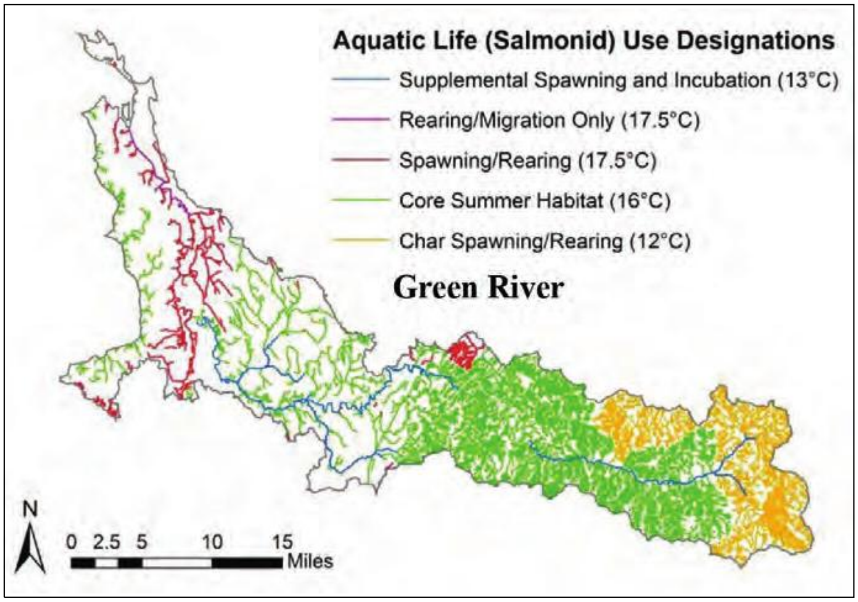
The Lower Green is the vital migration corridor used by Middle Green River fish going to and from the Duwamish estuary. It also provides limited rearing habitat for fish produced upstream. The Lower Green River has been highly engineered

(Continued on next page)

Map Data Sources: SSHIAP 2004,[9] USGS 2012,[10] WAECY 2014,[11] WAECY 2018,[12] WAECY 2000[13]

MUCKLESHOOT INDIAN TRIBE

Most of the streams monitored within King County fall within the "Core Summer Salmonid Habitat" Aquatic Life Use Category, with a maximum 7-day average temperature allowance of 16°C. Many of these streams also have Supplemental Spawning and Incubation Criteria applied to specific months of the year. A few stream and river stations in King County are categorized as "Spawning and Rearing Habitat" with a 7-day average temperature maximum allowance of 17°C.[8]



King County

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over time. The King County Flood District manages approximately 18 miles of levees along the Lower Green River, 16 miles of which are currently enrolled in the Corps' PL-84-99 program. These levees cut off salmon access to side-channel habitats such as sloughs and adjacent wetlands where young salmon feed and take shelter. Local jurisdictions throughout the Green River basin are responsible for implementing salmon recovery plans under the ESA, complying with the Clean Water Act (CWA), the Federal Emergency Management Agency's (FEMA) development standards, and mitigating impacts on habitat that may result from flood risk reduction projects.[5]

In 2016, the WRIA 9 Riparian Revegetation Work Group developed the Re-Green the Green: Riparian Revegetation Strategy for the Green/Duwamish and Central Puget Sound Watershed. This fund supports projects that enhance riparian shade to improve conditions for salmon and meet water quality standards. There is a need to restore trees and native vegetation on all land-use types, urban and rural, along the entire length of the Green River and its tributaries. Riparian revegetation projects improve water quality, salmon habitat and contribute to the urban tree canopy.[6] Even with such programs as Re-Green the Green, water quality modeling indicates that even the most urban leveed areas along the lower Green River will require 100-foot-plus buffers of tall trees with dense canopy cover to approach state temperature standards and restore a river that can sustain salmon including chinook that migrate upstream in summer. Climate change, particularly predicted increases in air temperature, is expected to result in warmer stream conditions without substantial investment in restoring riparian shade and summer flow conditions.[7]

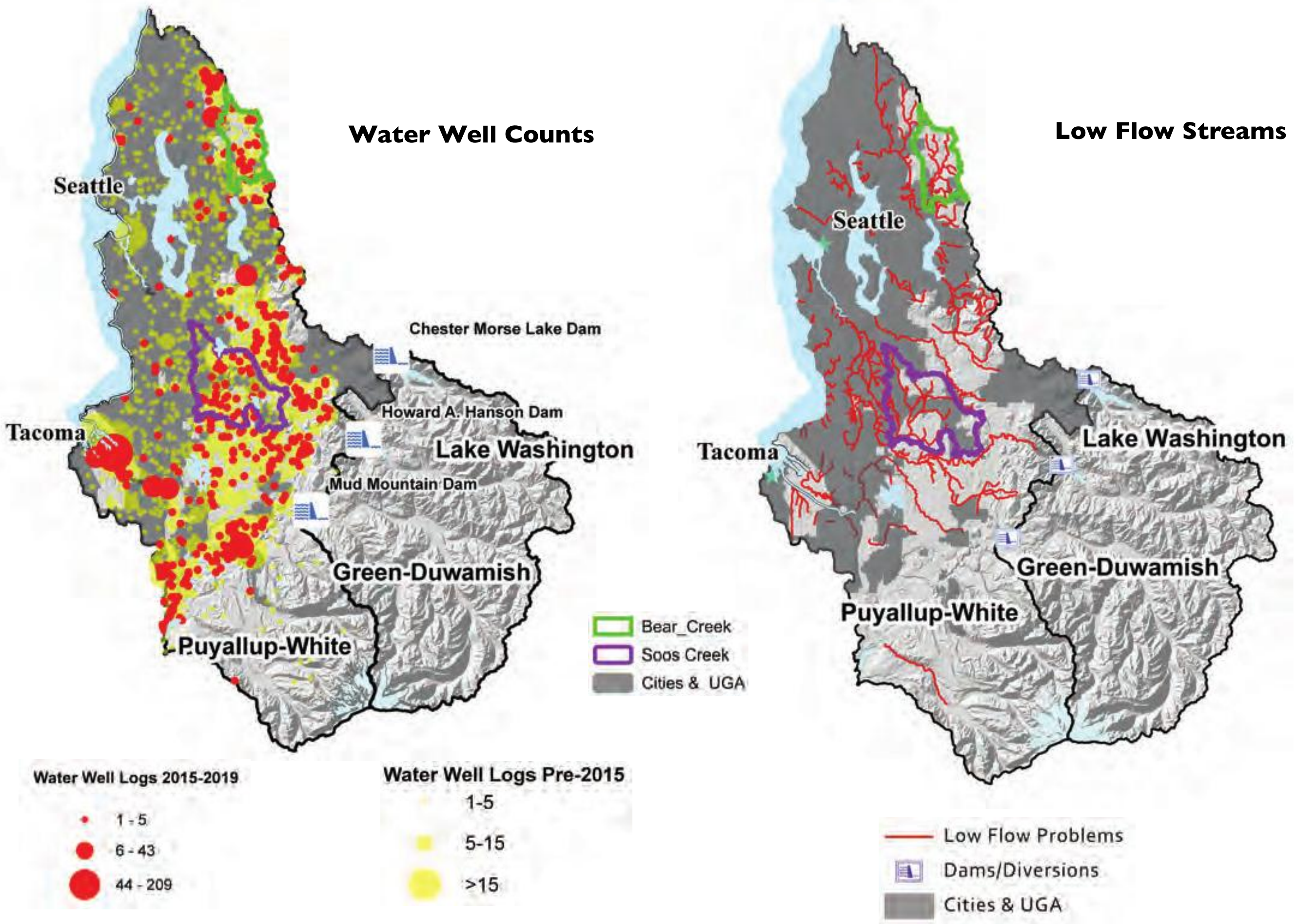
Loss of riparian vegetation, altered streamflow, and pollution from adjacent land uses limit fish production and survival in much of the Green-Duwamish, Lake Washington and White-Puyallup basins. While some efforts by local jurisdictions have been made, more action is needed to improve water quality and avoid further degradation.

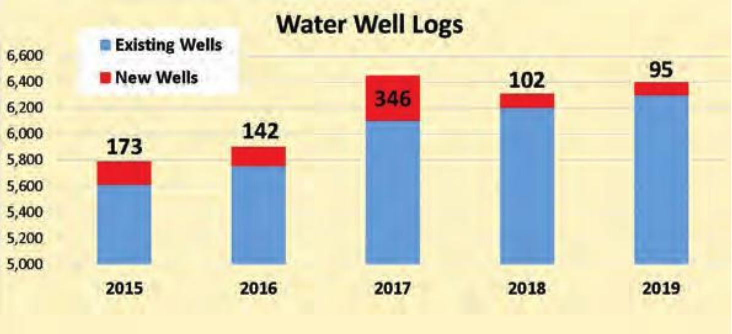
Re-Green the Green

Typical levee on the Lower Green River, with nonnative shrubs offering very little shade.

Summer-Fall Flows Decreasing as Water Resource Development Continues

From 2015-2019, 398 new water wells (7% increase) were added to the Lake Washington and Green-Duwamish basins, while the Puyallup-White basin saw an increase of 462 new water wells (18% increase).[1] A total of 482 miles of streams in the Lake Washington and Green-Duwamish basins are identified as having low streamflow problems, while in the Puyallup-White basin there are 122 miles of low flow concerns.[2]





On October 6, 2016, the Hirst decision of the Washington State Supreme Court established that counties had to make their own decisions about whether there was enough water, both physically and legally, to approve any building permit that would rely on a well.[1] In response, the Washington State Legislature passed the Streamflow Restoration Act in January 2018. This law directs local planning groups to develop watershed plans that offset impacts and achieve a net ecological benefit from new domestic permit-exempt wells.[2]

An estimated 30% of King County's population relies on groundwater wells for drinking water. That is over half a million people. Groundwater also feeds surface streams in the summer months, and provides water for salmon and other fish when there is little rain.[3] Both the natural environment and the community water supplies rely on healthy streamflows. Yet many streams around the state are often

(Continued on next page)

Map Data Sources: King Co. 2014,[14] SSHIAP 2004,[15] WADOT 2010,[16] WAECY 2000,[17] WAECY 2014,[18] WAECY 2018b,[19] WAECY 2019[20]

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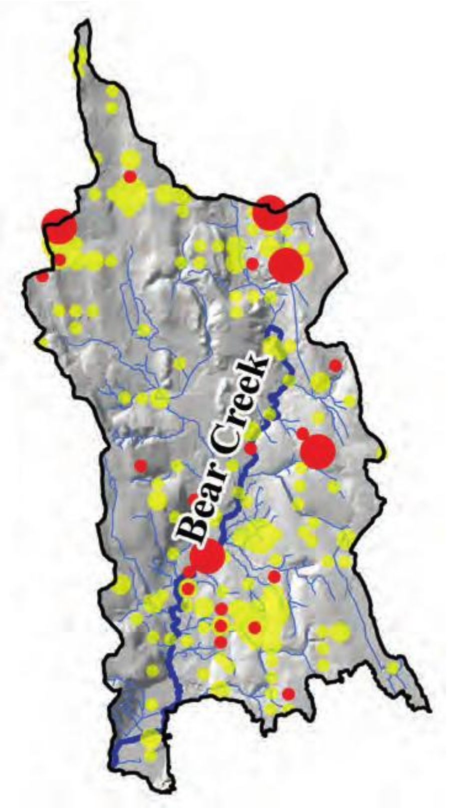
below or quickly approaching critical low flow levels. As more streams drop to historic lows, community and instream values are impacted. In the future, the rate of declining streamflow levels will likely increase, as population growth and reduced snowpack continue to put more stress on this finite resource.[4] From 2015-2019, 398 new water wells (7% increase) were added to the Lake Washington and Green-Duwamish basins, while the Puyallup-White basin saw an increase of 462 new water wells (18% increase).

Stream and river flows in King County were lower than normal in 2019. For example, the mouth of Bear Creek has a flow of 30 cubic feet per second (cfs), which is a little under half of the average flow of 55 cfs. The average monthly flows for monitored King County streams in 2019 tended be below typical, particularly in March, May and through June 26.[5]

The 2005 Lake Washington and Green-Duwamish Salmon Conservation Plans call for maintenance of adequate streamflows. Ground and surface water extractions are estimated to be 37% of the current summer low flows in the Green-Duwamish river basin.[9] Summer low flows in the Bear Creek drainage have been reduced by 39%.[10] Private and municipal well extractions in the Soos Creek sub-basin were estimated to equal 52% of the current summer low flow,[11] reducing habitat for chinook, coho and steelhead.

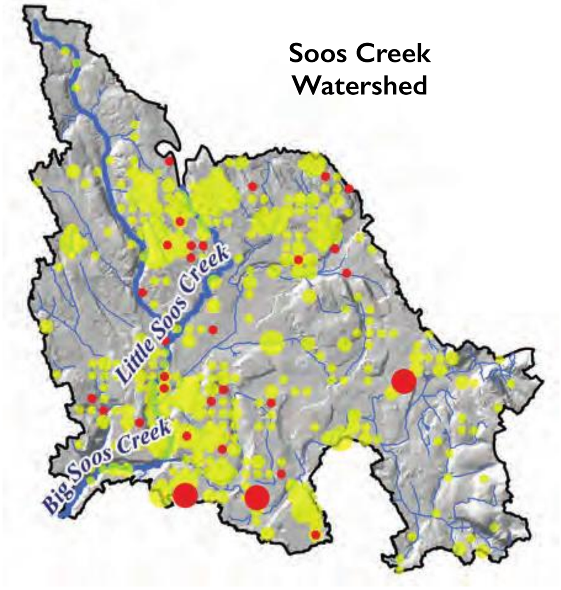


Bear Creek Watershed

Bear Creek watershed is located in King County in Water Resource Inventory Area (WRIA) 8 and drains into the Sammamish River. Bear Creek is typical of the low-gradient, meandering character of King County's lowland creeks. Along its path, Bear Creek flows from headwater forests and wetlands, alongside a golf course, through an occasional subdivision, past old farms and horse pastures, and finally, through urban development before it enters the Sammamish River. Despite the urbanization and other development, the creek retains considerable habitat for salmon: chinook, sockeye, coho, and cutthroat trout are found throughout the stream, even into its uppermost reaches.[7] From 2015-2019, 27 new water wells were added to the Bear Creek Watershed. This number is up from 6 new water wells in 2010-2014.

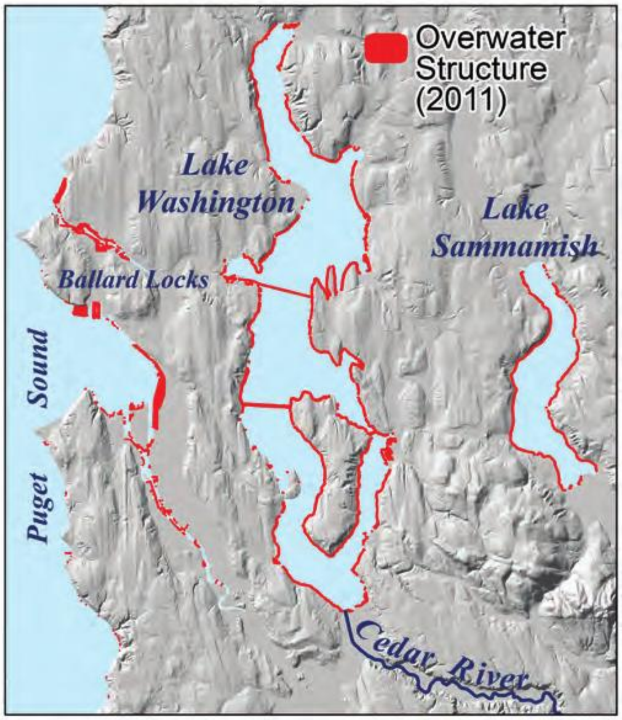
Soos Creek Watershed

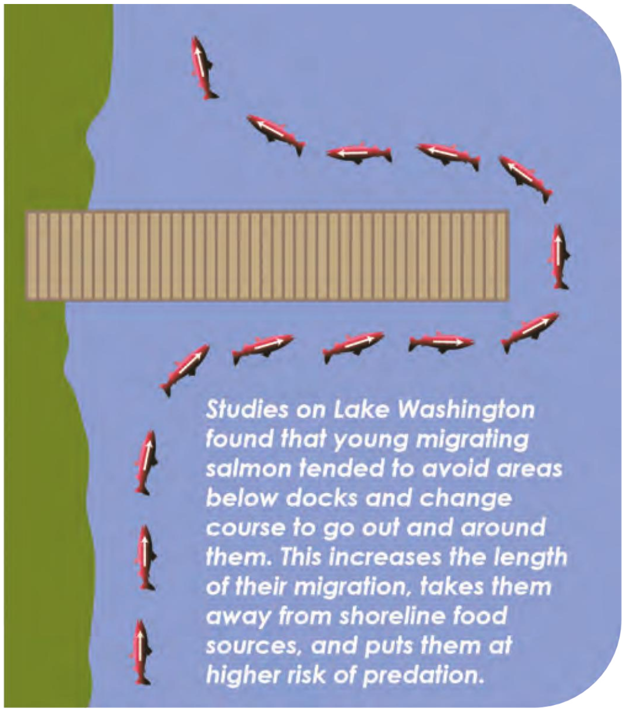
The Soos Creek watershed is located in South King County in Water Resource Inventory Area (WRIA) 9 and drains into the Middle Green River. The drainage basin covers an area of approximately 70 square miles. There are 25 tributaries to Soos Creek totaling over 60 linear miles. The main tributaries to Soos Creek are Covington Creek, Jenkins Creek, Little Soos Creek, Little Soosette Creek and Soosette Creek. Land use in the Soos Creek basin consists of rural residential, agriculture, and highly urban commercial and residential areas. The western area in particular has been subject to heavy urbanization in recent years. Increased impervious surface area has contributed to decreases in summertime low flows. Chinook, coho, sockeye, pink and chum salmon, as well as winter steelhead, have been observed spawning in Soos Creek.[8] Summer-fall flow in Big Soos Creek shows a statistically significant decline that coincides with development of municipal and private wells in the sub-basin. From 2015-2019, 44 new water wells were added. This number is up from 26 new water wells in 2010-2014.



Overwater Structures Impact Lakeshore Habitat in Lake Washington

Along Lake Washington alone, there are about 3,000 residential piers and marinas.[1] The number of new docks since 2016 is minimal as most homes already have docks and there is no more room for further development. An estimated 82% of Lake Washington's shoreline remains heavily modified with bulkhead and riprap.





Studies on Lake Washington found that young migrating salmon tended to avoid areas below docks and change course to go out and around them. This increases the length of their migration, takes them away from shoreline food sources, and puts them at higher risk of predation.

Docks cause overwater shading that harms bottom habitat and disrupts the movement of young fish, such as salmon. Docks also disrupt the natural flow of sediments, causing beach erosion, creating shallower water around neighboring docks, and eliminating places for fish to spawn and feed.[2] The most critical area for juvenile salmon is the first 30 feet from the edge of the shoreline.

In order to minimize the impacts of docks in this nearshore region, it is important to reduce conditions favored by predators, including pilings, dark shadows, and the sense of a dock that would force chinook out into deeper water.[3] While it takes a human eye only a few seconds to a few minutes to adjust from light to dark, it can take 20-40 minutes for a salmon eye to adjust. Instead of going into the dark shadow cast by a dock, juvenile salmon swim out around the structure. This takes them into deeper water where predators may lurk. Young salmon need safe, shallow water where predators can't come and where they can find food and shelter.[4]

Along Lake Washington alone, there are about 3,000 residential piers and marinas so you can imagine what a challenge they pose to young salmon trying to make their way out to sea.

Federal and state law requires that overwater structures be designed to protect habitat and migration corridors for species that depend on the nearshore environment. Local shoreline programs must comply with state law. New updates to Shoreline Master Programs may require new residential developments to provide joint use or community docks rather than individual docks for each home.[5]

The listing of chinook as threatened under the Endangered Species Act has resulted in much scientific research about the specific habitat needs of salmon, and has brought about improvements to the lakeshore. There are now design alternatives that enable the presence of fish-friendly docks. Light permeable docks have narrower ramps, surface grating for decking, or in some conditions, glass light tubes to let more light down under the dock. These features all result in a dappled light pattern similar to being under shoreline vegetation. Salmon-friendly dock designs can be architecturally graceful. The use of glue-laminated beams and steel pilings enables a span of 20 feet between pilings. For a continuous 30-foot span without any pilings, a prefabricated aluminum bridge can be employed.[6] Smaller docks, and docks with grating or other design features that let light through, can help endangered salmon survive.[7]

WADOE Coastal Atlas

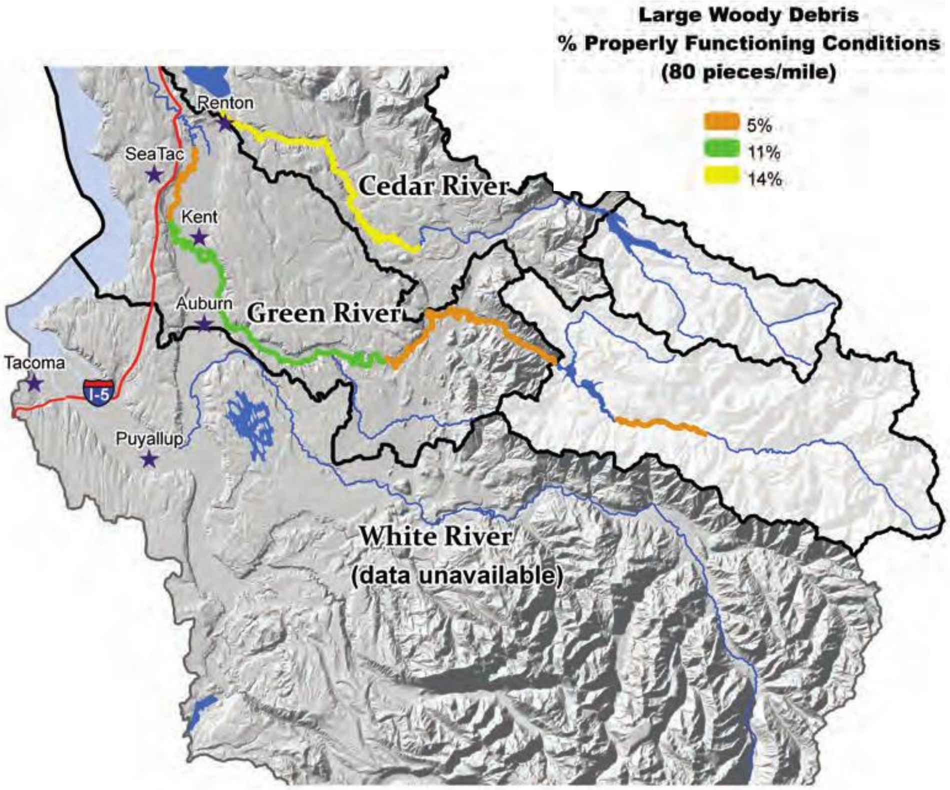
Example of large numbers of docks on the shore of Lake Washington.

Map Data Sources: WADNR 2007,[8] WAECY 2018,[9] SSHIAP 2004[10]

Muckleshoot Indian Tribe

Streams Still Lack Large Wood and Natural Habitat Features

Wood counts in the lower Cedar and Green rivers continue to have less than 5% of the expected key piece quantities.[1]



Map Data Sources: King Co. 2011,[9] SSHIAP 2004,[10] USGS 2012,[11] WADOT 2018a,[12] WAECY 2018,[13] WAECY 2000[14]

In-channel large woody debris (LWD) and wood recruitment have been diminished compared to historic levels in many Pacific Northwest rivers, including the Green and Cedar rivers, due to logging of the streambank and clearing of floodplain forests for agriculture. Wood was also removed from the Green River to address concerns about flooding, to facilitate navigation, and up until the late 1970s, to eliminate perceived barriers to upstream migration of salmonids. Reduction in instream LWD has been demonstrated to reduce fish population densities.[2]

Estimates of LWD in the Green and Cedar rivers meeting NMFS size and frequency criteria are 89% to 95% below the levels necessary for properly functioning conditions for salmon habitat.[3] Comparing the wood loads in these rivers to estimated historic conditions[4] and expected natural wood loads to which salmon have adapted,[5] these rivers have a mere fraction of the wood they once contained. The potential to restore large woody debris to improve salmon habitat in the Green-Duwamish and Lake Washington basins is restricted by land use and by policies that address river recreation safety. The Cedar, Green and Sammamish rivers are all designated by King County as recreational waterways where wood placement for restoration and mitigation purposes is restricted. The removal, lopping or repositioning of artificially placed or naturally recruited wood deemed hazardous to boaters commonly occurs.

Large woody debris enhances the quality of fish habitat in all sizes of stream. Removal of most trees in the riparian zone during logging, combined with thorough stream cleaning and short-rotation timber harvest, has altered the sources, delivery mechanisms and redistribution of debris in drainage systems, leading to changes in fish population abundance and species composition. There is an urgent need for controlled field experiments and long-term studies that focus on the protection of existing large woody debris in stream channels and the recruitment of new debris from the surrounding forest.[6]

Most evaluations of fish response to wood placement have shown positive responses for salmonids, though few studies have looked at long-term, watershed-scale response. Scientists need to focus on understanding where wood occurs naturally in different systems as well as how much, where and what type of wood placement should occur, and apply the information to guide and develop more natural and effective use of wood placement for restoration projects.[7]

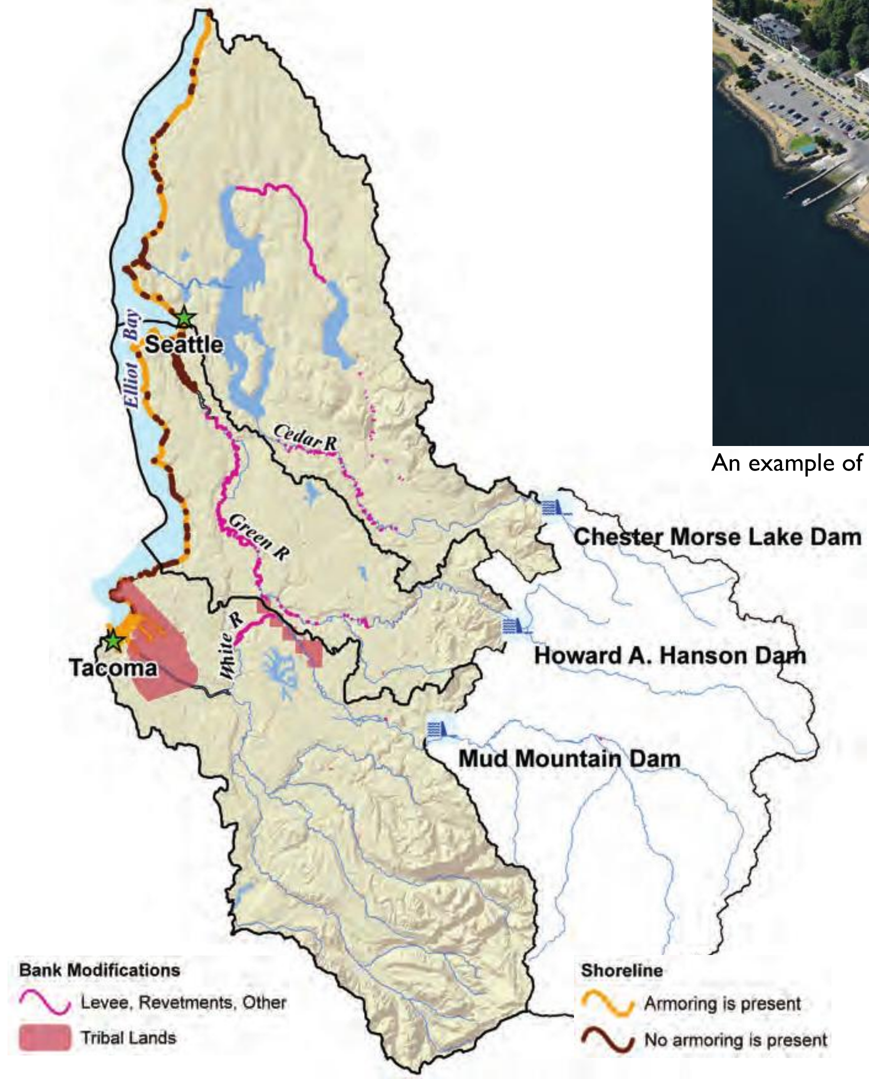
NOAA, Northwest Fisheries Science Center

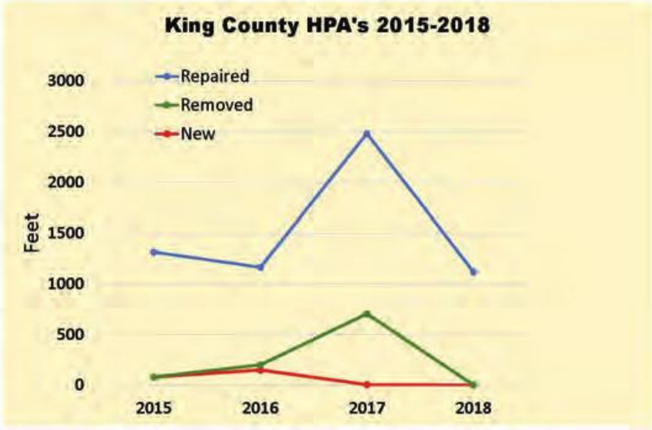
Large wood such as logs and root wads has always played a natural role in most river systems, and most studies have concluded that wood placed in rivers remains stable, improves habitat conditions and increases fish numbers – particularly for salmon and trout. Woody debris often improves habitat quality by creating pools and providing cover. Wood also increases the retention of organic matter and nutrients and helps create islands and new channels that provide additional refuge and habitat, especially for rearing juvenile fish.[8]

MUCKLESHOOT INDIAN TRIBE

Riverbank and Shoreline Modifications Limit Fish Habitat in Fresh and Marine Waters

From 2015-2018, marine shoreline conditions in King County have continued to change very little. During this time, 750 feet of armoring was removed, while 235 feet of new armoring was constructed. Almost 1 mile of armoring was replaced.[1] A total of 125 miles of artificial shoreline negatively affect nearshore and freshwater habitat for salmon.





Map Data Sources: King County 2012,[7] SSHIAP 2004,[8] WADOT 2010,[9] WADOT 2018b,[10] WAECY 2000,[11] WAECY 2018b[12]


WADOE Coastal Atlas

An example of shoreline armoring in King County.

Bulkheads and other forms of armoring line 92% of Seattle's marine shoreline. From 2015-2018, 750 feet of armoring was removed while 235 feet of new armoring was constructed. Three Hydraulic Project Approval (HPA) projects were issued for new bulkheads, 2 HPA projects were issued to remove bulkhead, while 43 projects were issued to replace bulkhead in King County.

Science shows that shoreline armoring – which includes structures such as bulkheads, riprap and seawalls – can profoundly disrupt the connection between land and Puget Sound's waters, degrading habitat for insects, birds and fish, including endangered chinook salmon and orcas that rely on salmon for food.

The Washington Department of Fish and Wildlife and the Puget Sound Partnership have each set a goal: that the total miles of Puget Sound armoring removed should be greater than the total miles added from 2011 to 2020.

Armoring can be devastating for sand lance and surf smelt that spawn on local beaches. Armoring buries their habitat, leaving them no place to spawn. These forage fish provide food for salmon, seabirds and other life.[2]

Revetments are very similar to bulkheads, but are typically constructed along the banks of rivers and streams to prevent erosion and horizontal movement of stream channels. They can also have a variety of negative impacts on fish and wildlife including increased erosion and increased rate of transport. Revetments also alter or reduce habitats along the edges of rivers and streams that are extremely important areas for juvenile salmon.

Generally, shoreline or riparian vegetation is

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Jason Toft, University of Washington

The new Seattle seawall below the sidewalk at low tide.

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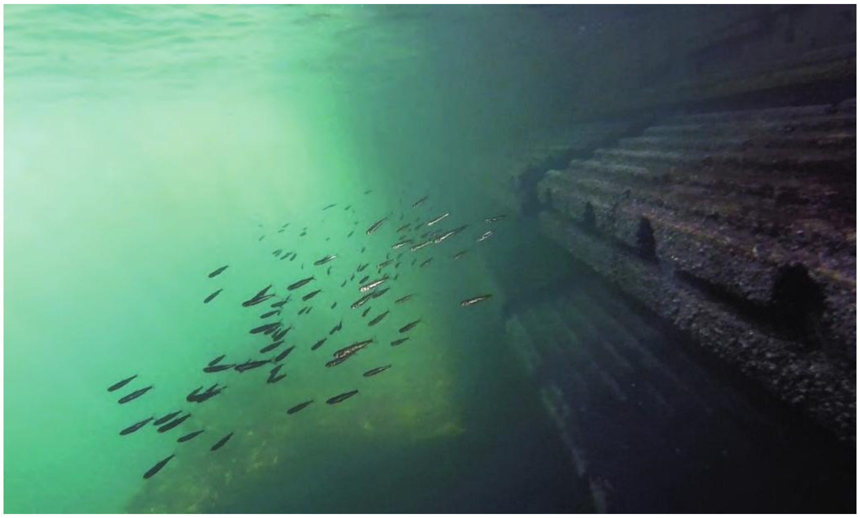
removed for revetment construction, and afterward the area is kept free of woody vegetation for structural purposes. However, riparian vegetation is very important for good water quality, as well as for fish and wildlife species. It shades rivers and streams, keeping water cold enough to maintain salmon. Branches and leaves hanging low over the water provide places for fish and wildlife to hide from predators. Currently King County has approximately 70 miles of levees and revetments that are negatively affecting salmon and their habitat.[3]

Removing armoring can help restore habitat. When armoring is removed, beach health can improve quickly.[4] An example is the new Seattle seawall. For close to a century, the seawall along Seattle's sprawling waterfront has protected waterfront buildings and other structures from the pounding waves of Elliott Bay. More than a hundred years of city development have left its tidelands covered in fill, flanked with concrete and overshadowed by industrial piers. Under natural conditions, juvenile salmon tend to stay in shallow waters along the shoreline to avoid larger predators as they search for food. One of the major problems caused by shoreline armoring is that shallow water disappears when the tide comes in. In fact, where tidelands have been filled in – such as in older downtown and industrial areas – the water may never leave the wall.[5]

The Seattle seawall lies on the migratory pathway used by juvenile chinook, chum, pink and coho salmon making their way to the Pacific Ocean from the Duwamish River and Green River. Since the replacement of the old downtown seawall, salmon habitat seems to be improving, scientists say, thanks to new features installed. The enhanced seawall, which has been called the largest eco-engineering project of its kind, may be boosting the fitness and chances of survival for young salmon as they migrate through a treacherous section of waterfront on their way to the ocean.

Instead of encountering a barren slab of concrete, salmon can now swim across a "bench" in front of the seawall. The bench forms a narrow strip of intertidal habitat, effectively providing a shallow-water pathway for juvenile salmon. Glass blocks in the sidewalk above the seawall allow light to penetrate to the water below, and a rough surface on the wall itself has horizontal shelves to encourage the growth of algae and invertebrates. New scientific findings about marine organisms growing on or near the seawall, plus behavioral changes in young salmon swimming through the area suggest a real payoff from these enhancements. After construction, researchers observed a notable increase in feeding behaviors under the piers, where the fish had never been known to feed before.[6]



Mike Caputo, University of Washington

Juvenile chum salmon swim along the new Seattle seawall.

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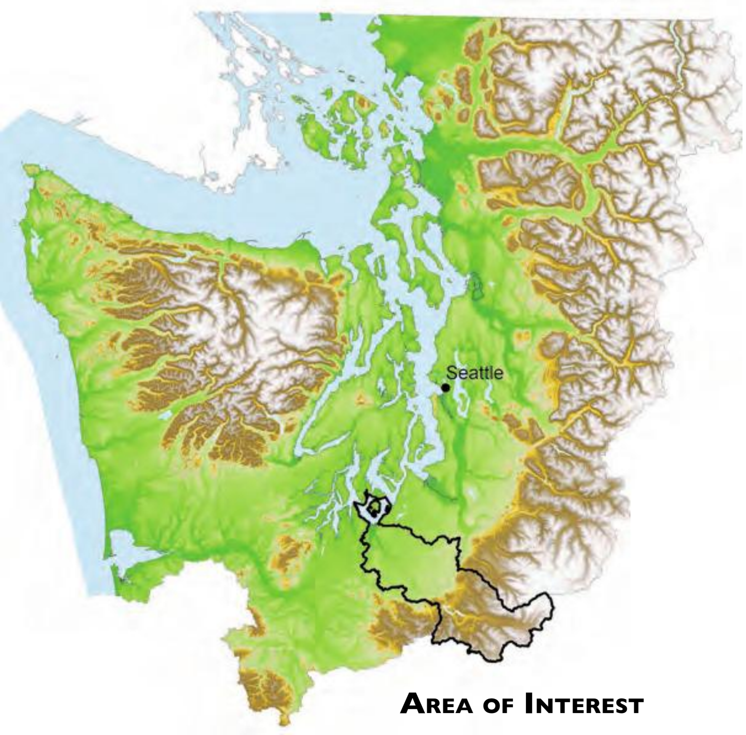
2020 State of Our Watersheds Report
Nisqually River Watershed

> *I am a Nisqually fisherman and, like my dad and his dad before him, the river flows through my veins. We need to be on the river to be whole. We need to always put our nets in the river and catch salmon forever because that is who we are. The work that we are doing in the Nisqually is aimed at making that real for generations to come.*
>
> **– Willie Frank III**
> **7th Tribal Council Member**



Area of Interest

Nisqually Indian Tribe

The Nisqually watershed is the center of the known universe. According to the tribe's creation story, first there was the Nisqually and then everything else followed.

It remains the center of the tribe's traditions, culture and exercise of its treaty rights that the tribe fought long and hard to have recognized.

The Nisqually have always been a fishing people. The salmon continues to be the mainstay of their diet, but the foundation of their culture as well.

The Nisqually Tribe is the prime steward of the Nisqually watershed's natural resources. In the 1855 Treaty of Medicine Creek, the Nisqually Tribe reserved their right to fish, hunt and gather in their traditional areas. Because of that constitutionally protected treaty between sovereigns, the federal government is obligated to protect those treaty-reserved trust resources.

This report will focus on the natural world of the Nisqually River basin and surrounding marine waters.

Nisqually Indian Tribe

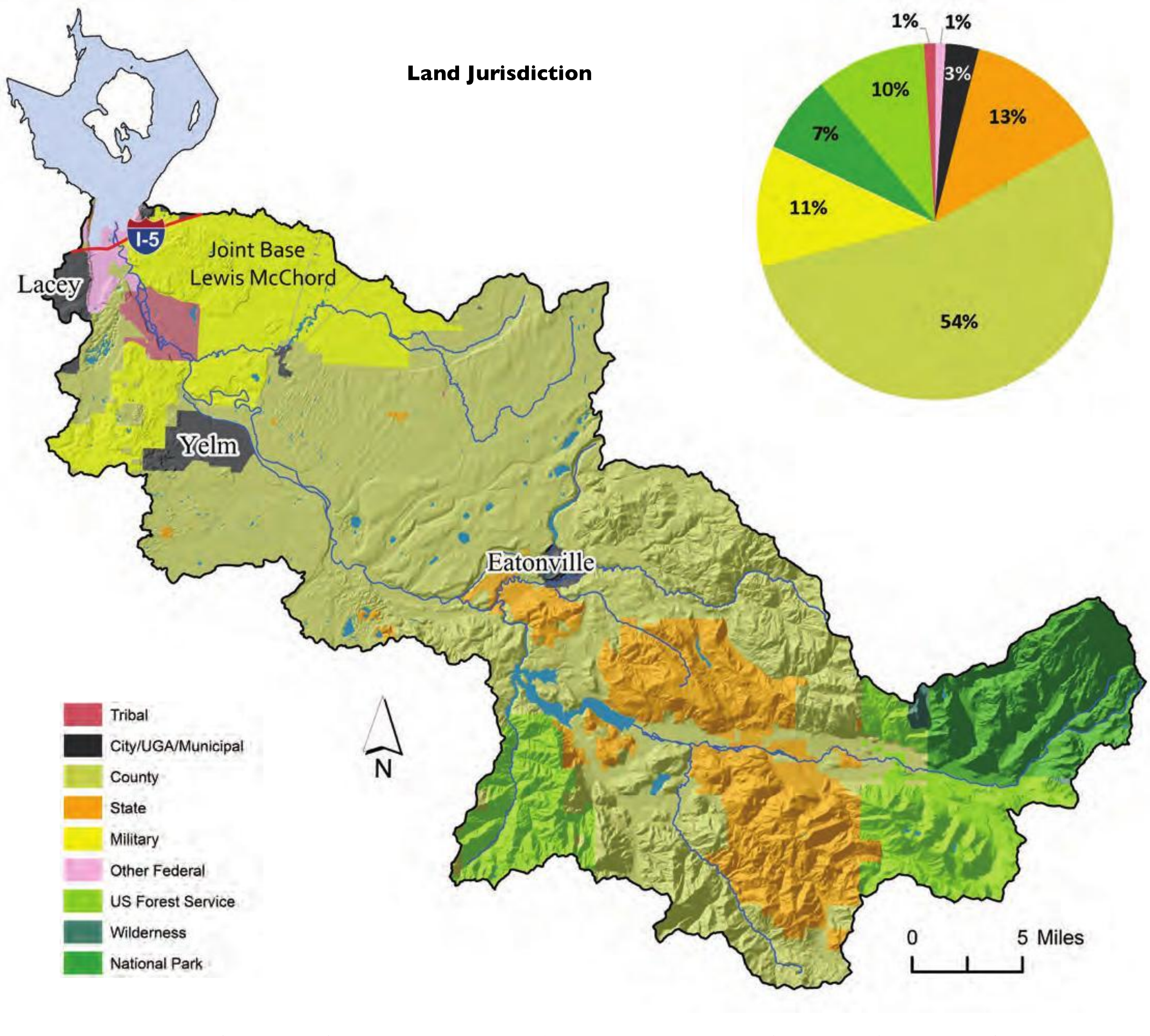
Nisqually Watershed

The Nisqually River basin (WRIA 11) and the surrounding marine waters are the ancestral home of the Nisqually Indian Tribe. The basin includes the Nisqually River, which originates from five separate glaciers on Mount Rainier, including the Nisqually Glacier, to its delta at Puget Sound with a total drainage area of 720 square miles. The Nisqually is one of the least developed and most pristine major rivers in Washington state. The river flows through national and state parks and forests, public and private timberlands, municipal hydropower projects, farmlands, the Nisqually Indian Reservation, Fort Lewis and the Nisqually National Wildlife Refuge.

Land use within the basin varies from agriculture in the valley bottom to forestry in the uplands, with increasing urban uses in several key areas in the watershed. The lower Nisqually watershed is one of the most intensely farmed basins in western Washington.[1]

Salmonid species existing within the basin include chinook, coho, chum, coastal cutthroat, pink, steelhead and bull trout. Chinook and steelhead are listed as threatened under the Endangered Species Act, while coho are listed as a candidate.

Five urban centers currently have boundaries within the Nisqually watershed (Lacey, DuPont, Eatonville, Roy and Yelm) comprising 8.9 square miles. The planned Urban Growth Areas (UGA) within the watershed adds the potential of another 14.2 square miles of use, for a total of 23.1 square miles or an increase of 160%. Based upon the Office of Financial Management (WAOFM) population estimates, the WRIA 11 population has increased by 14% from 2010-2018.[2] Based upon the WAOFM population forecasts, Thurston County's population could increase by as much as another 82,000 or 22% by 2040.



Map Data Sources: SSHIAP 2004,[3] USFWS 2018,[4] WADNR 2016,[5] WADNR 2018,[6] WADOT 2018a,[7] WADOT 2018b,[8] WAECY 1994,[9] WAECY 2018a,[10] WAECY 2018b[11]

Chapter Summary

The Nisqually people have lived in the Nisqually River watershed for thousands of years. According to legend, the *Squalli-absch* (ancestors of the modern Nisqually Indian Tribe), came from the Great Basin and erected their first village in a basin now known as Skate Creek, just outside the Nisqually River watershed's southern boundary. Later, a major village would be located near the Mashel River. The Nisqually have always been a fishing people. The salmon has not only been the mainstay of their diet, but the foundation of their culture as well.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org*.

For this report, the Nisqually Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Population Growth Increases Demand for Wells

The number of water wells in the Nisqually watershed continued to grow during 2015-2019 by 477 (7.8%) additional new wells. Most growth occurred in the focus area, with 438 (92%) new water wells. This area contains some of the most important and productive freshwater stream reaches for salmon in the Nisqually watershed. Unchecked growth and its associated increase in groundwater demand will reduce aquifer volume and thus the outflow to the streams, wetlands, lakes and saltwater nearshore vital to salmon.

Increased Population Growth and Impervious Surface in the Lower Nisqually Watershed

From 2011-2016, the lower and middle extent of the Nisqually watershed continued to see an increase (.5%) in impervious surface. This is a very slight increase, which helps in keeping the Nisqually watershed so resilient. The Nisqually River Council, working with members of the community, local government, and the tribe, has written low-impact development guidelines and is working with the counties to enable ordinances for the streamlined development of low-impact developments.

Nearshore Impairment Near Nisqually Delta

From 2015-2018 Thurston and Pierce counties' shoreline armoring was reduced by 107 feet, while 8,191 feet of shoreline armoring was replaced. The shoreline armoring indicator target from 2011-2020 is for the total amount of armor removed to be greater than the total amount of new armor installed in Puget Sound. Over this last four-year period, it appears the target has been met, but overall there is a need to accelerate our progress to restore shorelines by removing shoreline armor and preserving unarmored stretches.

Nisqually River Council Projects Continue in the Watershed

The Nisqually River Council's mission is to create sustainability in the Nisqually watershed for current and future generations by developing a common culture of environmental, social and economic balance. Today, the NRC has 24 member agencies, representing state, federal, tribal and local governments, as well as an active citizens advisory committee. They act as an education and advocacy organization that promotes collaboration, trust and communication between community members, agency representatives and nonprofit organizations.

Interstate 5 Crossing Through the Nisqually Delta

One of the tribe's priorities is the realignment of Interstate 5 where it crosses the Nisqually River delta. Its current alignment will not accommodate rising seas with climate change and in its current condition causes flooding upstream. The bridge footings embedded in the Nisqually River impede the river's flow and impact the Billy Frank Jr. Nisqually Wildlife Refuge, endangering both trout and salmon. WSDOT and the Nisqually Tribe are funding a study to be conducted with the U.S. Geological Survey (USGS) to help determine the extent the bridge may affect the salt marsh by reducing sediment delivery from the river.

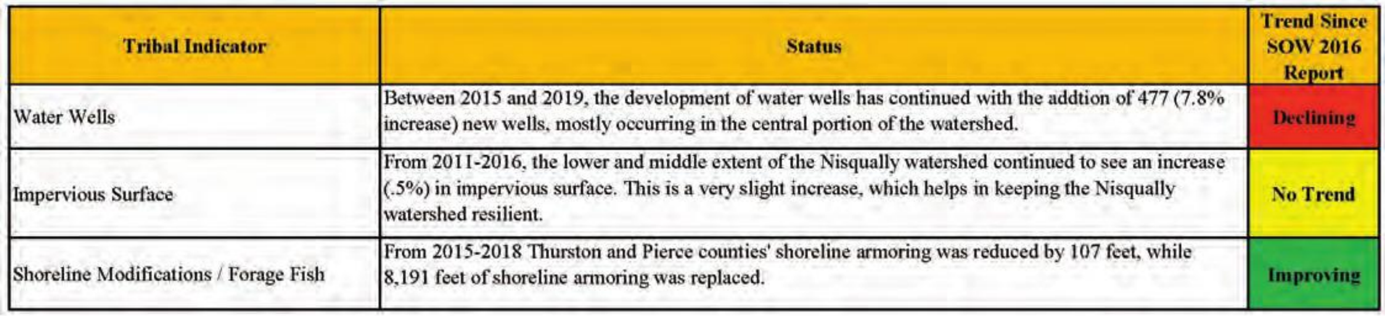
Conclusions

The Nisqually watershed has seen a few successes to the restoration of habitat over the past decade but other habitat indicators have stayed the same or worsened. The number of water wells in the Nisqually watershed continued to grow, with most occurring in the central area of the watershed. Impervious surfaces have increased slightly but with a looming threat of continued population growth, tribal leadership has concerns of the potential habitat impacts that come with it. Shoreline armoring saw a reduction of about 107 feet, but the impacts of the repairs/replacement of over 8,000 feet has not been determined. Even though restoration is occurring, it is not enough to keep up with the impacts of a growing population and their land-use decisions. Land use and water laws that are in place and meant to protect critical areas and fish habitat need to be implemented. Implementation includes education and voluntary actions but also needs to include enforcement where those laws are broken. The future of treaty rights in the Nisqually River basin depend on it.

Population Growth & Groundwater Demands

At the 15-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Nisqually watershed shows that there are significant concerns with the continued growth of the watershed's population, especially in the middle of the watershed, along with the associated increase in water wells and impervious surface area. The continued restoration of marine shoreline habitat conditions remains a priority issue for the survival of the juvenile salmon leaving the Nisqually watershed. In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects (e.g., Interstate 5 overpass/floodplain restoration) contribute to the slow pace of progress.

Review of the status of these key environmental indicators since the 2016 State of Our Watersheds Report shows an improvement from restoration activities but a steady loss in habitat status:



Tribal Indicator	Status	Trend Since SOW 2016 Report
Water Wells	Between 2015 and 2019, the development of water wells has continued with the addtion of 477 (7.8% increase) new wells, mostly occurring in the central portion of the watershed.	Declining
Impervious Surface	From 2011-2016, the lower and middle extent of the Nisqually watershed continued to see an increase (.5%) in impervious surface. This is a very slight increase, which helps in keeping the Nisqually watershed resilient.	No Trend
Shoreline Modifications / Forage Fish	From 2015-2018 Thurston and Pierce counties' shoreline armoring was reduced by 107 feet, while 8,191 feet of shoreline armoring was replaced.	Improving

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

Future projects, investigations and research efforts by the Nisqually Tribe:

- Seek planning and construction funding to complete NEPA process for complete reconfiguration of I-5 across the Nisqually Delta and begin construction within 6 years.
- Work on crafting a long-term management plan for the delta under a new I-5 configuration and the opportunity for significant restoration work.
- Develop plans for addressing substantial impacts to the habitat-forming processes in the delta, especially magnitude and delivery mechanisms of sediment.
- Continue research and monitoring in the delta restoration effort
- Investigate effects of climate change induced sea level rise and how it will impact delta structure and function if habitat-forming processes are not restored or enhanced.
- Continue building the size and ecological impact of our Community Forest project.
- Prepare for upcoming FERC relicensing of the Tacoma projects to better account for climate change, sediment delivery and salmon recovery.
- Using the I-5 as a case study, continue to advocate for a shift in the current mitigation model to one aligned with improving the environmental baseline as a deliverable for all publicly funded projects as described below:

A New Model for Ecosystem Services Delivery From Publicly Funded Capital Projects

David Troutt, Director
Natural Resources Nisqually Indian Tribe

Public investment in capital projects is a necessary outcome to a developing society. Economic health and quality of life are dependent on adequate transportation systems to support unencumbered movement of goods, services and people. Human health is dependent on clean water to drink and systems to treat our waste to levels that are compatible with human life and the other plants and animals that share this region. Proper handling of stormwater resulting from the impacts of our regional growth is critical to protect public and private rights and interests as well as to minimize pollution to our waterways and landscapes.

All of these publicly funded projects to solve various societal challenges come with their own problems. Many of these projects in the Puget Sound region are built along our lakes, streams and marine waters, and have significant associated environmental impacts. Our regulatory structures, from federal regulations to local ordinances, have been developed to facilitate these infrastructure investments for the public good while minimizing the negative environmental impact. The common mechanism to achieve these desired outcomes has been through mitigation, or offsets, to attempt to balance the environmental equation with the impacts associated with growth. These systems have failed to deliver and the result is a continually degraded ecosystem. This fact is evident in the Endangered Species Act designation of fish, plants and animals in every watershed in the Puget Sound region with the key listing factor given as degraded and loss of habitat.

There are several fundamental flaws associated with this approach that have become abundantly clear over the past 40 years of implementation. The first is that the intent for most if not all of these programs is to minimize the impacts and, at best, result in no net loss of environmental function as a result of the project. No net loss mitigation could be a workable model if the ecosystem were functional and resilient enough to absorb the additional stress of a given infrastructure project. In most cases, and most certainly in and around urban areas, the impact of growth and human habitation has resulted in a significantly degraded environmental baseline so these critical systems have lost their resiliency. Since the intent of mitigation is generally to result in no net loss, the best-case scenario is a degraded environment that is no worse, and certainly no better, than before the project.

Second, the mitigation of these large capital projects are usually located "onsite" or adjacent to the impact caused by the infrastructure project. These locations are typically in degraded environments with heavily impaired ecosystem processes, which lead to a failure of most onsite mitigation projects. The regulations governing mitigation for infrastructure project impacts inhibit the ability to conduct mitigation in areas that have the best chance for increasing the environmental baseline of a given watershed. The end result of the current onsite and no net loss mitigation paradigm is a failure rate in excess of 80% and an ever increasing rate of widespread environmental degradation.

Third, the mitigation requirements are burdensome obligations to project proponents whose goal is the successful implementation of the capital project. Large-scale transportation projects may cost billions of dollars and do not spend equivalent amounts on achieving environmental outcomes. These projects are evaluated on their success to move traffic, goods, services, stormwater and wastewater, and not on the mitigation of the associated impacts. Infrastructure projects will be maintained and reconstructed if they do not achieve their desired outcomes; mitigation projects do not receive similar attention and resources if they fail.

The goal of no net loss, the location of mitigation projects in failing ecosystems, and the lack of accountability for success have all resulted in a net loss of ecosystem function associated with publicly funded infrastructure across the Puget Sound region. As a result, salmon are disappearing. Orcas are starving. Tribal treaty rights are not being honored. Local jobs and economies are being impacted. The adage of leaving the world better for the next generation is being subverted by our system of infrastructure investment and environmental mitigation.

This needs to change and change now. We are proposing a new way at looking at public investment and environmental outcomes. We are proposing that a deliverable for all publicly funded capital projects be a measurable improvement to the existing environmental baseline and an increase in the ecosystem services. Our proposal would effectively link the health of the human economy to the health of the natural economy. This idea would leave the natural world in a better place than before the project.

This could be accomplished by requiring as a project deliverable an implemented plan of action, developed by a team of local experts (including the tribes), to achieve a stated environmental outcome aligned with local conditions and goals for functioning habitat. This project element would receive the same amount of scrutiny, attention, resources, monitoring, maintenance and corrective actions as the road or bridge or wastewater treatment facility.

There are places and projects that could serve as models for this kind of effort. The crossing of the Nisqually Delta by I-5 has created significant but reversible negative impacts to the estuary and upstream private property. The Nisqually Indian Tribe, working with all of our partners in South Sound including the Washington State Department of Transportation, is leading an effort to incorporate a large scale transportation project into a significantly increased environmental baseline for the watershed. Although still in the planning phase, there is tremendous promise in this new model. The challenge will be keeping this momentum and mutually shared desired outcomes in the face of regulatory systems that do not promote this paradigm.

This model can be easily exported throughout Puget Sound to include all publicly funded infrastructure. This single yet important action can significantly alter the trajectory of our regional ecosystems and all of the things we care most about from clean air and water to more salmon and orcas. We are at a critical point in our existence in this region and its ability to support all of us and the natural world around us.

Time is not our friend. If we are to have any chance at recovery in our lifetimes before we lose more populations of salmon and our resident orcas, this action is needed now. If we are to expect the public sector to lead in this issue and reduce the burden on private property landowners, this action is needed now. If we want to leave this world a better place than when we found it, we need action now.

Nisqually Indian Tribe

Population Growth Increases Demand for Wells

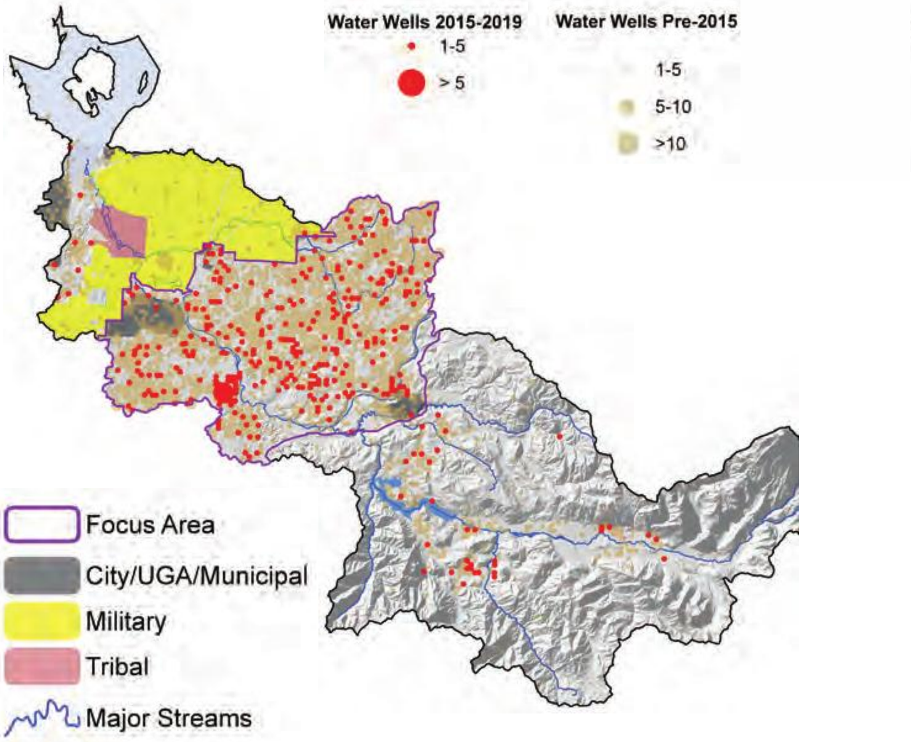
Between 2015 and 2019, the development of water wells has continued with the addition of 477 (7.8% increase) new wells, mostly occurring in the central portion of the watershed.[1]

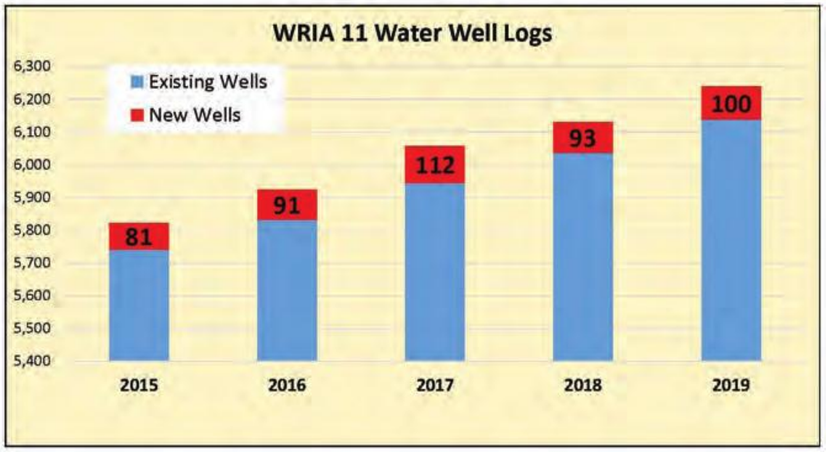
Most land in the upper extent of the Nisqually watershed is restricted from rural growth: it is either steep (slope over 30%), National Park, National Forest, state-owned or private forestland. A large block of land in the lower extent of the watershed consists of Joint Base Lewis-McChord (JBLM) and the Nisqually Indian Reservation. Between the upper and lower extents is a focus area of 230 square miles with mostly flat to gently sloping land, three urban areas (Eatonville, Roy and Yelm) and 87% of the watershed's water wells. This middle focus area of the watershed has seen the majority of water well growth and in the last five years saw an additional 438 water wells. This area controls some of the most important and productive freshwater stream reaches for salmon in the Nisqually watershed. Unchecked growth and its associated increase in groundwater demand will reduce aquifer volume and thus the outflow to the streams, wetlands, lakes and saltwater nearshore vital to salmon.

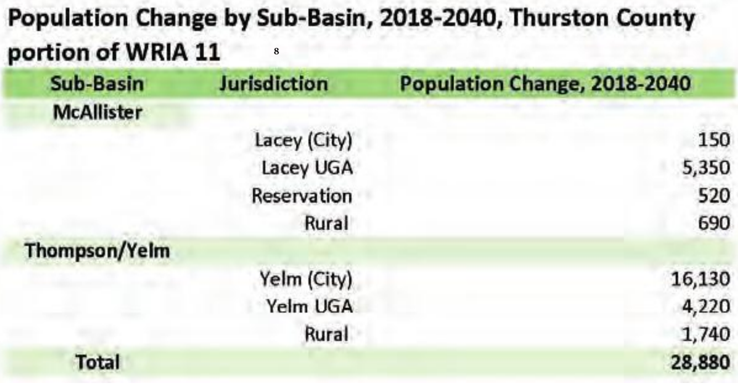
Unmanaged population growth within the Nisqually watershed will have an increased demand on groundwater resources. Surface and groundwater withdrawals in WRIA 11 tributaries for irrigation and domestic use will continue to grow and will affect instream flows during adult salmon upstream migration and spawning. Unmanaged growth in the middle extent of the watershed may also lead to a decrease in summer flows thus reducing rearing area for fish residing year-round in the watershed.

In January 2018, the Legislature passed the Streamflow Restoration law that helps restore streamflows to levels necessary to support robust, healthy and sustainable salmon populations while providing water for homes in rural Washington. The law was in response to the Hirst decision, a 2016 Washington State Supreme Court decision that limited a landowner's ability to get a building permit for a new home when the proposed source of water was a permit-exempt well. The law clarifies how counties issue building permits for homes that use a permit-exempt well for a water source. The law directs local planning groups to develop watershed plans that offset impacts from new domestic permit-exempt wells and achieve a net ecological benefit within the watershed.[2]

On Jan. 16, 2019, the Nisqually Watershed Response to the 2018 Streamflow Restoration Act (RCW 90.94) was adopted. This is an addendum to the Nisqually Watershed Plan. The plan was developed through the participation and input of numerous stakeholders from the Nisqually watershed over the past year in a rapid response to the mandate of the Streamflow Restoration Act (chapter 90.94 RCW).[3]






Population Change by Sub-Basin, 2018-2040, Thurston County portion of WRIA 11[8]

Sub-Basin	Jurisdiction	Population Change, 2018-2040
McAllister		
	Lacey (City)	150
	Lacey UGA	5,350
	Reservation	520
	Rural	690
Thompson/Yelm		
	Yelm (City)	16,130
	Yelm UGA	4,220
	Rural	1,740
Total		28,880

Map Data Sources: SSHIAP 2004,[4] WADOT 2018b,[5] WAECY 2018a,[6] WAECY 2018b[7]

Increased Population Growth and Impervious Surface in the Lower Nisqually Watershed

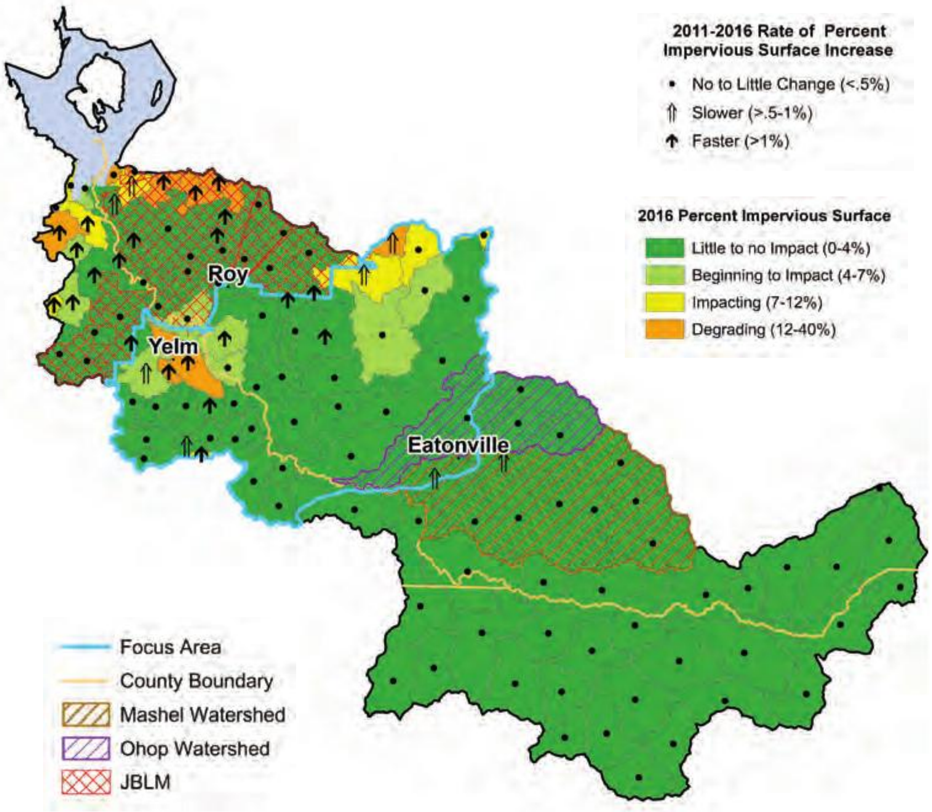
From 2011-2016, the lower and middle extent of the Nisqually watershed continued to see an increase (.5%) in impervious surface.[1,2] This is a very slight increase, which helps keep the Nisqually watershed resilient.

Impervious surfaces, and other forms of development, reduce the infiltration of water into the ground. They can contribute to higher stormwater runoff, greater sediment yields, and increased pollutant loads, all of which can degrade water quality. Sensitive streams can be impacted by as little as 5 to 10% impervious surface area, with greater impairments expected when rates exceed 20 to 25%.[3]

The Pollution Control Hearings Board issued a series of decisions in 2008 and 2009 directing the Washington State Department of Ecology to require rather than just encourage low-impact development (LID) in municipal stormwater permits for western Washington. Thurston County is among many counties and cities required to make LID the preferred and commonly used approach to site development. LID is a stormwater management strategy that is designed to minimize impervious surfaces, maximize native vegetation retention and filter stormwater on site as much as possible.[4]

The Nisqually Watershed Management Plan was developed through the participation and input of numerous stakeholders from the Nisqually watershed. It is intended to serve as a locally supported, long-term plan focusing on water availability, and addressing water quality, habitat and instream flows in the Nisqually watershed. The Nisqually Watershed Stewardship Plan seeks to obtain a sustainable future for the Nisqually watershed. This plan considers the Nisqually watershed an integrated whole. It is a community-based plan that will be voluntarily implemented by landowners and neighbors and communities, cities and counties, state and federal government, and the Nisqually Indian Tribe.[5]

The Nisqually River Council, working with members of the community, local government and the tribe, has written LID guidelines and is working with the counties to enable ordinances for the streamlined development of LID. The Council also plans several outreach efforts to aid in the adoption of low-impact development.[6]



NWIFC

Rain gardens running down the middle of the Nisqually Tribe's Billy Frank Jr. Blvd. are planted with native trees and plants as well as river rock.

Rain gardens are one of the most versatile and effective tools in a new approach to managing stormwater called low-impact development (LID). An LID project may incorporate several tools to soak up rain water, reduce stormwater runoff and filter pollutants. Other examples include permeable paving, compost-amended soils, vegetated roofs and rainwater collection systems.[7]

Map Data Sources: NLCD 2011,[7] NLCD 2016,[8] WADNR 2006,[9] WADNR 2012,[10] WADOT 2010,[11] WAECY 2011b,[12] WAECY 2019[13]

NISQUALLY INDIAN TRIBE

Nearshore Impairment Near Nisqually Delta

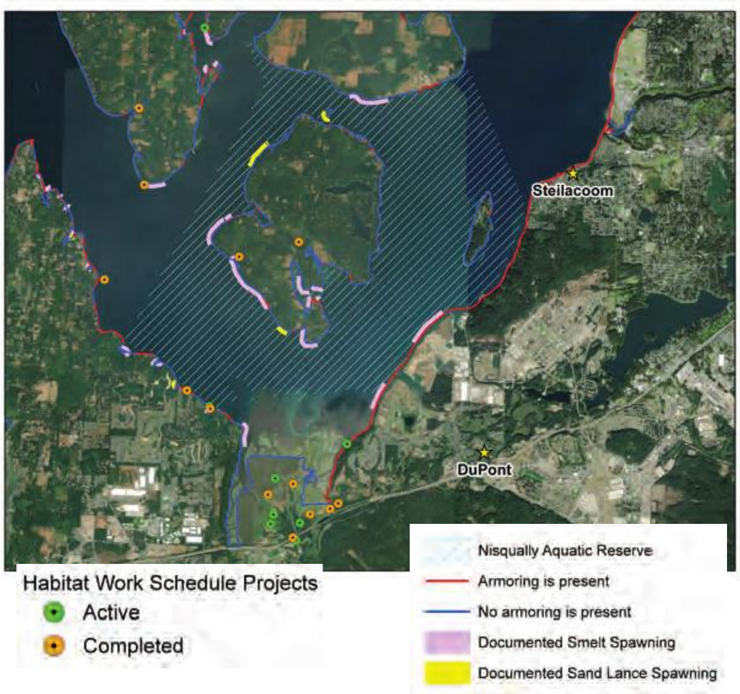
From 2015-2018 Thurston and Pierce counties' shoreline armoring was reduced by 107 feet, while 8,191 feet of shoreline armoring was replaced.[1]

Puget Sound shores have been integral to Native Americans' lives and cultural practices for millennia and provide important habitat for marine life and food webs. Over time, from the building of homes, roads and businesses near the water, we have installed "shoreline armor," also known as seawalls or bulkheads, to prevent erosion. Today, armor lines about 27% of the sound's shoreline. Shoreline armoring makes a dynamic shoreline static, disrupting many of the natural processes that replenish sand and gravel to beaches and spits of Puget Sound. As a result, beach material can wash away more quickly, threatening infrastructure and nearshore habitat.[2]

Surf smelt and sand lance rely on the upper beach habitat exclusively as spawning grounds. Sand lance spawn on mixed sand and gravel beaches between the elevation of mean high tide and mean tide. They are obligate intertidal spawners, which means that if their preferred habitat is unavailable, they cannot spawn successfully elsewhere. Surf smelt spawn on mixed sand and gravel beaches in the upper intertidal zone and have been found to spawn year-round on some beaches.[3]

The areas in which our forage fish spawn make them especially vulnerable to impacts from shoreline development, and there is no known way to replace lost forage fish spawning grounds. Additionally, not all forage fish spawning habitat may be known. Surveys for surf smelt spawning habitat are incomplete, so it is important to protect not only the known spawning beaches, but other beaches as well. Because healthy forage fish populations are so vital to the stability of salmon populations, the Department of Fish and Wildlife has a "no net loss" policy for forage fish spawning habitat.[4]

The shoreline armoring indicator target from 2011-2020 is for the total amount of armor removed to be greater than the total amount of new armor installed in Puget Sound. We need to accelerate our progress to restore shorelines by removing shoreline armor and preserving unarmored stretches.[5] From 2008-2017 there was a 4 mile decrease in armoring in the Nisqually delta. Data shows a slight decrease of 107 feet of shoreline armoring during the 2015-2018 time period in all of Pierce and Thurston counties combined.

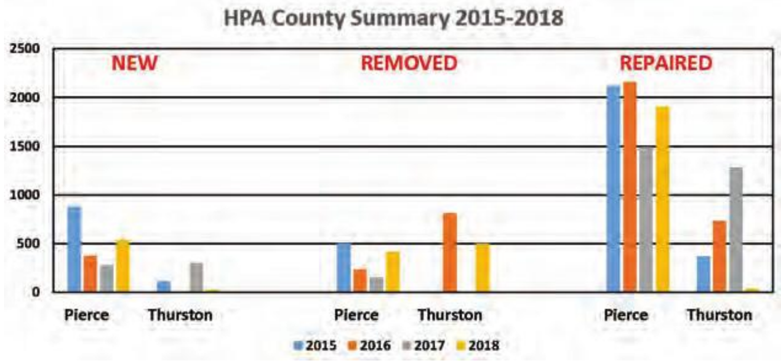


Shoreline Armoring in the Nisqually Watershed

WA Dept. Ecology Coastal Atlas

David Ayers, USGS

Juvenile sand lance (top) and surf smelt (bottom) collected on Bainbridge Island. Scale is in inches.



Map Data Sources: CGS 2017,[6] ESRI 2019,[7] SWIFD 2019,[8] WADOT 2010,[9] WADNR 2018,[10] WADFW 2019,[11] WSRC 2018[12]

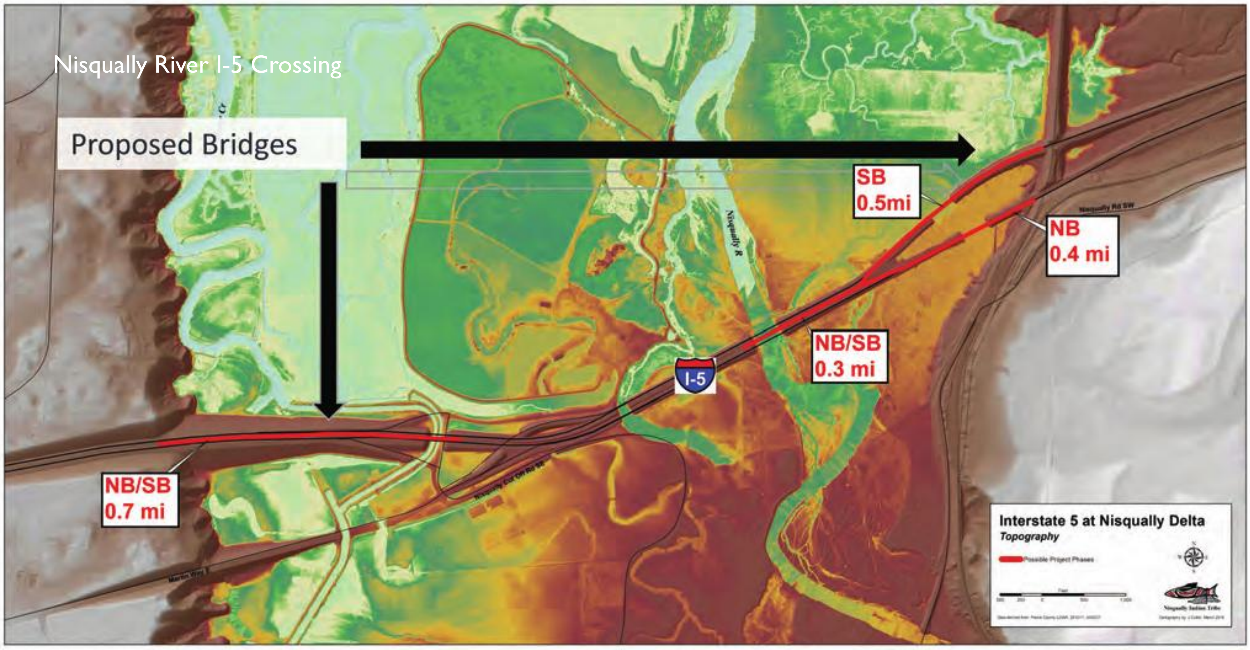
Interstate 5 Crossing through the Nisqually Delta

One of the tribe's priorities is the realignment of Interstate 5 where it crosses the Nisqually River delta. Its current alignment will not accommodate rising seas with climate change and causes flooding upstream.[1] The bridge footings embedded in the Nisqually River impede the river's flow and impact the Billy Frank Jr. Nisqually Wildlife Refuge, endangering trout and salmon.[2]

WSDOT and the Nisqually Tribe are funding a study conducted with the U.S. Geological Survey (USGS) to help determine to what extent the bridge may affect the salt marsh by reducing sediment delivery from the river. Habitat effects could also impact tribal fishing rights if the result is a decline in the river's fish populations.[3]

Conducting this study will help to develop strategies to address these concerns. It also will identify a long-term strategy for the Nisqually River bridges, including ecosystem benefits for salmon habitat and flood control with the goal of protecting and enhancing the environment including reducing the transportation and habitat constraints related to the Nisqually River bridges and the river's delta.[4]

Replacing the Nisqually bridges cannot wait. The time to act is now. Deterioration will continue on the Nisqually River and wildlife refuge, an important environmental ecosystem. In Pierce and Thurston counties, the longer we wait, the more we risk dramatically worsening the commute along I-5, and irreparable damage to the Nisqually River and its fish runs.[5]



Nisqually Tribe[6]

Sea level rise threatens the newly restored estuary, so the tribe is pushing federal and state agencies to bridge large sections of I-5 so the estuary can migrate inland as sea level rises.

WDOT

Nisqually River Council Projects Continue in the Watershed

The Nisqually River Council's mission is to create sustainability in the Nisqually watershed for current and future generations by developing a common culture of environmental, social and economic balance. The Nisqually watershed encompasses all lands that drain to the Nisqually River, and includes the communities of Ashford, Elbe, Mineral, Eatonville, McKenna, Roy, Yelm, Fort Lewis, and portions of Graham, Lacey, DuPont and Rainier.[1] The Nisqually River Council (NRC) has pursued sustainability in the Nisqually watershed since its creation in 1987.

After the Nisqually River was designated as a "River of Statewide Significance" in 1972, a task force of timber, agriculture, hydropower, conservation, landowners and tribal representatives worked to balance the rights of private landowners, statewide public interests, public access to the river, and fish and wildlife protection.

Today, the NRC has 24 member agencies, representing state, federal, tribal, and local governments, as well as an active citizens advisory committee. They act as an education and advocacy organization that promotes collaboration, trust and communication between community members, agency representatives and nonprofit organizations.[2] Water quality monitoring, habitat restoration, adult education, and forest protection are a few of their current projects.

The Nisqually River Foundation is a 501(c)3 nonprofit that provides the staffing and funding power for the Nisqually River Council. The Nisqually River Foundation (NRF) has been chosen to be a Powerful

(Continued on next page)

Nisqually River Council

Flowing 78 miles from its source at the Nisqually Glacier on Mount Rainier to its delta at the Nisqually National Wildlife Refuge, the Nisqually River is a direct link between the summit snows of Washington's highest peak and the marine waters of Puget Sound. It is a land greatly affected by human decisions and activities. Though the Nisqually is one of the healthiest and least developed rivers in southern Puget Sound, it faces many challenges, threats and opportunities, and an uncertain future.[4]

Nisqually River Council

(Continued from previous page)

Partner of Puget Sound Energy (PSE) in 2020. The Powerful Partnership's program, now in its fourth year, is part of PSE's commitment to help the environment and human services organizations. This year, PSE selected 24 organizations, including the NRF, across its 6,000 square mile service area to receive a total of $200,000. These partnerships allow PSE to enhance community engagement and awareness by focusing its giving efforts.

The NRF will use this funding to support its work fostering community partnerships, passionate volunteers and a sustainable future for the Nisqually watershed. Over the coming year, they will work through Powerful Partnerships to support volunteer restoration events and classes through the Nisqually Stream Stewards program, as well as expand outreach and education opportunities for the Nisqually River Council and Education Project. In addition, they will be partnering with PSE to educate clients, employees and donors on ways to restore habitat, save energy and money on their bills, and share safety and emergency preparedness information.

From the foundation's website: "The Nisqually watershed has been recognized for over 30 years as a leader in collaborative, community-based conservation. Our Nisqually Watershed Stewardship Plan looks at sustainability through environmental, economic, and social lenses to strive for thriving ecosystems and human communities, and we're proud to have PSE's support in engaging people in our work."[3]


Nisqually River Council

Nisqually River Education Project: Connecting kids with nature.


Nisqually River Council

A volunteer for the Nisqually River Education Project tosses a salmon carcass into the river.

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2020 State of Our Watersheds Report
Nooksack River Basin

> *Our natural resources are our responsibilities and our culture is the law of the land. It is what ties us to everything. Our fish and wildlife, our clean water and our forestlands are disappearing and with them our way of life. We as Nooksack people have nothing left to give, so it is important for us to hold accountable those responsible for protection of what little is left, while educating ourselves as to what we can do as individuals.*
>
> **– GEORGE SWANASET JR.**
> **NATURAL & CULTURAL RESOURCES DIRECTOR**

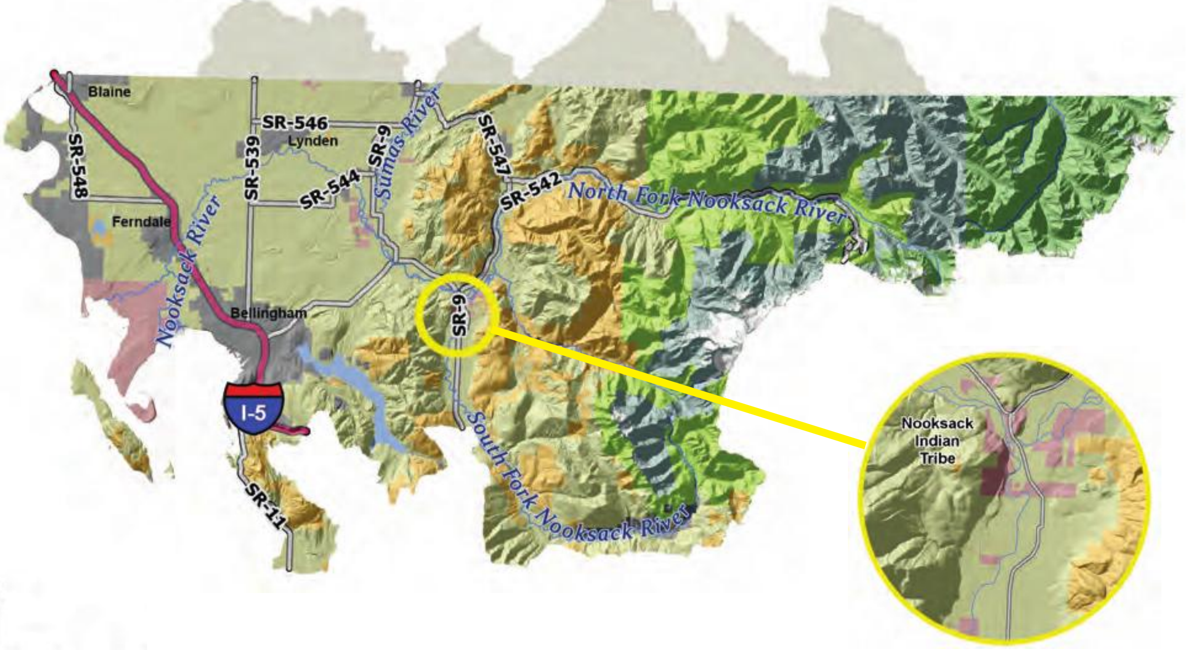
AREA OF INTEREST

Nooksack Indian Tribe

The Nooksack Indian Tribe is a recognized tribe under the Point Elliott Treaty of 1855 and has about 2,000 enrolled members. Traditionally, the Nooksack people occupied the watershed of the Nooksack River from the high mountain area surrounding Mount Baker to the salt water of Bellingham Bay, and extended into Canada north of Lynden and in the Sumas and Abbotsford areas. The primary Nooksack area was the Nooksack River watershed from near its mouth to the headwaters surrounding Mount Baker, plus most of the Sumas River drainage south of the present international border. Traditionally, the tribe fished Nooksack River waters and by descent or marriage ties also fished the Fraser, Skagit and Samish rivers. Similarly, the resources of Birch Bay and Semiahmoo Bay would have been accessed through these kin ties before these areas were abandoned by their native people in the early to mid-19th century. Nooksack is a place name that translates to "always bracken fern roots," illustrating close ties to the land and the resources that continue to give strength to Nooksack people.[1]

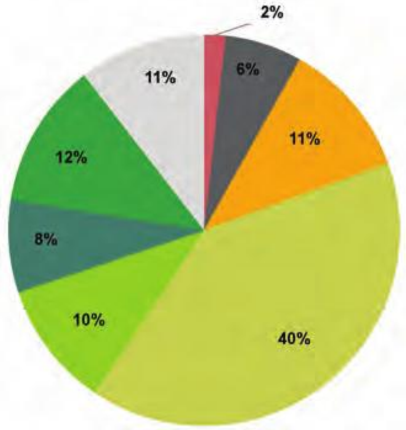
Nooksack Indian Tribe

WRIA 1: Mountains



Land Jurisdiction

Category
🟥 Tribal
⬛ City/UGA/Municipal
🟨 County
🟧 State
▨ Other Federal
🟩 US Forest Service
▨ Wilderness
🟩 National Park
⬜ Canada



The Nooksack River watershed is 832 square miles, the largest drainage in WRIA 1, and the fourth largest drainage in Puget Sound. It has three main forks: the North, Middle and South that originate in the steep high-elevation headwaters of the North Cascades and flow westerly descending into flats of the Puget lowlands. The North and Middle Forks are glacial rivers and originate from Mount Baker. The South Fork is a snow- and rain-fed river and originates from the non-glaciated slope of the Twin Sisters peaks. The Middle Fork flows into the North Fork upstream of where the North Fork confluences with the South Fork to form the mainstem Nooksack River. The mainstem then flows as a low-gradient, low-elevation river until flowing into Bellingham Bay. Historically, the Nooksack River alternated between flowing into Bellingham Bay, and flowing through the Lummi River, and into Lummi Bay.

While the Nooksack Tribe's ancestral home extends beyond the boundaries of the Nooksack watershed into watersheds adjacent, the Nooksack basin is central to the ancestral home as well as present home of the Nooksack Tribe. The Nooksack Tribe's reservation is located along the Nooksack River in the town of Deming, downstream from the confluence of the South and North Fork Nooksack Rivers; trust lands extend upstream to the lower reaches of the forks and downstream toward the town of Everson, as well as to the Sumas watershed.

Euro-Americans began settling the area in the 1850s primarily for the logging resources, with some arriving for opportunities in prairie farming and mining. Lowland clearing for agriculture began in earnest by the 1890s and by 1925, nearly all of the lower mainstem and delta forests had been converted to agricultural land.[1,2] Since 1950 land-use conversion has primarily been for commercial, residential, urban and industrial development.[3]

The Nooksack River and independent watersheds (WRIA 1) have five species of anadromous salmon: pink, chum, chinook, coho and sockeye; and three of anadromous trout: steelhead, cutthroat and bull trout.[4,5]

Map Data Sources: USFWS 2018,[6] WAECY 2018,[7] WAECY 2018a,[8] WAECY 1994,[9] WADNR 2014c,[10] WADNR 2014d,[11] WADOT 2013,[12] SSHIAP 2004[13]

Chapter Summary

Nooksack Indian history goes back thousands of years, or from time immemorial. There is nothing in that history of their people ever living anywhere outside of this region. The Nooksack Tribe were signatories of the Point Elliott Treaty in 1855 and exchanged land holdings while retaining hunting, fishing and gathering rights. They were expected to move onto the Lummi Reservation but declined. This affected their federal status as a tribe, but the Nooksack tribal community held together and remained a part of their ancestral home in the Nooksack watershed and surrounding areas. In 1973, they were granted federal tribal status. They are currently a tribe of 2,000 members, and they continue to make their home in the Nooksack River watershed.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org*.

For this report, the Nooksack Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Commercial Shellfish Growing Conditions Have Improved in Drayton Harbor and Birch Bay

In 2019, the Washington Department of Health (WADOH) fully approved 4,713 acres of commercial shellfish harvest area in Drayton Harbor and Birch Bay. At the same time, WADOH prohibited from harvest 1,847 acres of commercial shellfish growing area and left unclassified 1,297 acres of commercial shellfish growing areas. In both locations, nonpoint source pollution, wastewater treatment plants and boat marinas continue to force areas of commercial shellfish-growing into prohibited and unclassified status.

Shoreline Armoring Continues to Impact Forage Fish Habitat in Whatcom County

There are an estimated 152 miles of marine shoreline in Whatcom County, and over 88 miles (58%) are either modified or armored. Since August 2014, WDFW has issued marine shoreline permits for 15 Hydraulic Permit Applications (HPA) in WRIA 01. Only one of the 15 permits was for a beach or shoreline enhancement project. The other 14 permits all replaced hard armoring with hard armoring, and maintained the shoreline in a degraded state that continues to negatively impact forage fish spawning.

Floodplain Habitats Are Critical to Chinook Productivity as Climate Change Increases Variability of Winter Freshwater Flows in the Nooksack River

A recent study found that variation in North Fork Nooksack River winter streamflow (October-January) increased by 27% from 1950 to 2010. Increased variability in winter freshwater flows had a more negative effect on chinook productivity than any of the other climate signals researched within the study.

South Fork Nooksack River's Edge Improved to Provide More High Value Habitat for Juvenile Chinook

The lower South Fork Nooksack River increased from 85.5% natural bank edge to 88.5% natural bank edge between 2005 and 2016, nearly meeting the target for a good condition. Of the nine WRIA 01 SRP planning reaches that make up the lower South Fork Nooksack River, the percent of natural edge habitat declined in only two reaches (Van Zandt and Standard) during this time frame. Every planning reach has over 80% natural bank edge, except for the BNSF reach which remains more heavily impacted by riprap that is protecting the railroad.

Lack of Forest Cover Persists in the Inhabited Lowlands

In 2016, percent forest cover in the lowland inhabited area of the Nooksack River watershed and independent drainages of WRIA 01 was 35% and in a poor condition with respect to watershed health. From 2011 to 2016 percent forest cover and condition remained unchanged. From 1992 to 2016, percent forest cover declined by an estimated 2.6% in that same area.

Reforestation Still Needed in Nooksack River Riparian Zone to Reach Long-Term Chinook Recovery Targets

Between 2011 and 2017, the Nooksack River riparian zone lost 196 acres of its forest cover, 154 acres (78%) to natural channel migration and bank erosion and 42 acres (22%) to human land use. Over roughly that same period, 78 acres of riparian forest were restored in the Nooksack River riparian zone. Riparian replanting of trees exceeded human removal of trees from 2011 to 2017, but after accounting for natural forest cover loss there was a net loss of 118 acres in the Nooksack River riparian zone, during that time period.

Anadromous Barrier Culverts Have Increased

A total of 662 anadromous fish barrier culverts have been identified in the WRIA 01 area through 2019. This is an increase of 58 identified barrier culverts since 2014. Over 75% of barrier culverts are either privately owned (50%) or county owned (27%). For barrier repair to exceed the addition of new barriers, all ownerships need to accelerate their schedule for culvert barrier repair.

Forest Road Maintenance and Abandonment on Schedule to be Completed in the Upper Nooksack Watershed by 2021

Implementation of road maintenance and abandonment plans, as required by the Washington state Forests and Fish rule has led to the repair and/or abandonment of the majority of 1,426 total miles of private and state-owned forest roads in the Upper Nooksack River watershed. RMAP implementation has also resulted in the repair or removal of 128 of 132 (97%) culverts on private and state-owned forest roads. Remaining road work and culvert work falls on Sierra Pacific lands and is on track to be completed by 2021.

Middle Fork Nooksack River Dam Has Been Removed

Removing the Middle Fork Nooksack River Dam restored access to 16 miles of relatively pristine habitat for threatened chinook salmon, bull trout and steelhead in the Middle Fork Nooksack River. It is estimated that removing the dam will increase chinook in the North and Middle Forks by more than 30% and will increase steelhead habitat in the Middle Fork Nooksack by 45%. For the Nooksack Tribe, removal of the dam returns a physical and spiritual connection to the Middle Fork Nooksack River that has been disrupted since the dam was built in 1962.

Conclusion

Climate continues to change the flow and chemistry of fish habitat in Puget Sound and the Nooksack River watershed. Temperatures are rising, precipitation is coming at different times, less as snow and more as rain. Flows in the winter are variable and chinook are directly threatened.

Land-use patterns no longer change the landscape at a rapid pace, instead they hold the landscape in an ecologically degraded state, and improvement out of that state is either very slow or doesn't occur at all. Lowland forests were cleared in the region in the late 19th century, and remain that way today. Shoreline armoring that is in place, degrading the freshwater and marine shorelines, gets repaired, but remains in a degraded state. With each passing year, we continue to find new barrier culverts.

On the other hand, the Nooksack Tribe, working with Lummi Nation and other salmon recovery partners in the region, makes constant strides with restoration efforts. Edge habitat in the lower South Fork is improving for juvenile salmon. Acres of riparian forest are being planted. And, after nearly 60 years, the Middle Fork Nooksack River Dam has been removed. All of the research, planning, education, cooperation, volunteering and on-the-ground work that goes into these projects is critical to salmon recovery.

Every measure that can be taken to integrate climate change into planning, restoration and recovery has to be taken. While we address the legacy impacts that affect the current environment, we also need to plan for the forecast environment, as by 2080 it will be too late to react.

The legal and regulatory framework already in place to uphold the treaty rights of the tribe and protect the salmon needs to be funded and enforced. Without priority funding and dedicated enforcement, the behavioral shift that needs to occur at a societal level will occur too slowly. Enforcement of the law will need to occur at all levels of government, including local government where most of the environmental laws are implemented.

Recovery Efforts Show Signs of Improvement But Still Lagging in Key Indicators

At the 15-year mark of the Puget Sound Salmon Recovery Plan, a review of a selection of key environmental indicators for the Nooksack watershed shows improvements in water quality, river edge habitat, forest road improvements and the removal of the Middle Fork Nooksack River dam. But degradation has occurred with the continued permitting of shoreline armoring, loss of riparian forest cover and an increase of road crossing barriers. The Nooksack Tribe is leading the effort to conduct a broader accounting of habitat status and trend to inform an update of the Nooksack chapter of the Puget Sound Salmon Recovery Plan.

In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trend of these key environmental indicators since the 2016 State of Our Watersheds Report shows improvements in some and a declining trend in shoreline armoring, reforestation of riparian zones and fish barriers:

Tribal Indicator	Status	Trend Since SOW 2016 Report
Water Quality - Shellfish	In 2019, the total acres of fully approved commercial shellfish harvest area has increased since 2016 in both Drayton Harbor and Birch Bay. Drayton Harbor went from 0 acres to 1,577 acres fully approved and Birch Bay saw a 12% increase to 3,136 fully approved commercial shellfish harvest area.	Improving
Shoreline Modifications / Forage Fish	Since August 2014, WDFW has issued 15 marine shoreline armoring Hydraulic Permit Applications in WRIA 01 and only one is for a nearshore restoration project. The other 14 permits all replaced hard armoring with hard armoring, and maintained the shoreline in a degraded state that continues to negatively impact forage fish spawning.	Declining
Climate Change - Flows	Floodplain protection and restoration is critical to the protection of the chinook productivity in the North Fork Nooksack River. The variation in North Fork Nooksack River winter streamflow (October-January) increased by 27% from 1950 to 2010. Increased variability in winter freshwater flows has a more negative effect on chinook productivity than any of the other climate signals researched.	Concern
River Edge Habitat	The lower South Fork Nooksack River increased from 85.5% natural bank edge to 88.5% natural bank edge between 2005 and 2016, nearly meeting the target for a "good" condition. Of the nine WRIA 01 Salmon Recovery Plan planning reaches that make up the lower South Fork Nooksack River, only two (Van Zandt and Standard) saw decreases in percent natural edge habitat during this time frame. Every planning reach has over 80% natural bank edge, except for the BNSF reach which remains heavily impacted by rip rap that is protecting the railroad.	Improving
Forest Cover	From 2011 to 2016 percent forest cover and condition remained unchanged. In 2016 percent forest cover in the lowland inhabited area of the Nooksack River watershed and independent drainages of (WRIA 01) was 35% and in a 'poor' condition with respect to watershed health. From 1992 to 2016, percent forest cover declined by an estimated 2.6% in that same area.	No Trend
Riparian Zone Reforestation	Between 2011 and 2017, the Nooksack River riparian zone lost 196acres of its forest cover, 154 acres (78%) to natural channel migration and bank erosion and 42 acres (22%) to human land use. Over roughly that same period, 78 acres of riparian forest were restored in the Nooksack River riparian zone. Riparian replanting of trees exceeded human removal of trees from 2011 to 2017, but after accounting for natural forest cover loss to the river the Nooksack River riparian zone saw a net loss of 118 acres during that time period.	Declining
Stream Blockages - Culverts	A total of 662 anadromous fish barrier culverts have been identified in the WRIA 01 area through 2019, this is an increase of 58 culverts since 2014. There were 116 new anadromous barrier culverts surveyed from 2015 through 2019. Over that same period, approximately 58 culverts that were blocking anadromous fish have been repaired or abandoned and are consider passable to fish.	Declining
Stream Blockages - RMAP	The Washington State Forest Road Maintenance and Abandonment Plan (RMAP) has led to the repair and/or abandonment of the majority of 1,426 total miles of private and state owned forest roads in the Upper Nooksack River watershed. RMAP has also resulted in the repair or removal of 128 of 132 (97%) culverts on private and state owned forest roads. Remaining road work and culvert work falls on Sierra Pacific owned lands and is on track to be completed by 2021.	Improving
Restoration - Dam Removal	Removing the Middle Fork Nooksack River Dam will restore access to 16 miles of relatively pristine habitat for threatened chinook salmon, bull trout and steelhead. It is estimated that removing the dam will increase chinook salmon populations in the Nooksack River region by more than 30% and will increase steelhead habitat in the Middle Fork Nooksack by 45%.	Improving

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

The 2005 WRIA 1 Salmonid Recovery Plan identified both near-term and long-term actions necessary to recover salmon. Due to the critically low natural-origin abundances of both Nooksack chinook populations and consistent with the voluntary approach promoted by the Shared Strategy for Puget Sound, the plan focused largely on implementation of voluntary restoration projects to substantially improve habitat capacity and productivity to support salmon recovery. There was a secondary emphasis on implementing existing regulatory programs and management actions to prevent further degradation of ecological conditions. This year, the Nooksack Tribe and our partners in salmon recovery in the Nooksack watershed, committed to evaluating the effectiveness of past salmon recovery actions and incorporating lessons learned into an updated recovery plan. Although the updated Recovery Plan will not be completed until 2021 at the earliest, it is clear that there is a need for increased accountability in salmon recovery in general and land-use regulations in particular. Effectiveness monitoring needs to be expanded and results reported to both decisionmakers to inform adaptive management and the broader public to ensure continued public support for salmon recovery. Looking ahead, the Nooksack Tribe has identified the following necessary actions:

Habitat
- Continue to monitor effectiveness of and adapt habitat restoration projects.
- Expand and diversify restoration efforts to process-based restoration (wetland, riparian, floodplain).
- Increase the pace of local fish-passage barrier corrections.
- Integrate habitat restoration into floodplain planning process and prioritize actions that help recover important salmon stocks.
- Monitor effectiveness of land-use regulations and hold decisionmakers accountable when issues arise.

Water Quality
- Expand implementation and monitoring of TMDLs and other cleanup plans, including the South Fork Nooksack Temperature TMDL.

Water Quantity
- Model and/or monitor the impacts of consumptive water use on streamflow and continue to work with Ecology to protect instream flows.
- Plan, implement and monitor projects that restore streamflows, especially for priority species.

Monitoring and Climate Change
- Continue to monitor status and trends of key ecosystem elements (water quality, water quantity, habitat).
- Continue to incorporate climate science into planning and action to build ecosystem resilience to climate change.

Commercial Shellfish Growing Conditions Have Improved in Drayton Harbor and Birch Bay

In 2019, the total acres of fully approved commercial shellfish harvest area has increased since 2016 in both Drayton Harbor and Birch Bay. Drayton Harbor went from 0 acres to 1,577 acres fully approved and Birch Bay saw a 12% increase to 3,136 fully approved commercial shellfish harvest area.

Drayton Harbor

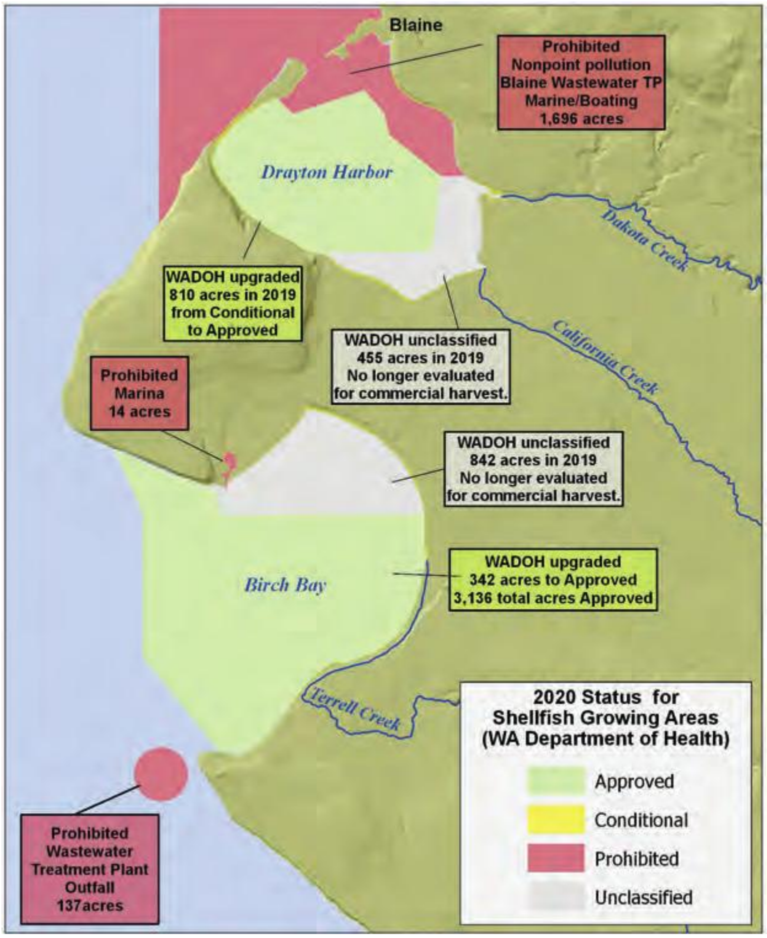
Washington State Department of Ecology[2]

In 2016 there was no fully approved commercial shellfish area in Drayton Harbor. In 2019, the conditions in Drayton Harbor improved enough to fully approve 1,577 acres for commercial shellfish harvest, leaving 2,151 acres (58%) of commercial shellfish area prohibited from harvest or left unclassified.

In 2016, Birch Bay had 2,793 acres of fully approved commercial shellfish area and in 2019 that number increased by 12%, raising the area fully approved to 3,136 acres. At the same time 993 acres of commercial shellfish area was prohibited from harvest or left unclassified. These are signs of improving water quality conditions in both watersheds draining to these areas but the effect of unclassified status is essentially the removal of that area from evaluation for commercial shellfish growing. While improvements have been made, continued efforts to improve water quality conditions within Drayton Harbor and Birch Bay is critical.

In both locations, nonpoint source pollution, agriculture practices, wastewater treatment plants and/or boat marinas continue to force areas of commercial shellfish growing into prohibited and unclassified status. Moving forward, cleanup and best management practices efforts will be tasked to maintain the approved growing areas as opened and approved, moving more prohibited areas towards approval, and bringing unclassified areas back to a condition that can be evaluated for possible approval classification.

Drayton Harbor and Birch Bay Shellfish Growing Areas



Current Status of Commercial Shellfish Growing Areas in Drayton Harbor and Birch Bay.[2]

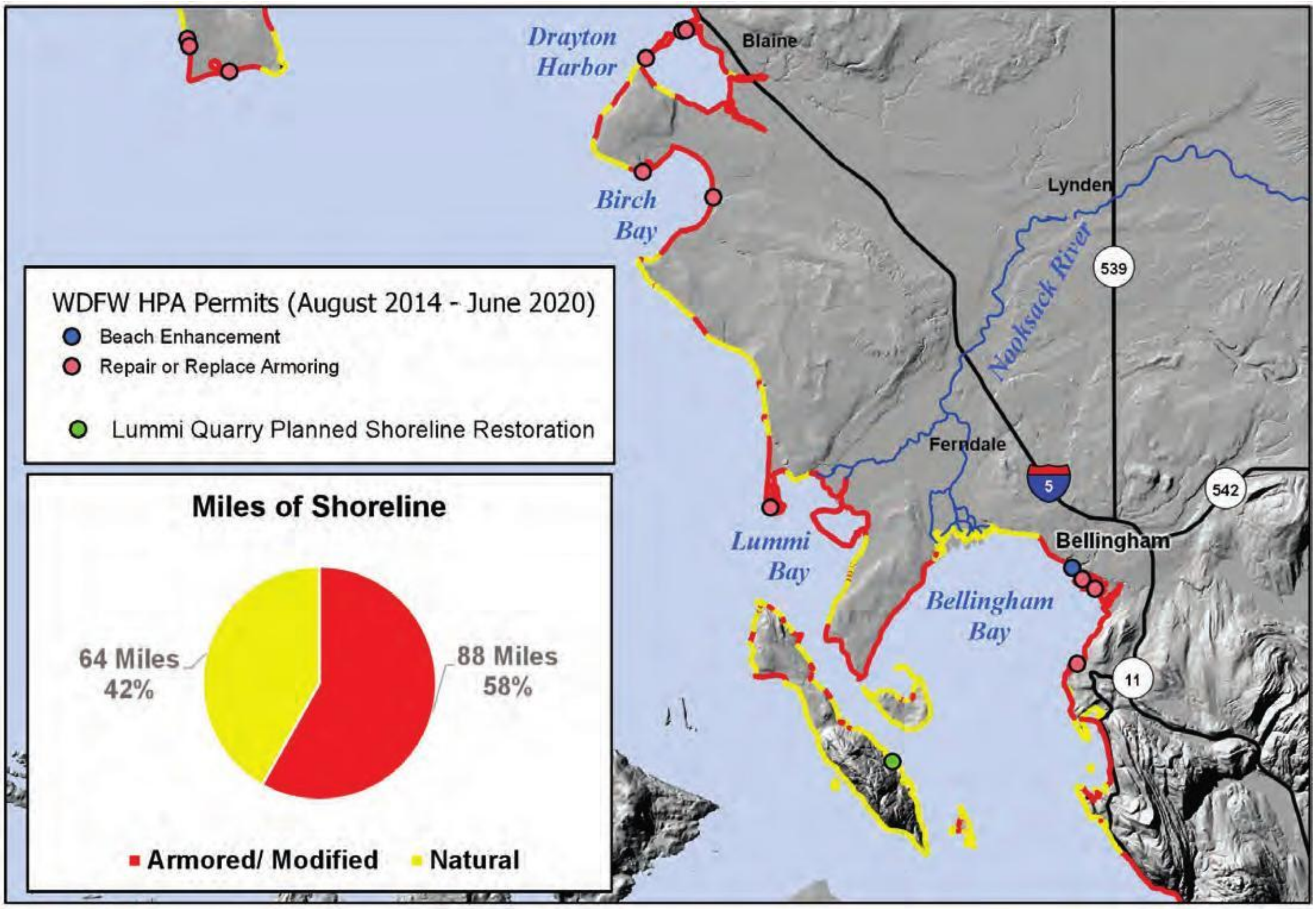
	Shellfish Growing Area Status		
	Approved	Prohibited	Unclassified
Birch Bay	3,136	151	842
Drayton Harbor	1,577	1,696	455

Map Data Sources: WADOT 2020,[3] *SSHIAP 2004,*[4] *USGS 2018,*[5]

Nooksack Indian Tribe

Shoreline Armoring Continues to Impact Forage Fish Habitat in Whatcom County

There are an estimated 152 miles of marine shoreline in Whatcom County, and over 88 miles (58%) are either modified or armored.[1] Since August 2014, WDFW has issued marine shoreline armoring permits for 15 Hydraulic Permit Applications (HPA) in WRIA 01.[2] Only one of the 15 permits was for a beach or shoreline enhancement project. The other 14 permits all replaced hard armoring with hard armoring, and maintained the shoreline in a degraded state that continues to negatively impact forage fish spawning.



Since August 2014, WDFW has issued marine shoreline armoring permits for 15 Hydraulic Permit Applications (HPA) in WRIA 01.[4] Only one of the permits was a Port of Bellingham project to enhance beach cobble and gravel at Little Squalicum Beach along Bellingham Bay. Surf smelt and/or Pacific sand lance have been documented spawning at this site and so far is a success.

The other 14 of the permits, all replaced or repaired hard armoring with hard armoring, providing little or no ecological benefit for the marine shoreline, and 7 of these hard armoring replacement projects continue to impact beaches that are documented as surf smelt and/or Pacific sand lance spawning beaches.[5] None of the permits issues were for removal of shoreline armoring.

Juvenile Puget Sound salmon depend on the quantity and quality of nearshore habitats for their population viability.[6] Armored shorelines impact juvenile salmon's nearshore migration, food availability, safety from predators, and overall survivability.[7]

There is an opportunity for landowners to improve the shoreline conditions during "repair/replacement" of existing shoreline armoring. Soft shore armoring can protect both private property and improve the ecological condition of the shoreline and must be prioritized in the state's permitting process. Only when soft armoring will not provide sufficient property protection should hard armoring be used. By using these alternative approaches to shoreline protection, we can over time, begin the process to improve conditions instead of continuing the degradation of the critical shoreline habitat.

Map Data Sources: CGS 2017,[8] PSEMP 2020,[9] WADFW 2020,[10] SSHIAP 2004[11]

NOOKSACK INDIAN TRIBE

Floodplain Habitats Are Critical to Chinook Productivity as Climate Change Increases Variability of Winter Freshwater Flows in the Nooksack River

The variation in North Fork Nooksack River winter streamflow (October-January) increased by 27% from 1950 to 2010.[1] Increased variability in winter freshwater flows had a more negative effect on chinook productivity than any of the other climate signals researched within the study.[2,3] Floodplain protection and restoration is critical to the protection of chinook productivity in the North Fork Nooksack River.

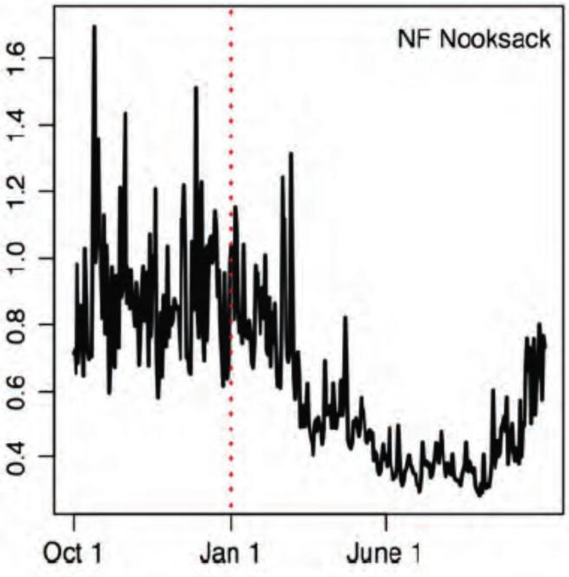
In a recent study modeling the effects of climate change on streamflow in the Nooksack River, and ensemble of General Circulation Models (GCM) predict that the Nooksack River will have higher winter flows and lower summer flows as a result of climate change. This is based on both precipitation timing and higher temperatures.[4] The variability in temperature in the winter coupled with more precipitation may also mean a higher variability in winter streamflow as snow storage of precipitation changes elevations depending on the temperature of the precipitation event.

Increasing variability of winter streamflows may be having a more negative impact on chinook salmon because the winter season coincides with their incubation period, and chinook are most vulnerable to mortality during the freshwater incubation period.[5,6] Climate change is expected to increase winter streamflow variability. If the effects of this are left unmitigated, chinook recovery may be in jeopardy.

It is unlikely that management actions to slow climate change will decrease the variability of winter freshwater flows in the Nooksack River system. A more effective approach will be to focus on protection and restoration actions that buffer chinook salmon from increasing flow variability.[7] Floodplain restoration is critical to this approach, reconnection of floodplain channel networks to provide more storage and off-channel habitats, and restoration of lateral connectivity of floodplain aquifers will buffer against increasing winter streamflow variability.[8]

RonK, Daily KOS

A multi-channeled section of the Nooksack River floodplain provides the space necessary to carry increasingly variable winter flows without disrupting incubating chinook salmon, giving them a better chance to survive.



Coefficient of variation (CV) for each day of the water year calculated across years, 1951-2012. This shows the high variability of freshwater flows in the North Fork Nooksack River during the winter months (October-January).[9]

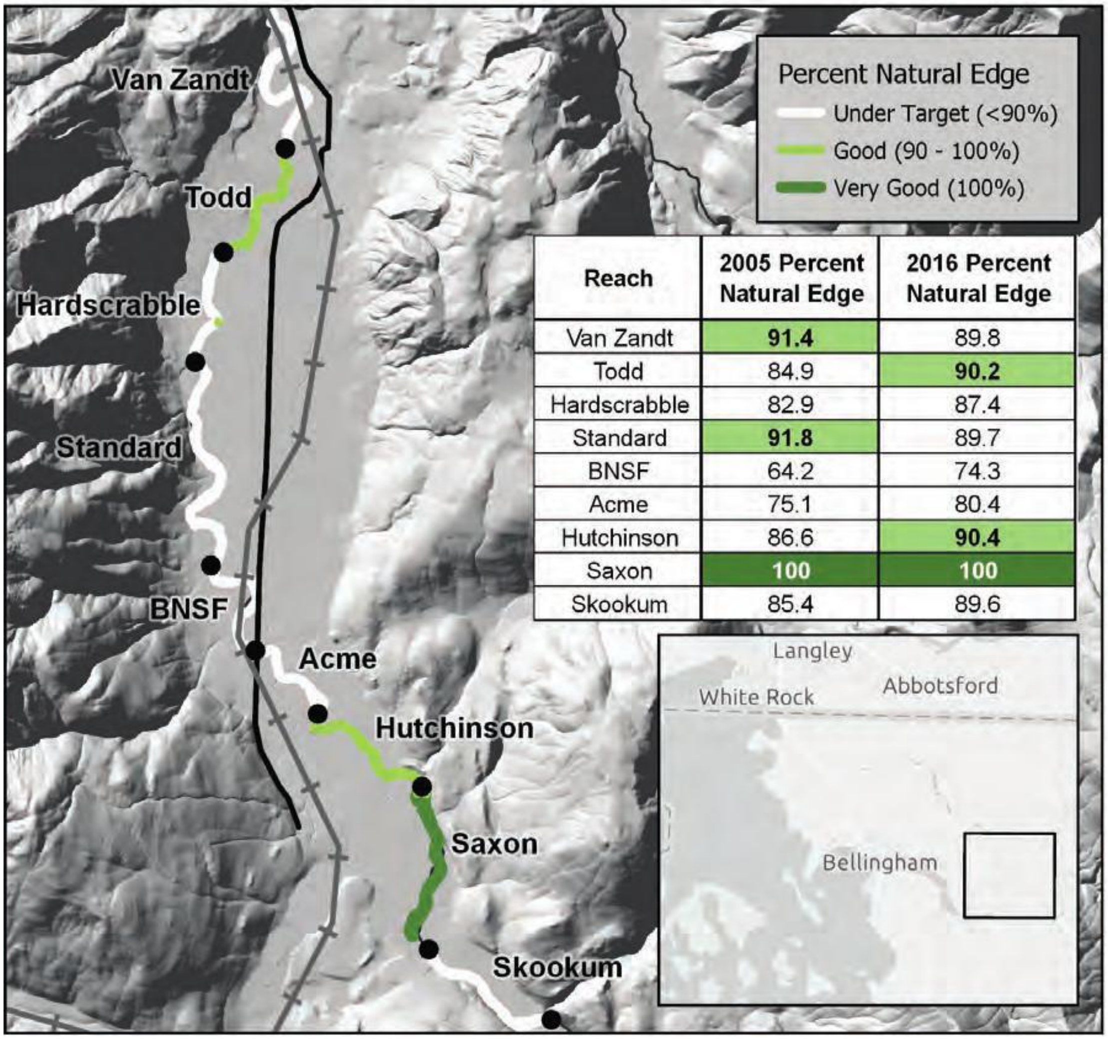
South Fork Nooksack River's Edge Improved to Provide More High Value Habitat for Juvenile Chinook

The lower South Fork Nooksack River increased from 85.5% natural bank edge to 88.5% natural bank edge between 2005 and 2016, nearly meeting the target for a "good" condition.[1] Of the nine WRIA 01 Salmon Recovery Plan planning reaches that make up the lower South Fork Nooksack River, only two (Van Zandt and Standard) saw decreases in percent natural edge habitat during this time frame.[2] Every planning reach has over 80% natural bank edge, except for the BNSF reach which remains heavily impacted by riprap that is protecting the railroad.

A lack of natural channel edge in the lower South Fork Nooksack River was identified as a component of habitat diversity, which is a "high impact" limiting factor for anadromous salmon in the WRIA 01 SRP.[3] Natural edge habitats are slow water areas at the edge of channels that include bar edge, bank edge and logjam edge. They are especially important for juvenile salmon, and when they have wood associated with them, natural edges attract even higher densities of juvenile salmon.[4]

Riprap (artificial bank hardening) edge habitats are found in the developed landscape where the river is being constrained to protect property and infrastructure. They are often simpler edge types and they limit the amount of edge habitat available to juvenile salmon.[5] The only riprap added in the lower South Fork Nooksack since 2005 was in the Van Zandt reach for further protection of the railroad.

The WRIA 01 Salmon Recovery Plan (WRIA 01 SRP) targets for "percent natural bank edges" are "good" condition (90-100%) and "very good" condition (100%).[6] The lower South Fork Nooksack River is approaching a "good" condition, and the restoration strategy for edge habitat is increasing the percent natural edge and improving habitat diversity overall. As the lower South Fork Nooksack is improving overall, the railroad continues to constrain percent natural bank edge in the BNSF and the Van Zandt reaches.



Reach	2005 Percent Natural Edge	2016 Percent Natural Edge
Van Zandt	91.4	89.8
Todd	84.9	90.2
Hardscrabble	82.9	87.4
Standard	91.8	89.7
BNSF	64.2	74.3
Acme	75.1	80.4
Hutchinson	86.6	90.4
Saxon	100	100
Skookum	85.4	89.6

Percent Natural Edge (2016) by WRIA 01 SRP Planning Reach in the Lower South Fork Nooksack River.

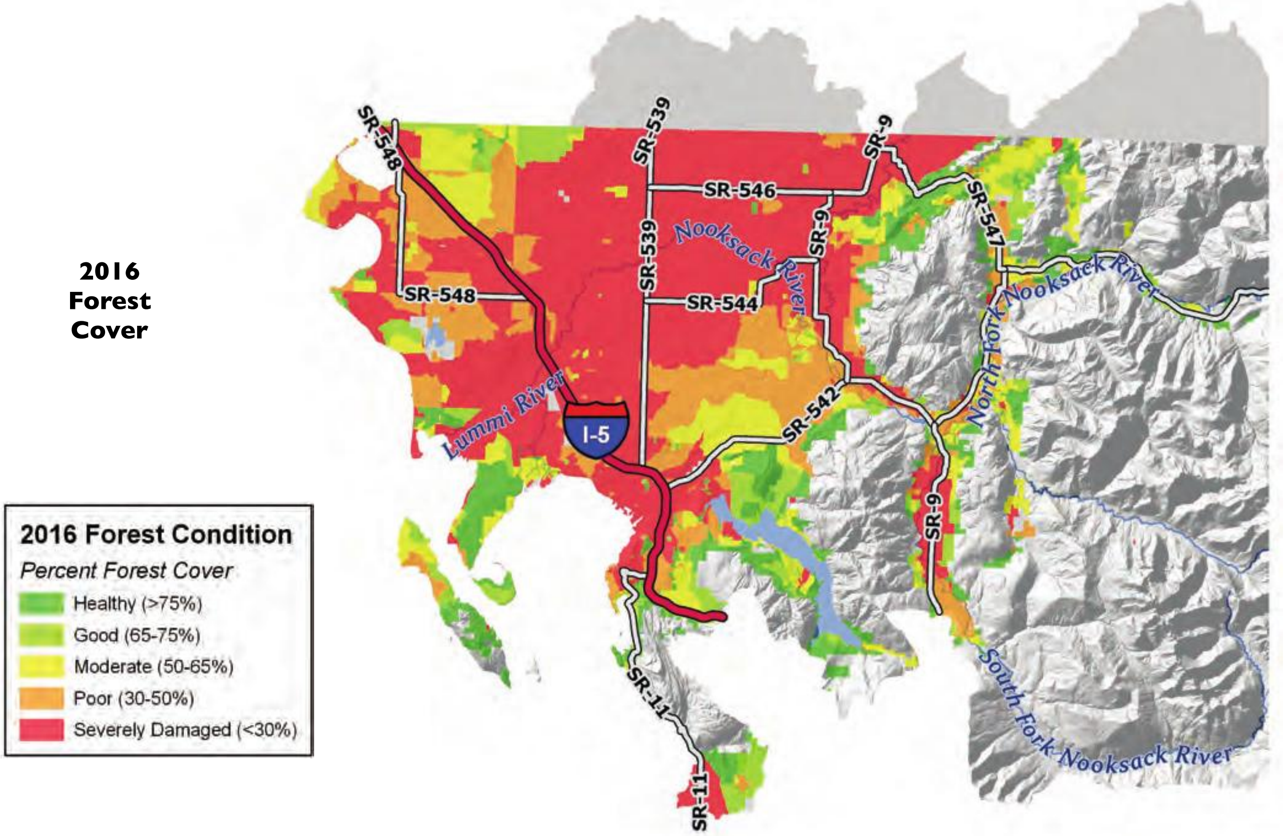
Map Data Sources: Maudlin 2020,[7] SSHIAP 2004,[8] WADOT 2017,[9] WADOT 2020,[10] WRIA 01 SRP 2020[11]

NOOKSACK INDIAN TRIBE

Lack of Forest Cover Persists in the Inhabited Lowlands

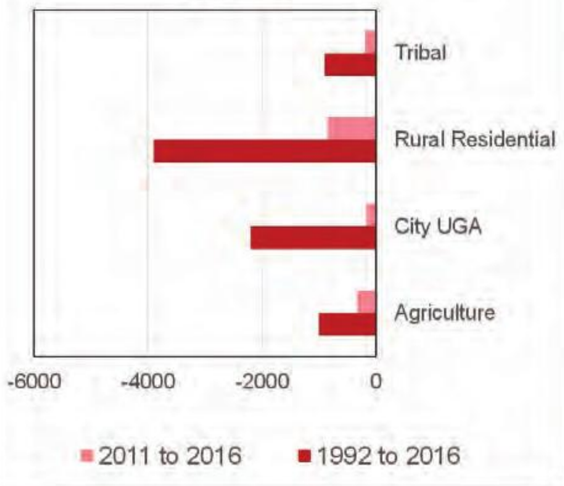
From 2011 to 2016 percent forest cover and condition remained unchanged. In 2016 percent forest cover in the lowland inhabited area of the Nooksack River watershed and independent drainages of (WRIA 01) was 35% and in a "poor" condition with respect to watershed health. From 1992 to 2016, percent forest cover declined by an estimated 2.6% in that same area.[1,2,3,4]

2016 Forest Cover



Between 1992 and 2016, land development associated with a growing population resulted in forest cover loss in the inhabited lowlands of WRIA 01. The majority of lowland forest cover loss between 1992 and 2016 was in rural residential areas and the second largest amount of forest cover loss was in the city UGA areas. While there was very little continued forest cover loss on agricultural lands during this period, agricultural lands had a "severely damaged" forest condition in 1992, at less than 10% forest cover, and that condition persists in 2016.[5,6,7,8]

Acres of forest cover loss by land use in the inhabited lowlands of WRIA 01: 1992 to 2016 and 2011 to 2016.[14,15,16,17]

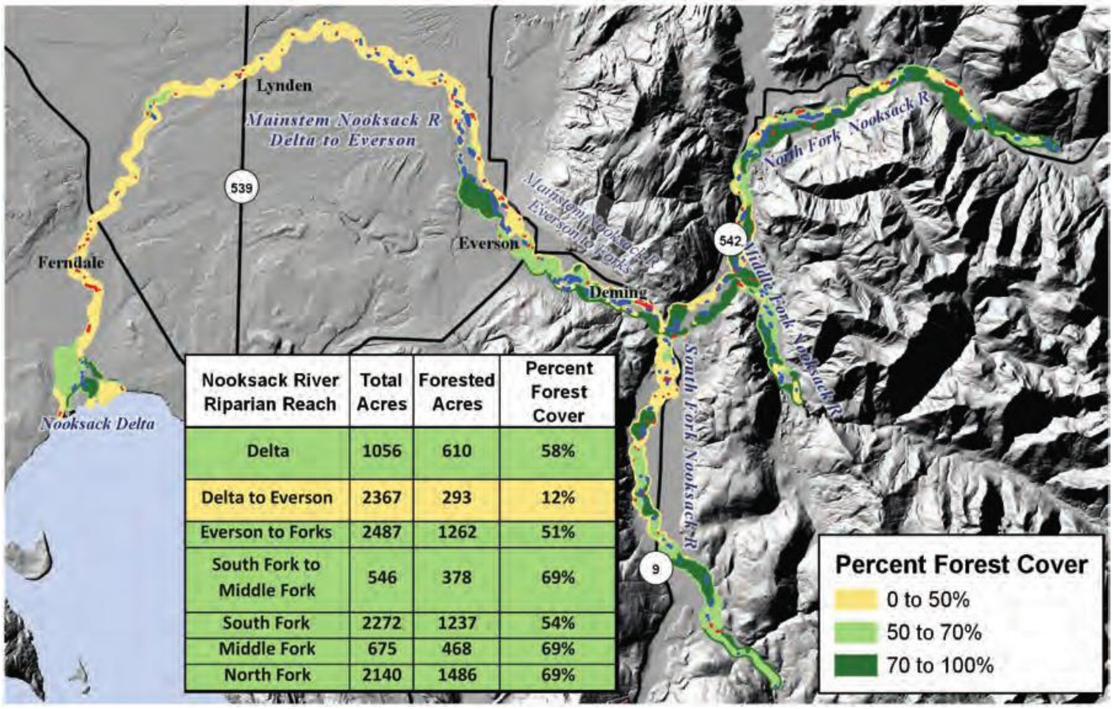


Map Data Sources: WAECY 1992-2016,[9] *Whatcom County 2020,*[10] *SSHIAP 2019,*[11] *Skagit County 2020,*[12] *SSHIAP 2004,*[13]

Reforestation Still Needed in Nooksack River Riparian Zone to Reach Long-Term Chinook Recovery Targets

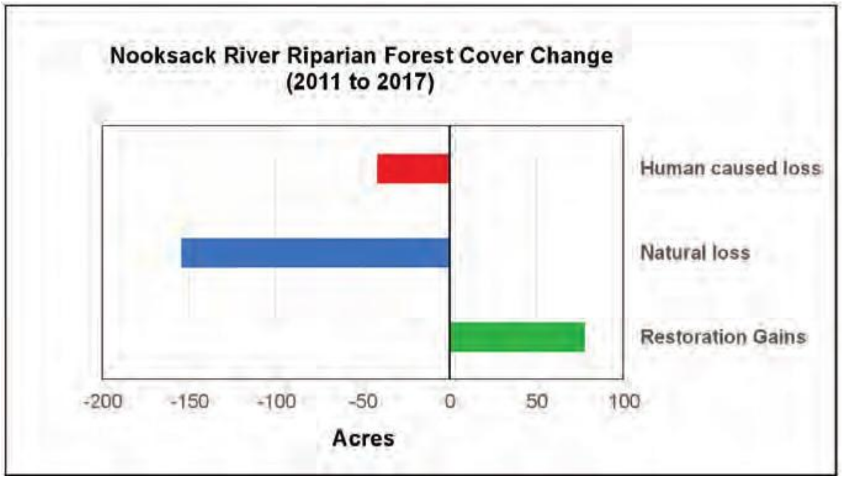
Between 2011 and 2017, the Nooksack River riparian zone lost 196 acres of its forest cover, 154 acres (78%) to natural channel migration and bank erosion and 42 acres (22%) to human land use.[1] Over roughly that same period, 78 acres of riparian forest were restored in the Nooksack River riparian zone.[2,3] Riparian replanting of trees exceeded human removal of trees from 2011 to 2017, but after accounting for natural forest cover loss to the river, the Nooksack River riparian zone saw a net loss of 118 acres during that time period.

Nooksack River Riparian Zone Forest Cover[7,8]



Nooksack River Riparian Reach	Total Acres	Forested Acres	Percent Forest Cover
Delta	1056	610	58%
Delta to Everson	2367	293	12%
Everson to Forks	2487	1262	51%
South Fork to Middle Fork	546	378	69%
South Fork	2272	1237	54%
Middle Fork	675	468	69%
North Fork	2140	1486	69%

Poor forest conditions in the Nooksack River riparian zone are primarily in the lower mainstem from the Nooksack Delta to the town of Everson.[12]



Forest Cover Change in the Nooksack River Riparian Zone (2011 to 2017)[9,10,11]

Map Data Sources:WAECY 1992-2016[12]

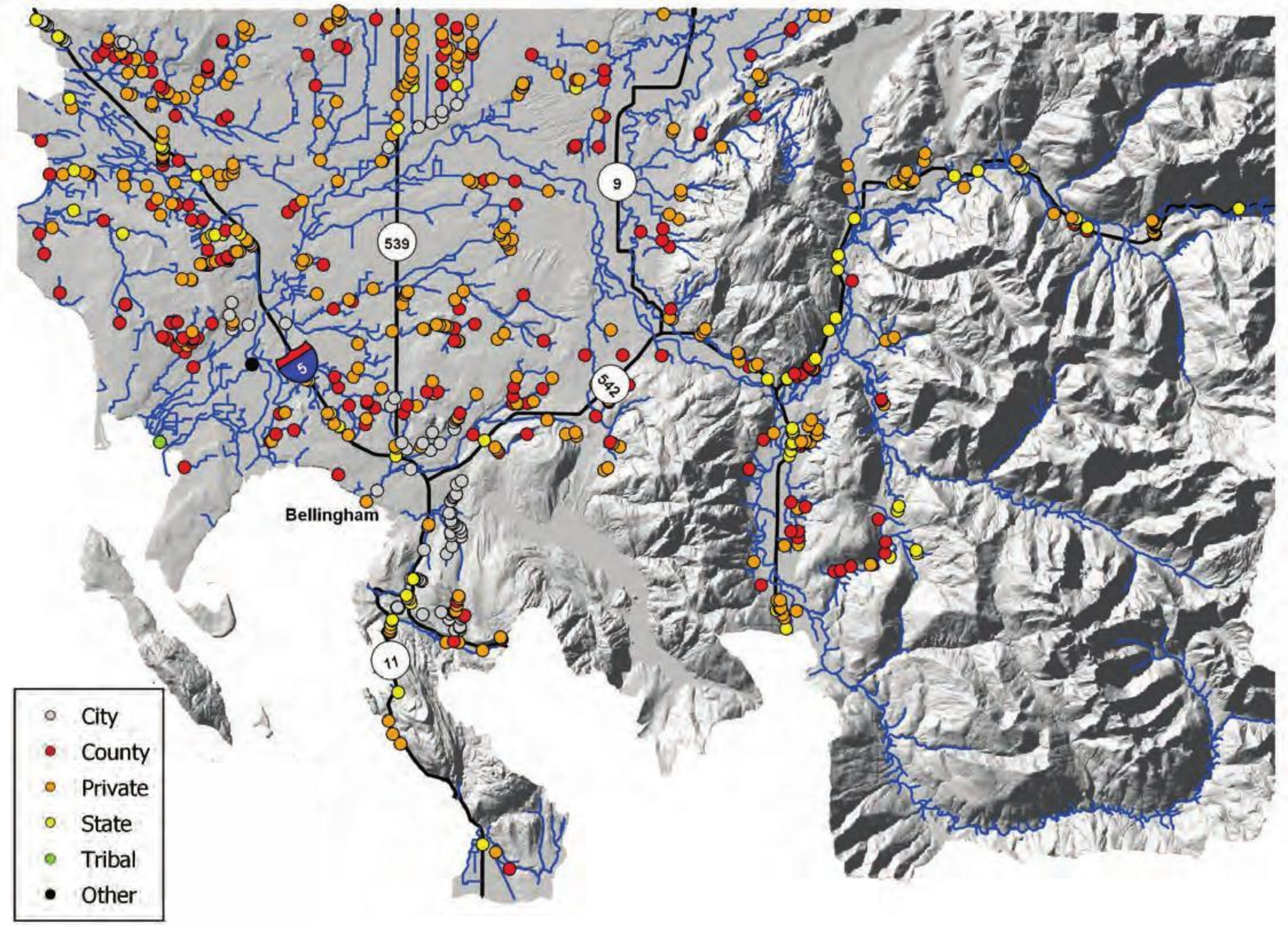
Forest cover from mature trees is critical to chinook habitat, providing shade to regulate stream temperatures, large woody debris to help form pools, and cover and root structure to help stabilize streambanks.[4] The WRIA 1 Salmon Recovery Plan targets a condition of greater than 70% riparian forest cover for the Nooksack River riparian zone.[5] The Nooksack River riparian zone was 50% forested in 2016, and right at the WRIA 1 Chinook Recovery Plan threshold between "poor" forest condition and "fair" forest condition.[6]

Forest cover is not distributed equally throughout the Nooksack River riparian zone. Most of the land needing riparian restoration to meet the 70% target is between the delta and the town of Everson. Riparian restoration opportunities in this area are challenging to come by, because it is primarily zoned in agriculture. If a 70% target is going to be reached, a higher priority will need to be placed by state and county government to ensure that landowners follow the law as it pertains to critical area buffers within channel migration zones and along large rivers.

Anadromous Barrier Culverts Have Increased

A total of 662 anadromous fish barrier culverts have been identified in the WRIA 01 area through 2019, this is an increase of 58 culverts since 2014. There were 116 new anadromous barrier culverts surveyed from 2015 through 2019. Over that same period, approximately 58 culverts that were blocking anadromous fish have been repaired or abandoned and are consider passable to fish.[1]

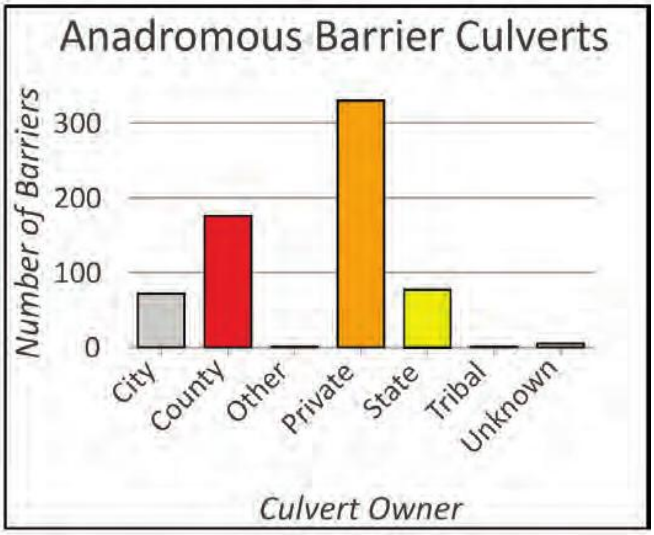
Barrier Culverts by Ownership within the WRIA 01 Watersheds



Through 2014, there were an estimated 604 culverts at least partially blocking anadromous migration in the WRIA 01 watersheds, and through 2019 this number had increased to 662 culverts.[2] Currently in the WRIA 01 watersheds, 54% of all barrier culverts are under government jurisdiction. Over 75% of barrier culverts are either privately owned (50%) and county owned (27%). Cities (11%.) and the state (12%) own the remaining barrier culverts. Less than 1% of culverts fall outside of these four ownership categories.[3]

Even with culvert repair, more barrier culverts are being discovered than repaired over time. For barrier repair to exceed the addition of new barriers, all ownerships need to accelerate their schedule for culvert barrier repair.[4]

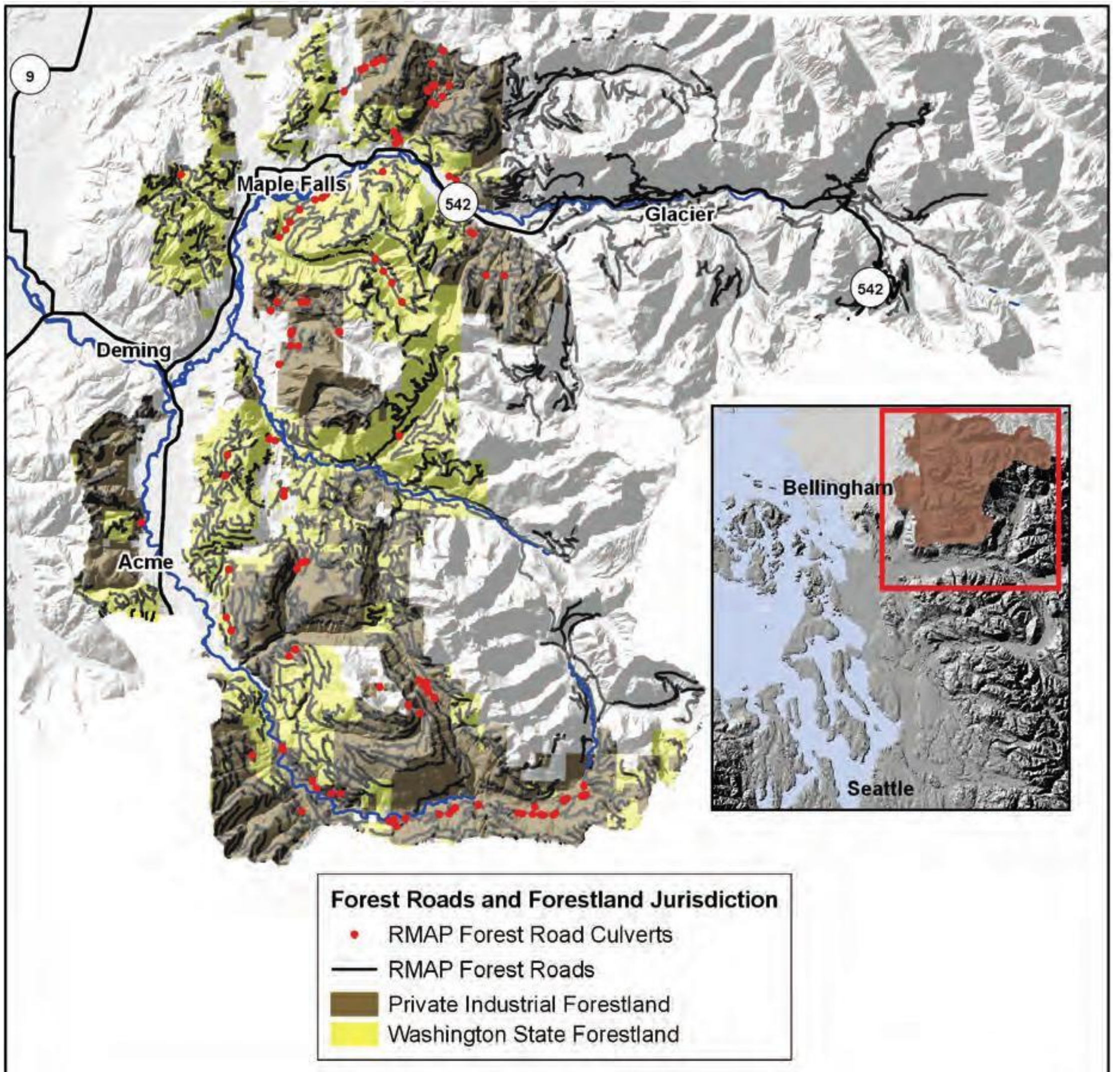
Map Data Sources: WADFW 2019,[7] SWIFD 2019,[8] SSHIAP 2004,[9] WADNR 2014c[10]



Culvert barriers to anadromous habitat in WRIA 01.[5,6]

Forest Road Maintenance and Abandonment on Schedule to be Completed in the Upper Nooksack Watershed by 2021

The Washington State Forest Road Maintenance and Abandonment Plan (RMAP) has led to the repair and/or abandonment of the majority of 1,426 total miles of private and state-owned forest roads in the Upper Nooksack River watershed.[1] RMAP has also resulted in the repair or removal of 45 of 58 (78%) fish barrier culverts on private and state-owned forest roads. Remaining road work falls primarily on Sierra Pacific owned lands and is on track to be completed by 2021.[2]



RMAP only applies to state and private forestland jurisdictions.

No alteration of the human landscape has a greater and more far-reaching effect on aquatic habitat than roads. The majority of forest roads in the Upper Nooksack basin are on private industrial and state lands and fall under the RMAP mandate. Considering the role improved water quality plays in chinook habitat, the current status of RMAP being almost complete in the Upper Nooksack watershed is good news to salmon recovery. While forest road density has increased in the Upper Nooksack basin since 2005,[4] it is expected that RMAP road repairs and abandonment offset some of the water quality problems associated with higher forest road densities. RMAP has resulted in the repair or removal of 45 of 58 (78%) fish barrier culverts on private and state owned forest roads and the remaining road work falls primarily on Sierra Pacific owned lands, which is on track to be completed by 2021. Culvert repair is scheduled to be done for 4 culverts by 2021, all on Sierra Pacific lands. The remaining 9 culverts are scheduled to be replaced when the culvert fails or at the end of the 'life of the pipe'.

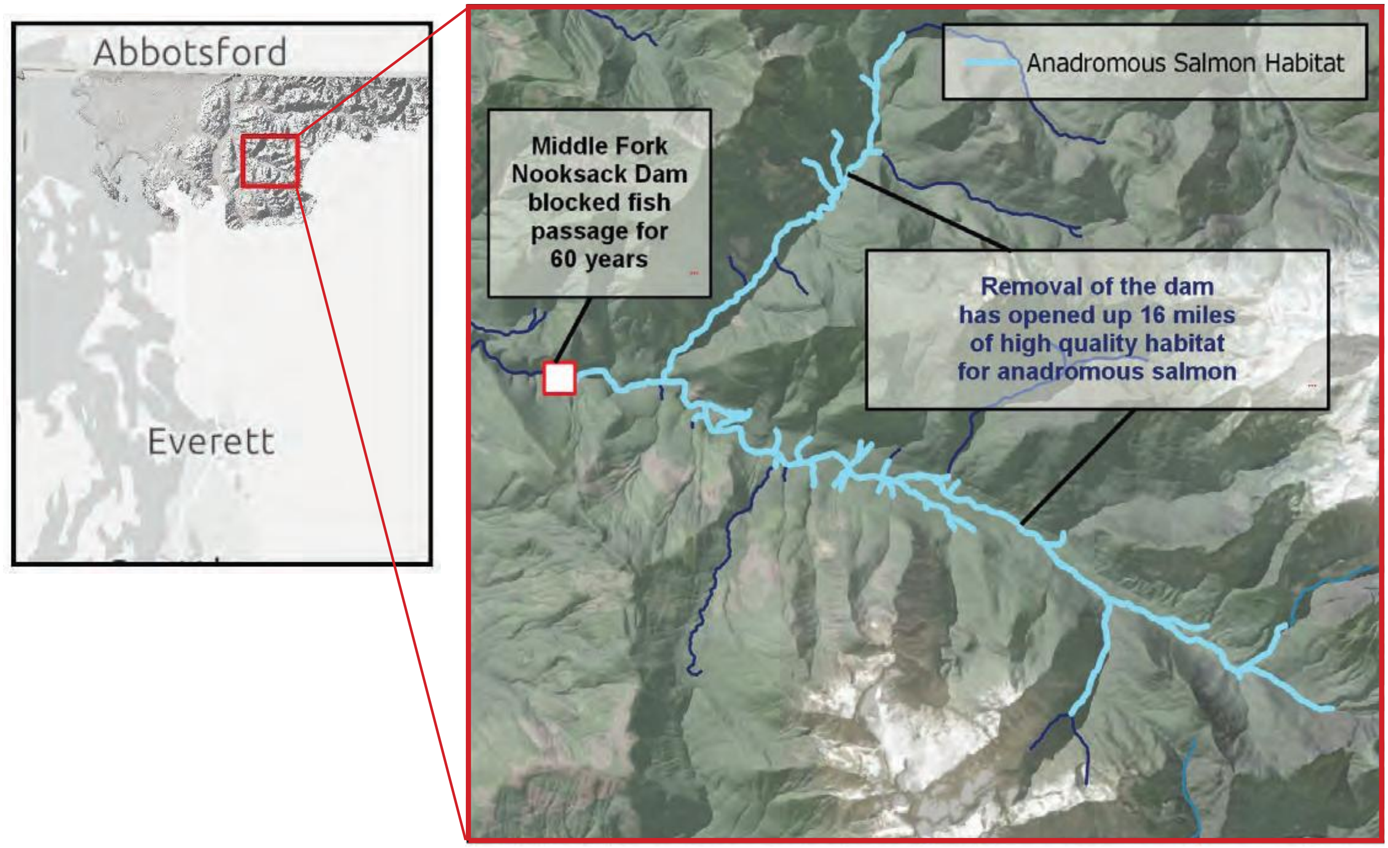
Small forest landowners were not required to develop a RMAP, and instead are expected to bring their roads up to standard and repair fish passage barriers as the roads are used for forest practices activities. Since no plans are in place there remains a great deal of uncertainty about the condition of the non-RMAP roads in the watershed.

Map Data Sources: Skagit Co. 2010,[5] Whatcom Co. 2011b,[6] WADNR 2014d,[7] WADNR 2014c[8]

Nooksack Indian Tribe

Middle Fork Nooksack River Dam Has Been Removed

Removing the Middle Fork Nooksack River Dam will restore access to 16 miles of relatively pristine habitat for threatened chinook salmon, bull trout and steelhead.[1] It is estimated that removing the dam will increase chinook salmon populations in the Nooksack River region by more than 30% and will increase steelhead habitat in the Middle Fork Nooksack by 45%.[2]



Removal of the Middle Fork Nooksack River Dam has opened up over 16 miles of potential anadromous salmonid habitat.

American Rivers, 2020

After 60 years, the Middle Fork Nooksack River Dam is being removed.[7]

The Middle Fork Nooksack diversion dam has been a fish passage blockage for 60 years since its construction for Bellingham city water in the early 1960s. Removal of the Middle Fork Nooksack Dam was the number one priority of the WRIA 01 Salmon Recovery Plan, and is considered to be the single most important habitat improvement for increased chinook populations. It also benefits bull trout, coho, steelhead, and the southern resident killer whales that forage on chinook salmon.[3]

Most importantly, it returns a physical and spiritual connection to this sacred river and watershed for the people of the Nooksack Tribe and Lummi Nation.

Map Data Sources: Skagit Co. 2010,[5] Whatcom Co. 2011b,[6] WADNR 2014d,[7] WADNR 2014c[8]

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Commercial Shellfish Growing Conditions Have Improved in Drayton Harbor and Birch Bay

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Shoreline Armoring Continues to Impact Forage Fish Habitat in Whatcom County

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Floodplain Habitats Are Critical to Chinook Productivity as Climate Change Increases Variability of Winter Freshwater Flows in the Nooksack River

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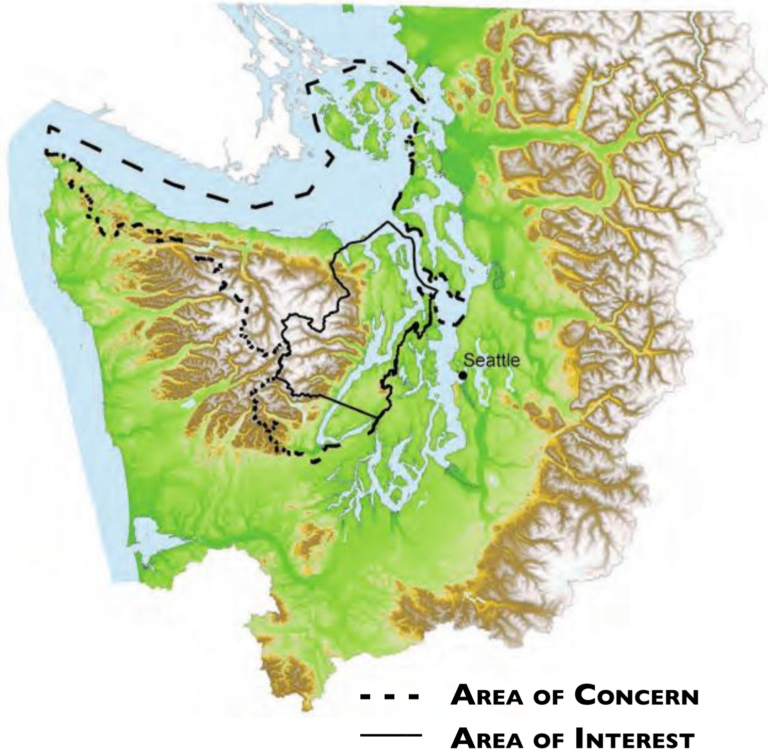
2020 State of Our Watersheds Report
Olympic & Kitsap Peninsulas

> *We are in the middle of challenging times. Our natural resources are facing many threats – a multitude of ESA listings and decreasing populations for subsistence and commercial salmon species, and increasing shoreline development and human population growth. In addition, we're dealing with new threats, such as climate change and ocean acidification. We are struggling to manage, conserve, enhance and protect our declining and threatened salmon populations. Restoration and recovery efforts are more important than ever before as we realize the realities we face of new threats and a critical need for immediate action.*
>
> **– PAUL McCOLLUM**
> **NATURAL RESOURCES DIRECTOR**

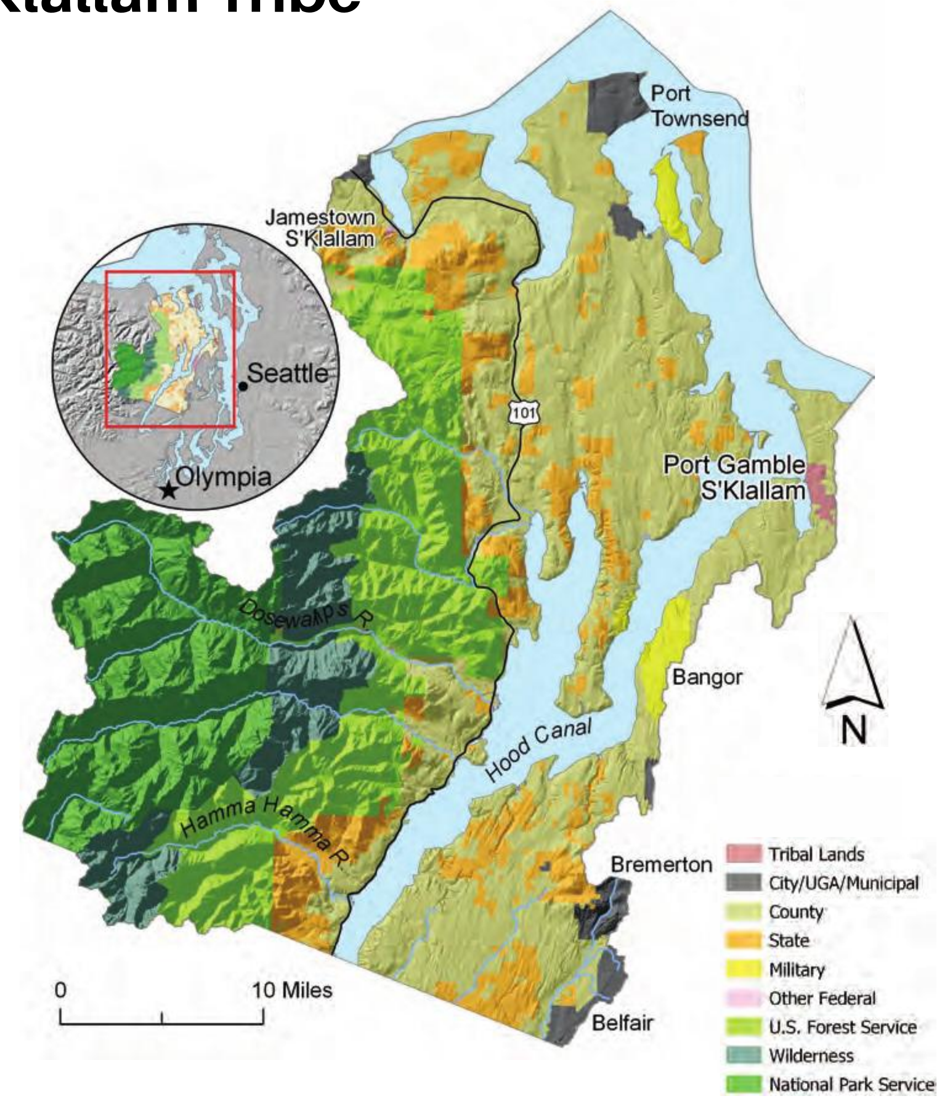


Port Gamble S'Klallam Tribe

The Port Gamble S'Klallam Tribe is part of the Klallam Band of Indians that has resided throughout the Strait of Juan de Fuca, Hood Canal and Port Gamble Bay for generations.

The northern Hood Canal and WRIA 17 watersheds have remained largely rural and forested with a natural resources-based economy focused on shellfish harvesting, commercial forestry, commercial fisheries, tourism and agriculture. Major land-use impacts on salmon habitat have occurred from floodplain and shoreline development, road construction and past logging practices. This report will focus on the WRIA 17 basin and surrounding marine waters, which is only a portion of the area where the Port Gamble S'Klallam Tribe works and manages.

Port Gamble S'Klallam Tribe



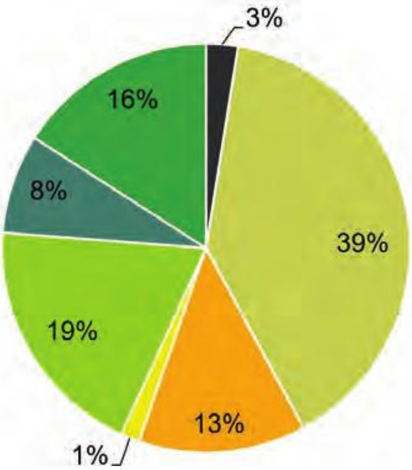
The Area of Interest for the Port Gamble S'Klallam Tribe report encompasses the northeast corner of the Olympic Peninsula in the rain shadow of the Olympic Mountains, south to the Hamma Hamma watershed. The area includes many smaller watersheds that drain the low elevation terrain of the Kitsap Peninsula and the steep eastern slopes of the Olympic Mountains into the Hood Canal, Admiralty Inlet and the Strait of Juan de Fuca. The Area of Interest is made up of portions of four counties: Kitsap, Jefferson, Clallam and Mason.

Geologic features in the landscape were created from a combination of seismic uplift, glaciation and fluvial processes. These past and current forces have had important consequences for the evolution of coastal shoreline features, stream drainages and headwater wetlands, many of which provide important spawning and rearing habitats in the nearshore for forage fish species and salmonids, including the Endangered Species Act (ESA) Threatened Hood Canal/Eastern Strait Summer chum and Puget Sound chinook.

Many streams in the Area of Interest have natural periods of low flows and may go dry during the summer months when precipitation is sparse. This tendency renders streams particularly vulnerable to human impacts on the habitat, such as from riparian vegetation removal and water extractions. While these streams may not flow year round, they provide important spawning habitat for fish populations, including coho, fall chum and steelhead.

Native American people in the Hood Canal and eastern Strait region had villages and fishing camps along the shorelines and near the mouths of major streams where they could take advantage of plentiful fish and shellfish resources. After the Point No Point Treaty of 1855, the Skokomish (traditionally the Twana) and S'Klallam tribes ceded their lands to the United States government and several Indian reservations were established. Euro-Americans had begun settlements around sawmills in the region to continue logging the old-growth timber that dominated the landscape.

Today the area is largely rural and forested, with communities relying on logging, fishing and recreation. Sizable portions of Water Resource Inventory Areas (WRIAs) 16 and 17 are contained within the Olympic National Park or United States Forest Service (USFS) Wilderness Areas and are protected from major habitat alterations. Major land use impacts on salmon habitat include floodplain and shoreline development, roads, and logging (especially in steep forested terrain). Today the vegetation is primarily made up of shrubs and young forests, with areas of primarily semi-rural residential and urban development across the landscape.



Map Data Sources: USFWS 2018[1], WAECY 2011[2], WAECY 2018[3], WAECY 1994[4], WADNR 2018[5,6,7], WADOT 2018[8]

Chapter Summary

The Port Gamble S'Klallam Tribe has fished, hunted and gathered in their watersheds in western Washington since time immemorial and are leaders in the region's salmon recovery effort, especially in the Olympic Peninsula and Hood Canal regions. The S'Klallams, among other tribes, have taken a large role not only culturally, but also scientifically to know these watersheds because of their importance to their people and the future. The tribe believes that if salmon and shellfish are to survive, real gains in habitat protection and restoration must be achieved.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The 2020 State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the salmon resource. The goal of this report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun collectively by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org*.

For this report, the tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. This document is considered a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Impervious Surfaces Increase with Population

Impervious surfaces prevent groundwater infiltration, increase stream temperatures, decrease biodiversity and contribute to pollutant run-off. Since the 2016 State of Our Watershed report, impervious surfaces in the Area of Interest have increased by 0.8%, or 61 acres. Increases in population bring increases in impervious surfaces as well and by 2040, the area is expected to have an additional 100,000 people.

New Wells Continue to be Added in Sensitive Areas

Over a four-year period, 342 wells were installed in the tribe's Area of Interest, from 2015 to 2019. This is a 108% increase since the 2016 State of Our Watershed report. Groundwater withdrawals negatively impact surface flow in rivers and streams critical for salmon habitat. Of the new wells, 112 were installed in WRIAs 15 and 17 that are closed to new water withdrawals for at least part of the year.

Hood Canal Bridge Impedes Salmon Migration

The Hood Canal Bridge spans the northern outlet of Hood Canal, connecting the Olympic and Kitsap Peninsulas. Its floating pontoons extend 15 feet deep from the surface of the water. These pontoons are impassable to juvenile salmon as they migrate to the ocean in the upper three feet of water. The bridge also traps plankton on which the fish feed. These combined factors cause fish to linger longer at the bridge, resulting in an increase to salmon predation. The Hood Canal Bridge Ecosystem Impact Assessment project reveals that up to 50% of migrating juvenile steelhead do not survive past the bridge en route to the ocean.

Port Gamble Bay Cleanup and Restoration Completed

In 2017, the Port Gamble Bay Mill site cleanup was completed, one of the biggest nearshore restorations in Washington state. A total of 106 acres were cleaned and 2/3 of a mile of shoreline was restored. The cleanup included removal of 8,500 toxic creosote pilings, 110,000 cubic yards of toxic wood waste and 55,000 square feet of overwater structures. The tribe is eager to see fish and wildlife return to the area as conservation easements are established and environmental monitoring continues.

Armored Shorelines Decrease Nearshore Habitat

In the Port Gamble S'Klallam Tribe's Area of Interest, 18% of the shoreline, or 54 miles, is identified as armored. Armored shorelines inhibit natural sediment movement and are detrimental to fish that spawn in the nearshore areas.

Sand Lance and Surf Smelt Habitat Conditions

Of the currently surveyed shoreline in the Port Gamble Focus Area, 20% of known sand lance and surf smelt shoreline spawning grounds are currently armored. Forage fish are a critical component in the Puget Sound food web and their numbers have greatly decreased from historic counts. These fish need adequate habitat and natural shorelines to successfully spawn. Forage fish are critical to salmon diet.

Herring Stocks Remain Critical in Port Gamble Bay

Since 1970, the herring stock in Port Gamble Bay went from a status of "Increasing" to "Critical." Of the herring's preferred shoreline spawning grounds in the area, 19% are currently armored. Historically, Port Gamble Bay had one of the largest herring stocks in the sound, but their numbers are greatly reduced due to shoreline alterations.

Monitoring Bluff Erosion for Climate Resilience

With ever increasing concerns of climate change, the tribe completed its first Climate Change Impact Assessment in 2017. One of their primary concerns was bluff erosion impacts. The entire coastline of the Port Gamble S'Klallam Reservation is being monitored so that a long-term dataset can provide accurate bluff erosion and sediment transport rates. The tribe plans to use this data for any necessary remediation to sustain healthy shellfish populations and to protect homes and infrastructure.

Chum Egg Survival may be Reduced by Hypoxic Conditions for Spawning Adults

The Port Gamble S'Klallam Tribe undertook an experiment to study the effects of hypoxic water on adult chum just prior to spawning and the effects on egg survival after spawning. This pilot experiment is to be used as a baseline and will be scaled up in the future. Initial results show that common hypoxic conditions in the Hood Canal may reduce the rate of egg survival of chum to the eyed-egg stage.

Conclusion

The biggest of success in the Port Gamble Bay is the completion of the large nearshore restoration project in the bay. The nearshore has been restored and both riparian restoration and nearshore restoration have been implemented. At the same time, the incremental decline in habitat conditions across the watersheds in their focus area has continued. Too much nearshore habitat remains armored, wells have increased their withdrawals from critical watersheds, impervious surfaces continue to expand as populations increase, habitat conditions for forage fish and herring continue to decline, and chum fish egg survival is a problem. Restoration is not enough to keep up with the impacts of a growing population and their land use in the watershed. People have to be held accountable to protecting, conserving and improving fish habitat in their land use decisions, and federal, state and local governments all have a role in that. Land use and water laws that are in place and meant to protect critical areas and fish habitat need to be implemented. Implementation includes education and voluntary action, but it also needs to include enforcement when those laws are broken. The future of tribal treaty rights in this area depends on it. The Port Gamble S'Klallam Tribe is working toward climate resilience, through monitoring of bluff erosion and evaluation of impacts to their reservation, and beyond.

Recovery Efforts Lagging

At the 15-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for WRIA 17 and northern Hood Canal area shows degrading water quantity and quality, increasing impervious surface areas, and degrading marine shoreline habitat conditions remain priority issues while some improvements are occurring with restoration efforts. In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the status of these key environmental indicators for the Port Gamble S'Klallam Tribe since the 2016 State of Our Watersheds Report shows a steady loss in habitat but improvement in restoration efforts:

Tribal Indicator	Status	Trend Since SOW 2016 Report
Impervious Surface	Impervious surfaces prevent groundwater infiltration, increase stream temperatures, decrease biodiversity and contribute to pollutant run-off. Since the last reported, impervious surfaces in the Area of Interest have increased by 0.8%, or 61 acres. Increases in population bring increases in impervious surfaces as well and by 2040, the area is expected to have an additional 100,000 people.	**Declining**
Water Wells	Over a four-year period, 342 wells were installed in the Port Gamble S'Klallam Tribe's Area of Interest, from 2015 to 2019. This is a 108% increase since the last State of Our Watershed report. Groundwater withdrawals negatively impact surface flow in rivers and streams critical for salmon habitat. Of the new wells, 112 were installed in WRIAs 15 and 17 that are closed to new water withdrawals for at least part of the year.	**Declining**
Restoration - Port Gamble Bay	The long awaited Port Gamble Mill Site cleanup was completed in 2017. Restoration efforts continue along with environmental monitoring to ensure the 10-year clean-up goals of the project are achieved.	**Improving**
Shoreline Modifications	In the Port Gamble S'Klallam Tribe's Area of Interest, 18% of the shoreline, or 54 miles, is identified as armored. Armored shorelines inhibit natural sediment movement and are detrimental to fish that spawn in the nearshore areas.	**Declining**
Forage Fish Habitat Conditions	Of the currently surveyed shoreline in the Port Gamble focus area, 20% of known sand lance and surf smelt shoreline spawning grounds are currently armored. Forage fish are a critical component in the Puget Sound food web and their numbers have greatly decreased from historic counts. These fish need adequate habitat and natural shorelines to successfully spawn. Forage fish are critical to salmon diet.	**Declining**
Pacific Herring Habitat Conditions	Since 1970, the Port Gamble Bay herring stocks have decreased from a status of increasing to critical, revealing potential relationships between fish decline, shoreline armoring, and climate change. Of the herring's preferred shoreline spawning grounds in the area, 19% are currently armored. Historically, Port Gamble Bay had one of the largest herring stocks in the Sound, but their numbers are greatly reduced due to shoreline alterations.	**Declining**
Climate Change	With ever increasing concerns of a changing climate, the tribe has completed its first Climate Change Impact Assessment (2017). One of their primary concerns was bluff erosion impacts. The entire coastline of the Port Gamble S'Klallam Reservation is being monitored so that a long-term dataset can provide accurate bluff erosion and sediment transport rates. The tribe plans to use this data for any necessary remediation to sustain healthy shellfish populations and to protect homes and infrastructure.	**Concern**

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

The Port Gamble S'Klallam Tribe's priorities center around the protection of Hood Canal, Admiralty Inlet and Port Gamble Bay marine and terrestrial resources and the ecosystems they depend upon for current and future generations. Most of their efforts are intended to protect and sustainably manage as well as enhance existing resources.

Their programs focus on sustainable management, beach seeding and enhancement including use of a shellfish nursery floating upweller system (FLUPSY) and protecting Hood Canal from impacts of threatening developments and pollution.

Greater focus and effort is required in conservation measures and restoration activities to offset negative habitat trends. Enhancement and restoration efforts in the Focus Area are not on pace to achieve the identified 10-year goals due to the lack of funding, staff capacity and landowner expectations.[1] Additionally, upgrading the regulatory framework that serves to protect salmon habitat must occur if the underlying assumption to meet all the recovery goals is to be realized – that existing habitat will be protected from loss.[2] Obviously, the 1999 recovery goals of keeping impervious covered areas maintained at or within the 10% threshold and rural growth rate of 1.08% have not been realized. A monitoring program on habitat status and trends should be implemented in conjunction with this regulatory reform to determine if observable differences can be detected as a result of implementation of new land-use regulations. "Net Ecological Gain" is a nice sounding new effort with legislation starting to stack up but the political will or lack thereof is always the primary limiting factor.

Climate change is emerging as a key priority for the tribe. More science is needed to better determine the potential impacts of climate change including sea level rise, bluff erosion, high energy storm impacts, ocean acidification and changes in temperature. Understanding the potential impacts is important, but it must be followed by actions. The tribe plans to determine what the environment may look like in generations ahead and address the management challenges to ensure that sustainably fishable and harvestable resources are achieved.

The tribe is trying to secure healthy and sustainable salmon populations, as well as access to them, for future generations with limited resources. Another concern is with the population and availability of cockles, which are an important subsistence resource for the tribe.

The tribe has placed much of its energy into nearshore work, including acoustic, beach seine and tow-netting studies to better understand the early marine life history of juvenile salmon. This includes a long-term partnership study on the effects of the Hood Canal Bridge on juvenile salmon.

The tribe is looking at associated limiting and/or constraining factors with juvenile salmon and forage fish relating to their nearshore habitat use, the floating bridge in Hood Canal, and dependence and impacts from the large areas of altered shorelines.

The tribe is involved in many projects to further understand and protect the resources within their Focus Area. The tribe is one of many partners working to determine how the Hood Canal Bridge impacts salmon and steelhead migration. The anthropogenic impacts on the water quality of the Hood Canal and Port Gamble Bay are of great concern to the tribe. The cleanup efforts of Port Gamble Bay remain a priority for the tribe, as is the Pollution Identification and Correction program, which they would like to see expanded.

Further research on using DNA to identify source pollution has also emerged as a priority for the tribe. Other emerging concerns include the contaminants found in fish that is consumed and associated effects on human health.

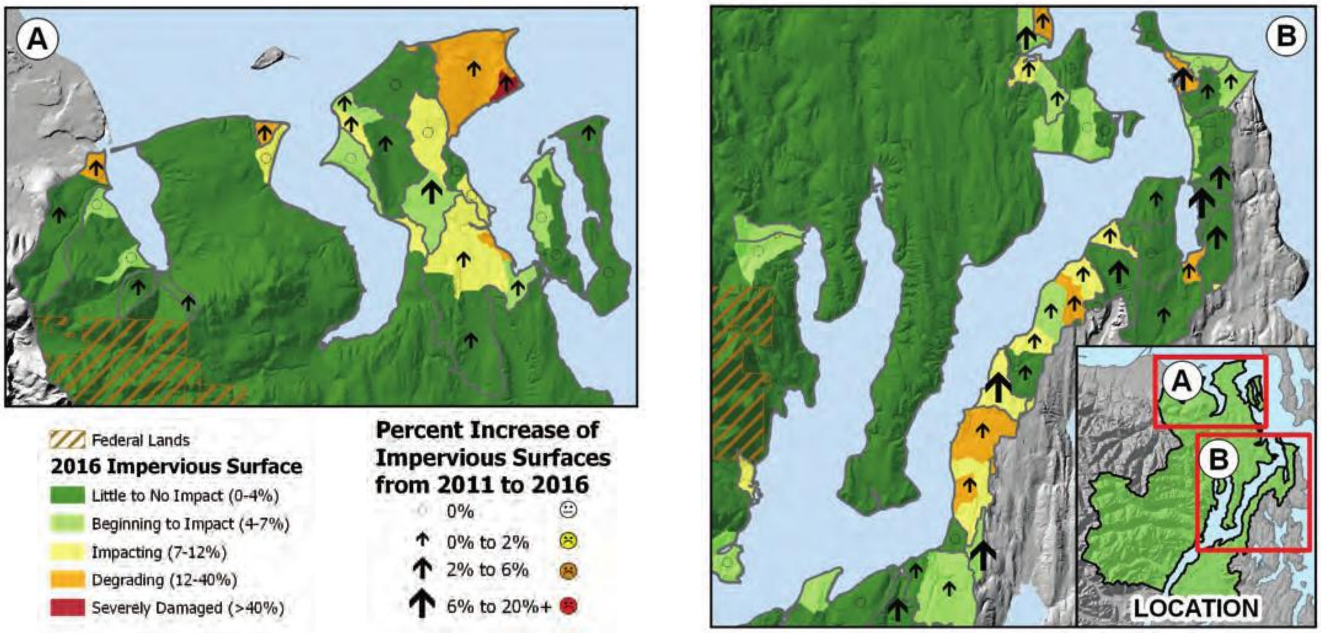
Tiffany Royal, NWIFC

Habitat biologist Hans Daubenberger prepares hydroacoustic equipment for launch in Port Gamble Bay.

PORT GAMBLE S'KLALLAM TRIBE

Population Density and Impervious Surface Impact Water Quality

The total impervious surface area increased by 0.8% from 2011 to 2016 in the Area of Interest. Of the 328 sub-watersheds, 38 had impacted habitat conditions from impervious surfaces in 2016 and 61 sub-watersheds had increases of impervious surface area between 2011 to 2016. The areas with the highest population densities had the most impervious surfaces.



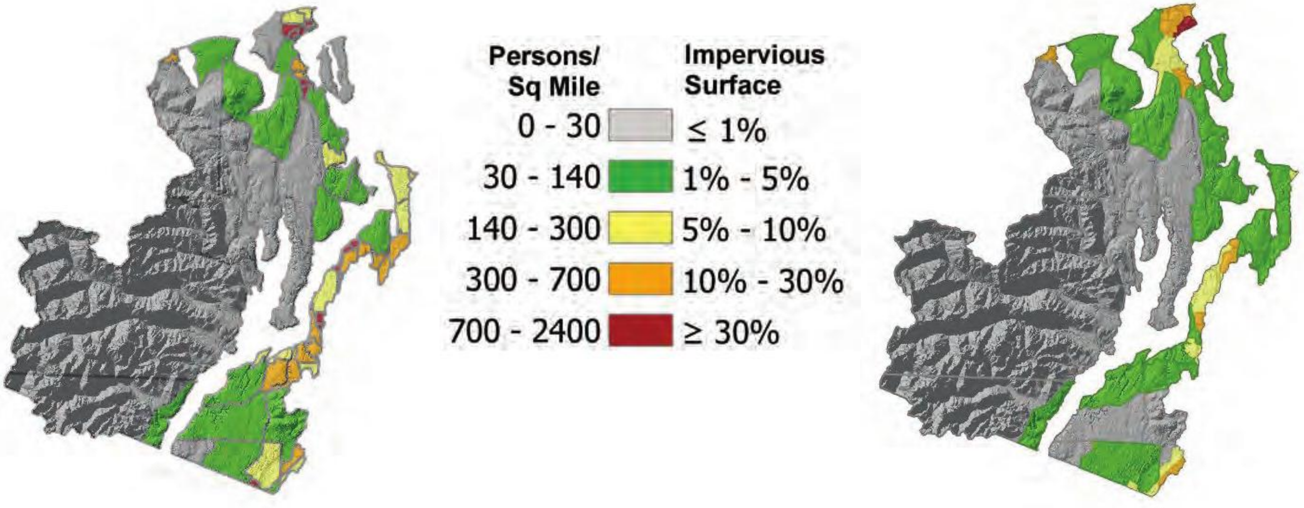
Impervious surface area is well documented as a coarse measure of human impact on watershed-scale hydrology and biology.[1,2,3] The Hood Canal and Strait of Juan de Fuca Summer Chum Recovery Plan describes thresholds of 10% impervious surface area in a watershed at which sensitive stream habitat elements are lost, while 25% to 30% impervious surface area results in poor water quality.[4]

Each watershed will have a different reaction to a given amount of impervious surface area; thresholds serve only to generalize the degradation that accrues as impervious surface area increases and forest cover is lost.[2] Many species within the watersheds show signs of stress and population decline well before the 10% impervious surface area threshold is reached.[5]

Impervious surface area causes increases in stream temperatures, decreases in stream biodiversity, and contributes to pollutants in point and nonpoint sources of stormwater runoff which can contaminate local aquatic systems[6] and lead to shellfish area closures. Aquatic and marine organisms respond immediately to these changing habitat elements, resulting in fatalities,[7] impaired physiological functions or migration to more hospitable areas.[8]

Areas with high population densities also have large amounts of impervious surfaces. Clallam, Jefferson, Kitsap and Mason counties are projected to have a total increase in population of nearly 100,000 people between the years of 2020 and 2040; over half of those people are projected to be in Kitsap County.[9]

Impervious Surface Area Increases with Population Density

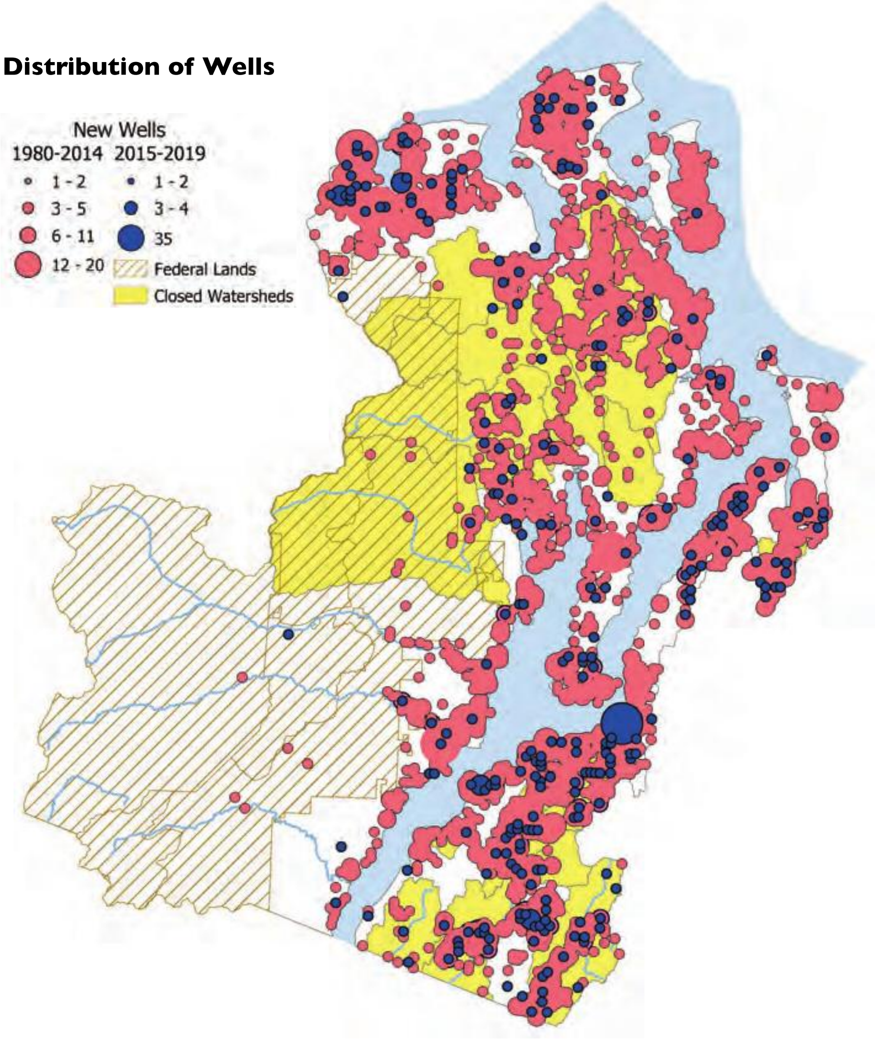


Map Data Sources: WAECY 1994,[10] WAECY 2011,[11] WAOFM 2016,[12] WADNR 2014,[13] NLCD 2019[14,15]

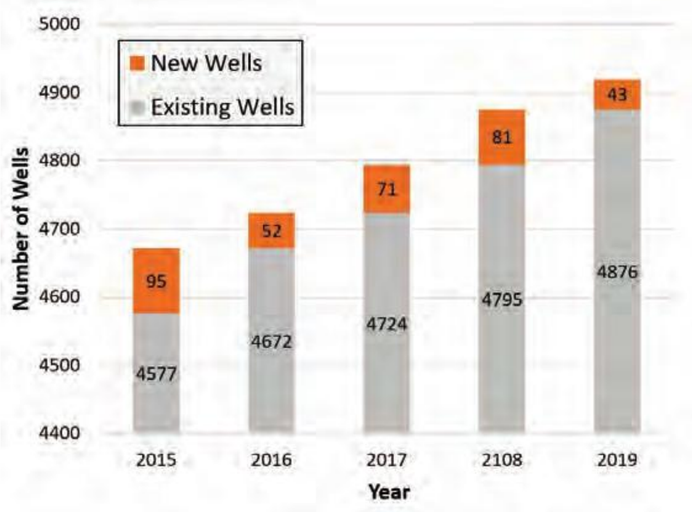
Water Extractions Impact Surface Flow and Fish Usage

From 1980 to 2014, 4,577 wells were installed in the Port Gamble S'Klallam Tribe's area of interest. From 2015 to 2019, 342 new wells were added. This is a 108% increase over the new well installs reported in the 2016 State of Our Watershed report (164 new wells installed from 2011-2014). Of the 342 new wells added from 2015 to 2019, 112 were installed in WRIAs 15 and 17 that are closed to new water withdrawals at least part of the year.

Distribution of Wells



New Wells in the Area of Interest



The watersheds within the Area of Interest receive 15-100 inches of precipitation per year, primarily in the winter months.[1,2,3] Little precipitation falls during the dry summer months when water needs are greatest, resulting in stream recharge from groundwater sources. However, groundwater and surface water are one resource and changes to one will impact the other.[4]

Salmonid species, including summer chum and steelhead, rely on adequate streamflows to access suitable, upstream spawning habitats and to regulate water temperatures and stream substrate.[5] Exempt wells are entitled to withdraw up to 5,000 gallons of water per day, which impacts the instream flow of nearby salmon streams. With climate change impacting the area, summer low flow periods are expected to get longer which will result in increased stream temperatures.[6] This will compound the negative effects of groundwater extractions on freshwater salmon habitats. The Area of Interest experienced several periods of severe drought since the last SOW report.[7]

From 2015 to 2019, new wells in the Area of Interest increased 108% over the 2011 to 2014 period. Of the 364 new wells added since 2015, 112 were installed in WRIAs 15 and 17 which, combined, have 8 streams closed to new surface and groundwater withdrawals at least part of the year, and 32 streams completely closed to all new water uses.[1,8]

The Department of Ecology's instream flow rules are designed to protect instream resources by mandating minimum water levels for streams.[9] However, many of the instream flow rules are inadequate for protecting salmonid species and ensuring their ability to reproduce in the wild, a primary goal in the evaluation of instream flow rules.[10] Tribes have attempted to update instream flow rules for important salmon-bearing streams through the Department of Ecology with little success, occasionally resorting to legal action.[11]

Conservation of freshwater resources for instream and human uses is one of the five primary objectives in Puget Sound Partnership's Action Agenda.[12] Water withdrawals and diversions are listed as one of the high pressures on the local ecosystem within the Hood Canal Action Area.[13]

Map Data Sources: WAECY 1994,[14] USGS 2018,[15] WADNR 2018,[16] WAECY 2019[17]

PORT GAMBLE S'KLALLAM TRIBE

Hood Canal Bridge Ecosystem Impact Assessment

Up to 50% of migrating juvenile steelhead that encounter the Hood Canal Bridge (Figure 1) do not survive migration past the structure. Tribes, state, federal, non-profit and local agencies are studying the impacts the bridge is having on fish, water quality and habitat.

Figure 1. Hood Canal Bridge Location

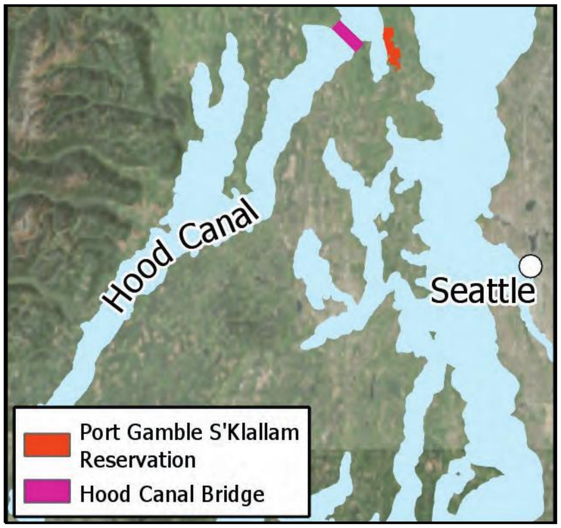
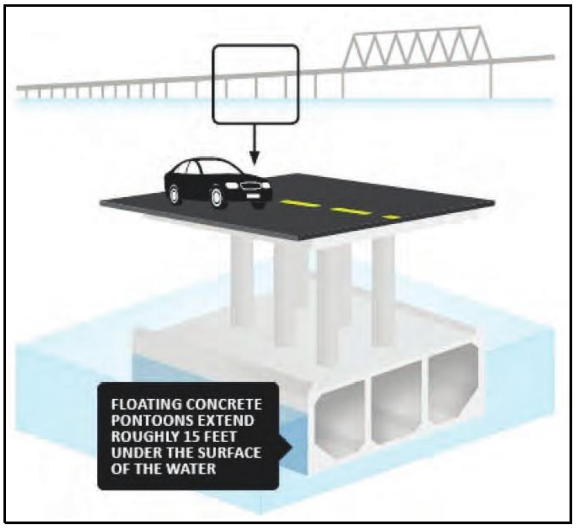


Figure 2. Hood Canal Bridge Cross Section[2]



The Hood Canal Bridge Ecosystem Impact Assessment project is aimed at investigating the causes of high steelhead mortality at the bridge and whether the bridge is impacting other fish species and overall ecosystem health in the Hood Canal.[1] The goal of this project is to provide potential solutions that can improve fish passage and survival.

The Hood Canal Bridge Assessment Team is a collaboration of federal, state, tribal and non-profit partners, in which the Port Gamble S'Klallam Tribe plays a role. Long Live the Kings, a regional non-profit, coordinates this group.[2]

The Hood Canal Bridge spans the northern outlet of Hood Canal, connecting the Olympic and Kitsap peninsulas. As a floating bridge, its pontoons span 83% of the width of Hood Canal and extend 15 feet down into the water (Figure 2).[3]

A study was designed to measure survival probability of steelhead smolts from their origins at Big Beef Creek and the Skokomish River (Figure 3). Survival is defined as detection at telemetry arrays along the fish's migration route from Hood Canal to the Pacific Ocean (Figure 4). Lack of detection at a subsequent array indicates mortality of the individuals that had been detected at the previous array. Some mortality occurs between each array, but survival probability drops significantly between detection at the Hood Canal Bridge and detection only six miles (10km) further at Twin Spits.

(Continued next page)

Figure 3. Survival Probability of Steelhead Smolts with Distance from Origins[4]

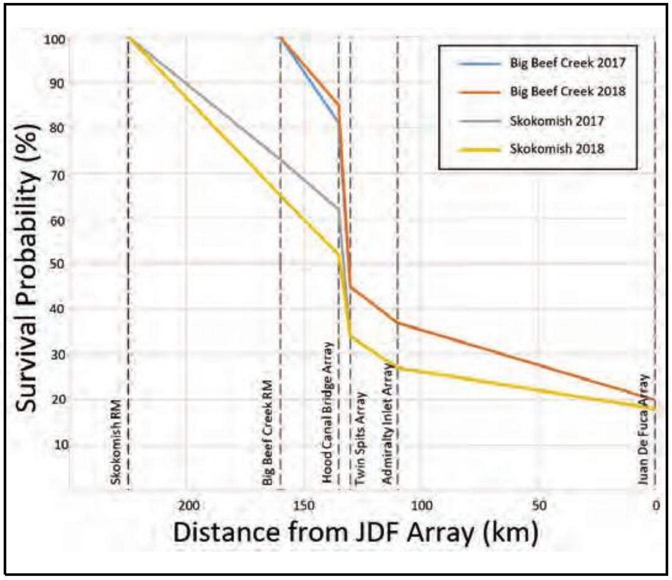
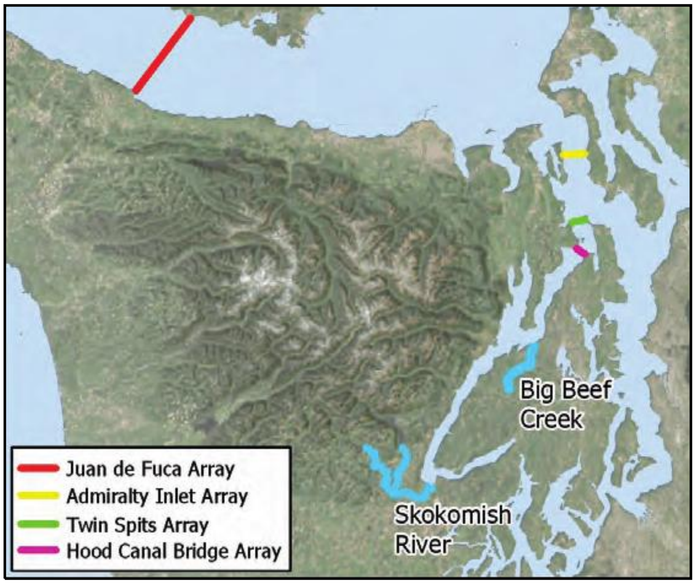
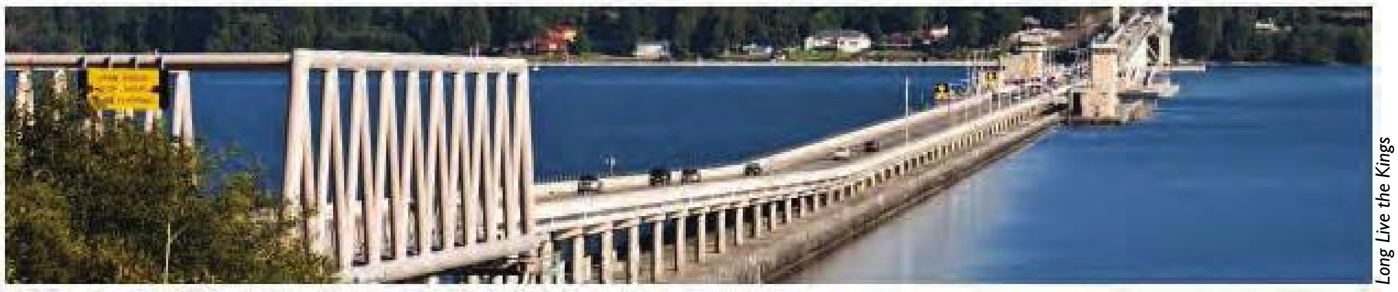


Figure 4. Telemetry Array Locations



Map Data Sources: NOAA 2019,[4] NAIP 2017,[5] LLTK 2019[6]


Long Live the Kings

(Continued from previous page)

Results from Phase 1 of the Impact Assessment show that light and noise from the bridge do not appear to directly contribute to fish mortality. The bridge also did not appear to impact fish densities in the greater vicinity of the structure. However, results showed that steelhead and other juvenile Pacific salmon species out-migrate within a few feet of the water's surface, therefore they experience a physical obstruction when encountering the bridge (Figure 5).[1,2] The assessment team observed very high densities of fish in the immediate vicinity of the structure, particularly at sections of the pontoons that form sharp angles, confounding the fish searching for passage around either end. Certain portions of the bridge appear to aggregate plankton, motivating chinook and chum salmon as well as forage fish species to linger and feed.

Increased time at the bridge leaves juvenile fish susceptible to predation (Figure 6). Results from Phase 1 show high densities of bird and mammal predators at the bridge compared to the surrounding area. Visual acoustic data indicate that seals feed around the clock, taking advantage of the pontoon's sharp angles which cluster the fish. Additional research is needed to fully understand the impacts to marine life near the bridge.

During Phase 2, the assessment team and the management committee, made up of local, state and federal stakeholders, will develop, test, refine and implement a suite of potential near-term actions to mitigate adverse impacts of the bridge while developing a long-term solution to address the obstruction of fish passage.

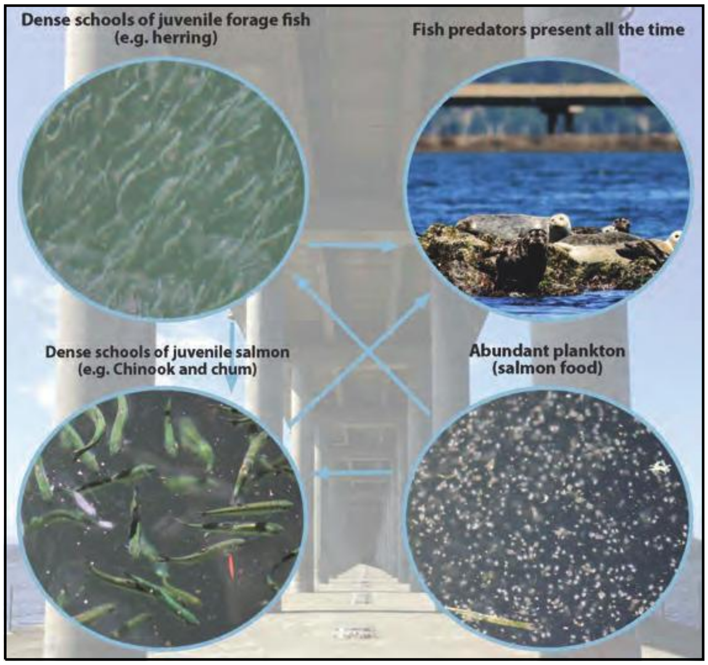
Use Your Phone to Scan and Watch

Survive the Sound

HCB Q13 Story

Figure 5. Hood Canal Bridge Obstructs Out-Migration of Fish[2]

Figure 6. Predator and Prey Interaction at the Hood Canal Bridge[2]



Port Gamble Bay Aquatic Cleanup

The long-awaited Port Gamble Bay aquatic clean up was completed in 2017. Plans for the upland clean up and restoration continue along with environmental monitoring to ensure the 10-year aquatic cleanup goals of the project are achieved.

Port Gamble Bay, *nəxʷqiyt* or *Noo-kayet* in S'Klallam, is located at the north end of the Kitsap Peninsula, just south of the opening to Hood Canal (Figure 1). Port Gamble Bay is part of the tribe's ancestral history, with archeology from Point Julia indicating that people have been using and living along the bay's shore for more than 1,000 years.[1]

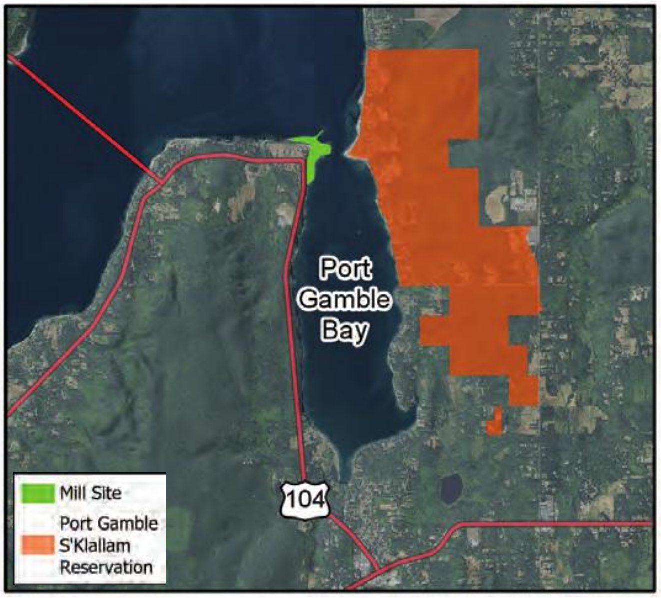
It is home to one of the largest herring stocks in Puget Sound among many other culturally, subsistence and commercially important species such as clams, oysters, geoduck and several species of salmon.[1]

With the signing of the Point No Point Treaty of 1855,[2] the S'Klallam tribes retained the right to fish, hunt and gather in their Usual and Accustomed areas.[3] A healthy and functional ecosystem in Port Gamble Bay is essential for the tribes to exercise their treaty-reserved rights.

In 1853, The Puget Mill Company (Pope & Talbot, Inc.'s predecessor) built a mill at the mouth of Port Gamble Bay, where an ancestral S'Klallam village was already established.[1] In the mid-1980's, pollutant monitoring began in the bay by the tribe.[1] The state Department of Health and Department of Ecology took notice of the tribe's studies, resulting in the mill being shut down in 1995 and removed in 1997.[1] By 1999 Ecology began issuing shellfish closures in the bay due to toxins leached from hundreds of thousands of tons of woody debris from the mill site.[1] These toxins included cadmium, petroleum hydrocarbons, lead, arsenic, carcinogenic polycyclic aromatic hydrocarbons (cPAHs) and dioxins/furans.[4] Negotiations between Pope Resources (owner of the mill site) and Ecology went on for more than a decade when an agreement was finally reached in 2013 outlining how the site cleanup was to be performed.[1]

Cleanup of the bay was completed in 2017. A total area of 106 acres from the polluted bay was remediated including the removal of more than 8,500 creosote pilings, 110,000 cubic yards of contaminated wood waste, and 55,000 square feet of overwater structures.[4] In addition, 200,000 tons of clean capping and habitat materials were placed, and 113,000 cubic yards of clean sand was introduced.[4] Ecology is currently monitoring the area to ensure the project meets the 10-year remediation goals.[1]

Figure 1. Location of Former Mill Site and Port Gamble S'Klallam Reservation



Planning for the upland cleanup of the mill site soils is now underway. The upland cleanup consent decree between Ecology and Pope Resources and a cleanup action plan are scheduled for completion by the end of 2020.

A mediated agreement was reached between Pope Resources and the tribe in November 2019. This agreement includes the sale of 937 acres of timberland to the tribe, an 18.4-acre conservation easement on the former mill site and adjacent tidelands, tidelands leased to the tribe, and protections to ensure healthy water quality, shorelines and streams.[5]

The tribe was generously awarded Washington State ESRP, WWRP, and ALEA grants for the protection of the former mill site in perpetuity for the purpose or restoration and public access. Development of the shoreline restoration design is now underway.

Before Cleanup at Mill Site

After Cleanup at Mill Site

"The Port Gamble S'Klallam have a long history with Pope Resources. The mill played a big role in our lives as a source of employment as we adapted to European settlement, but also hurt Port Gamble Bay and its shoreline. The last several years have brought good things: the cleanup work on the bay and, of course, our conversations with Pope Resources that led to this deal. We look forward to the future and watching this area that we call nəxʷqiyt or Noo-kayet *continue to heal and come back to life. Our culture and traditions depend on it."* – Jeromy Sullivan, PGST Chairman.[5,6]

Map Data Sources: NAIP 2017,[7] WADOT 2020,[8] WADOT 2018[9]

PORT GAMBLE S'KLALLAM TRIBE

Nearshore Habitat Loss in Hood Canal and Strait of Juan de Fuca

Since 2009, nearly 18% of the marine shoreline in the Port Gamble S'Klallam Tribe's Area of Interest has been identified as armored. A closer look at Port Gamble Bay's shoreline shows almost 27% is currently armored.

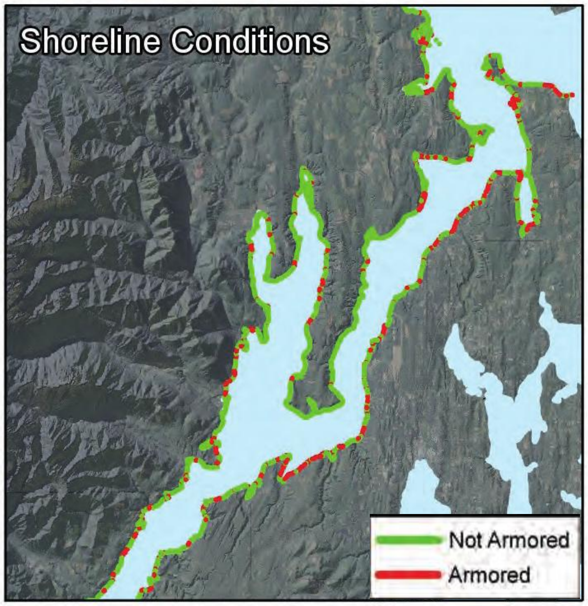
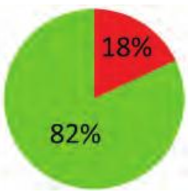


Figure 1



No portion of the Hood Canal has been more radically altered than the southern Hood Canal. In contrast, Point Julia, home to the Port Gamble S'Klallam Tribe, has the most frequently used and most heavily accessed spit complex on Hood Canal while maintaining natural functions and values.[1]

Natural Shoreline

Armored Shoreline

Washington Coastal Atlas (2)

The Action Agenda[2] has identified habitat alteration as a primary threat in the Puget Sound region. Shoreline alterations such as jetties and rockwalls interrupt the flow of sand on beaches. Docks and bulkheads cover beaches so that plant life and fish species are not productive in these areas.[2] Data from the tribe's Area of Interest shows that nearly 18% of the shoreline is armored (Figure 1). However, when focusing on the area around Port Gamble Bay, a known productive area for salmonids and forage fish, it is noted that nearly 27% of the shoreline is armored (Figure 2). The Port Gamble Bay area and surrounding shoreline has a significant amount of forested area upland of the bay that is not developed. Shorelines in the reservation section of the drift cell remain mostly unmodified and have significant wooded bluffs which contribute sediment supply to the spit at Point Julia.[1] Additionally, these bluffs provide large woody structure in the nearshore environment and overhanging shade for out-migrating salmon.[1]

The tribe's Area of Interest comprises portions of four county jurisdictions: Clallam, Jefferson, Kitsap and Mason. Data available from the HPA database shows that shoreline armoring is increasing for each of these counties.[1] From 2015 to 2018, there was 3,692 feet of shoreline armored in Clallam, Jefferson, Kitsap and Mason counties combined (Figure 3).[1] As of 2017, there is 54 miles of armored shoreline in the tribe's Area of Interest.[3]

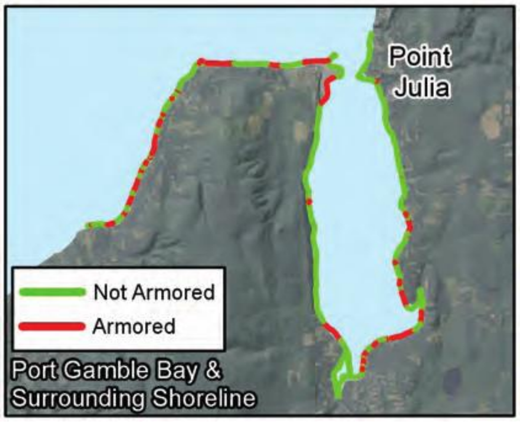
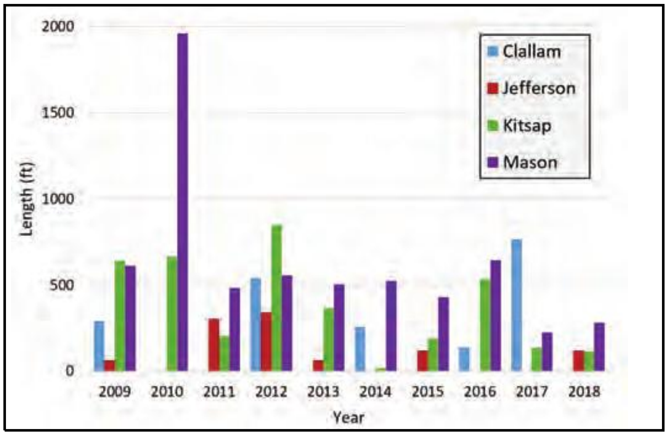


Figure 2

Figure 3: New Shoreline Permits Length by County



There is an unknown amount of unpermitted armoring that is not included in the graph above.

Map Data Sources: NAIP 2017,[4] WADNR 2011,[5] WADOE 2012,[6] Carman 2015,[7] WDFW 2019,[8] SSHIAP 2004,[9] GCS 2017[10]

Sand Lance and Surf Smelt Spawning Habitat Conditions

As of 2014, approximately 22 miles (or 20%) of shoreline has been armored out of 111 miles of documented sand lance and surf smelt spawning habitat in the Port Gamble S'Klallam Tribe's Area of Interest. Shoreline armoring interrupts the movement of sediment along beaches and can negatively affect forage fish spawning habitat.

Surf smelt and Pacific sand lance are a key link in the Puget Sound food web between zooplankton and larger predatory fish and wildlife, such as salmonids.[1,2] Sand lance are recognized as a critical element of juvenile chinook salmon's nearshore diet.[3] Sand lance and surf smelt spawn on upper intertidal beaches consisting of sand and gravel, and shoreline armoring and development can negatively affect these species' spawning sites.[1]

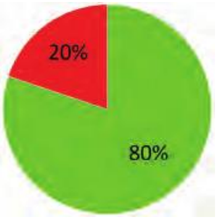
Currently, almost 20% of the shoreline in the tribe's Area of Interest has been armored by various anthropogenic means to the possible detriment of these species. Additionally, sea level is expected to rise substantially this century, which would profoundly affect the structure and function of the Puget Sound ecosystem.[4] Maintaining abundant surf smelt and sand lance in Puget Sound is a conservation imperative, but current regulations do not consider cumulative or off-site impacts of armoring, cannot prohibit armoring in most cases,[5] and do not address likely future conditions such as climate change.[6]

Cumulative distribution functions of catch per unit effort indicate that historically dominant forage fishes (Pacific herring and surf smelt) have declined in Central and South Puget Sound.[7] The results of this study suggest that some Puget Sound sub basins have reduced capacity to support forage fish that were highly abundant historically, and these patterns are consistent with other historic studies. These studies suggest the possible linkage between anthropogenic activities and development, as well as changing climate conditions on the abundance of forage fish in Puget Sound.


PNPTC 2014

Shoreline armoring impacts nearshore spawning habitat for forage fish in Puget Sound.

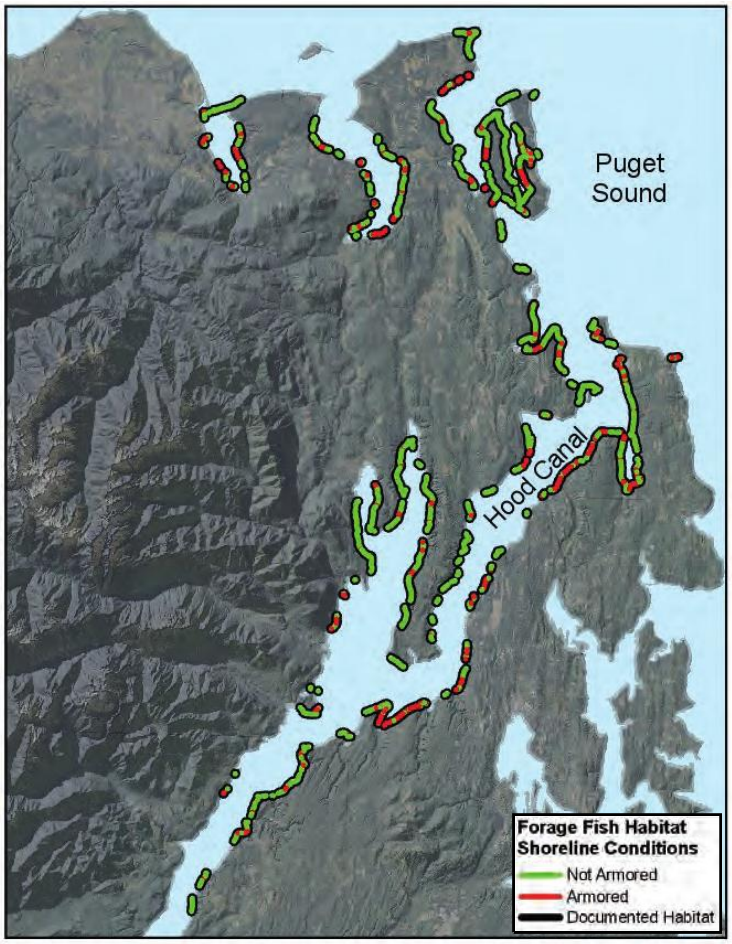
Pacific Sand Lance and Surf Smelt Habitat Conditions




WDFW

Surf smelt (top) and sand lance (bottom)

This pie chart shows the proportion of armored and unarmored shorelines within known forage fish spawning areas in the Port Gamble S'Klallam Tribe's Area of Interest. Armoring affects the natural sediment dynamics of spawning beaches and can negatively impact the habitat for these fish. Of note, not all beaches were surveyed for forage fish.

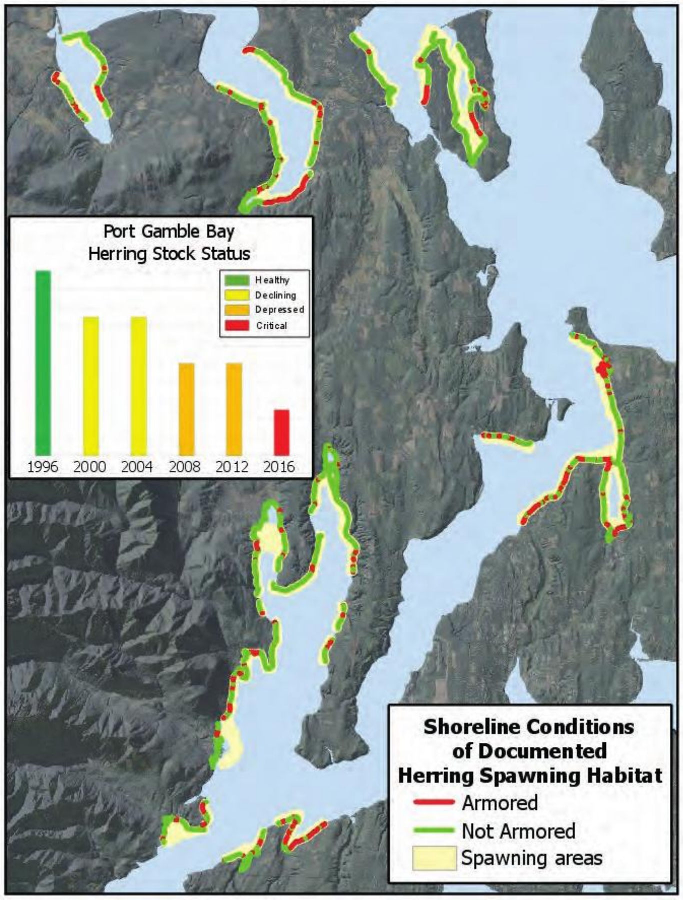


Map Data Sources: NAIP 2017,[8] WADOE 2012,[9] WDFW 2014,[10] WADFW 2014[11]

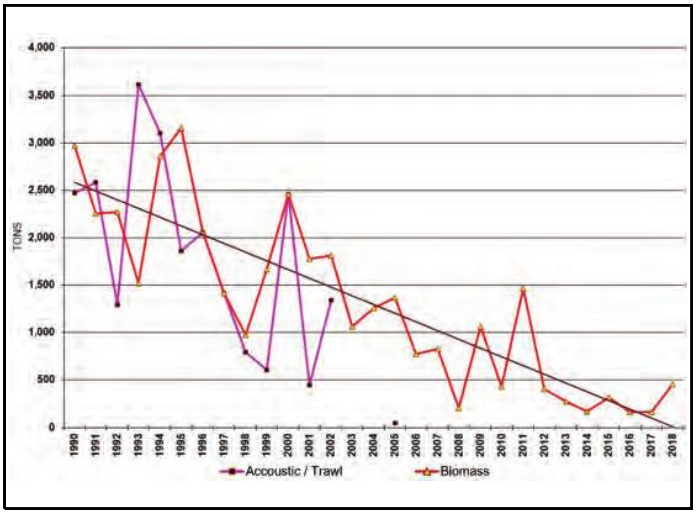
PORT GAMBLE S'KLALLAM TRIBE

Pacific Herring Spawning Habitat Conditions

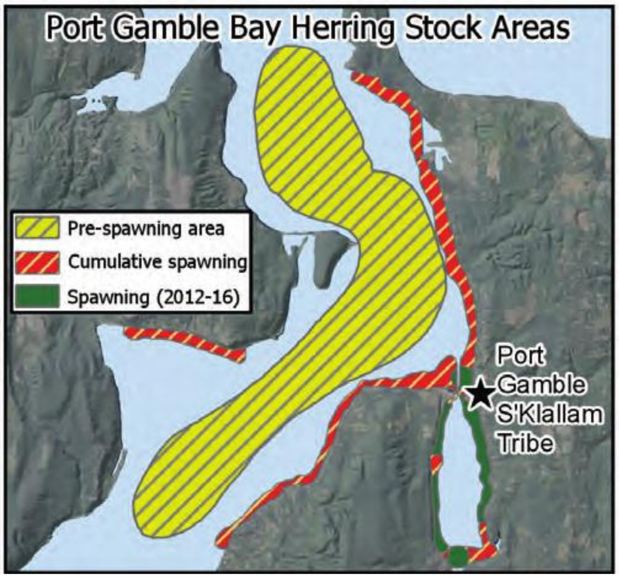
From 1970 to 2016, Port Gamble Bay herring stocks have decreased from a status of increasing to critical, revealing potential relationships between fish decline, shoreline armoring and climate change.[1] As of 2016, approximately 22 miles (19%) out of 118 miles of documented herring spawning areas in the Port Gamble S'Klallam Tribe's Area of Interest are identified as armored. Historical evidence shows Port Gamble Bay having one of the largest Pacific herring stocks in Puget Sound. However, considerable spawning habitat has been lost due to shoreline alterations.[2]



Port Gamble Herring Stock, Spawning & Recruitment 1990 to 2018



Map Data Sources: WDFW 2019,[7] GCS 2017,[8] SSHIAP 2004,[9] NAIP 2017[10]



Herring were included in the 1974 Boldt decision, which defines Native American fishing rights.[3] They are a vital forage fish in the marine ecosystem and an indicator of the overall health of the marine environment.[4]

The herring stock in Port Gamble Bay was considered one of the larger stocks in Puget Sound when quantitative survey efforts began in the late 1970s.[4] However, this stock has shown a decreasing trend since then and are currently listed as critical (a 4-year mean abundance 81-99% below the 25-year mean).[4] Research indicates that priority habitat for herring is in sheltered bays, like Port Gamble Bay, where sediment grain size, tidal fluctuations and vegetation types are all suitable for spawning.[4] Currently, 19% of documented spawning habitat within the Port Gamble S'Klallam Tribe's Area of Interest have armored shorelines which affects the ability of herring to successfully spawn.[4]

Herring spawn in a select few areas where the environmental conditions are suitable such as sheltered bays like Port Gamble and Quilcene bays.[2] Since 1992, the WDFW Port Gamble stock status has declined from increasing to critical.[4] Development and other anthropogenic impacts within these bays will continue to remove viable healthy habitat for herring. The decline of herring stock could be exacerbated with the unknown consequences of climate change.[1] A 2015 study revealed that Pacific herring embryos had a lower survival rate within Port Gamble Bay than outside of it due to toxic contaminants in creosote pilings at the old mill site.[5] However, the tribe recently completed a cleanup and restoration of the mill site, removing more than 8,000 creosote pilings, with the intention of supporting increased herring spawning and survival into adulthood.[6]

PORT GAMBLE S'KLALLAM TRIBE

Monitoring Bluff Erosion for Climate Resilience

The Port Gamble S'Klallam Tribe is concerned about the impacts of a changing climate on its reservation and natural resources in their region. In 2017, the tribe completed their Climate Change Impact Assessment which assesses their resources and the impacts of climate change. Of particular concern is bluff erosion which poses a threat to homes and infrastructure, while also supplying sand and gravel to beaches. Bluff erosion is a natural process which supports important natural resources like shellfish and forage fish and sustains important cultural features like Point Julia.

Figure 1. Bluff Study Location

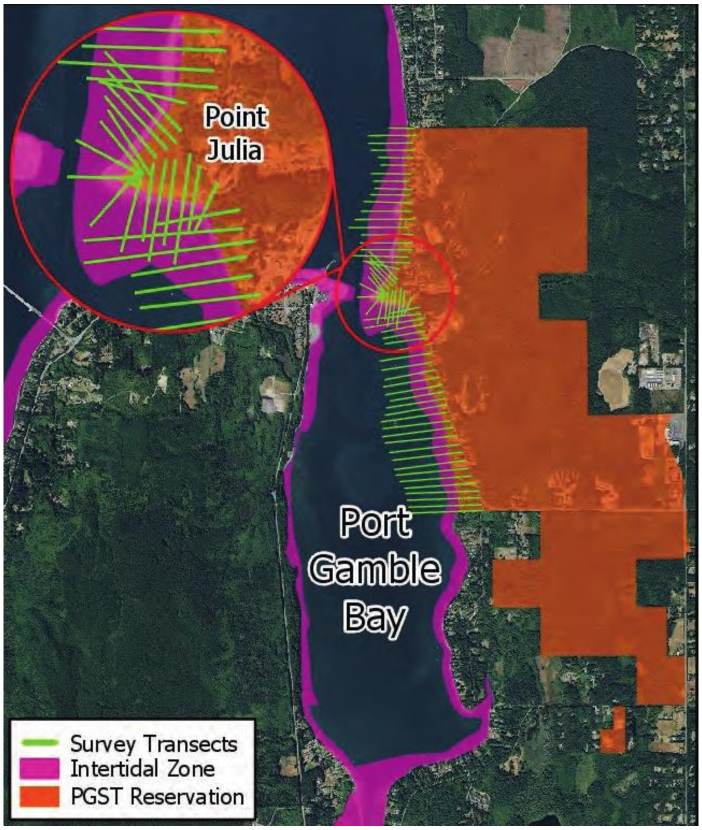


Photo 1. Bluff erosion from a 2014 slide.

Photo 2. Repeated sloughing prevents vegetation from stabilizing this bluff.

Managing natural resources in the face of a changing climate, which poses significant impacts to sustainable yields of finfish and shellfish is a primary concern for the Port Gamble S'Klallam Tribe. While many natural resources are threatened by warming temperatures, changing precipitation and ocean chemistry, the tribe identified the most immediate need of managing ongoing bluff erosion on the reservation.[1]

As the bluffs erode, they provide sand, silt and gravel to the beach, where wind and waves move the sediment along the shore. However, research shows the bluff erosion rate will change with a changing climate.[2] Sea level rise will increase wave exposure and changing precipitation could make the bluffs more susceptible to landslides (Photo 1, 2). To better understand the problem, the tribe consulted with the University of Washington Earth and Space Sciences Department and Washington Sea Grant to develop a study on bluffs in Port Gamble Bay (Figure 1), completing the first phase of the project in 2019.

Using historical maps and aerial photographs, a bluff erosion rate of 3.7 inches/year over a 162-year period was calculated. Water level data along the tribe's coastline was collected and compared with long-term records at Port Townsend and Seattle to evaluate extreme water levels. Beach transects were established for long-term monitoring using high-accuracy GPS surveys to measure sediment transport and beach conditions over time. Lastly, using 2018 Washington State projections and accounting for local land movement, coastal inundation maps were created for several sea level rise scenarios.

Repeat surveys will allow sediment transport rates to be estimated and determine how unarmored shorelines can supply the necessary volume to maintain healthy beaches that support shellfish habitat. To better understand substrate characteristics, the tribe plans to compare shellfish abundance with grain size distributions from sediment samples along the coast. If beach conditions are determined to be unsupportive for shellfish due to unsuitable substrate conditions, remedies such as shoreline armor removal may be employed to allow for continued bluff erosion and sediment supply.

"Over the years while working on climate change resilience, I've become increasingly worried about the tribal children in our community and what the future of their natural resources, fisheries, wildlife, plants, and marine and aquatic ecosystems will be like. It's clear we must do everything we can to minimize the impending impacts of climate change for our community and do our best to empower and prepare our future generations for this change."

– Paul McCollum,
PGST Natural Resources Director

Map Data Sources: NAIP 2017,[4] WADNR 2010,[5] WADNR 2018,[6] Hatfield, Miller & Troost 2020[7]

Port Gamble S'Klallam Tribe

Effects of Low Oxygen on Adult Chum Spawners

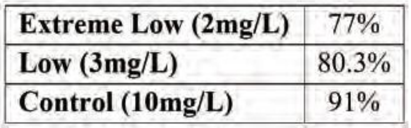
Hypoxia, low or depleted oxygen in a water body, is a major concern for salmonid spawning and survival in the Hood Canal. The Port Gamble S'Klallam Tribe designed an experiment to understand the effects that hypoxic water has on adult chum salmon and their ability to successfully spawn.

At the southern end of Hood Canal, hypoxia most often occurs as a result of the natural topography of the basin in combination with anthropogenic factors such as wastewater discharge and agricultural runoff.[1] During periods of hypoxia, which often occur in the late summer, oxygen levels are reduced to below 2 mg/L[1], far below thresholds known to impact salmon. The U.S. Environmental Protection Agency (EPA) cites the dissolved oxygen (DO) level for salmonid survival at a minimum of 3 mg/L of oxygen.[2] However, behavioral changes occur below 5-6 mg/L, and growth and swimming performance may be reduced below 8-9 mg/L.[3]

Most studies investigating the effects of hypoxic water on salmonid species have focused on the early life stages when fish are believed to be particularly vulnerable to such events. Yet hypoxic water presents many potential problems for adult fish as well, such as reduced swimming rate and avoidance behaviors that occur when fish encounter a low DO episode while returning to spawning grounds. Adult salmon may wait for conditions to improve, or find a new destination altogether.[4,5] These delays during migration can lead to increased predation opportunities, less time for the salmon to spawn when they finally reach their spawning grounds, and less energy to spawn.[4] Despite a hypothesized reduction in energy available for spawning under these scenarios, the effect of hypoxia on fecundity in anadromous fish is currently still unknown. This is concerning given the increased frequency of hypoxic events within the southern Hood Canal in recent years.[1]

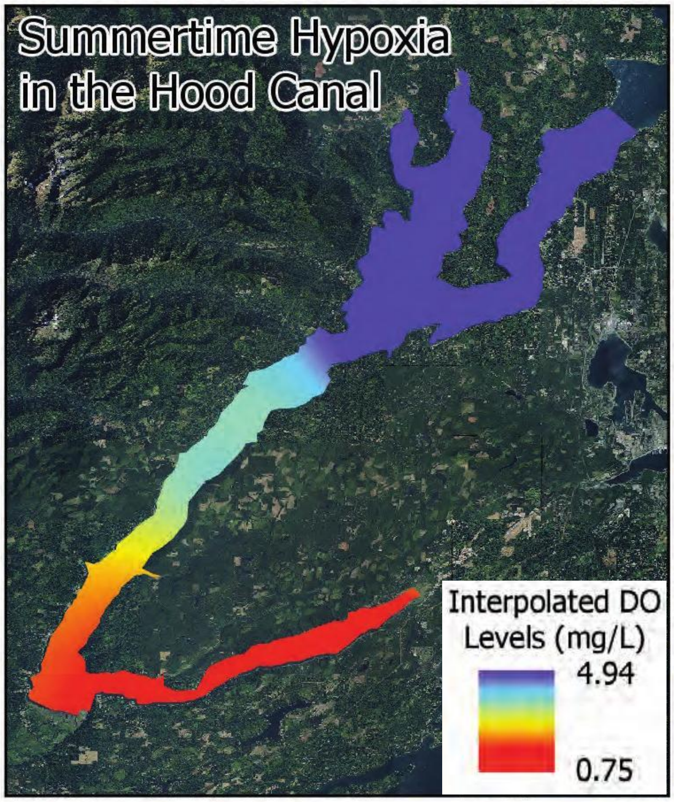
To understand what effect these low DO events have on returning salmon and their fecundity, the Port Gamble S'Klallam Tribe conducted pilot experiments to measure egg survival from female salmon held in water with artificially lowered oxygen content prior to spawning. During trials in November 2017, female chum salmon were collected from the holding pond at the tribe's hatchery, then added to holding tanks where DO levels were slowly decreased. Within three separate tanks, groups of 5-6 fish were held at oxygen levels of 2 mg/L to represent extreme hypoxia conditions (Map), 3 mg/L to represent common hypoxic conditions in Hood Canal (Figure 1), and 10 mg/L as a control. The fish were kept at these DO levels for more than 24 hours before spawning, at which point the eggs were collected and spawned by hatchery workers using standard hatchery procedures. Survival rates of eggs to the eyed stage are shown by treatment in Figure 2. Preliminary results from this pilot-scale study indicate that even if adult salmon survive hypoxic conditions during migration through the southern Hood Canal, their eggs may be less viable. The tribe will be repeating this experiment on a larger scale using their new lab facility in the near future.

Figure 2. Egg Survival Results



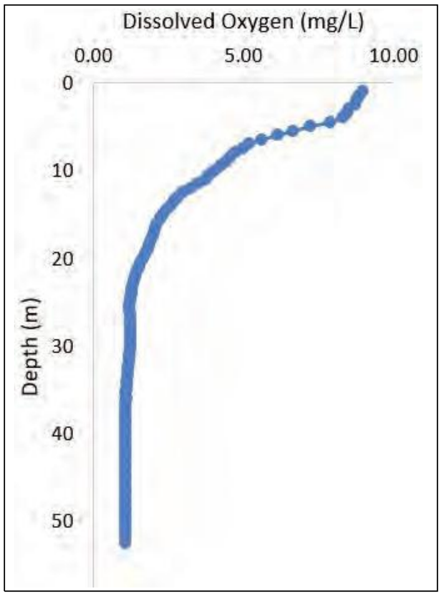
Extreme Low (2mg/L)	77%
Low (3mg/L)	80.3%
Control (10mg/L)	91%

Egg survival to eyed stage following low oxygen levels exposure of pre-spawned females.



Measured and interpolated values of DO content in Hood Canal collected in early September 2015 at 10 meters depth. These values are representative of the general trend of seasonal hypoxia, though actual measurements vary between years.

Figure 1. Typical Dissolved Oxygen Profile, Late Summer



Measured dissolved oxygen values collected during a data collection in early September 2019 at Sister's Point. Data are binned in 0.5 meter intervals. These values represent a typical profile of oxygen concentrations at various depths at the end of summer in the southern Hood Canal.

Map Data Sources: NAIP 2017,[6] WADOE 2020[7]

Citations

Port Gamble S'Klallam Tribe

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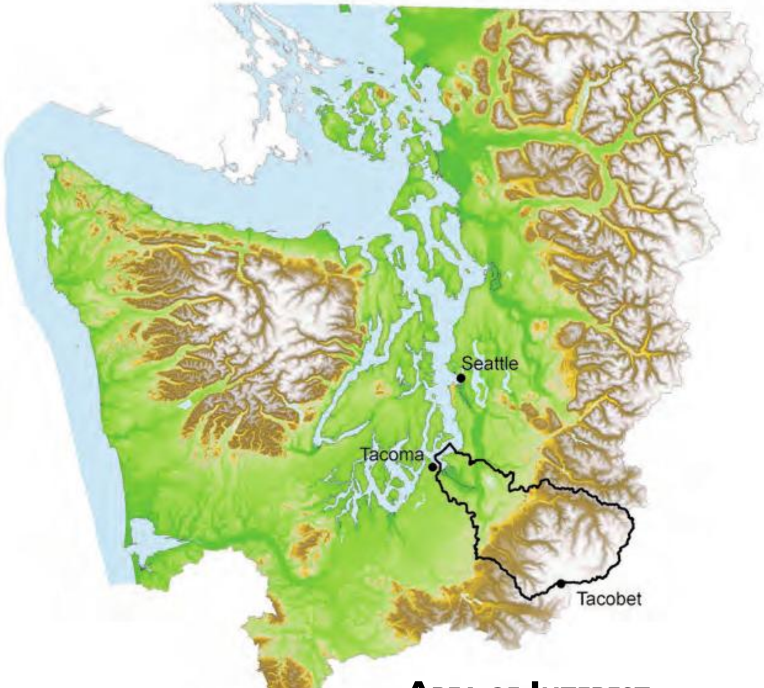
2020 State of Our Watersheds Report
Puyallup River Basin

> *We believe completion of the new Buckley Trap and Haul facility will have the greatest positive influence on fish survival of any single action within the White River.*
>
> **– Russ Ladley**
> **Resource Protection Manager**



Area of Interest

Puyallup Tribe of Indians

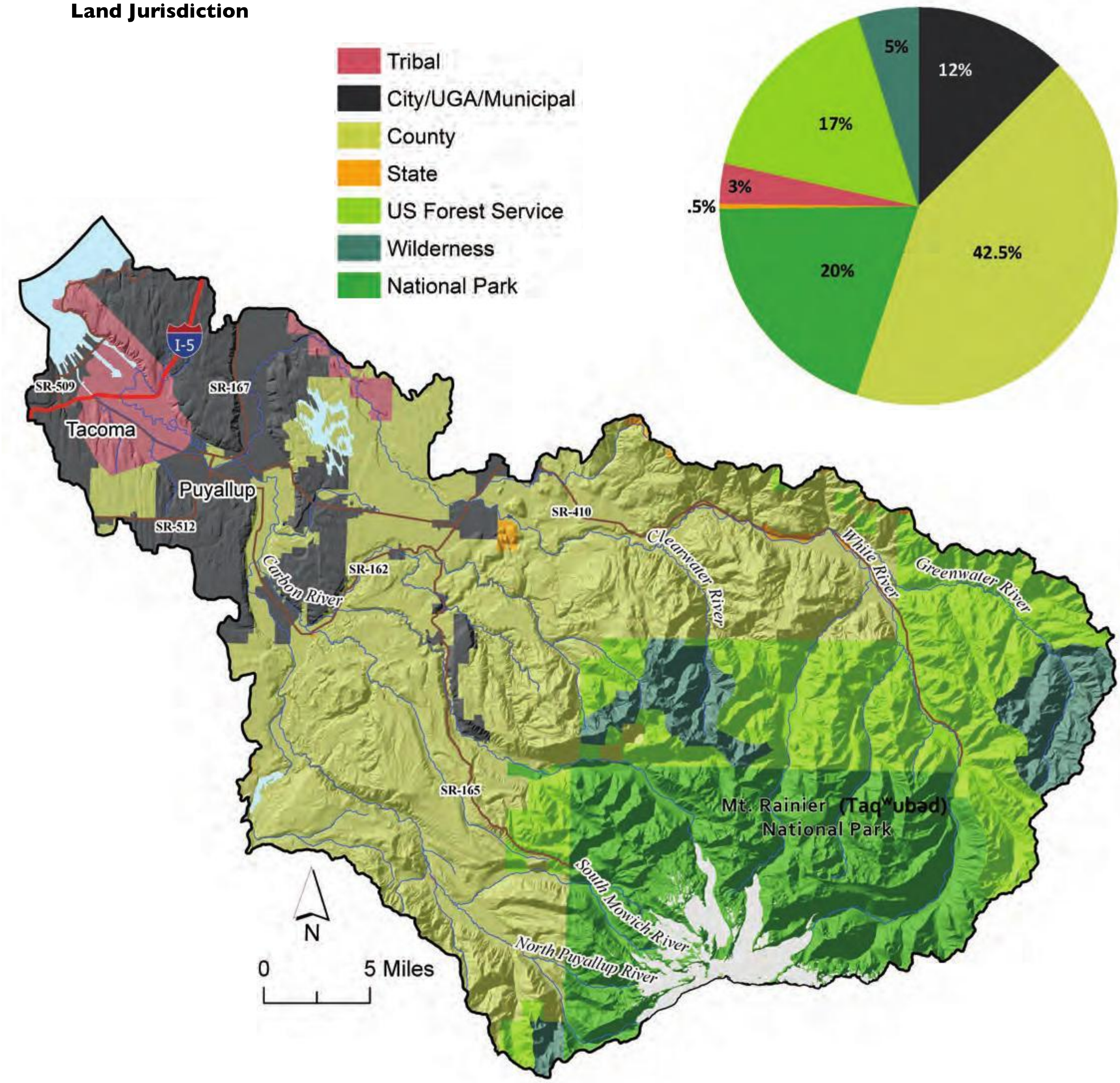
The Puyallup watershed was one of the earliest areas to be settled by Euro-Americans in the Puget Sound region. Consequently, it was also one of the first watersheds in Puget Sound to experience the full impacts of industrial, urban and agricultural development. This development and conversion of floodplain, uplands and forestlands has completely altered the hydrologic conditions within the watershed to the detriment of salmonid production. The Puyallup are fishing people. They lived on food provided by the fisheries since time immemorial. It was not until after the *U.S. v. Washington* court decision that they were able to exercise their rights to the fishery.

Puyallup Tribe of Indians

Puyallup River Basin

The Puyallup River Basin (WRIA 10) includes the White, Puyallup and Carbon rivers, which have their origins in the glaciers of the northwestern slopes of Mount Rainier. The Puyallup River basin flows to Commencement Bay at the Port of Tacoma, the third largest port in the western United States. Historically, the drainage did not always include the White River until 1906, when the White was diverted from the Green River to the south into the Puyallup for flood control purposes, which effectively doubled the flow in the lower Puyallup River. The basin drainage area is about 1,065 square miles, and has over 4,300 miles of river and streams. The Puyallup River basin has been substantially altered from its historic conditions. The basin has 96 miles of "total" levee in the system including the Puyallup, White and Carbon rivers. The system is not continuous; rather it is disconnected, particularly on the upper White River. Salmonid species existing within the basin include chinook, coho, chum, coastal cutthroat, pink, steelhead, bull trout and the occasional sockeye. Chinook, steelhead, and bull trout are listed as threatened under the Endangered Species Act, and coho are listed as a candidate.[1]

Land Jurisdiction



Map Data Sources: SSHIAP 2004,[2] USFWS 2018,[3] WADNR 2016,[4] WADNR 2018,[5] WADOT 2018a,[6] WADOT 2018b,[7] WAECY 1994,[8] WAECY 2018a,[9] WAECY 2018b[10]

Chapter Summary

The Puyallup are fishing people. They lived on food provided by the fisheries since time immemorial. The Puyallup Tribe are leaders in the region's salmon recovery effort. No other people know these watersheds as well as the tribes and none has a greater stake in their future. The tribes believe that if salmon are to survive, real gains in habitat protection and restoration must be achieved.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org*.

For this report, the Puyallup Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Habitat Restoration Continues in WRIA 10

The Puyallup Tribe has ranked the Clarks Creek Channel Stabilization Project as its highest priority in the Clarks Creek basin. The goal of the project is to reduce downstream sediment input to the Puyallup River. It has multiple benefits with regard to helping detain groundwater discharge to the channel and capturing subsurface water flows. Two other important restoration projects underway for the Puyallup Tribe are the Needham Road Floodplain Reconnection Project and the Jones Setback Levee.

Levees and Revetments – Side Channels Proving Very Beneficial

An extensive system of levees, approximately 96 miles, exists along the Puyallup, White and Carbon rivers. Levees block access to peripheral habitat and reduce the available area of active channel, which have a limiting effect on fish production. Channel confinement by levees has dramatically reduced availability of suitable spawning habitat. Levee setback projects are proving very beneficial, yet very expensive. The Orville Road and South Fork Road Setback levee projects are in their final phase of completion.

Water Quality Shows No Improvement

Since 2013, the average stream grade for the Puyallup River watershed remained the same at C+, on a scale of A-F, with the water quality and aquatic habitat conditions still considered "fair." The most common water quality concerns in Pierce County streams are fecal coliform bacteria, high levels of nitrogen and phosphorus, high temperature and low dissolved oxygen concentrations. These issues are typical, but difficult to treat in communities with a combination of urban and rural land uses.

Impervious Surface and Population Continues to Increase

The Puyallup River basin continued to see a slight increase in impervious surface (.9%) from 2011 through 2016. The Washington State Office of Financial Management estimates a population growth of 41,448 (10.04%) from 2010-2018 for the basin. Clarks Creek basin saw an increase in impervious surface in all of its watershed analysis units. South Prairie basin saw a slight increase in impervious surface but remains largely undeveloped.

Water Wells Continue to Increase While Low Flows Continue to Decline

The Puyallup watershed is one of the most intensely populated and farmed basins in western Washington, and much of the water in the Puyallup-White watershed has already been spoken for. There is little water available for new uses, especially given that river levels need to be maintained to ensure adequate water quality and fish migration. Even so, the Puyallup River basin saw an increase of 462 water wells from 2015-2019. This is up from 101 water wells that occurred during the 2010-2014 time. Low flows continue to decline especially during the critical late summer early fall flow periods.

RMAPs Work Very Close to Being Completed in the Puyallup River Basin

The Forests & Fish Law requires that all state and private forest landowners develop Road Maintenance and Abandonment Plans (RMAPs) for the management and improvement of their forest roads. According to the Forests & Fish Law, the roads will need to be brought up to the new forest roads standards by 2021. Forest landowners are required to improve their forest roads to protect public resources, including water, fish, and wildlife habitat. Currently 97% of the RMAPs in WRIA 10 are repaired. This is on target for the goal of all being finished by 2021. The private companies are doing their part to provide fish access and now we need the counties and cities to follow.

Commencement Bay – EPA Superfund Site – Fear for Health Concerns to Puyallup Tribal Members

Tribal chairpersons are very concerned regarding health issues of tribal members from industry pollution in the Port of Tacoma. Air toxics, discharges/permits, caps, metals and greenhouse gases, are just a few of their many concerns, as well as whether industries are meeting their regulatory obligations. Concerns about the pollution in particular, and its implications for the ecological and human health in the area, led to the addition of Commencement Bay to the

National Priorities List for cleanup under the EPA Superfund program in the 1980s. With continued legislation and cleanup efforts, perhaps someday Commencement Bay could be restored to the beauty and vitality it once had.

Conclusion

The Puyallup watershed has seen a few successes to the recovery of habitat over the past decade but other habitat indicators have stayed the same or worsened. Tribal chairpersons are very concerned regarding health issues of tribal members from industry pollution in the Port of Tacoma and these sources of pollution need immediate attention.

Impervious surfaces have increased slightly but with a looming threat of a 10% population growth, tribal leadership have concerns of the potential impacts that come with an increased population. The increase in water wells continued at four times the rate of growth from the previous evaluation period and there has been no improvement in water quality.

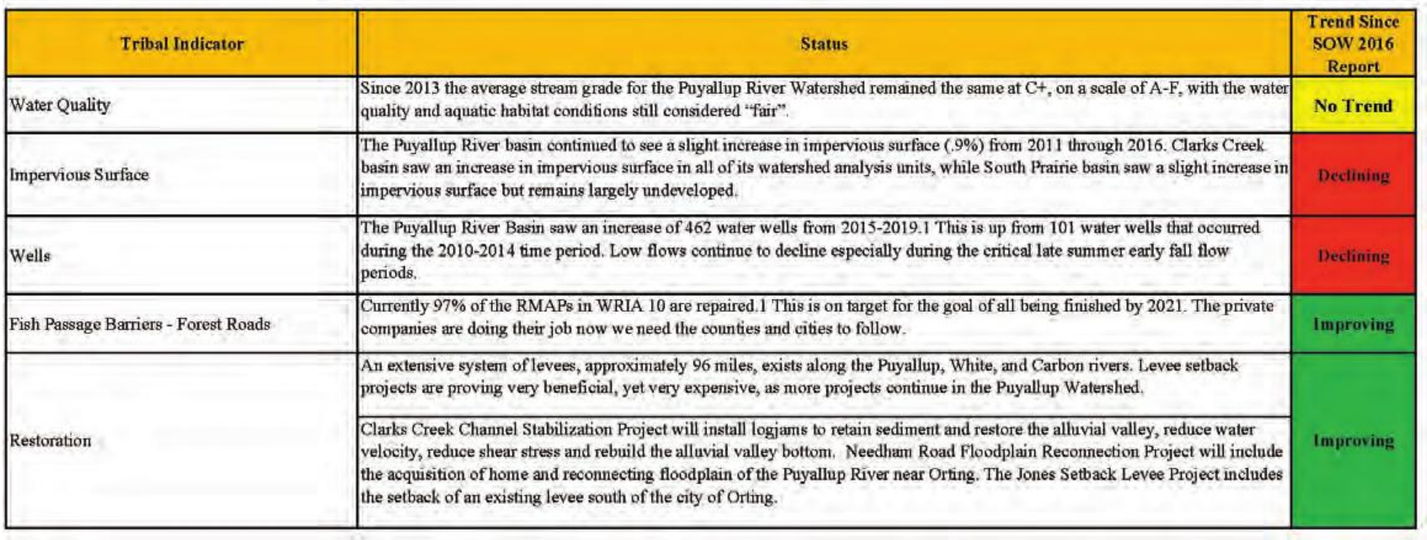
What has seen improvement was in the completion of restoration projects and implementation of forest road improvement projects. The forest landowners are completing their Road Maintenance and Abandonment Plans, RMAPs, and improving salmon and steelhead access to the forest streams.

Even though restoration is occurring it is not enough to keep up with the impacts of a growing population and their land-use decisions. Land-use and water laws that are in place and meant to protect critical areas and fish habitat need to be implemented. Implementation includes education and voluntary actions, but it also needs to include enforcement when those laws are broken. The future of treaty rights in the Puyallup river basin depend on it.

Recovery Efforts Show Signs of Improvement But Still Lagging in Key Indicators

At the 15-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Puyallup basin planning area shows improvements in the removal of forest road barriers and implementation of restoration projects, but degradation by increase of impervious surface areas and an increase in well development remains a concern. In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trend for these key environmental indicators since the 2016 State of Our Watersheds Report shows improvement for some indicators and a steady loss for others in habitat status:



Tribal Indicator	Status	Trend Since SOW 2016 Report
Water Quality	Since 2013 the average stream grade for the Puyallup River Watershed remained the same at C+, on a scale of A-F, with the water quality and aquatic habitat conditions still considered "fair".	No Trend
Impervious Surface	The Puyallup River basin continued to see a slight increase in impervious surface (.9%) from 2011 through 2016. Clarks Creek basin saw an increase in impervious surface in all of its watershed analysis units, while South Prairie basin saw a slight increase in impervious surface but remains largely undeveloped.	Declining
Wells	The Puyallup River Basin saw an increase of 462 water wells from 2015-2019.1 This is up from 101 water wells that occurred during the 2010-2014 time period. Low flows continue to decline especially during the critical late summer early fall flow periods.	Declining
Fish Passage Barriers - Forest Roads	Currently 97% of the RMAPs in WRIA 10 are repaired.1 This is on target for the goal of all being finished by 2021. The private companies are doing their job now we need the counties and cities to follow.	Improving
Restoration	An extensive system of levees, approximately 96 miles, exists along the Puyallup, White, and Carbon rivers. Levee setback projects are proving very beneficial, yet very expensive, as more projects continue in the Puyallup Watershed.	Improving
	Clarks Creek Channel Stabilization Project will install logjams to retain sediment and restore the alluvial valley, reduce water velocity, reduce shear stress and rebuild the alluvial valley bottom. Needham Road Floodplain Reconnection Project will include the acquisition of home and reconnecting floodplain of the Puyallup River near Orting. The Jones Setback Levee Project includes the setback of an existing levee south of the city of Orting.	

Looking Ahead

Greater strides must be taken in managing water resources and improving water quality in concert with habitat restoration in the Puyallup basin. New habitat projects must be wetted with adequate quantities of clean water. Resources need to be brought to bear on making sure this happens. Some age-old problems remain, such as restoration of instream flows (particularly in the Electron reach of the upper Puyallup), lack of enforcement of TMDLs (or other mechanisms to improve water quality), and absence of TMDLs for water quality parameters that adversely affect fish. Enhanced stormwater treatment of roof runoff and cleanup prior to ground infiltration would greatly improve base flows in streams as well as water quality in the absence of truly protective prescriptions in stream temperature TMDLs, continuous monitoring, or monitoring for inadvertent releases of toxics to stormwater.

The projected population growth and associated economic development for the Puyallup watershed will continue to challenge salmon conservation and recovery efforts. Current trends indicate that land-use regulation reform is required (especially within CMZs of unincorporated Pierce County and rural communities, and continued funding of habitat restoration activities is necessary in order to achieve recovery goals. The continued decline in water quality and quantity remains the biggest impediment to recovery. Additional funding support is required to complete the development of an integrated, comprehensive strategy for recovery across all H's (habitat, harvest and hatcheries). One of the biggest challenges remains securing the funding necessary for the large, multi-year restoration projects required to conduct levee setbacks and estuarine habitat creation.

Habitat Restoration Continues in WRIA 10

Clarks Creek Channel Stabilization Project

The Puyallup Tribe has ranked the Clarks Creek Channel Stabilization Project as its highest priority in the Clarks Creek basin for storing sediment and reducing downstream sedimentation. The goal of the project is to reduce downstream sediment input to the Puyallup River. It has multiple benefits with regard to helping detain groundwater discharge to the channel and capturing subsurface water flows. The project construction started in 2018 in collaboration with the city of Puyallup, the Puyallup Tribe of Indians and Natural Systems Design. The city of Puyallup paid for the construction of the project, in large part to meet their TMDL obligation for addressing sediment and oxygen impairment of the creek.[1] The project will install logjams to retain sediment and restore the alluvial valley, reduce water velocity, reduce shear stress and rebuild the alluvial valley bottom. Native vegetation (8,700 plants) is scheduled to be planted, which will help retain sediment and form the cohesion needed to slow erosion of the channel walls. The water quality then improves, sediment source is stabilized, cooler water temperatures and cleaner outflow occur, and subsurface flow is restored. The project has challenging logistics: Steep, unstable slopes, loose soils, vast material quantities, short timeline and narrow difficult install sites.[2]

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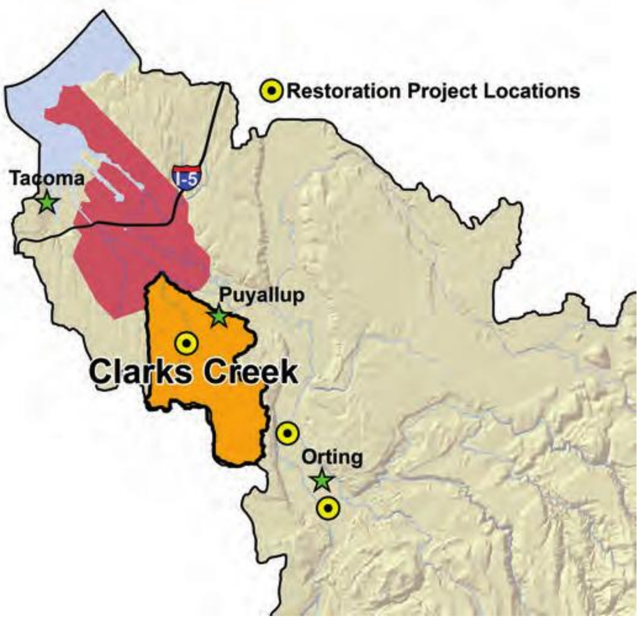
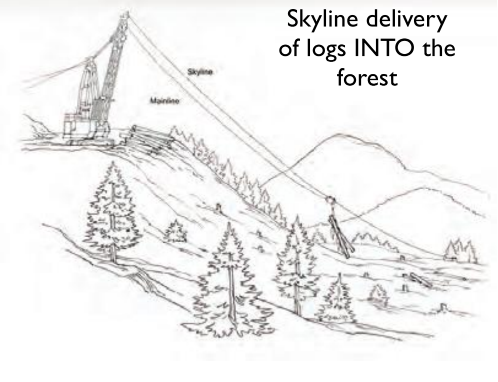


Puyallup Tribe and City of Puyallup

Puyallup Tribe and City of Puyallup



Map Data Sources: SSHIAP 2004,[3] SSHIAP 2019,[4] WADNR 2010,[5] WADOT 2010,[6] WAECY 2000,[7] WAECY 2019,[8] WADOT 2018a[9]

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Two other important restoration projects for the Puyallup Tribe are the Needham Road Floodplain Reconnection Project and the Jones Setback Levee.

Needham Road Floodplain Reconnection Project

Acquisition of homes (almost completed) and reconnecting floodplain of the Puyallup River near Orting, Wash. Obligations: USACE, Floodplain Management and Endangered Species Act. The Current Phase is Preliminary Engineering and Land Acquisition (2019). The project is expected to be completed by 2024 pending funding dollars.[10]

Pierce County

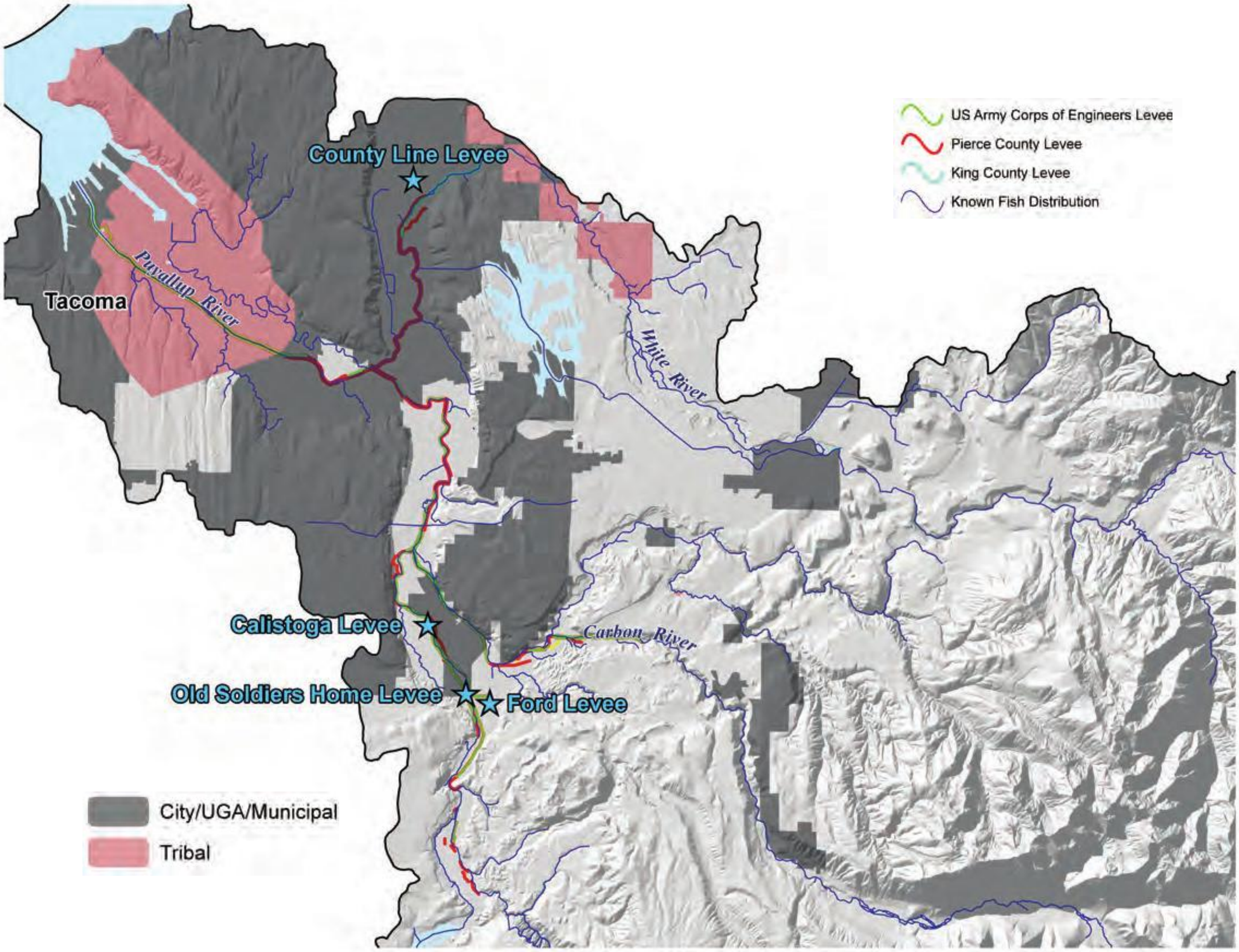
Jones Setback Levee Project

Pierce County

Replace section of existing levee with new setback left bank of the Puyallup River south of the city of Orting Obligations: Floodplain Management, USACE Current Phase Preliminary Engineering. This project is a high priority in the Corps of Engineers' General Investigation report (draft). The potential exists for Corps financial assistance identified under grants.[11] The Current Phase is Preliminary Engineering (2019). The project is expected to be completed by 2024 pending funding dollars.

Levees and Revetments – Side Channels Proving Very Beneficial

An extensive system of levees, approximately 96 miles, exists along the Puyallup, White and Carbon rivers.[1] Levee setback projects are proving very beneficial, yet very expensive, as more projects continue in the Puyallup watershed.



Several significant fish-bearing tributaries feed the Puyallup, White and Carbon river mainstems including; the West Fork White River, Clearwater River, Greenwater River, Mowich River, Huckleberry Creek, Boise Creek and South Prairie Creek. Levees block access to peripheral habitat and reduce the available area of active channel, which have a limiting effect on fish production. Channel confinement by levees has dramatically reduced availability of suitable spawning habitat. As a result, habitat restoration and enhancement actions must emphasize the need to promote freedom for stream channel movement and natural floodplain processes.[2]

Within the Salmon Recovery Planning Act, limiting factors are defined as "conditions that limit the ability of habitat to fully sustain populations of salmon." Setback levees are one of the solutions to mitigating this problem. Levee setbacks relocate a traditional river levee farther away from the channel to provide additional floodplain storage, thereby reducing flood heights, slowing flood peaks, and in some cases, providing ecosystem and recreational benefits.[3] The first setback levee project on the Puyallup River (RM 24-26) is an outstanding example of what can be accomplished and the many benefits that are possible. In the period since the completion of the Ford setback levee in 1998, the river has braided and migrated forming a natural meander pattern that has reduced gradient. The lower average velocity has permitted retention of gravel material that was previously scoured away under high velocity flows. Channel braiding and large woody debris recruitment has added channel complexity and established productive spawning and rearing habitat where it did not previously exist.

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Map Data Sources: King Co. 2014,[8] Pierce Co. 2020,[9] SSHIAP 2004,[10] SSHIAP 2019,[11] SWIFD 2019,[12] USACE 2008,[13] WAECY 2018b[14]

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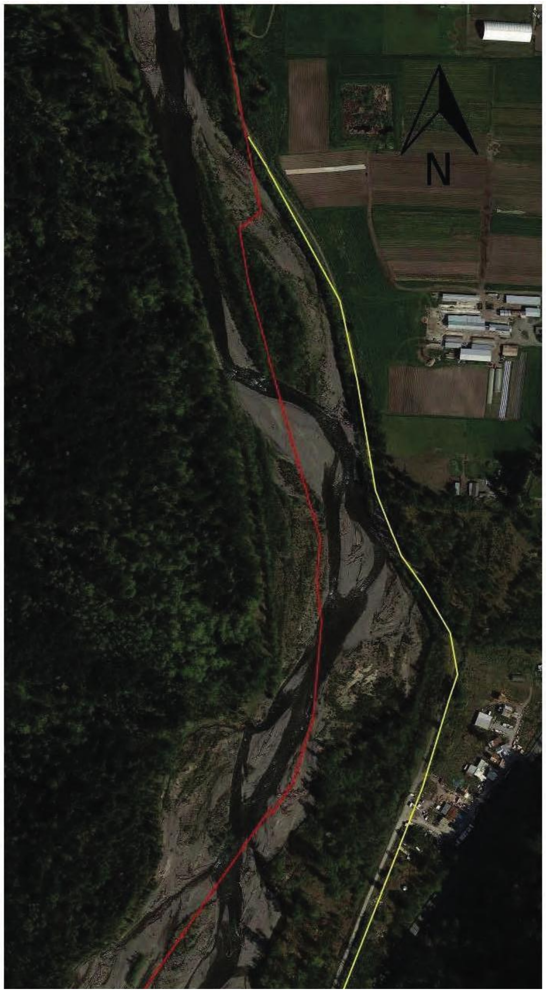
Additional setback levee projects include the Old Soldiers Home levee setback (2006) on the Puyallup River between river mile 21.3 and 22.3; the Calistoga setback levee (city of Orting) on the Puyallup River (2014), and the County Line setback levee on the White River (2017) between river mile 5 and 6.3.[4]

Another concern with levees is the vegetation or lack of on levees. The U.S. Army Corps of Engineers announced a reversal of its policy requiring removal of all trees and shrubs from levees to obtain federal money for disaster assistance. The vegetation removal policy was challenged by conservation groups and opposed by many local flood districts, since vegetation on many levees provides important habitat for endangered fish and wildlife, and its removal actually may reduce levee safety. Riparian vegetation reduces sedimentation harmful to anadromous fish and provides shade that reduces water temperatures, which is critical for salmonids and other aquatic species.[5]

The Puyallup Tribe has entered into a levee vegetation management agreement with both Pierce County and the Corps of Engineers. The Corps has flood facility jurisdiction on the lower Puyallup River from RM 3.0 to the mouth. Pierce County has jurisdiction upstream of RM 3.0 to RM 8.26 on the Carbon and to RM 27 on the Puyallup. The agreements specify where and what vegetation is permissible both on and/or near revetment structures. Since the agreements were adopted, levee vegetation has flourished. Although riparian conditions are still far from ideal, the existing vegetation does provide an important shading function.[6]

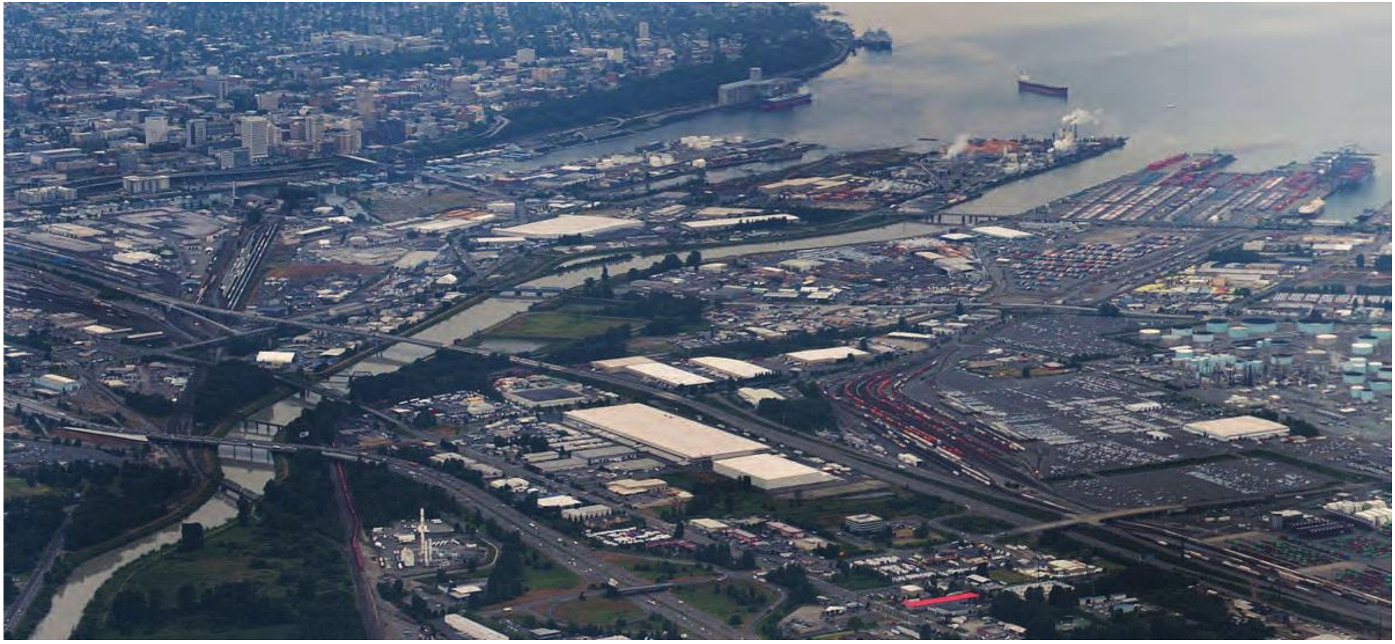
Puyallup River Levee



USACE

Levee setback on the Puyallup River with flow from bottom to top. The red line indicates the historical right-descending bank levee alignment. The yellow line approximates the present setback levee, which has more than doubled the room for the river in some areas.

Commencement Bay Levee



Wikipedia

Flood control was achieved through a combination of practices such as dredging, straightening, revetment and levee construction. The most intensive application of these methods was directed toward the lower Puyallup River from the confluence of the White River to Commencement Bay. In this 10.4-mile stretch, the river is channeled and constrained within a concrete trapezoidal revetment. This effort was initiated by a Legislative Act in 1913, which created the Inter-County River Improvement District. This joint entity between King and Pierce County was established to address flooding problems that primarily originated on the White River but which have the greatest impact on the lower Puyallup River.[7]

PUYALLUP TRIBE OF INDIANS

Water Quality Shows No Improvement

Since 2013 the average stream grade for the Puyallup River watershed remained the same at C+, on a scale of A-F, with the water quality and aquatic habitat conditions still considered "fair."[1]

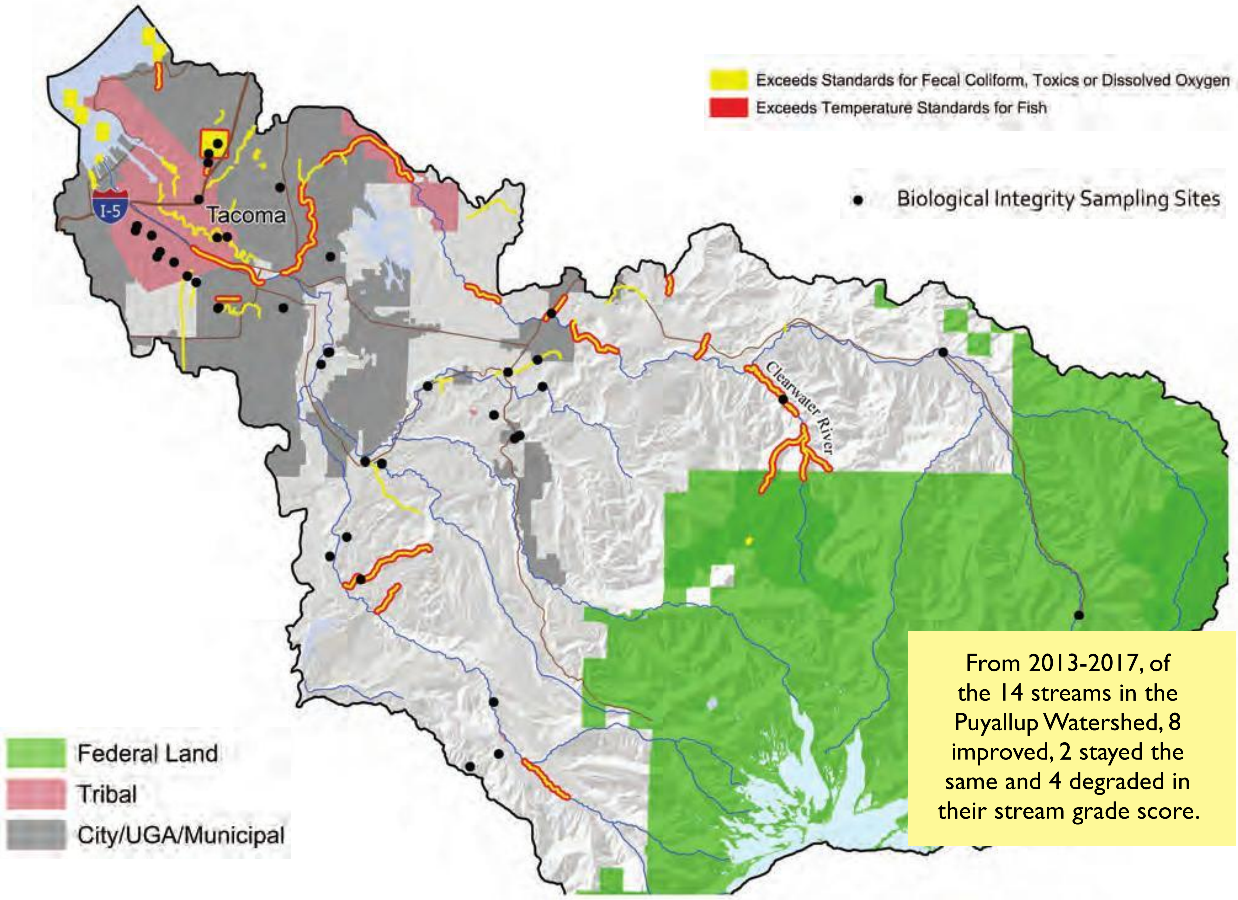
Pierce County Planning and Public Works monitor water quality monthly at 53 Pierce County streams. Benthic samples from a subset of 44 streams are collected every summer. Stream grades are based on two scores: a Water Quality Index (WQI) and Benthic Index of Biotic Integrity (BIBI).The Benthic Index of Biotic Integrity scores are calculated using benthic macroinvertebrate (bugs living on the bottom of streams) samples collected at least once every five years. Scores between 80-100 are excellent; 60-79 are good; 40-59 are fair; 20-39 are poor and 0-19 are very poor. The Water Quality Index (WQI) score is calculated using monthly stream water quality sampling for fecal coliform bacteria, pH, dissolved oxygen, temperature, turbidity, total suspended solids, total nitrogen and total phosphorus. Streams with scores of 80-100 are of the lowest concern, 40-79 are of marginal concern and less than 40 are of highest concern.[2]

The most common water quality concerns in Pierce County streams are fecal coliform bacteria, high levels of nitrogen and phosphorus, high temperature and low dissolved oxygen concentrations. These issues are typical, but difficult to treat in communities with a combination of urban and rural land uses. The. Puyallup River watershed is the largest in Pierce County at about 670,000 acres (1,053 square miles) with a population of approximately 419,660.[3]

If a stream's biological condition is degraded, it is safe to conclude that the stream will not support healthy salmon or other fish populations. The decline of healthy salmon spawning and rearing habitat has been identified as one major cause of the decline of wild salmon populations.[4]

NWIFC

The Clarks Creek watershed is located in the lower Puyallup River watershed. Tributaries include Rody, Diru, Woodland, and Meeker creeks. Clarks Creek is impaired due to low dissolved oxygen and excess sediment. The Puyallup Tribe monitors this urban salmon stream for BIBI and WQI.



From 2013-2017, of the 14 streams in the Puyallup Watershed, 8 improved, 2 stayed the same and 4 degraded in their stream grade score.

Map Data Sources: Pierce Co. 2017,[5] SSHIAP 2004,[6] SSHIAP 2019,[7] WADOT 2018a,[8] WAECY 2018,[9] WAECY 2000,[10] WAECY 2016[11]

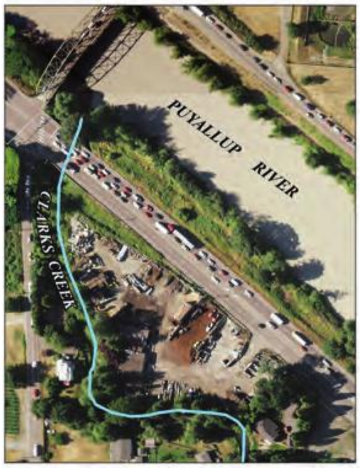
Impervious Surface and Population Continues to Increase

The Puyallup River basin continued to see a slight increase in impervious surface (.9%) from 2011 through 2016. Clarks Creek basin saw an increase in impervious surface in all of its watershed analysis units, while South Prairie basin saw a slight increase in impervious surface but remains largely undeveloped.

The Puyallup River basin absorbed an estimated population growth of 41,448 (10.04%) from 2010-2018.[1] The basin includes the state's third largest city, Tacoma, with a population estimate of 211,400 for 2019 up from 2016's population of 206,100 (2.5% increase).[2] Increased population pressure and development, with the conversion of forested areas to impervious surfaces, is the major factor affecting water quality in the region.[3] Greater numbers of people in the region result in increased impervious surface, greater volumes of wastewater, more septic systems and more sources of nutrients entering surface waters.

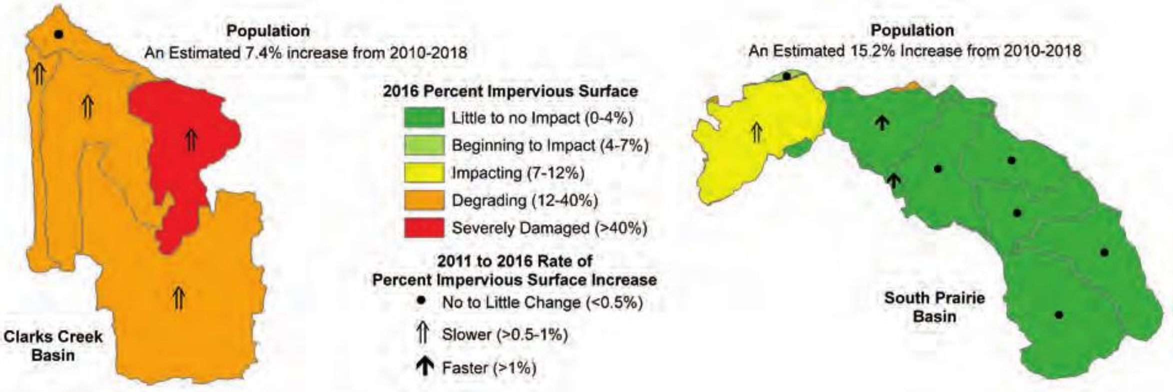
Clarks Creek is an urban stream located within the city of Puyallup that provides important habitat for salmon and trout. Clarks Creek is about 5 miles in length and has a watershed area of about 13 square miles. The creek drains into the Puyallup River, which in turn flows into Puget Sound. Clarks Creek flows through two local parks and supports five species of salmon and trout. Salmon are an important food and cultural resource for the Puyallup Tribe of Indians of the Puget Sound region, and the Puyallup Tribe has operated a salmon hatchery on the creek since 2004.[4]

Stormwater is a significant and growing source of environmental degradation in Clarks Creek and downstream waters. According to the Washington State Department of Ecology's 2004 assessment, Clarks Creek is impaired for bacteria, pH, fish habitat, fish passage, and dissolved oxygen. Analyses conducted by Ecology identified stormwater as a major driver of the high levels of bacteria and low levels of dissolved oxygen in Clarks Creek. Stormwater washes wildlife and pet waste into the creek, elevating levels of fecal coliform bacteria. Stormwater also washes nutrients from fertilizers into the creek's waters, causing excessive growth of elodea (or waterweeds). The dense beds of waterweeds in Clarks Creek not only cause dissolved oxygen levels to plummet when the weeds decompose, but also increase flooding and sedimentation. As the city of Puyallup and Pierce County become urban, these environmental pressures will only grow. County planners estimate that the population in the Clear and Clarks creek basins will increase by 15% from 2000 to 2020 (from 61,700 to 71,000), and that effective impervious area could increase by 40% (from 25% of the basin to 35%).[5]



An example of impervious surface is where Clarks Creek (a salmon-bearing stream supporting chinook, coho, and chum salmon, steelhead, and cutthroat trout) joins the Puyallup River.

South Prairie Creek is a major tributary to the Carbon River that flows into the Puyallup River and empties into Puget Sound at Commencement Bay. The South Prairie Creek basin is approximately 90.2 square miles in area, and extends a total distance of about 30 miles. As the most important spawning stream in the Puyallup watershed, South Prairie Creek supports six species of salmon: Puget Sound chinook, chum, coho, pink, coastal cutthroat and steelhead.[6] The South Prairie Creek mainstem is identified as a high priority for protection, meaning that further degradation would have a large negative effect on chinook performance in this system. Land-use policy, increasing development and water allocation are three issues that will play a critical role in the long-term viability of this unique and vital drainage. South Prairie Creek was placed on the state 303-d list in 1997 for water temperature and bacteria excursions.[7]



Map Data Sources: WAECY 2017,[8] NLCD 2011,[9] NLCD 2016,[10] NAIP 2018,[11]

Water Wells Continue to Increase While Low Flows Continue to Decline

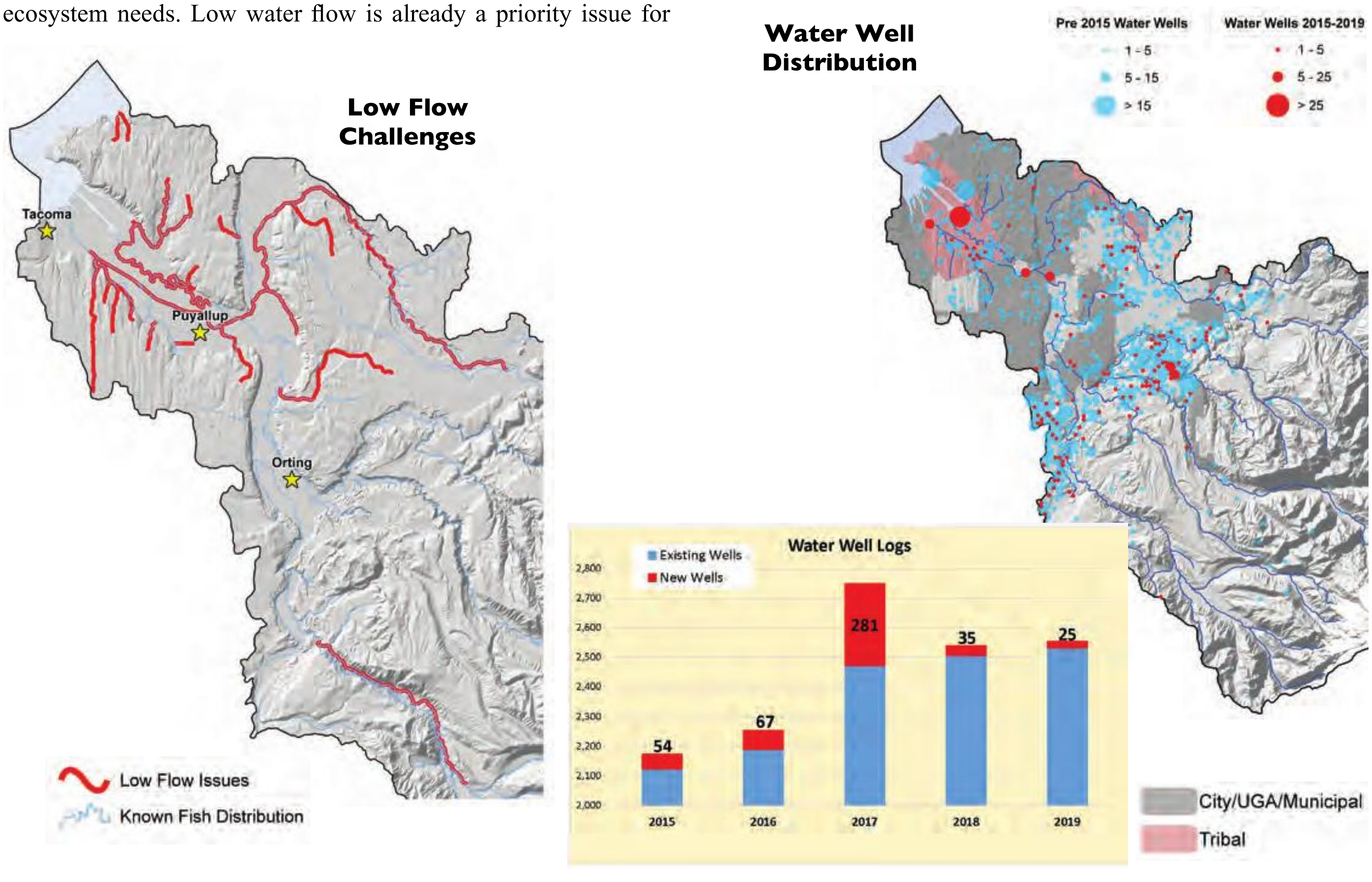
The Puyallup River basin saw an increase of 462 water wells from 2015-2019.[1] This is up from 101 water wells that occurred during the 2010-2014 time period. Low flows continue to decline especially during the critical late summer, early fall flow periods.

The Puyallup watershed is one of the most intensely populated and farmed basins in western Washington, and much of the water in the Puyallup-White watershed has already been spoken for. There is little water available for new uses, especially given that river levels need to be maintained to ensure adequate water quality and fish migration. Increased demands from population growth, naturally low summer and early fall streamflow levels, and impacts of climate change add to the challenge of finding new water supplies in the Puyallup watershed.[2]

With the upturn in the economy, the Puyallup River basin saw an additional 462 water wells, up from 101 new water wells during the 2010-2014 five-year period. This is a significant gain and is a concern since the population continues to grow. The Puyallup basin has over 120 miles of stream with low flow issues. Both of these factors continue to affect salmon survival. Low flows increase water temperature and reduce dissolved oxygen, both stressors for salmon populations.

During the summer, the snowpack is gone, there is little rain, and naturally, low stream flows are dependent on late summer glacial melting and groundwater inflow. This means that groundwater and surface water are least available when water demand is highest in the summer. If summer flows continue to decline as demand for water continues to increase for uses such as drinking water and irrigation, there is potential for conflict between human and ecosystem needs. Low water flow is already a priority issue for salmon in 14 of the 19 Puget Sound Water Resource Inventory Areas. Changes in stream flow are associated with shifts in salmon habitat, water temperature, nutrient availability, and sediment levels. These changes can affect both human uses and the life cycles of salmon and other aquatic life.[3]

WRIA 10 (the Puyallup watershed) has an Instream Resources Protection Program rule (WAC 173-510 – *www.ecy.wa.gov/biblio/wac173510.html*) that establishes instream flows on the Upper and Lower Puyallup River and Carbon River, including all tributaries. The purpose of the instream flow rule is to retain perennial rivers, streams, and lakes in the Puyallup River basin's instream flows and at levels necessary to provide protection for wildlife, fish, scenic-aesthetic, environmental values, recreation, navigation, and to preserve water quality standards (WAC 173-510 1988). All future water withdrawals are subject to the instream flows. All water uses that have impacts to surface waters will be interrupted when stream flows fall below levels set in rule unless the impacts are offset through mitigation. WAC 173-510-050 addresses groundwater and notes "in future permitting actions relating to groundwater withdrawals, particularly from shallow aquifers, a determination shall be made as to whether the proposed withdrawal will have a direct, and measurable, impact on stream flows in streams for which closures and instream flows have been adopted."[4]



Map Data Sources: SSHIAP 2004,[5] SWIFD 2019,[6] WADOT 2018b,[7] WAECY 2018a,[8] WAECY 2019,[9] WAECY 2018b[10]

PUYALLUP TRIBE OF INDIANS

RMAPs Close to Completion

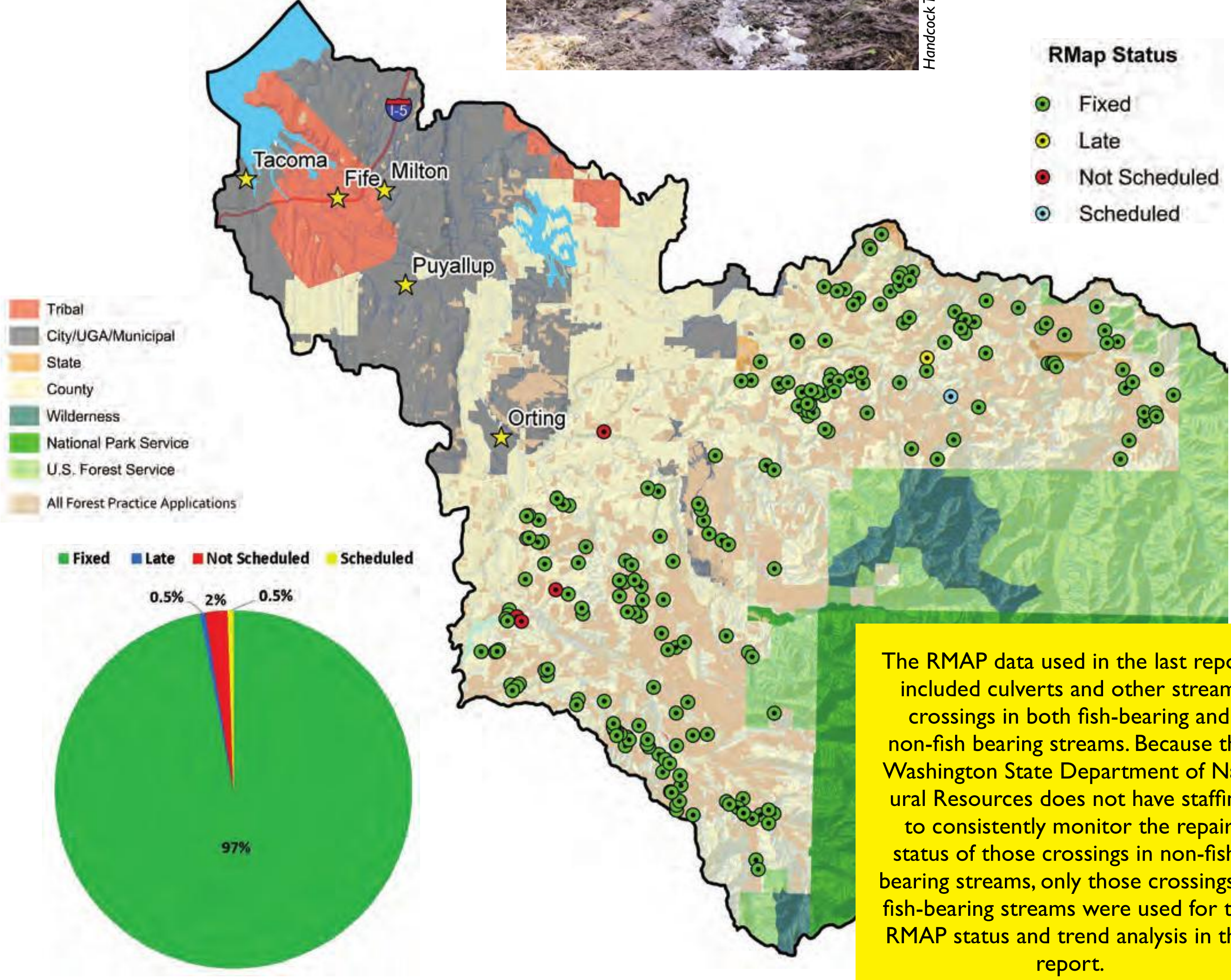
Currently 97% of the RMAPs in WRIA 10 are repaired.[1] This is on target for the goal of all being finished by 2021. The private companies are doing their job, now we need the counties and cities to follow.

The Forests & Fish Law requires that all state and private forest roads be brought up to new forest roads standards by 2021 through Road Maintenance and Abandonment Plans (RMAPs). Forest landowners are required to improve their forest roads to protect public resources, including water, and fish and wildlife habitat. Improved road maintenance and construction practices reduce or eliminate runoff and fine sediment being delivered into streams, which can degrade water quality and fish habitat.[2]

Road maintenance is required to prevent potential or actual damage to public resources, such as disconnecting road drainage from delivering sediment to streams and removing any artificial structures that block fish passage. The current results show 5,200 miles of fish habitat has been opened by removing or replacing an impressive 7,900 stream blockages statewide.[3]

Handcock Timber Resource Group

Recent innovations in road building materials and techniques have allowed fish habitat to be recovered, while maintaining important forest roads. By using sturdier road building materials, private forest landowners are able to create less intrusive structures over streams and other potential fish passage barriers. In some instances, new techniques allow private forest landowners to remove conventional culverts and replace them with small bridges or eco-puncheons[4] (barrels made of eco-friendly materials – that allow fish to pass unimpeded).



The RMAP data used in the last report included culverts and other stream crossings in both fish-bearing and non-fish bearing streams. Because the Washington State Department of Natural Resources does not have staffing to consistently monitor the repair status of those crossings in non-fish-bearing streams, only those crossings in fish-bearing streams were used for the RMAP status and trend analysis in this report.

Map Data Sources: SSHIAP 2004,[5] SSHIAP 2019,[6] WADNR 2019,[7] WADNR 2018,[8] WADOT 2010,[9] WADOT 2018a,[10] WAECY 2018b,[11]

PUYALLUP TRIBE OF INDIANS

Commencement Bay – EPA Superfund Site – Fear for Health Concerns to Puyallup Tribal Members

Tribal chairpersons are very concerned regarding health issues of tribal members from industry pollution in the Port of Tacoma. Air toxics, discharges/permits, caps, metals and greenhouse gases, are just a few of their many concerns, as well as whether industries are meeting their regulatory obligations.

The alteration of Commencement Bay, which was once a pristine estuary, began in the early 1900s, when the meandering streams of the Puyallup River Delta were channelized and its tideflats filled to create the eight artificial waterways now found in the bay. In the late 19th century, the city of Tacoma was a newly expanding industrial area, fueled by the activity of the Northern Pacific Railroad terminus. Tacoma was the site of the region's first sawmill, which would be the catalyst for the establishment of hundreds of other businesses and industrial plants that, over the years, would compromise the waters of the bay. The Port of Tacoma was officially established in 1918. The massive amount of dredging and building of the new waterways in Commencement Bay dramatically altered the landscape. The immediate effect was the reduction of habitat for many native species. It was realized, too late, that the many estuaries and streams of the Puyallup River had been important spawning grounds for several species of young salmon. Another consequence of industrialization was the prolific pollution of the bay, from the numerous sawmills, pulp mills, refineries, and smelting plants that sprung up along its shoreline. Concerns about this pollution in particular, and its implications for the ecological and human health in the area, led to the addition of Commencement Bay to the National Priorities List for cleanup under the EPA Superfund program in the 1980s.[1]

The Port of Tacoma is playing catchup in cleaning up generations of poor business practices, spending millions on site studies, contractors and environmental remediation. The Port of Tacoma controls about half of the tideflats' roughly 5,000 acres. Dozens of companies own the rest. From the 1980s through 2012, the Port spent around $175 million on a combination of

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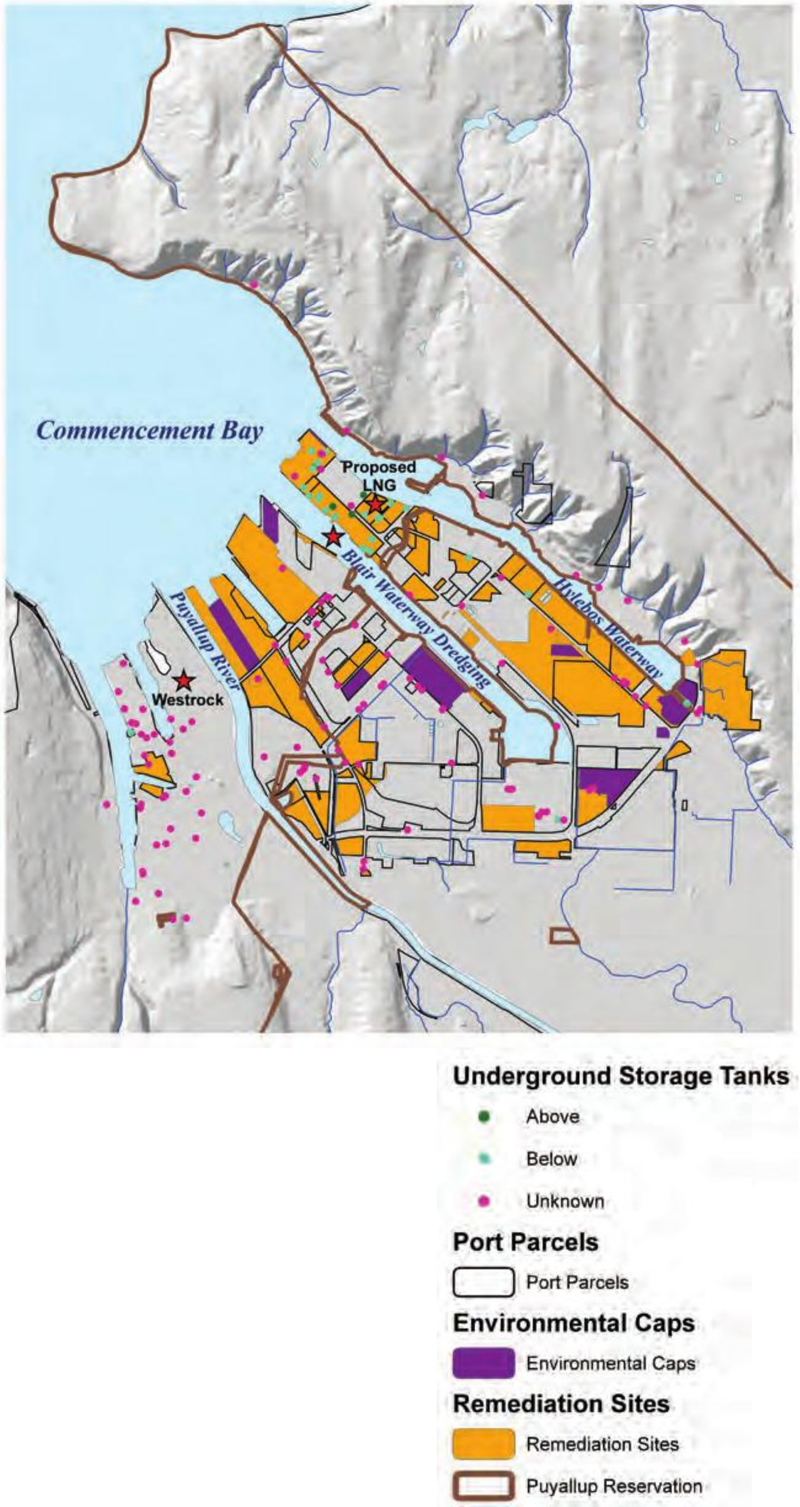


NWIFC

Puyallup staff seining in Puyallup River in the Port of Tacoma.

Map Data Sources: Port of Tacoma 2012,[9] SSHIAP 2004,[10] WADOT 2018b,[11] WAECY 2018b[12]

Proposed Site of PSE LNG Facility

Port of Tacoma

(Continued from previous page)

projects that included mitigation and remediation. The Port has a goal of cleaning up 200 acres of tideflats land by 2022. By that time, the port could spend another $80 million to $140 million.[2]

A few of the projects in Commencement Bay that the Puyallup Tribe has serious concerns with:

- Blair Waterway dredging: The Port of Tacoma stated that it was seeking to deepen and widen the Blair Waterway, ostensibly to accommodate the world's most massive container ships. The Army Corps of Engineers was asked to determine whether there is a federal interest in sharing the costs of the project, now estimated at $242 million. The Puyallup Tribe of Indians has voiced serious concerns about this project, which could negatively affect water quality, treaty fishing rights, and fisheries. Should the project move forward, approximately 2.4 million cubic yards of dredged material could wind up in Commencement Bay and the rest would be dumped at an upland facility. The Blair Waterway is surrounded by dozens of industrially polluted sites, many of which still contain contaminated groundwater that could be leeching into the waterway.[3]
- Puget Sound Energy (PSE) plans to build a facility at the Port of Tacoma to provide LNG for natural gas customers and maritime transportation needs. The Puyallup Tribe says it will not go along with plans to put a liquefied natural gas facility on a site at the Port of Tacoma. The site is located on land that lies sandwiched between parcels on its reservation. The tribe says its biggest concern is that its reservation lies in an urban area and the heart of that is the Port of Tacoma.[5] The Puyallup Tribe of Indians and the nonprofit law firm Earthjustice filed legal challenges against this liquefied natural gas storage facility in Tacoma, Washington. It is the latest show of opposition to a dangerous fossil-fuel project that is vehemently opposed by the Tribe and health and environmental advocates. The Puyallup Tribe identifies how the community immediately surrounding the LNG facility would be disproportionately burdened by increased emissions of hazardous air pollutants in an area already heavily burdened by toxic and hazardous emissions as well as the associated safety risks from operation of the facility. Natural gas is primarily methane. When methane is released into the atmosphere, it traps more heat than other greenhouse gases, making it a significant driver of the climate crisis we all face. Even a minor leak of this fracked gas along the supply chain will result in even worse climate pollution than burning coal.[6]
- WestRock is a kraft pulp and paper mill. With around 400 employees, the mill makes about 1,400 tons of bleached and unbleached packaging-grade paper, linerboard, and unbleached pulp each day. It treats its wastewater and sends it to Commencement Bay.[7]

The true scope of the damage to Commencement Bay is so extensive that the work to restore the Bay to a pristine ecological condition is just beginning. With continued legislation and cleanup efforts, perhaps someday Commencement Bay can be restored to the beauty and vitality it once had.[8]

Citizens for a Healthy Bay

Thick layer of smog lingers over the Port of Tacoma.

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Habitat Restoration and Preservation Continues in WRIA 10

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Levees and Revetments – Side Channels Proving Very Beneficial

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2020 State of Our Watersheds Report
Quillayute River Basin


Debbie Preston, NWIFC

Sustainable fisheries are the primary economy of our tribe. If we are to continue our culture and way of life, protecting the habitat is key, whether it be the ocean, the rivers or on land.

FRANK GEYER
NATURAL RESOURCES DIRECTOR

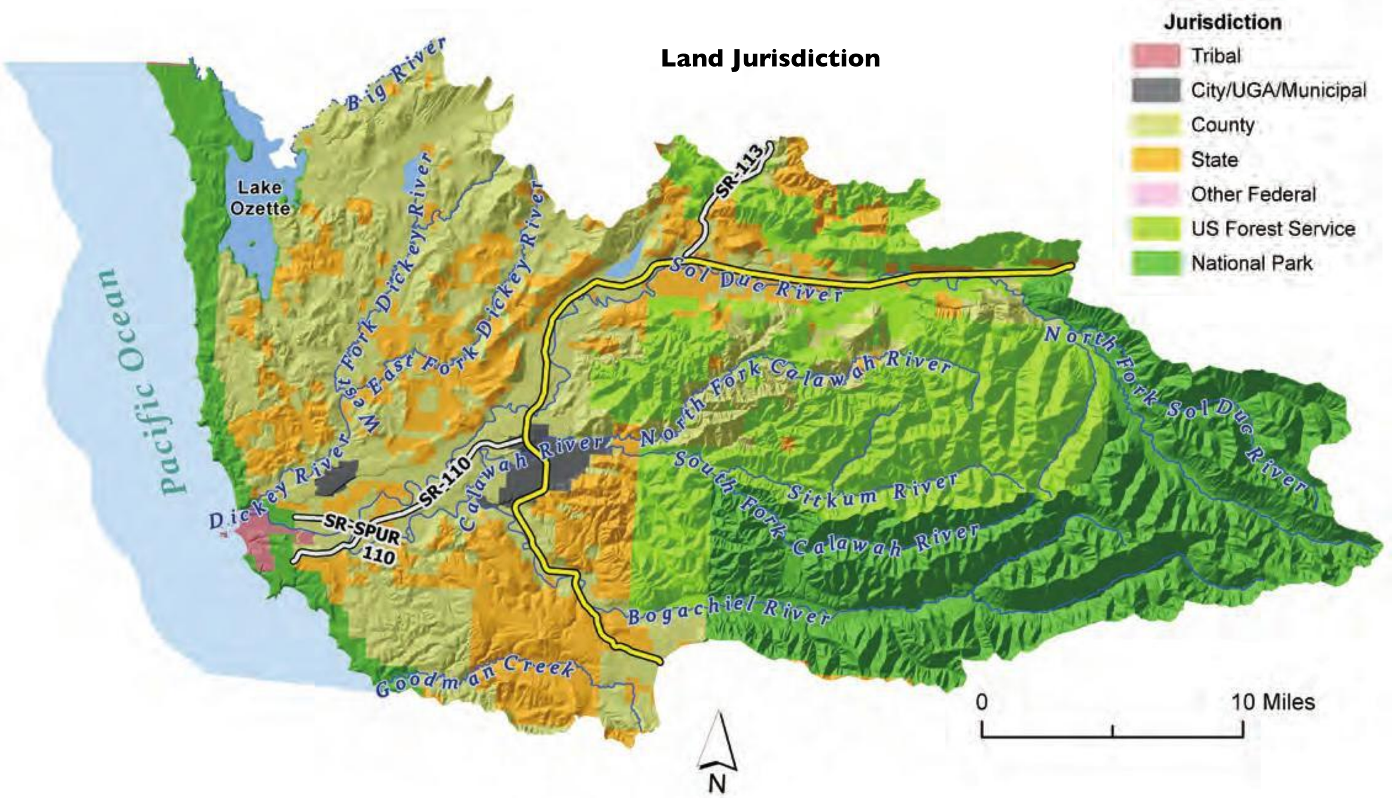
AREA OF INTEREST

Quileute Tribe

The Quileute Tribe is located in La Push, on the shores of the Pacific Ocean, where tribal members have lived, hunted and fished since time immemorial. Although their reservation is only about 2 square miles, the tribe's original territory stretched along the shores of the Pacific, from the glaciers of Mount Olympus to the rivers of the rain forests. Much has changed since those times, but Quileute elders remember the time when the people challenged *Kwalla*, the mighty whale. They also tell the story of how the *bayak*, or raven, placed the sun in the sky.

Quileute Tribe

Lake Ozette, Quillayute River and Goodman Creek

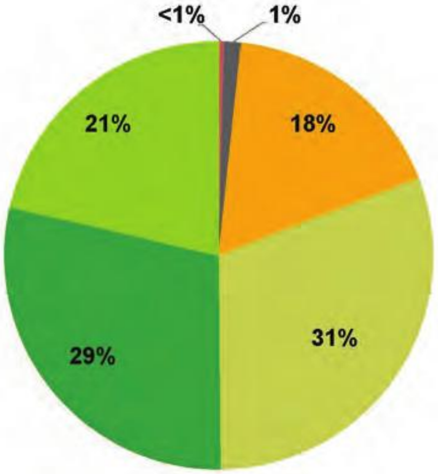


Similar to the 2016 SOW report, the Quileute Tribe's Area of Interest includes the northern portion of Water Inventory Resource Area (WRIA) 20, from Lake Ozette to the Goodman Creek watershed. For this report however, the area extends further east to include part of the Olympic National Park. The largest basin in the area is the Quillayute, with four major subbasins: the Dickey, Sol Duc, Calawah and Bogachiel rivers. The Quillayute River, a broad low gradient river, flows westerly from the confluence of the Sol Duc and Bogachiel rivers and empties into the Pacific Ocean at La Push, the ancestral home of the Quileute Tribe. The Bogachiel and Sol Duc rivers enter the Quillayute about 5.5 miles from its mouth ("Three Rivers"). The Calawah River, a major tributary of the Bogachiel River, enters the Bogachiel about 8.5 miles from the latter's confluence with the Quillayute River. The Dickey River enters the Quillayute River approximately one mile up from the mouth. The final 2.5 miles of the Quillayute River pass through a narrow strip of the Olympic National Park. A number of smaller independent streams, such as Cedar Creek and Goodman Creek, also drain into the Pacific Ocean.

Streamflows in the area are generally provided by abundant rainfall, the average of 120 inches a year being among the highest in Washington state. A part of the basin lies in Olympic National Park, which has been protected from timber harvest and other major human impacts. Those lands outside the park include Olympic National Forest, state forests and private timberland.

The area supports chinook, coho, sockeye, chum and pink salmon as well as steelhead and cutthroat trout.[1,2] Chum and pink salmon are infrequent and not managed by the tribe, nor does the tribe manage cutthroat trout.

All the fisheries are co-managed with the state of Washington. The Quileute Tribe shares Usual and Accustomed areas with the Makah Tribe in the Lake Ozette basin.



In 1999, the National Marine Fisheries Service listed the Lake Ozette sockeye as a threatened species under the Endangered Species Act (ESA)[3] and reaffirmed in 2005.[4] Although a recovery plan[5] was developed and is being implemented, a subsequent status review[6] found little evidence of an increasing trend in population abundance of the Lake Ozette sockeye, therefore the species remains listed as threatened.

A watershed management plan, approved by the tribe and other stakeholders, provides specific guidance and recommendations on water resources management. A detailed implementation plan was developed to guide the actions needed to protect, preserve and/or restore the natural resources in WRIA 20.[7]

Map Data Sources: SSHIAP 2004,[8] USFWS 2018,[9] WADNR 2016,[10] WADNR 2018,[11] WADOT 2018a,[12] WADOT 2018b,[13] WAECY 1994,[14] WAECY 2018a,[15] WAECY 2018b[16]

Chapter Summary

The Quileute Tribe has fished, hunted and gathered in their watersheds and the Pacific Ocean since time immemorial and are leaders in the region's salmon recovery effort. No other people know these resources as well as the tribe and none has a greater stake in their future. The tribe believes that if salmon are to survive, real gains in habitat protection and restoration must be achieved.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org*.

It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Forest Cover Conditions

Current forest cover conditions are generally good to healthy in most watershed units in the Quileute Area of Interest, with 16 watersheds having more than 75% forest cover. This is similar to the forest cover conditions in the last report, showing little change in forest cover between 2011 and 2016. However, there was a slight negative trend over the longer period between 1992 and 2016.

Timber Harvest Activities

From 2016 to 2019, 51.2 square miles of forestlands were permitted for harvesting in the Quileute Area of Interest. Of these, 11.8 square miles (or 23%) were on state-managed lands while 39.4 square miles (or 78%) were on private lands. By comparison, between 2011 and 2015, a total of 122.7 square miles of forestlands were permitted for harvesting. However from 2011 to 2015, the average rate of harvest was 24.5 square miles per year while from 2016 to 2019, it was 17.1 square miles/year, indicating a trend towards a slower rate of harvest activity.

Impact of Roads on Fish Habitat

Fifteen watersheds in the Quileute Area of Interest, representing 56% of the land area, may not be properly functioning because of road densities that exceed 3 miles per square mile. While this appears to be a decrease in overall road density compared to the 2016 results (64%), it is because the Area of Interest was expanded to include part of Olympic National Park. When direct watershed comparisons were made using the same Area of Interest, there was little to no change in road densities between 2016 and 2019.

Impact of Culverts on Fish Habitat

Of the 691 culverts identified under the Road Maintenance and Abandonment Plan (RMAP) in the Quileute Area of Interest, 587 (or 85%) have been fixed and are now fish passable while the other 104 (or 15%) remain barriers to fish passage. This suggests that the RMAP program appears to be working. However, there are an additional 371 barrier culverts that are not part of the RMAP program. Of these, 210 (or 57%) are totally impassible to fish.

Streamflow Trends

From 2016 to 2019, streamflows for the Calawah River has followed the same overall trends as the previous 40 years, increasing peak flows and decreasing low flows. In both the Calawah and Bogachiel rivers, it is becoming common for peak flows to be at or above flood stage. These trends could threaten salmon habitat and other aquatic ecosystem functions.

Invasive Species

The Quileute Tribe has implemented a multi-species management approach to invasive weed species. While knotweed plants are still present in the riparian zone, their numbers have dropped, likely the result of the eradication effort of the tribe. With knotweed less prevalent on the landscape, Scotch broom, reed canarygrass, and herb Robert are now species of higher concern. Also of concern are invasive fish species in the watersheds that impact salmon survival, such as the brook trout that overwinters in large lake and pond habitats. In addition to the threat of the European green crab, which is yet to be confirmed in the Quillayute system, these invasive species could negatively impact fish habitat and threaten the relatively healthy salmon runs in the area.

Thunder Road Restoration Project

The Quileute Tribe partnered with the Natural Resource Conservation Service to reconnect 22 acres of habitat to the Quillayute River by restoring a connection between a tributary slough and four wetlands. Work included restoring 1.2 miles of road, fixing four fish barriers, installing two relief culverts, and replacing a drivable ford.

Climate Change Impact

As a result of climate change, spring precipitation and winter streamflows have increased while spring snowpacks and summer streamflows have decreased in the Quileute Tribe's Area of Interest. The area also is prone to flooding and erosion from sea level rise, high tides, coastal storms, large waves and high streamflow events, potentially resulting in habitat loss. These temperature and precipitation changes negatively impact the forests, wetlands, prairies, and fisheries, further putting the tribe's treaty reserved rights at risk.

Ocean Conditions

The marine Areas of Interest for the Quileute Tribe have been heavily impacted by ocean warming, including marine heatwaves, hypoxia and harmful algal blooms. Bottom water low oxygen conditions have been recorded between June and September for up to 35% and 33% of the season off Cape Alava and off Teahwhit Head, respectively. These adverse marine conditions have caused the tribe to declare three fisheries economic disasters in the past.

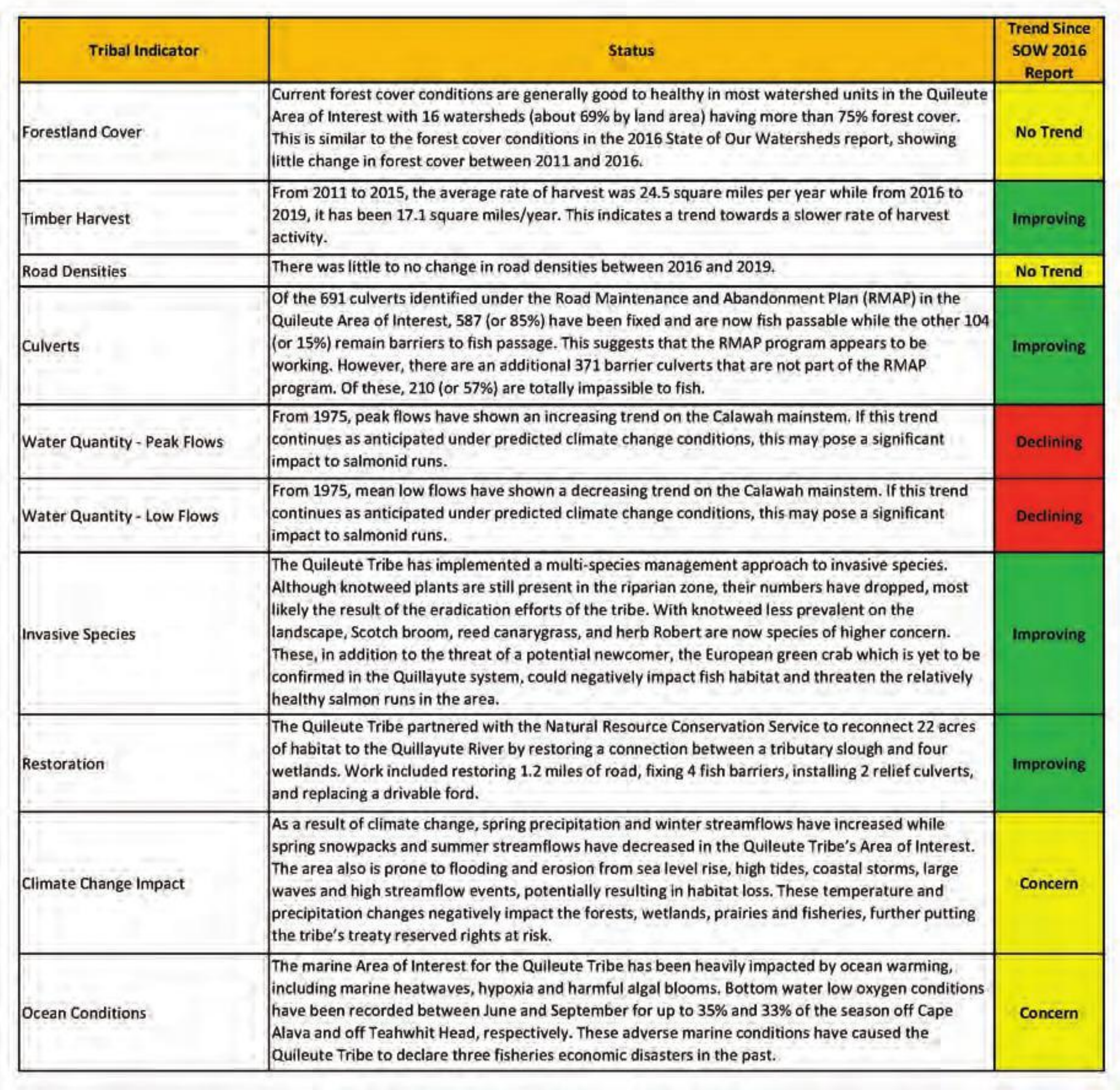
Conclusion

There have been a number of restoration successes in the Lake Ozette, Quillayute River and Goodman Creek watersheds since the 2016 State of the Watershed report. Forest road barriers have been fixed, forest cover has increased, Japanese knotweed infestation has been reduced, and restoration is occurring. At the same time, the incremental decline in low flow conditions raises concerns with the changing climate conditions. Restoration is not enough to keep up with the impacts of a growing population and their land use in the watershed. People have to be held accountable to protecting, conserving and improving fish habitat in their land-use decisions, and federal, state and local governments all have a role in that. Implementation includes education and voluntary action, but also needs to include enforcement when those laws are broken. The future of tribal treaty rights in the Lake Ozette, Quillayute River and Goodman Creek basins depends on it.

Recovery Efforts Shows Signs of Improvement

A review of key environmental indicators for the Quillayute basin shows that priority issues continue to be degradation of water quantity and quality, degradation of floodplain and riparian processes, degradation of forest cover, and high road densities. There have been improvements in the repair or abandonment of forest road culverts and the successful treatment of invasive species. In general, there is a shortage of staff at all levels (e.g., federal, state, tribal and county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trends for these key environmental indicators since the 2016 State of Our Watersheds Report shows an improvement for some indicators, no improvement in road densities and forest cover, and a continued decline in water quality:



Tribal Indicator	Status	Trend Since SOW 2016 Report
Forestland Cover	Current forest cover conditions are generally good to healthy in most watershed units in the Quileute Area of Interest with 16 watersheds (about 69% by land area) having more than 75% forest cover. This is similar to the forest cover conditions in the 2016 State of Our Watersheds report, showing little change in forest cover between 2011 and 2016.	No Trend
Timber Harvest	From 2011 to 2015, the average rate of harvest was 24.5 square miles per year while from 2016 to 2019, it has been 17.1 square miles/year. This indicates a trend towards a slower rate of harvest activity.	Improving
Road Densities	There was little to no change in road densities between 2016 and 2019.	No Trend
Culverts	Of the 691 culverts identified under the Road Maintenance and Abandonment Plan (RMAP) in the Quileute Area of Interest, 587 (or 85%) have been fixed and are now fish passable while the other 104 (or 15%) remain barriers to fish passage. This suggests that the RMAP program appears to be working. However, there are an additional 371 barrier culverts that are not part of the RMAP program. Of these, 210 (or 57%) are totally impassible to fish.	Improving
Water Quantity - Peak Flows	From 1975, peak flows have shown an increasing trend on the Calawah mainstem. If this trend continues as anticipated under predicted climate change conditions, this may pose a significant impact to salmonid runs.	Declining
Water Quantity - Low Flows	From 1975, mean low flows have shown a decreasing trend on the Calawah mainstem. If this trend continues as anticipated under predicted climate change conditions, this may pose a significant impact to salmonid runs.	Declining
Invasive Species	The Quileute Tribe has implemented a multi-species management approach to invasive species. Although knotweed plants are still present in the riparian zone, their numbers have dropped, most likely the result of the eradication efforts of the tribe. With knotweed less prevalent on the landscape, Scotch broom, reed canarygrass, and herb Robert are now species of higher concern. These, in addition to the threat of a potential newcomer, the European green crab which is yet to be confirmed in the Quillayute system, could negatively impact fish habitat and threaten the relatively healthy salmon runs in the area.	Improving
Restoration	The Quileute Tribe partnered with the Natural Resource Conservation Service to reconnect 22 acres of habitat to the Quillayute River by restoring a connection between a tributary slough and four wetlands. Work included restoring 1.2 miles of road, fixing 4 fish barriers, installing 2 relief culverts, and replacing a drivable ford.	Improving
Climate Change Impact	As a result of climate change, spring precipitation and winter streamflows have increased while spring snowpacks and summer streamflows have decreased in the Quileute Tribe's Area of Interest. The area also is prone to flooding and erosion from sea level rise, high tides, coastal storms, large waves and high streamflow events, potentially resulting in habitat loss. These temperature and precipitation changes negatively impact the forests, wetlands, prairies and fisheries, further putting the tribe's treaty reserved rights at risk.	Concern
Ocean Conditions	The marine Area of Interest for the Quileute Tribe has been heavily impacted by ocean warming, including marine heatwaves, hypoxia and harmful algal blooms. Bottom water low oxygen conditions have been recorded between June and September for up to 35% and 33% of the season off Cape Alava and off Teahwhit Head, respectively. These adverse marine conditions have caused the Quileute Tribe to declare three fisheries economic disasters in the past.	Concern

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

Current trends indicate that continued funding of habitat restoration activities is necessary to achieve the identified salmon restoration goals for WRIA 20. Upgrading of the regulatory framework that serves to protect salmon habitat must occur if the underlying assumption to all the recovery goals is to be realized: that existing habitat will be protected from loss. Growth and development along the rivers and lake shores, and associated clearing of riparian vegetation for views and water access, are growing problems. The current regulatory framework clearly is not providing adequate protection of the water quality, instream flow and riparian habitat within the Area of Concern.

Quileute Natural Resources continues to work with government and private partners on improvements to salmon habitat, most recently with the continued participation in the Lead Entity and Regional Recovery Process (a fusion of four coastal lead entities), developing strategies for recovery and participating in the grant process.

The greatest need is continued funding, since habitat restoration is an ongoing process (e.g., culvert, bridge and road maintenance, and weed control). Funding also is needed for staff programs to monitor, assess and develop plans for needed restoration and/or protection.

Water quality monitoring through federal and state programs is a vital part of salmon habitat protection and will need continued support as well. For more information about the efforts of the Quileute Natural Resources program, visit *www.quileutenation.org/natural-resources.*

Over the next five years, the tribe will continue to focus on maintenance of stream monitoring and salmon habitat restoration throughout WRIA 20. The tribe is exploring flood control and habitat restoration projects in cooperation with state and federal agencies. The tribe also is working on climate change concerns through existing federal grants from EPA and BIA, and as watershed management interfaces with climate (e.g., flooding, new precipitation cycles, low flows, changes in invasive species or habitat for native species), the tribe will need to address such issues.

Two of the tribe's top priorities are increasing support for funding for the Salmon Recovery Funding Board, and increasing funding for the Washington Coast Restoration and Resiliency Initiative, which is crucial to tribal initiatives such as the Quillayute River Restoration Project, and the efforts to assess and plan for future habitat restoration and resilience projects in the Bogachiel, Sol Duc and other key salmon tributaries.

QUILEUTE TRIBE

Forest Cover Conditions

Current forest cover conditions are generally good to healthy in most watershed units in the Quileute Area of Interest with 16 watersheds (about 69% by land area) having more than 75% forest cover. This is similar to the forest cover conditions in the 2016 State of Our Watersheds Report, showing little change in forest cover between 2011 and 2016. However, there was a slight negative trend over the longer period between 1992 and 2016.

The current forest cover conditions of most of the watershed units in the Quileute Area of Interest were generally good to healthy but moderate forest cover conditions do exist in the northwest part of the area near Lake Ozette, especially in the Big River and West Fork Dickey River watersheds. Areas within Olympic National Forest and Olympic National Park, which are generally protected from major anthropogenic disturbances like tree removal, had the healthiest forest cover conditions.

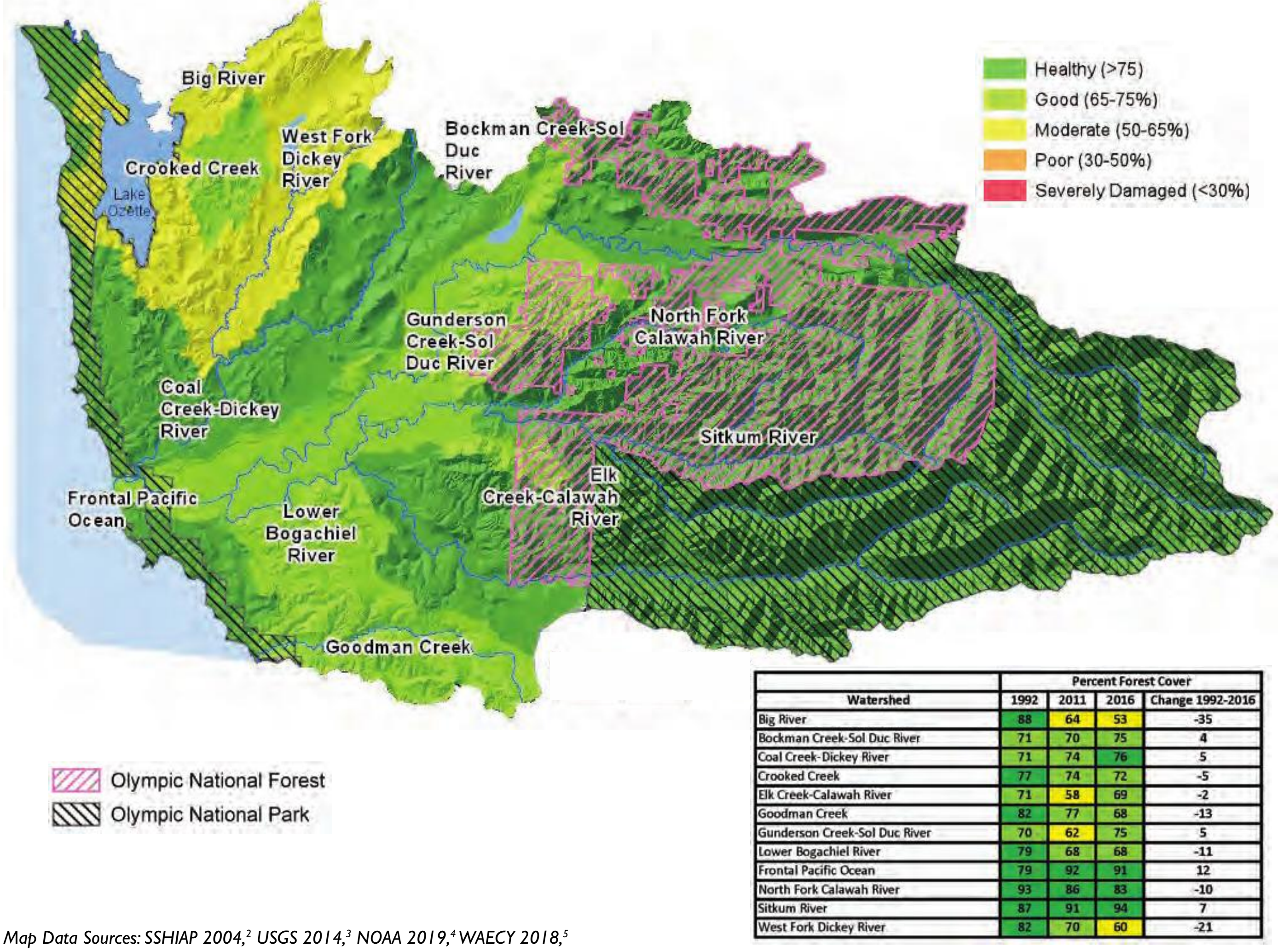
Currently, 16 watersheds which represent about 69% by land area have healthy (more than 75%) forest cover conditions. This is similar to the forest cover conditions in the last report, showing little change in forest cover between 2011 and 2016. However, a slightly different picture in forest cover emerges over the longer period between 1992 and 2016. In 1992, 20 watersheds which represent about 81% by land area had a healthy forest cover as opposed to 69% in 2016.

The greatest declines in forest cover between 2011 and 2016 were in the Big River (10%), West Fork Dickey River (10%) and Goodman Creek (9%) watersheds while the highest declines between 1992 and 2016 were in the Big River (35%), West Fork Dickey River (21%), Goodman Creek (13%), Lower Bogachiel River (11%) and North Fork Calawah River (10%) watersheds. Since these areas are generally in private forestlands, it is likely that these changes were caused by timber harvesting.

Between 1992 and 2016, there were some gains in forest cover, particularly in the Frontal Pacific Ocean (12%) and Sitkum River (7%) hydrologic units (or watersheds) which are both in the Olympic National Park and Olympic National Forest, respectively.

Healthy forest cover conditions are vital for the maintenance of proper watershed processes and thus salmonid habitat. A major goal of the WRIA 20 watershed plan "is the maintenance of forest cover to benefit fish habitat, water quantity and water quality and to provide additional ecosystem services such as carbon sequestration."[1]

While the overall forest conditions are good to healthy, the general trend for most watersheds outside the park and forest service lands appears to be negative. However, it is important to note that except for the national park, this area (especially private and state ownership) is under continuous harvest and replanting, so figures change over time.



	Percent Forest Cover			
Watershed	**1992**	**2011**	**2016**	**Change 1992-2016**
Big River	88	64	53	-35
Bockman Creek-Sol Duc River	71	70	75	4
Coal Creek-Dickey River	71	74	76	5
Crooked Creek	77	74	72	-5
Elk Creek-Calawah River	71	58	69	-2
Goodman Creek	82	77	68	-13
Gunderson Creek-Sol Duc River	70	62	75	5
Lower Bogachiel River	79	68	68	-11
Frontal Pacific Ocean	79	92	91	12
North Fork Calawah River	93	86	83	-10
Sitkum River	87	91	94	7
West Fork Dickey River	82	70	60	-21

Map Data Sources: SSHIAP 2004,[2] USGS 2014,[3] NOAA 2019,[4] WAECY 2018,[5]

Timber Harvest Activities

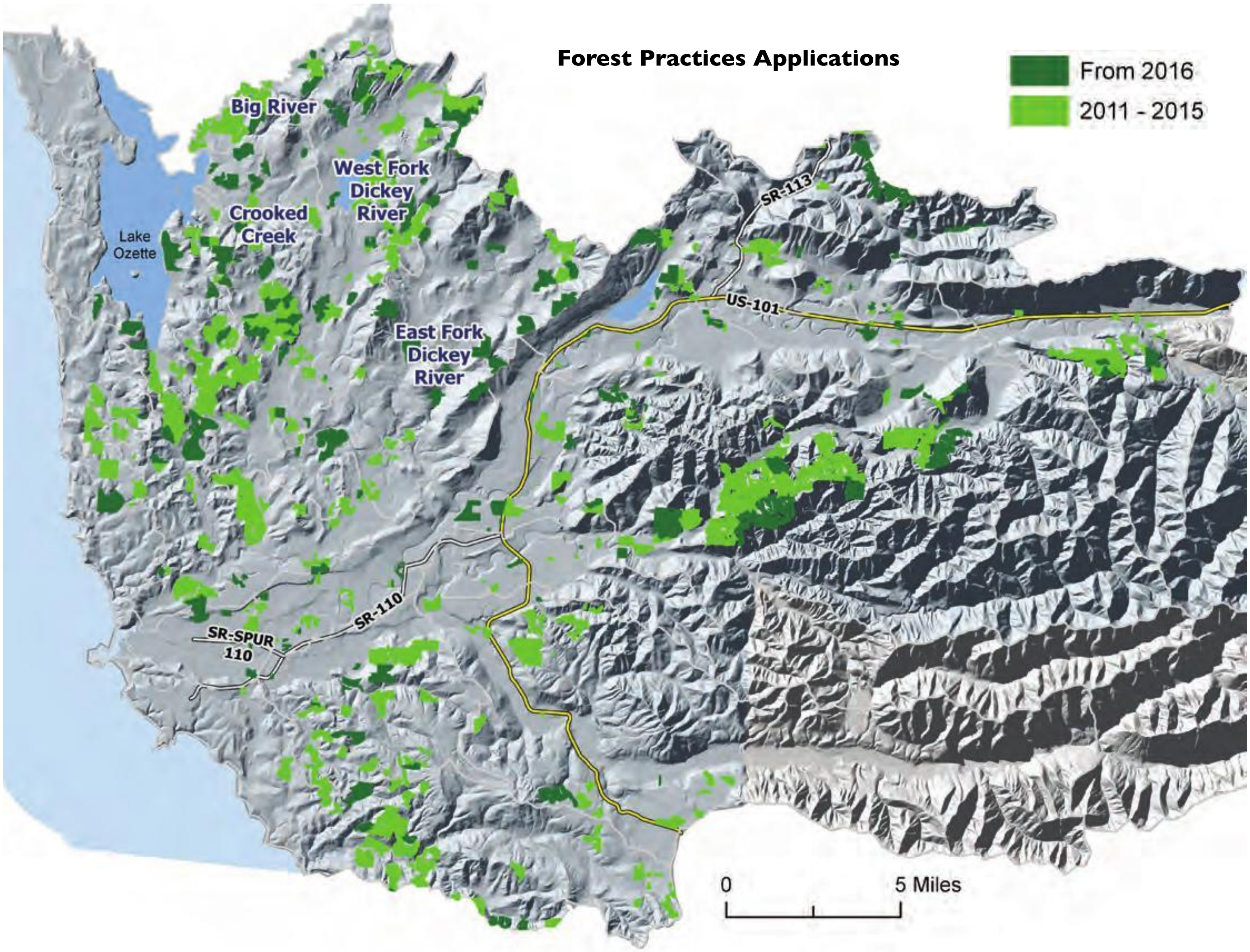
From 2016 to 2019, 51.2 square miles of forestlands were permitted for harvesting in the Quileute Area of Interest. Of these, 11.8 square miles (or 23%) were on state-managed lands while 39.4 (or 78%) were on private lands. By comparison, between 2011 and 2015, a total of 122.7 square miles of forestlands were permitted for harvesting. However from 2011 to 2015, the average rate of harvest was 24.5 square miles per year while from 2016 to 2019, it has been 17.1 square miles/year. This indicates a trend towards a slower rate of harvest activity.

Forests in the Quileute Tribe's Area of Interest have been relied upon for many important resources including timber. However, the removal of vegetation from commercial timber harvesting negatively impacts riparian function, results in poor large woody material recruitment in streams, impacts stream temperatures and alters the flow regime which are factors limiting salmon production in the area.[1]

Forest practice applications filed for the purposes of cutting or removal of commercial timber products in the Area of Interest show that from 2016 to 2019, 51.2 square miles of forestlands were permitted for harvesting. Of these, 11.8 square miles (or 23%) were on Washington DNR-managed lands while 39.4 (or 78%) were on private lands. Most of the recent forest practice activities seem to be concentrated in the West and East Fork Dickey, Big River and Crooked Creek watersheds, which are predominantly private forestlands.

By comparison, between 2011 and 2015, a total of 122.7 square miles of forestlands were permitted for harvesting: 12.1 square miles (10%) on state-owned lands and 110.5 square miles (or 90%) on private lands.

In both time periods analyzed, the amount of forestland permitted for harvest as well as the harvest rate was significantly higher on private than on state-owned lands. From 2011 to 2015, the average rate of harvest was 24.5 square miles per year and while from 2016 to 2019, it has been 17.1 square miles/year. This indicates a trend towards a slower rate of harvest activity.



Map Data Sources: SSHIAP 2004,[2] WADNR 2019,[3] WADOT 2018[4]

Impact of Roads on Fish Habitat

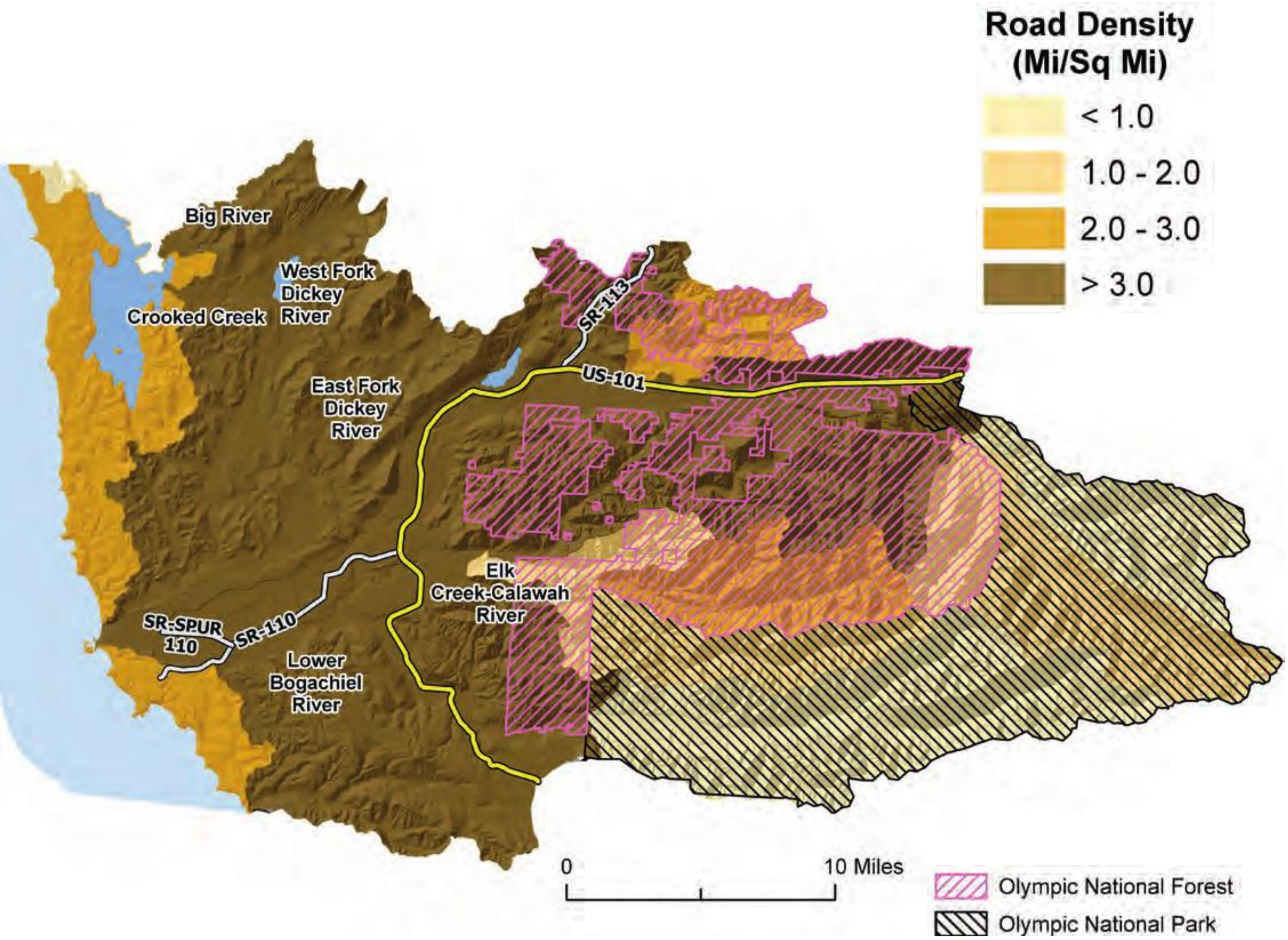
Fifteen watersheds in the Quileute Area of Interest, representing 56% of the land area, may not be properly functioning because of road densities that exceed 3 miles per square mile. Although this appears to be a decrease in overall road density compared to the results obtained in 2016 (64%), this is because of the expansion of the Area of Interest to include part of the Olympic National Park. When direct watershed comparisons were made using the same Area of Interest, there was little to no change in road densities between 2016 and 2019.

Roads are a vital component of the human use of forested watersheds but they can affect fish habitat by increasing erosion and sediment loading, and by changing channel morphology. If not properly constructed or maintained, culverts at road crossings may become fish barriers.

The National Marine Fisheries Service[1] defined watersheds with road densities greater than 3 miles per square mile of watershed area as “not properly functioning” for salmon habitat. Watersheds were classified as “properly functioning condition” when road densities were less than 2 miles per square mile and “at risk” when values were 2-3 miles per square mile.

Fifteen watersheds in the Quileute Area of Interest, representing 56% of the land area, had road densities that placed them in the “not properly functioning” category and this could have an impact on stream hydrology, fish habitat and salmonid production. The highest density of more than 5.5 miles per square mile was in the West Fork Dickey River watershed. Other high density watersheds were the Elk Creek-Calawah, the Crooked Creek, the East Fork Dickey, the Lower Bogachiel River and Big River watersheds.

Although there appears to be a decrease in overall road density since the last report, that is not the case because of differences in the Area of Interest as well as the sizes of some of the watersheds. The eastward expansion of the Area of Interest to include part of the Olympic National Park in this report resulted in the inclusion of many watersheds with much lower anthropogenic activities and fewer roads. When direct watershed comparisons were made using the same Area of Interest, there was little to no change in road densities between 2016 and 2019.



Map Data Sources: SSHIAP 2004,[2] WADNR 2016,[3] WADNR 2019,[4] WAECY 2018[5]

Impact of Culverts on Fish Habitat

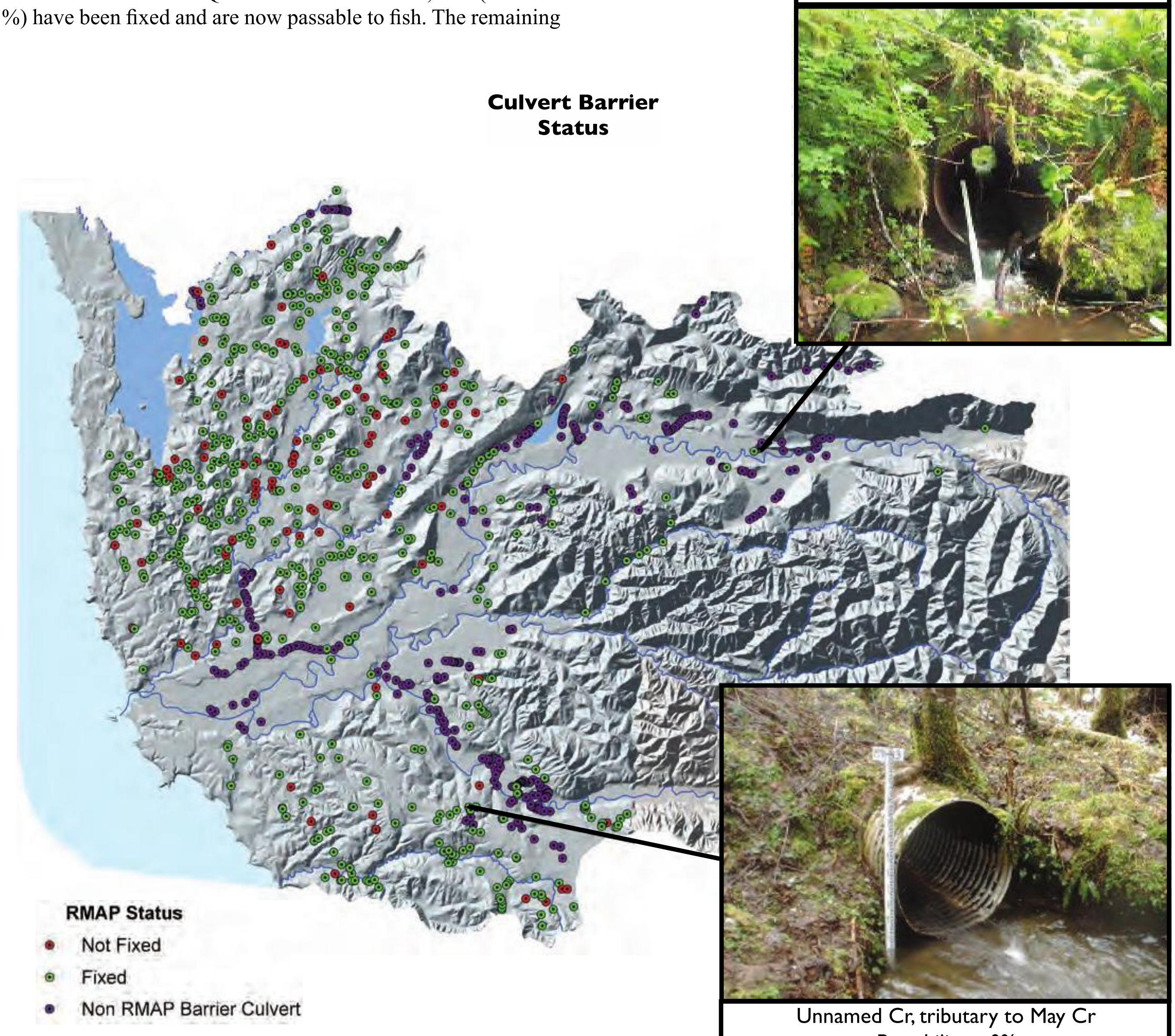
Of the 691 culverts identified under the Road Maintenance and Abandonment Plan (RMAP) in the Quileute Area of Interest, 587 (or 85%) have been fixed and are now fish passable while the other 104 (or 15%) remain barriers to fish passage. This suggests that the RMAP program appears to be working. However, there are an additional 371 barrier culverts that are not part of the RMAP program. Of these, 210 (or 57%) are totally impassible to fish.

If not properly constructed or maintained, culverts at road crossings may become fish barriers and impede fish access to important habitat. The WRIA 20 detailed implementation plan recommends restoring fish populations by working to remove fish passage barriers.[1]

The Washington State Forest and Fish Law requires most forest landowners to have a RMAP which includes a planning process that provides landowners with a method to evaluate their forest roads and identify areas that do not meet standards. They are then required to come up with a schedule for any repair work needed to improve road systems at stream crossings and address aquatic habitat and fish passage issues. The RMAP data shows that of the 691 culverts identified in the Quileute Area of Interest, 587 (or about 85%) have been fixed and are now passable to fish. The remaining 104 (or 15%) have yet to be repaired and remain barriers to fish. This suggests that the RMAP program appears to be working in the Quileute Area of Interest, which in turn should have a positive impact on fish habitat.

However, there were an additional 371 barriers culverts in the area that are not part of the RMAP program which impede fish access to miles of stream habitat. These are mostly culverts on state, county and other roads. Of these, 210 (or 57%) are totally impassible to fish while an additional 85 are only about 30% passable.

Stream - Wisen Creek
Passability - 33%
Potential Habitat Gain - 2,097 m



Unnamed Cr, tributary to May Cr
Passability – 0%
Potential Habitat Gain – 1,317 m

Map Data Sources: CSP 2019,[2] SSHIAP 2004,[3] WADFW 2019,[4] WADNR 2019,[5] WAECY 2018[6]

Continued Streamflow Trends Threaten Salmon

From 2016 to 2019, streamflows for the Calawah River has followed the same overall trends as the previous 40 years – increasing peak flows and decreasing low flows. In both the Calawah and Bogachiel rivers, it is becoming increasing common for peak flows to be at or above flood stage. These trends could threaten salmon habitat and other aquatic ecosystem functions.

In order to provide suitable habitat for fish survival and productivity and maintain healthy ecosystems, rivers and streams must have adequate water. Protection of instream flows is a key goal of the WRIA 20 detailed implementation plan.[1]

The Quileute Tribe works with the Washington Department of Ecology to continue operation of the monitoring gauge on the Sol Duc River, which supports stocks of coho, chinook and sockeye salmon as well as native runs of steelhead and cutthroat trout. The variation in streamflow timing and magnitude shown for the Sol Duc is typical for streams in this basin with peak flows in the winter months and low flows in the summer months.

In cooperation with USGS, the tribe operates a gauge on the Bogachiel River which is used to track flooding and road access from Forks to La Push. In the 16-year period between 2003 and 2019, the river reached or exceeded flood stage at least 12 of the 16 years.

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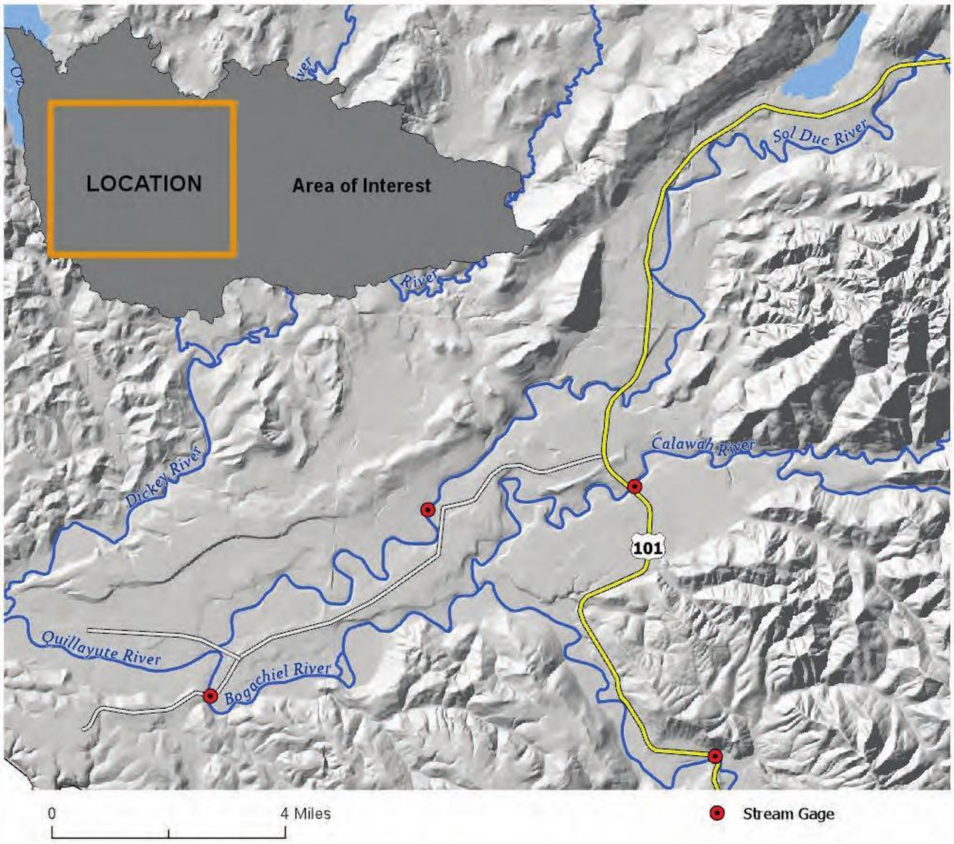
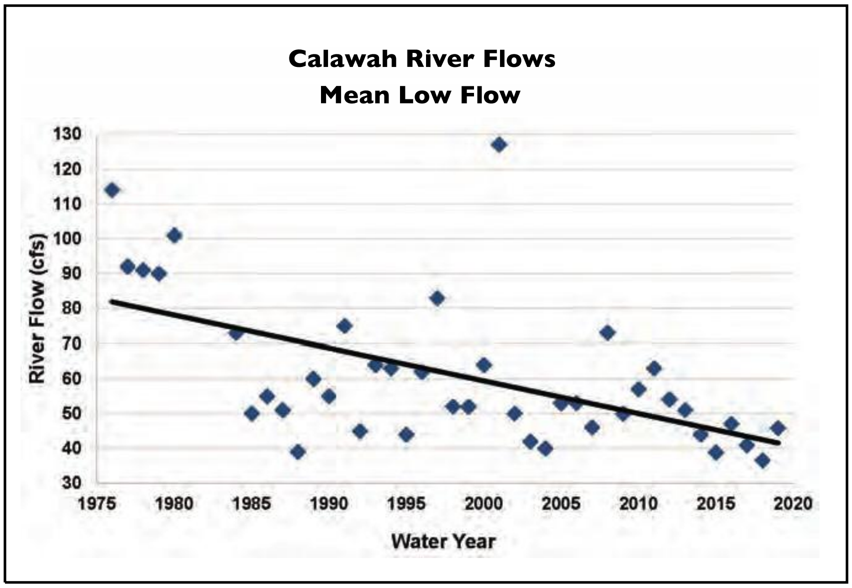




Map Data Sources: SSHIAP 2004,[8] USGS 2020a,[9] USGS 2020b,[10] WAECY 2018,[11] WAECY 2020[12]

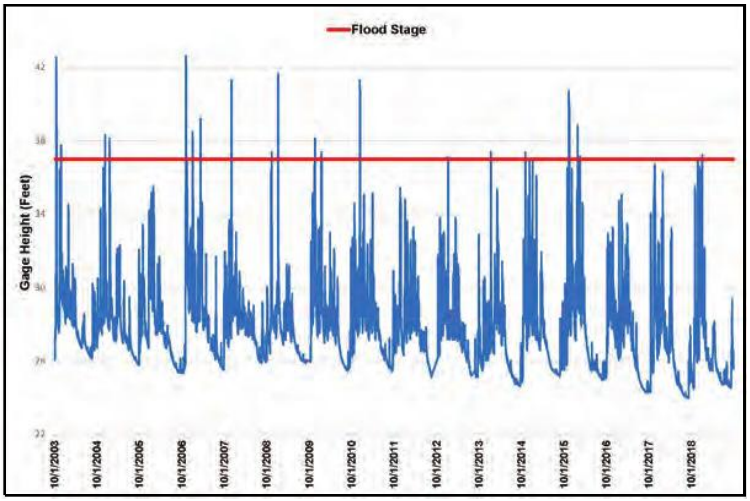
(Continued from previous page)

Since 2016, the tribe has also completely funded a gauge on the Bogachiel River at Highway 101 which is used monitor sediment loads, turbidity, temperature and discharge for fisheries management.

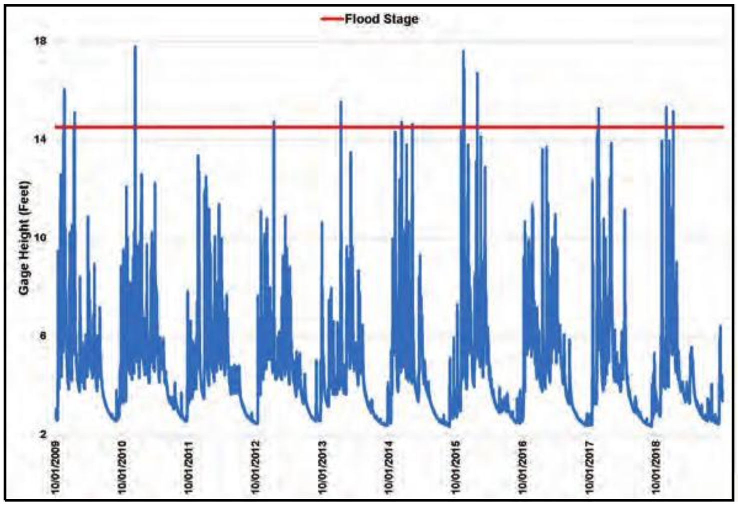
Although values have varied widely from year to year, streamflows from 2016 to 2019 for the Calawah River have followed the same overall trends as the previous 40 years – increasing peak flows and decreasing low flows. In the decade between 2010 and 2019, the peak flow of the river has been at or above flood stage in eight of those years.

Such scenarios are predicted to occur as a result of climate change[2] and both trends could threaten salmon habitat and other aquatic ecosystem functions. Increased peak flows may also be the result of removal of vegetation.[3,4] They cause scouring of streambeds, channel incision (and subsequent disconnection from floodplain), and downstream transport of wood, resulting in simplified stream channels and greater instability. The trend of increasing peak flows has been shown to make streams less productive.[5]

Many studies in the Pacific Northwest[6,7] have documented the relationship between low streamflows and poor salmonid survival. The reduction in streamflows may result in less fish habitat because of dry streambeds or pools which become cut off from the main channel and strand fish.



Gauge Height for Bogachiel River near La Push



Gauge Height for Calawah River near La Push

Jennifer Hagen, Quileute Tribe

Erosion at the mouth of the Quillayute River.

Invasive Species Management

The Quileute Tribe has implemented a multi-species management approach to invasive weed species. Although knotweed plants are still present in the riparian zone, their numbers have dropped, most likely the result of the eradication effort of the tribe. With knotweed less prevalent on the landscape, Scotch broom, reed canarygrass, and herb Robert are now species of higher concern. Also of concern are invasive fish species in the watersheds that impact salmon survival such as brook trout that overwinter in large lake and pond habitats. In addition to the threat of the European green crab, which is yet to be confirmed in the Quillayute system, these invasive species could negatively impact fish habitat and threaten the relatively healthy salmon runs in the area.

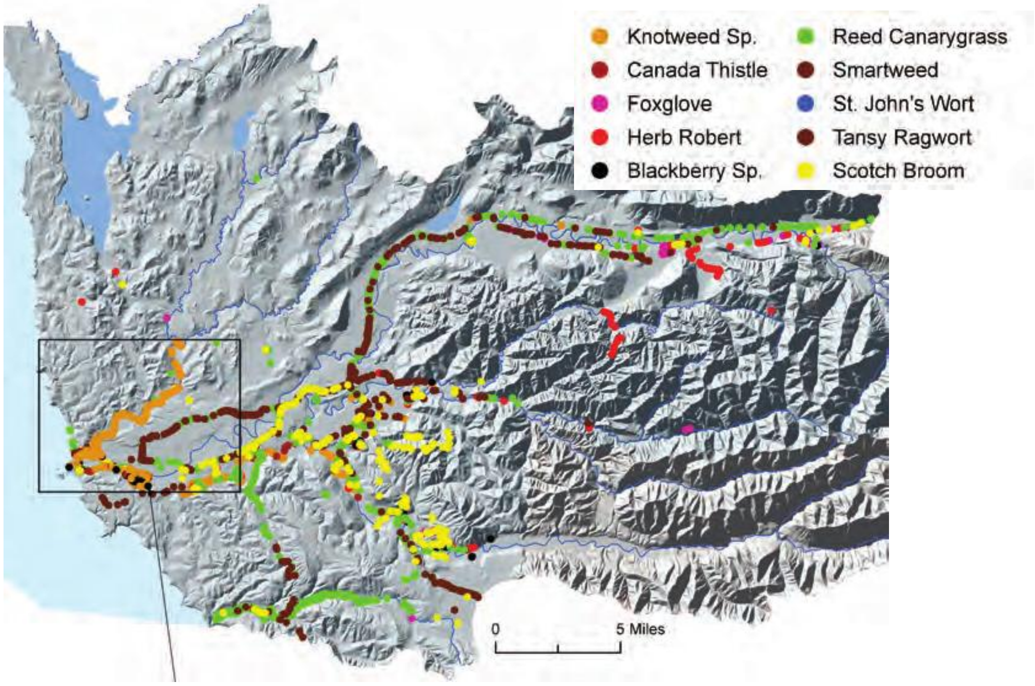
The Quileute Tribe has implemented a multi-species management approach to invasive weed species and completed the first season of a multi-year on-reservation inventory in 2019. Another inventory and treatment of invasive weed species was equally carried out in the Quileute Area of Interest by the 10,000 Years Institute and its partners. As a result, the types and distribution of the invasive species differ significantly from the previous report[1] in which the primary species of focus was knotweed (*Polygonum*).

Although knotweed plants are still present in the riparian zone, their numbers have dropped significantly and they are no longer as widely distributed, most likely the result of the multi-year effort embarked by the tribe and the 10,000 Years Institute to eradicate them.

Based on the area surveyed for invasive plant species, Scotch broom (*Cytisus scoparius*), reed canarygrass (*Phalaris arundinacea*), and herb Robert (*Geranium robertianum*) now occupy more area than knotweed. Other species of note include tansy ragwort (*Jacobaea vulgaris*), and Canada thistle (*Cirsium arvense*).

The three-year period between 2017 and 2019 for which data from the new survey is available is short. Since different sites where surveyed in different years and infestation rates vary from site to site, it is difficult to do a trend analysis. However, it appears that the amount of area occupied by the invasive plants may be reducing. Most invasive weed species were identified in 2018.

Map Data Sources: 10KYI 2019,[2] Quileute 2019,[3] SSHIAP 2004,[4] WAECY 2018[5]



Quileute Tribe monitoring, 2019

Debbie Preston, NWIFC

Giant knotweed control by the Quileute Tribe.

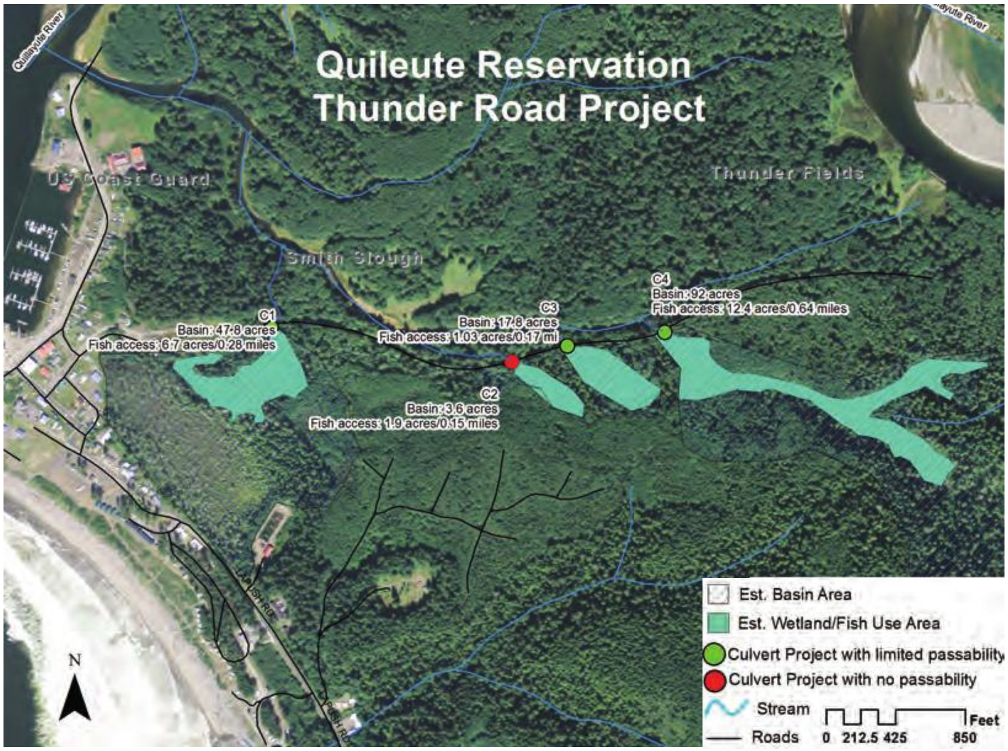
Quileute Tribe

Left: Bright yellow-green colored knotweed in 2009 throughout the floodplain of the Bogachiel. Right: Same area in 2016 showing how knotweed is not visible after treatment and is currently just treated for maintenance.

QUILEUTE TRIBE

Thunder Road Restoration Project

The Quileute Tribe partnered with the Natural Resource Conservation Service to reconnect 22 acres of habitat to the Quillayute River by restoring a connection between a tributary slough and four wetlands. Work included restoring 1.2 miles of road, fixing 4 fish barriers, installing 2 relief culverts, and replacing a drivable ford.



The Quillayute River watershed is one of the Olympic Peninsula's largest salmon producing basins. The watershed is comprised of four major tributaries (Bogachiel, Calawah, Sol Duc and Dickey rivers) which come together to form the short and powerful Quillayute River, before emptying into the Pacific Ocean at La Push.

Although the Quillayute mainstem is only 5.5 miles long, it provides critical fish habitat both in its floodplain and off-channel habitats. For decades, a critical tributary slough and wetland complex was disconnected from the Quillayute due to an abandoned PUD road ripe with fish barriers. In 2012, the tribe acquired the land and the road, known as Thunder Road, from the National Park Service through Public Law 112-97, known as the tsunami legislation. However, this meant the tribe had fish barriers to replace.

In 2015 the tribe partnered with the Natural Resource Conservation Service (NRCS) to restore the road for water quality issues and restore fish access. Through their efforts, 22 acres of habitat were connected to the Quillayute by restoring a connection between a tributary slough and four wetlands by replacing a series of culverts under a road with three larger culverts and a bridge. Work included restoring 1.2 miles of road, fixing four fish barriers, installing two relief culverts and replacing a drivable ford. Now, tribal members can access their historic fishing, hunting and gathering grounds on a fish-friendly road, which both enhanced fish habitat and restored a critical cultural gathering place.

The Quillayute watershed flows over some of the most fertile salmon habitats in the state; however, fish passage barriers continue to block and fragment this system, creating increased habitat loss for the system's salmon populations.

Despite the tribe's proactive approach to restoring fish passage, regional stakeholders have not been as committed. There are hundreds of fish barriers on land owned by Clallam County, and on private timber tracts. Through a recent effort funded through the Washington Salmon Recovery Funding Board, field staff from several regional groups have assessed all the culverts in Clallam County and are creating a plan to restore more fish passage barriers. One such group is the Coast Salmon Partnership which has carried out an inventory and assessment of county road culverts in western Jefferson and Clallam counties.

Nicole Rasmussen, Quileute Tribe (2)

Before (left) and after photos of the Thunder Road restoration project.

Climate Change Impact

As a result of climate change, spring precipitation and winter streamflows have increased while spring snowpacks and summer streamflows have decreased in the Quileute Tribe's Area of Interest. The area also is prone to flooding and erosion from sea level rise, high tides, coastal storms, large waves and high streamflow events, potentially resulting in habitat loss. These temperature and precipitation changes negatively impact the forests, wetlands, prairies and fisheries, further putting the tribe's treaty reserved rights at risk.

The cherished way of life of the Quileute Tribe is threatened by environmental pressures caused by climate change. The tribe recently sponsored two comprehensive reports[1,2] to study the effect of climate change on its land, waters, natural and cultural resources, as well as way of life.

Temperatures in the Quileute Tribe's Area of Interest have increased over the past century. Spring precipitation and winter streamflows have increased, while spring snowpacks and summer streamflows have decreased. In 2015, as a result of warmer temperatures, much of Washington, including the Olympic Mountains, had less than a quarter of the normal snowpack.[3] Three of the four rivers that flow into the Quillayute mainstem depend on winter snowpack in the Olympic Mountains for consistent water supply in the summer. Wildfires also are expected to be larger, increase in frequency and be more intense. The thermal expansion of oceans caused by the absorption of more than 90% of the heat generated by greenhouse gases combined with the melting of glaciers and ice sheets has led to sea level rise which could reduce spawning habitat for some species that spawn near tidewater.

The proximity of La Push to both the ocean and the Quillayute River makes it prone to flooding and erosion from sea level rise, high tides, coastal storms, large waves and high streamflow events, potentially resulting in habitat loss.[4] Ruggiero et al.[5] also report that climate change impacts may significantly change the frequency with which the Quillayute River floods.

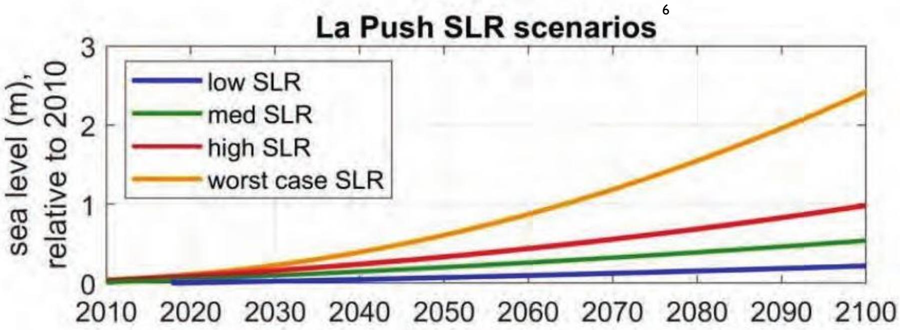
Changes to high water levels will impact the river stage as far as 5 km inland, likely significantly worsening the existing Thunder Field erosion/avulsion threat.

These temperature and precipitation changes negatively impact the forests, wetlands, prairies, wildlife and salmon, which depend on clean, cold, well-oxygenated water.

Warmer stream temperatures could result in accelerated egg and embryo development, leading to earlier emergence of smaller individuals. Increasing water temperatures will affect the physiological aspects of smolting while changes in hydrology will affect downstream smolt migration. All these could result in fewer and smaller returning adults and affect reproductive success, further putting the tribe's treaty reserved fishing rights at risk.

Tony Foster, Quileute Tribe

Local flooding near La Push.



Debbie Preston, NWIFC

A cooperative state-tribal sandbagging effort on the Sol Duc River during the low flows of 2015 helped fish reach spawning grounds.

Ocean Conditions

The marine Area of Interest for the Quileute Tribe has been heavily impacted by ocean warming, including marine heat waves, hypoxia and harmful algal blooms. Bottom water low oxygen conditions have been recorded between June and September for up to 35% and 33% of the season off Cape Alava and off Teahwhit Head, respectively. These adverse marine conditions have caused the Quileute Tribe to declare three fisheries economic disasters in the past.

The marine Areas of Interest for the Quileute Tribe have been heavily impacted by ocean warming, including marine heat waves (MHWs), hypoxia and (HABs).

In recent years, the California Current System (CCS) has experienced two major MHWs – the 2014-16 "Blob" and the 2019 event. The 2014-16 MHW persisted for multiple years due to weak atmospheric circulation, and the presence of warm waters down to 300m. This MHW was aided by a strong El Nino event, which weakened upwelling and brought warm waters northward. The 2019 MHW coincided with a weak El Nino, and only lasted one year. In 2015 the CCS experienced a prolonged, severe HAB driven by the MHW. McCabe et al.[1] and McKibben et al.[2] have found that HABs in the CCS are strongly correlated with El Nino events, with the worst conditions occurring when southward winds drive upwelling of nutrient rich waters, followed by northward winds that drive downwelling and push these waters onshore (and the phytoplankton bloom that can accompany them).

Summertime hypoxia has been a growing concern on the Washington state continental shelf, with more severe conditions to the south. Since 2006, Olympic Coast National Marine Sanctuary (OCNMS) has deployed seasonal moorings[6] off the Olympic Coast. Moorings north of La Push (off Cape Alava) recorded bottom water hypoxic conditions between June and September up to 35% of the season (average of 4%), and moorings to the south (off Teahwhit Head) recorded hypoxic conditions up to 33% of the season (average of 16%). Adverse marine conditions have caused the tribe to declare three fisheries economic disasters since 2015.[3] Their 2015 Dungeness crab fishery was closed due to adverse HAB conditions and their 2015 and 2016 fall coho fisheries had very poor returns.

Nicole Rasmussen, Quileute Tribe

Plankton bloom in the Quileute Area of Interest.

Jennifer Hagen, Quileute Tribe

Part of the Quileute Tribe boat fleet.

Recent changes in ocean chemistry such as acidification, hypoxia and harmful algal bloom events are becoming a reality in our coastal waters, with the potential of severe consequences for marine organisms and ocean economies. The Northeastern Pacific Ocean, where the Quileute Tribe calls home, is experiencing declines in pH, dissolved oxygen and possibly recurrent HAB events.

Currently, the knowledge of the temporal and spatial variation of these parameters is limited at best. Reoccurring hypoxic events resulting in marine organism fatalities and HAB events which close shellfish harvesting are seemingly becoming the norm.

While data poor, Quileute's region has been fortunate to have several local monitoring programs to aid in the development of an understanding of the oceanographic processes that affect their marine resources.

Since 2001, the Quileute Tribe's Department of Natural Resources has maintained a biotoxins monitoring program within their Usual and Accustomed fishing grounds. This monitoring program provides almost real time information on the presence of biotoxins in seawater and shellfish and has been successful in protecting Quileute community members and other consumers from consuming shellfish tainted with biotoxins.

In addition, since 2009, researchers with the Applied Physics Laboratory at the University of Washington (UW), under the umbrella of the Northwest Area Network of Ocean Observing Systems (NANOOS; *nanoos.org/Explorer*), has worked with the tribe to maintain an oceanographic mooring 13 miles off the coast of La Push in the tribe's fishing area.

As a cooperator with OCNMS, the tribe has been maintaining a seasonal mooring program, providing monthly updates on oceanographic characteristics along the coast. These are extremely valuable assets providing near real-time

(Continued next page)

Map Data Sources: NOAA 2018,[3] OCNMS 2020[4]

QUILEUTE TRIBE

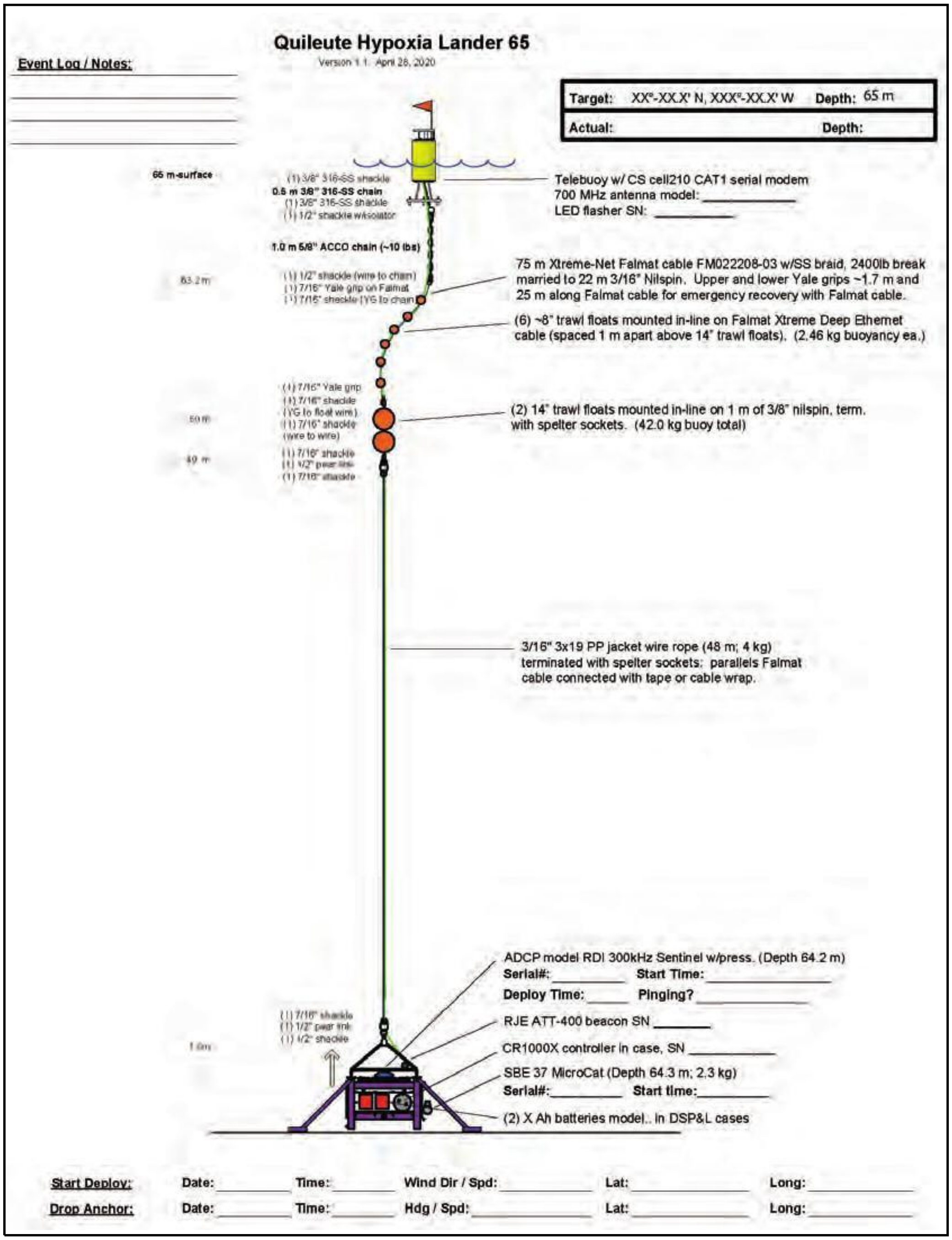
(Continued from previous page)

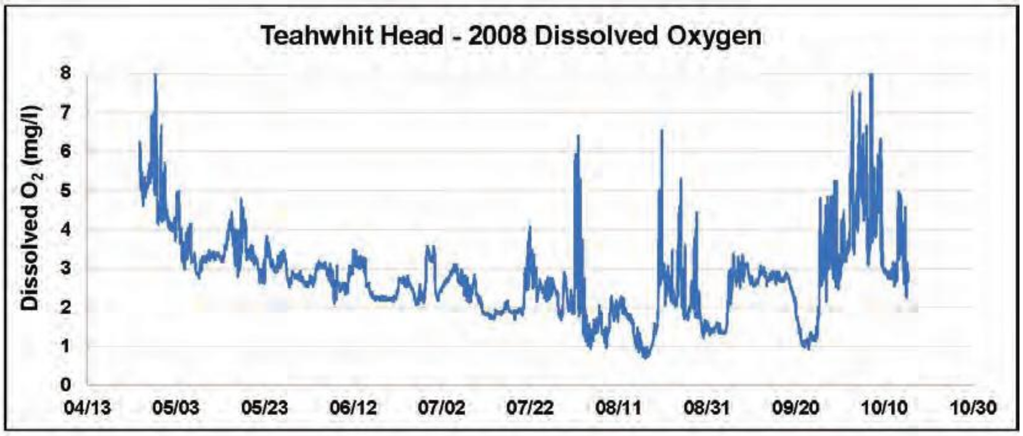
data to both the Quileute community and the Olympic Peninsula community at large.

The tribe's Department of Natural Resources has in-house capacity for both oceanographic monitoring and sample analysis. They also have built partnerships with academic researchers at UW and staff at OCNMS. These partnerships will be useful in ensuring that as monitoring assets are deployed, they complement each other in the data they acquire.

Specific to this program, conversations have been initiated in what additional assets are needed. The tribe was successful in obtaining funding to fabricate and deploy six Seabird SBE-37 with optical oxygen sensors, three acoustic doppler current profilers (ADCP) and a cellphone communication package for two moorings to be deployed in a central location of the tribe's crabbing grounds (due to Covid-19, deployment was delayed until 2021).

The tribe believes that furthering their understanding of the effects of ocean conditions on the distribution of crabs will serve to empower the tribe's management responses.





Summertime hyposia (low dissolved oxygen levels) recorded off Teahwhit Head in 2018.

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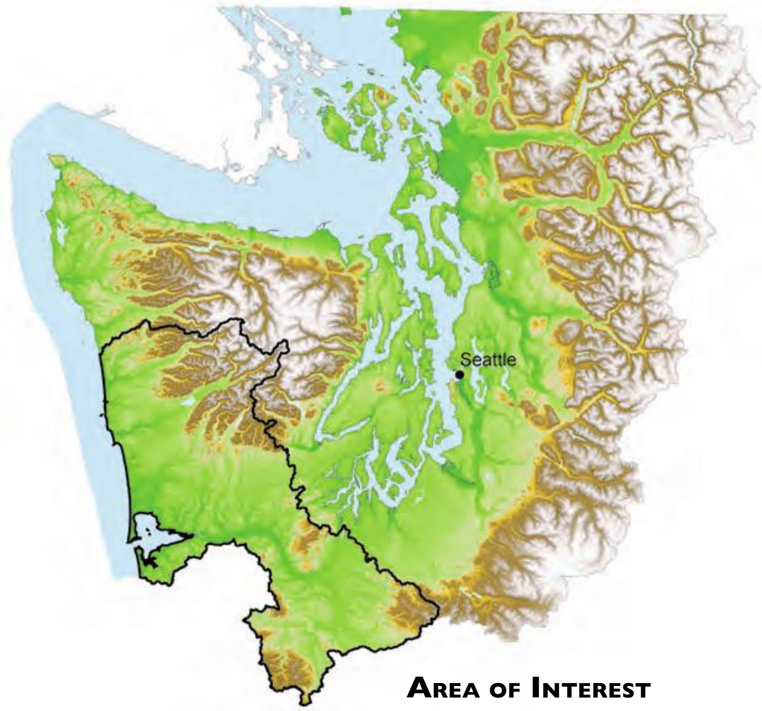
2020 State of Our Watersheds Report
Queets – Chehalis Basins

> *We have a profound and unique cultural and spiritual relationship with this land and territory. We have lived here since time immemorial. These lands are a gift to us that we have a sacred responsibility to take care of and maintain. Anything that is a threat to that we are cognizant of and we will do anything we can to address those threats.*

– Tyson Johnston
Vice President



Area of Interest

Quinault Indian Nation

The Quinault Indian Nation (QIN) consists of the Quinault and Queets tribes and descendants of five other coastal tribes: Quileute, Hoh, Chehalis, Chinook and Cowlitz.

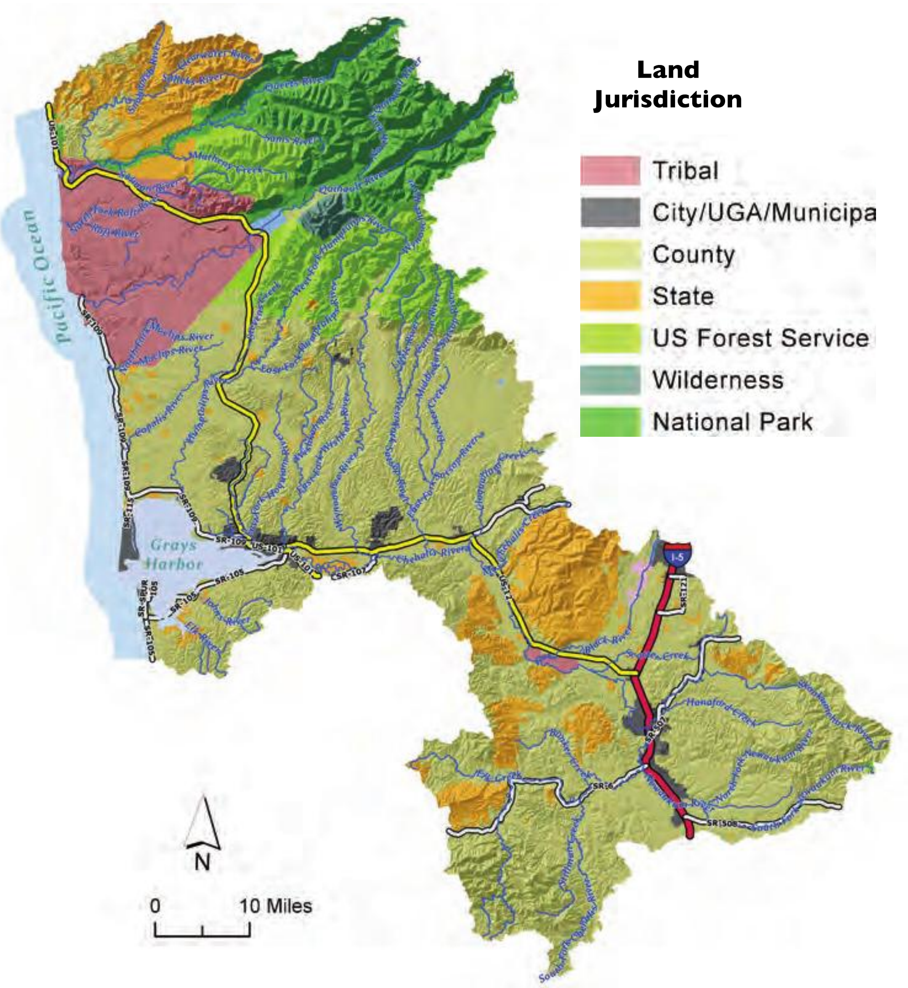
Quinault ancestors lived on a major physical and cultural dividing line. Beaches to the south are wide and sandy, while to the north, they are rugged and cliff-lined. Quinault people shared in the cultures of the people to the south as well as those to the north.

Living in family groups in longhouses up and down the river, they were sustained by the land and by trade with neighboring tribes. Salmon runs, abundant sea mammals, wildlife and forests provided substantial material and spiritual wealth. A great store of knowledge about plants and their uses helped provide for the people. The western red cedar, the "tree of life," provided logs for canoes, bark for clothing, split boards for houses and more.

The Quinault are the Canoe People, the people of the cedar tree. Tribal headquarters are located in Taholah, Wash.

Quinault Indian Nation

The Queets, Quinault and Chehalis Watersheds



The Quinault Indian Nation's Area of Interest (AOI) for this report is the Queets-Quinault basin (WRIA 21) and Chehalis basin (WRIAs 22 and 23), but most of the data analysis will focus on the Queets and Chehalis watersheds. The tribe's Area of Concern (AOC) goes beyond the AOI and extends further south to the Columbia River.

WRIA 21 contains the tributaries to the Pacific Ocean from Kalaloch Creek in the north to Conner Creek in the south near Grays Harbor. Major watersheds include the Queets and Quinault, which originate from the Olympic Mountain range, as well as the Raft, Moclips and Copalis rivers and other independent drainages which begin at the foothills of this range. All these streams provide suitable spawning and rearing habitat for salmon.[1]

The Lower Chehalis (WRIA 22) is comprised mainly of the lower portion of the Chehalis River drainage, and include major tributaries like the Wishkah, Wynoochee and Satsop rivers as well as a number of independent streams like the Humptulips, Hoquiam, and Johns rivers which drain into Grays Harbor.

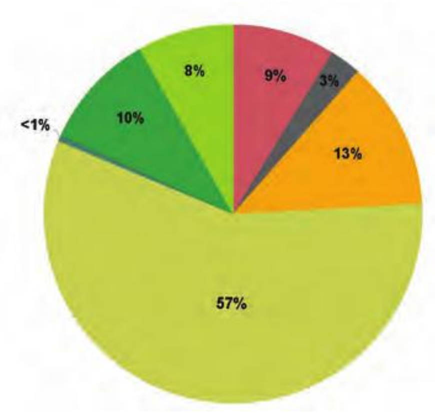
The Upper Chehalis (WRIA 23) includes the upper reaches of the Chehalis River drainage and a number of major tributaries such as the South Fork Chehalis, Newaukum, Black and Skookumchuck rivers. The Chehalis Basin, which is the largest river basin in western Washington, supports chinook, chum and coho salmon, as well as steelhead and cutthroat trout.[2]

The majority of the area is forestland owned by corporations and government, including the Capitol State Forest, Quinault Indian Reservation, plus portions of the Olympic National Forest, the Gifford Pinchot National Forest, and the Olympic National Park. The Quinault Nation has concerns about restricted tribal access to parts of the area with private timber companies locking forest roads and charging fees.

Although salmonids in this area have fared better than in Puget Sound,[3] several habitat factors limit salmonid production in the basin. These include increased channel incision, sedimentation, riparian loss or conversion, loss of large woody material, reduced channel complexity, water quality problems, and reduction in streamflow.[4,5]

Most of these problems are caused and or exacerbated by human activity. As a result, once robust salmon runs are now a tiny fraction of their historic numbers.

To address the dual challenges of extreme flood damage and extensive loss of aquatic species habitat in the Chehalis Basin, the Washington state governor and legislature provided funding to develop a Chehalis Basin Strategy which is a collection of potential actions and projects.[6] The large longer-term projects are currently being reviewed for possible implementation.



Map Data Sources: SSHIAP 2004,[7] USFWS 2018,[8] WADNR 2016,[9] WADNR 2018,[10] WADOT 2018a,[11] WADOT 2018b,[12] WAECY 1994,[13] WAECY 2018a,[14] WAECY 2018b[15]

Chapter Summary

The Quinault Indian Nation is a sovereign nation with the inherent right to govern itself and deal with other tribes and nations on a government-to-government basis. Located on the southwestern corner of the Olympic Peninsula, the Quinault Indian Nation reservation's rain-drenched lands support important species of fish, wildlife and other natural resources. Its boundaries enclose more than 208,000 acres and includes some of the most productive conifer forestlands in the United States, swift-flowing rivers, gleaming lakes beaming with life, and 25 miles of Pacific coastline.

The Quinault people are proud to be among the small number of Americans who can walk the same beaches, fish the same waters, and hunt the same lands their ancestors did centuries ago. But their way of life is threatened by decades of human-caused changes to the landscape, putting the waters, fish, wildlife, conifer forests and stands of hardwoods at risk.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters. The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org.*

The Quinault Indian Nation's Area of Interest (AOI) for this report is the Queets-Quinault basin (WRIA 21) and Chehalis basin (WRIAs 22 and 23), but most of the data analysis will focus on the Queets and Chehalis watersheds. The Nation's Area of Concern (AOC) goes beyond the AOI and extends further south to the Columbia River.

Principal Findings

Forest Cover Conditions

A total of 56 watersheds (about 51% of the land area) within the Quinault's Area of Interest are in healthy and good forest conditions with more than 65% forest cover. Other areas which are predominantly private forestlands are in moderate (<65%) to poor (<50%) forest cover conditions. Between 2011 and 2016, there was a slight overall decrease in forest cover. However, between 1992 and 2016, there was a clear negative trend with 27 of the sub watersheds with at least a 10% decrease in forest cover, likely the result of conversion to non-forest uses..

Impervious Surface

As in the 2016 State of Our Watersheds Report, 103 watersheds (92% of the land area) have impervious surface levels of 0-4%, showing little to no impact from those conditions. Between 2011 and 2016, there was little or no change in impervious conditions in 96 watersheds (84% of the land area). Overall, current status of the impervious surface indicator is good in most watersheds and the trend is neutral to slightly negative.

Impact of Culverts on Habitat

Under the Road Maintenance and Abandonment Plan (RMAP), about 86% of the identified 1,433 culverts in the Quinault Area of Interest have been fixed but another 14% are yet to be repaired and continue to create barriers to fish passage. Overall, the RMAP program appears to be working. However, there are 3,108 non-RMAP barrier culverts with 728 (or 23%) totally impassable to fish. These reduce or eliminate fish access to all habitats above and thus negatively impact the ability of fish to spawn upstream or reach traditional rearing areas.

The Impact of Road Densities and Crossings

Eighty-seven percent of the Quinault Area of Interest is impacted by high road densities (greater than 3 miles per square mile) which is considered to be the level at which streams cease to function properly. The only exceptions were watersheds in and around Olympic National Park. Road crossings were generally highest, with values of over 1 per mile of stream, in the headwaters of the Chehalis and Skookumchuck Rivers as well as in watersheds near the twin cities of Chehalis and Centralia.

Streamflow

As in the 2016 State of Our Watersheds Report, peak flows for the glacier-fed Queets River show an increasing trend over time while mean low flows show a decreasing trend. In the Chehalis River, which is rain dominated, both peak flows and mean low flows show an increasing trend, similar to the last report.

Water Quality Impairment

Fifty-three water bodies are currently placed on the 303(d) list for water pollution, an increase of 22 since 2012. Water temperature is the most common problem, although the proportion of stream length impaired by temperature dropped marginally from 49% to 42%, followed by dissolved oxygen, which increased to 31% from 12% in 2012. The Chehalis River is the single most polluted body of water by water temperature, dissolved oxygen and turbidity.

Water Wells

Currently, there are 9,860 water wells which may affect groundwater supply and instream flows in the Quinault Area of Interest. Between 1980 and 2014, a total of 8,764 wells were completed in this area at an average rate of about 250 wells per year. Since 2015, a total of 1,096 wells have been added at a slightly lower average rate of 219 new wells per year, with actual numbers increasing in four of five years.

Invasive Species and Tribal Control Efforts

The Quinault Indian Nation has an active invasive species control program both on and off the Quinault Indian Reservation. They have been working to control invasive knotweed species, as well as other invasive species such as Scotch broom (*Cytisus* *scoparius*), tansy ragwort (*Jacobaea vulgaris*), and herb Robert (*Geranium robertianum*) common in the floodplain of the Quinault and Queets rivers as well as in many timber harvest units. A relatively new invasive species, found in Grays Harbor, is the European green crab (*Carcinus maenas*) that occupies what would otherwise be Dungeness crab habitat and has the potential to wipe out the Dungeness crab fishery.

Climate Change Impacts on Glaciers

One of the impacts of climate change on the Quinault Reservation has been the loss of glaciers. The Anderson Glacier which supplied a steady streamflow to the Quinault River is now gone. Other glaciers are quickly receding, including those which supply a steady streamflow to both Quinault and the Queets rivers. The result is less fish habitat, higher stream temperatures and greater sediment load.

Ocean Conditions

The marine Areas of Interest for the Quinault Indian Nation have been heavily impacted by ocean warming, including marine heatwaves, hypoxia and harmful algal blooms. Adverse marine conditions have caused the Quinault Indian Nation to close their Dungeness crab fishery early in 2017 and 2018 due to severe hypoxia. Fish kills have also been observed in recent years.

Conclusion

In the Quinault's Area of Interest, there has been successes to the restoration of habitat and reduction of barriers through the RMAP program, but other habitat indicators have stayed the same or worsened. Growth continues with increases in groundwater use, impervious surfaces, and increased road densities, plus loss of forest cover and stream crossings. With the looming threat of continued population growth, tribal leadership have concerns of the potential habitat impacts that come with it. Even though restoration is occurring, it is not enough to keep up with the impacts of a growing population and land use decisions. Land use and water laws that are in place and meant to protect critical areas and fish habitat need to be implemented. This includes education and voluntary actions but also needs to include enforcement where those laws are broken. The future of the natural resources we all share depend on it.

Recovery Efforts Lagging

A review of key environmental indicators for the Queets to Chehalis basins shows that priority concerns continue to be degradation of water quantity and quality, degradation of floodplain and riparian processes, loss of forest cover conditions, and habitat blocked to fish access. However, there have been improvements in forest roads barriers. In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat, and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trend for these key environmental indicators since the 2016 State of Our Watersheds Report shows an improvement by forest landowners in repairing fish passage barriers, but no trend, concerns or a decline in habitat conditions for the other habitat indicators:

Tribal Indicator	Status	Trend Since SOW 2016 Report
Forestland Cover	Between 2011 and 2016, there was a slight overall decrease in forest cover. However, over the longer period between 1992 and 2016, there was a clear negative trend with 27 of the sub watersheds with at least a 10% decrease in forest cover.	**Declining**
Impervious Surface	As in the 2016 State of Our Watersheds report, 103 watersheds (92% of the land area) have impervious surface levels of 0-4%, showing little to no impact from those conditions. Between 2011 and 2016, there was little or no change in impervious conditions in 96 watersheds (84% of the land area). Overall, current status of the impervious surface indicator is good in most watersheds and the trend is neutral to slightly negative.	**No Trend**
RMAP - Culverts	Under the Road Maintenance and Abandonment Plan (RMAP), about 86% of the identified 1,433 culverts in the Quinault Area of Interest have been fixed, leaving about 200 culverts yet to be repaired. Overall, the RMAP program appears to be working.	**Improving**
Barriers - Culverts	Outside of the forestlands, there are about 3,100 barrier culverts that need to be repaired.	**Concerns**
Road Densities & Crossings	Since the 2016 State of Our Watersheds report, there is an increase of about 4% of road densities having greater than 3 miles of roads per square mile, the level at which streams cease to function properly. Road crossings were generally highest with values of over 1 per mile of stream, in the headwaters of the Chehalis and Skookumchuck Rivers as well as in watersheds near the twin cities of Chehalis and Centralia.	**Declining**
Water Quantity - Peak Flows	Peak flows continue to have an increasing trend for both the Queets River and Chehalis River.	**Concerns**
Water Quantity - Low Flows	Low flows continue to have an increasing trend in the Chehalis River.	**Concerns**
	Low flows continue to have a decreasing trend in the Queets River.	**Concerns**
Water Quality	Fifty-three water bodies are currently placed on the 303(d) list for water pollution, an increase of 22 since 2012. Water temperature is the most common pollutant, although the proportion of stream length impaired by temperature dropped marginally from 49% to 42%, followed by dissolved oxygen which increased to 31% from 12% in 2012. The Chehalis River is the single most polluted water body by water temperature, dissolved oxygen, and turbidity.	**Declining**
Water Wells	Currently, there are 9,860 water wells which may affect groundwater supply and instream flows in the Quinault Area of Interest. Between 1980 and 2014, a total of 8,764 wells were completed in this area at an average rate of about 250 wells per year. Since 2015, a total of 1,096 wells have been added at a slightly lower average rate of about 219 new wells per year, with actual numbers increasing in four of five years.	**Concerns**
Climate Change - Loss of Glaciers	One of the impacts of anthropogenic climate change on the Quinault Reservation has been the loss of glaciers. The Anderson Glacier, which supplied a steady streamflow to the Quinault River, is now gone. Other glaciers are quickly receding, including those which supply a steady streamflow to both Quinault and the Queets rivers. The result is less fish habitat, higher stream temperatures and greater sediment load.	**Declining**
Ocean Conditions	The marine Areas of Interest for the Quinault Indian Nation have been heavily impacted by ocean warming, including marine heatwaves, hypoxia and harmful algal blooms. Adverse marine conditions have caused the Quinault Indian Nation to close their Dungeness crab fishery early in 2017 and 2018 due to severe hypoxia. Fish kills have also been observed in recent years.	**Concerns**

The Quinault Indian Nation continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

Pressure from population growth and related development, agricultural practices and timberland use within the Chehalis River basin will continue to present challenges to salmon conservation and restoration efforts. Land-use management and forest practice regulations continue to allow the further degradation of floodplain and riparian habitat throughout the watershed. This degradation becomes even more impactive in the face of climate change.

Current trends indicate that land-use regulation reform is required and continued funding of habitat restoration activities is necessary in order to achieve salmon restoration goals. The Chehalis Basin Salmon Habitat Restoration and Preservation Strategy for WRIA 22 and 23 relies almost exclusively on restoration to address limiting factors within the basin. The Aquatic Species Restoration Plan (ASRP) developed under the Chehalis Basin Strategy has great potential to improve and protect salmon and other aquatic species habitats within the basin as long as the needed funding is provided by the legislature over the next few decades of the Plan implementation. The willingness of landowners to accomplish these protection and restoration activities may be an obstacle to implementation of the ASRP and incentives to participate may be required.

However, we are still witnessing the continued loss and fragmentation of habitat through barrier culverts, high road densities and crossing, forest cover removal and wells. The implementation of the Addendum to the Chehalis Watershed Plan required by the Streamflow Restoration Act may help to stabilize further loss of surface water from permit-exempt wells. The lack of progress on the protection of existing habitat remains the biggest impediment to salmon restoration along with the slow degradation of habitat through the changing climate.

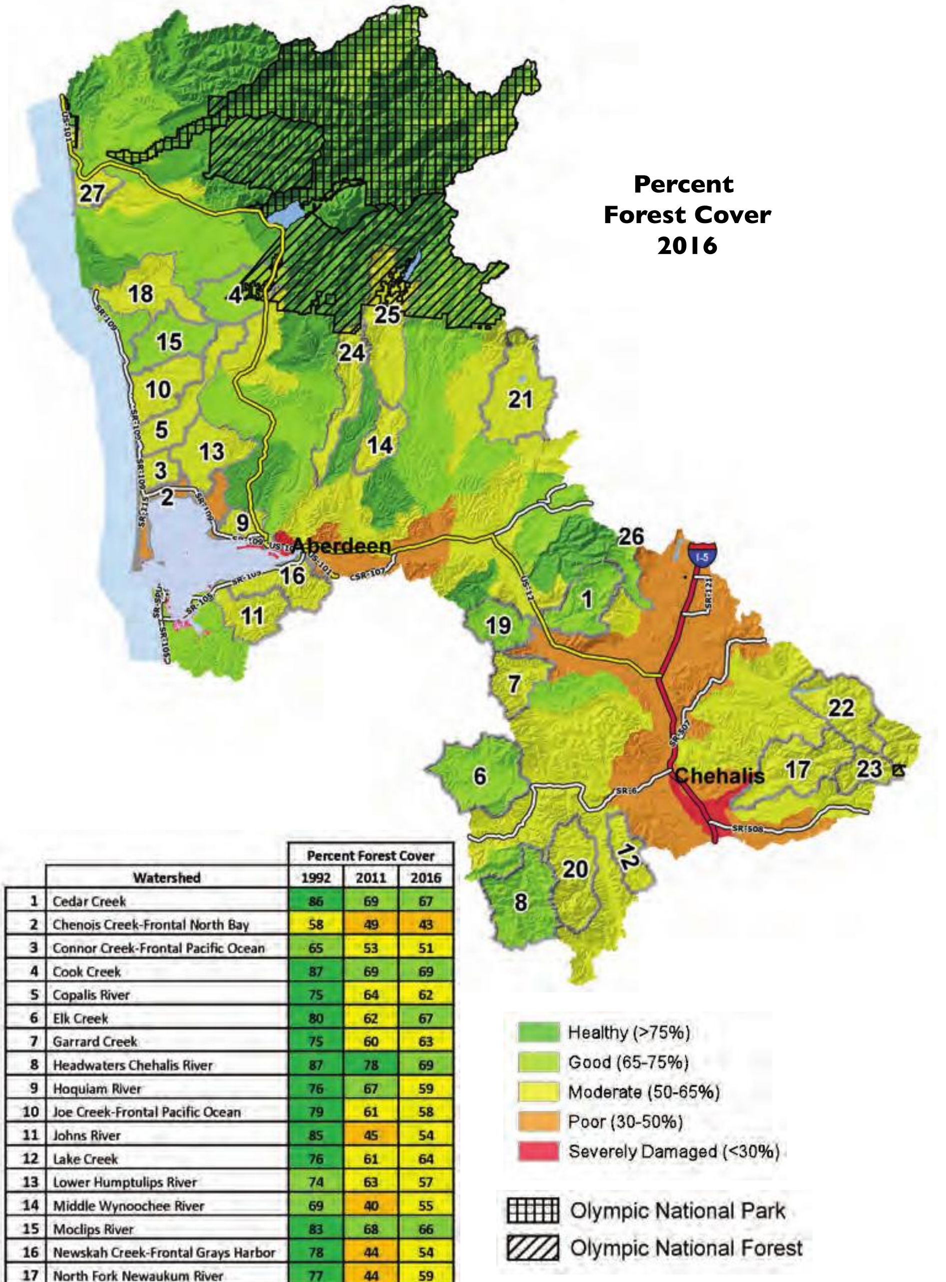
Forest Cover Conditions

A total of 56 watersheds (about 51% of the land area) within the Quinault Nation's Area of Interest are in healthy and good forest conditions with more than 65% forest cover. Other areas which are predominantly private forestlands are in moderate (<65%) to poor (<50%) forest cover conditions. Between 2011 and 2016, there was a slight overall decrease in forest cover. However, over the longer period between 1992 and 2016, there was a clear negative trend with 27 of the sub-watersheds with at least a 10% decrease in forest cover, likely the result of conversion to non-forest uses.

The 2016 forest cover data show about 51% of the Quinault Area of Interest in healthy and good forest conditions, with over 65% forest cover. These include parts of the Olympic National Forest, Olympic National Park and Capitol State Forest. Other areas which are predominantly private forestlands are generally in moderate to poor forest cover conditions, with less than 65% forest cover.

Although some sub-watersheds have increases in forest cover between 2011 and 2016, there was a slight overall decrease in forest cover in the Quinault Area of Interest. The highest overall decrease of about 9.2% was in the headwaters of the Chehalis River, probably due to conversion of forest to non-forest uses. Watersheds in Olympic National Park, and Olympic National Forest had little or no change in forest cover conditions. However, over the longer period between 1992 and 2016, there was a clear negative trend with 27 of the sub-watersheds with at least a 10% decrease in forest cover. The highest reduction of 35.5% in forest cover over this period was in the Stillman Creek watershed, likely due to timber harvest. Other watersheds with more than 25% reduction were the Johns River, Upper Skookumchuck River and Upper South Fork Newaukum watersheds. A decrease in forest cover negatively alters salmon habitat by increasing peak flow and water yield from a watershed, increasing sediment supply, reducing wood recruitment, decreasing water quality, and raising water temperatures.[1,2]

Forest cover conditions impact the ecological processes that create and maintain fish habitat. This makes it critical to protect and preserve those watersheds with good or better forest conditions. The extensive loss of riparian vegetation (coupled with the conversion of conifer to hardwoods) mainly from agriculture and urbanization has been identified as a factor limiting the production of salmonids in the basin due to the reduced forest cover in those areas.[3] The Chehalis Basin Strategy Aquatic Species Restoration Plan intends to protect and restore riparian forested areas that can provide the large wood, nutrients, shading and cooling, stream bank protection, and migration corridors needed by aquatic species.[4]

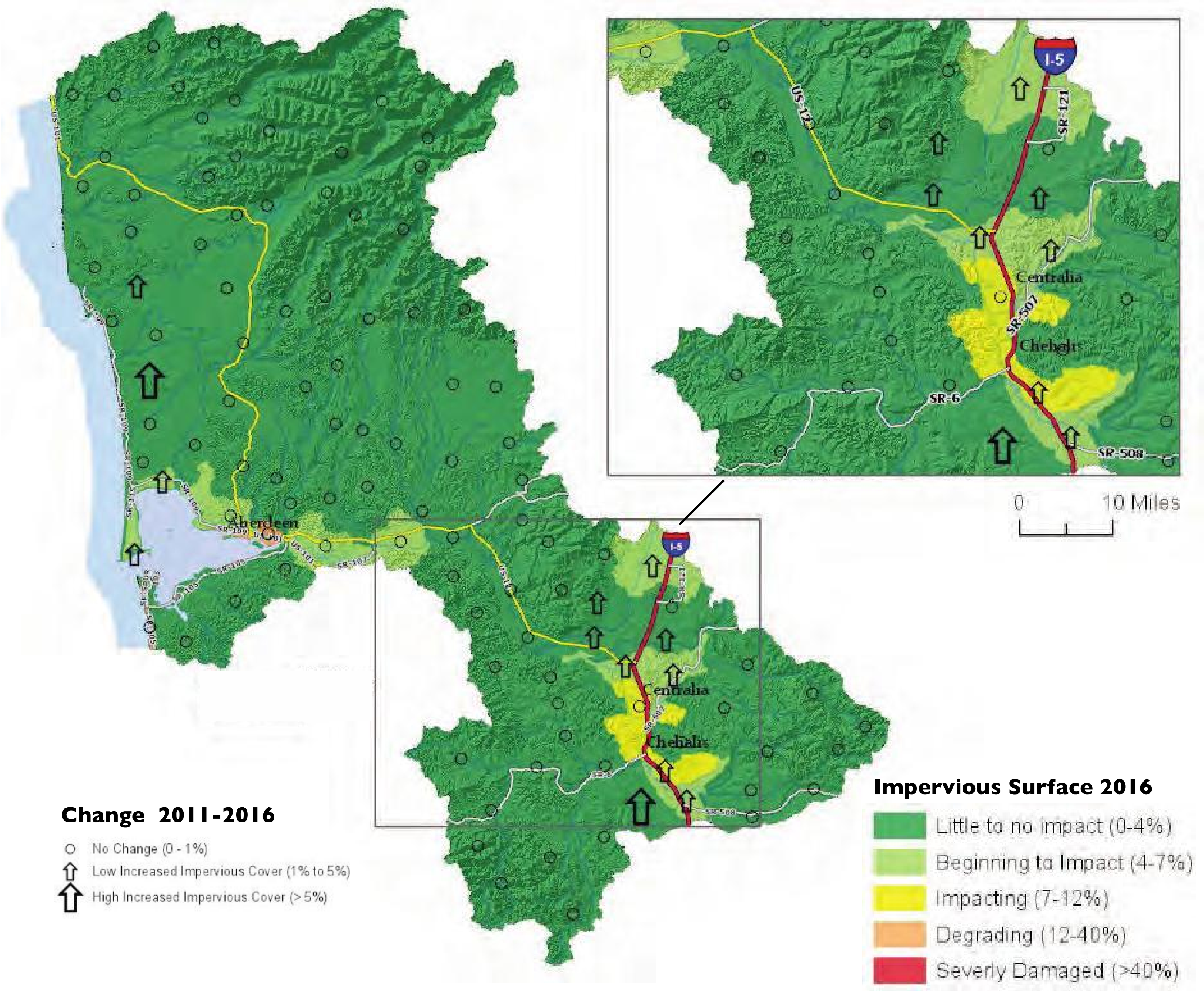


		Percent Forest Cover		
	Watershed	1992	2011	2016
1	Cedar Creek	86	69	67
2	Chenois Creek-Frontal North Bay	58	49	43
3	Connor Creek-Frontal Pacific Ocean	65	53	51
4	Cook Creek	87	69	69
5	Copalis River	75	64	62
6	Elk Creek	80	62	67
7	Garrard Creek	75	60	63
8	Headwaters Chehalis River	87	78	69
9	Hoquiam River	76	67	59
10	Joe Creek-Frontal Pacific Ocean	79	61	58
11	Johns River	85	45	54
12	Lake Creek	76	61	64
13	Lower Humptulips River	74	63	57
14	Middle Wynoochee River	69	40	55
15	Moclips River	83	68	66
16	Newskah Creek-Frontal Grays Harbor	78	44	54
17	North Fork Newaukum River	77	44	59
18	Quinault River	78	69	65
19	Rock Creek	79	69	68
20	Stillman Creek	86	45	51
21	Upper East Fork Satsop River	72	36	57
22	Upper Skookumchuck River	82	41	54
23	Upper South Fork Newaukum River	89	49	61
24	Upper Wishkah River	79	59	62
25	Upper Wynoochee River	83	62	60
26	Waddell Creek	85	74	71
27	Whale Creek-Frontal Pacific Ocean	72	63	61

Map Data Sources: SSHIAP 2004,[5] USGS 2014,[6] NOAA 2019,[7] WAECY 2018[8]

Impervious Surface

As in the 2016 State of Our Watersheds Report, 103 watersheds (92% of the land area) have impervious surface levels of 0-4%, showing little to no impact from those conditions. Between 2011 and 2016, there was little or no change in impervious conditions in 96 watersheds (84% of the land area). Overall, current status of the impervious surface indicator is good in most watersheds and the trend is neutral to slightly negative.



Impervious surfaces refer to hard surfaces like paved roads, parking lots or roof tops. These prevent the naturally slow process of rainwater seeping into the streams through the porous ground. Imperviousness is an indicator of urbanization. It negatively impacts fish habitat by increased erosion stream channel destabilization, loss of pool habitat, excessive sedimentation and scour, and large woody debris reduction. A high percentage of impervious surface also leads to higher stream peak flows, increased sediment and pollutant delivery, and decreases in stream biodiversity.[1]

A total of 103 watersheds (representing 92% of the land area) in the Quinault area of interest currently have impervious surface levels of 0-4%, showing little to no impact from those conditions. This is an indication that urbanization is not a major limiting factor in this area. Exceptions to this are a few watersheds near Aberdeen as well as Chehalis and Centralia where impervious surface conditions were impacting (7 – 12%) or degrading (12 – 40%). This is similar to what was in the 2016 report and is likely a result of the development of roads, housing and other urban infrastructure in these areas.

Between 2011 and 2016, there was little or no change in impervious conditions in 96 watersheds, 11 watersheds had a low increase while 2 watersheds had a high increase in impervious surface conditions. Overall, current status of the impervious surface indicator is good in most watersheds and the trend is neutral to slightly negative because land development is predicted to increase over the next reporting period.

Map Data Sources: NLCD 2011,[2] NLCD 2016,[3] SSHIAP 2004,[4] WADOT 2018,[5] WAECY 2018[6]

Impact of Culverts on Habitat

Under the Road Maintenance and Abandonment Plan (RMAP), about 86% of the identified 1,433 culverts in the Quinault Area of Interest have been fixed but another 14% are yet to be repaired and continue to create barriers to fish passage. Overall, the RMAP program appears to be working. However, there are 3,108 non-RMAP barrier culverts with 728 (or 23%) totally impassable to fish. These reduce or eliminate fish access to all habitats and thus negatively impacting the ability of fish to spawn upstream or reach traditional rearing areas.

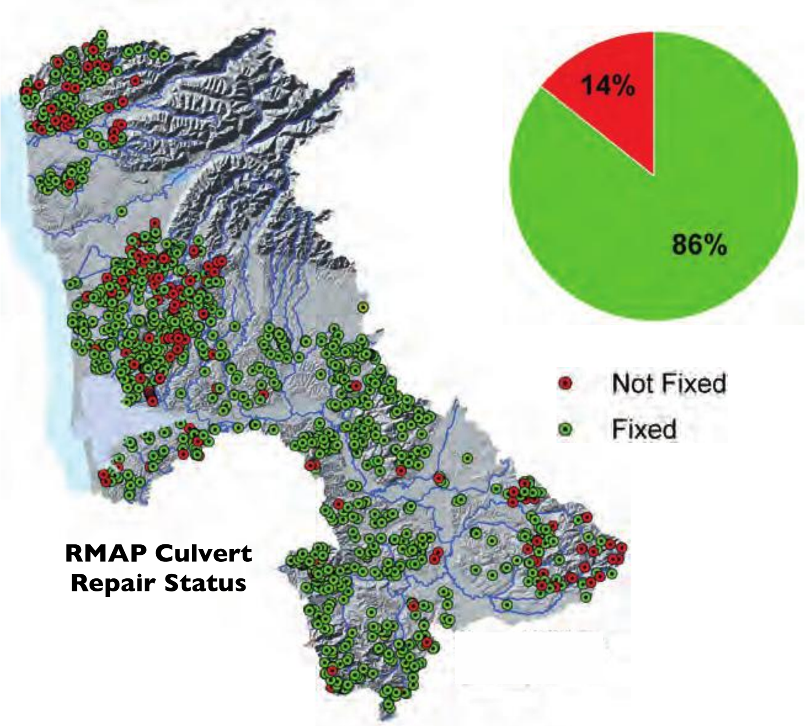
In order to reduce the adverse effects of forest roads on fish habitat, Washington State Forest and Fish law requires most forest landowners to have a Road Maintenance and Abandonment Plan (RMAP), a schedule for any repair work needed to up-grade road systems at stream crossings and address aquatic habitat and fish passage issues. RMAPs are only required in designated forest lands and there is no process in place to consistently inventory or repair blocking culverts outside of designated forest lands. Further, since the law exempts small forest landowners (defined as those who harvest less than 2 million board feet of timber each year on the average), the RMAP culvert numbers are only a fraction of the total number of fish barriers in existence.

The RMAP data shows that about 86% of the identified 1,433 culverts in the Quinault Area of Interest have been fixed but another 14% are yet to be repaired and create barriers to fish passage. Overall, the RMAP program is reducing the total number of fish barriers in the Quinault AOI. Compared to 2016, there are fewer culverts and a smaller proportion is yet to be fixed. This should have a positive impact on fish habitat and water quality in the Quinault Area of Interest.

A more complete picture of the problem of barrier culverts emerges with the mapping of other non-RMAP culverts, including those owned by the state of Washington, counties, cities, private land owners and others. This database shows a total of 3,108 barrier culverts in the Quinault Area of Interest with 728 (or 23%) totally impassable to fish. One such culvert on Davis Creek has the potential of opening up more than 13.5 miles of fish habitat when fixed.

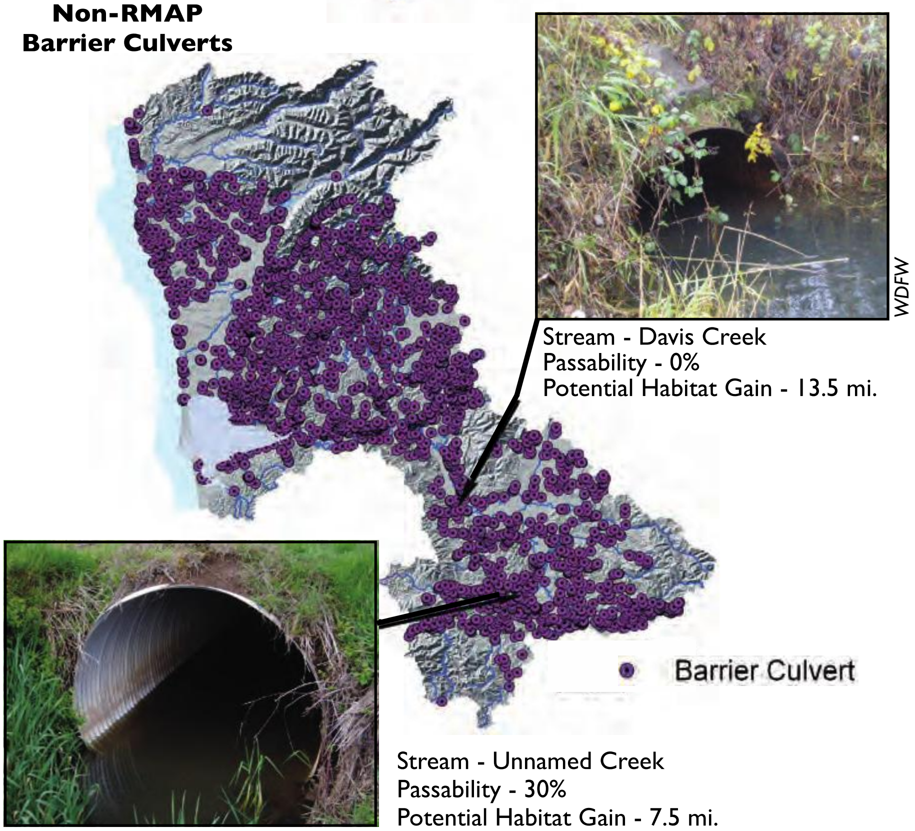
The Chehalis Basin Strategy Aquatic Species Restoration Plan[1] identified the replacing of dysfunctional culverts as a very high priority because they eliminate access to upstream habitat by wild salmonids. It is critical that fish in all life stages have access to all habitats in their watershed in order to successfully evade high water flows and temperatures, escape predators, spawn and find food. Otherwise, the fish cannot spawn upstream or reach traditional rearing areas, resulting in decreased populations.

Map Data Sources: SSHIAP 2004,[2] WADFW 2019,[3] WADNR 2019,[4] WAECY 2018[5]



RMAP Culvert Repair Status

Non-RMAP Barrier Culverts



WDFW

Stream - Davis Creek
Passability - 0%
Potential Habitat Gain - 13.5 mi.

Stream - Unnamed Creek
Passability - 30%
Potential Habitat Gain - 7.5 mi.

WDFW

QUINAULT INDIAN NATION

The Impact of Road Densities and Crossings

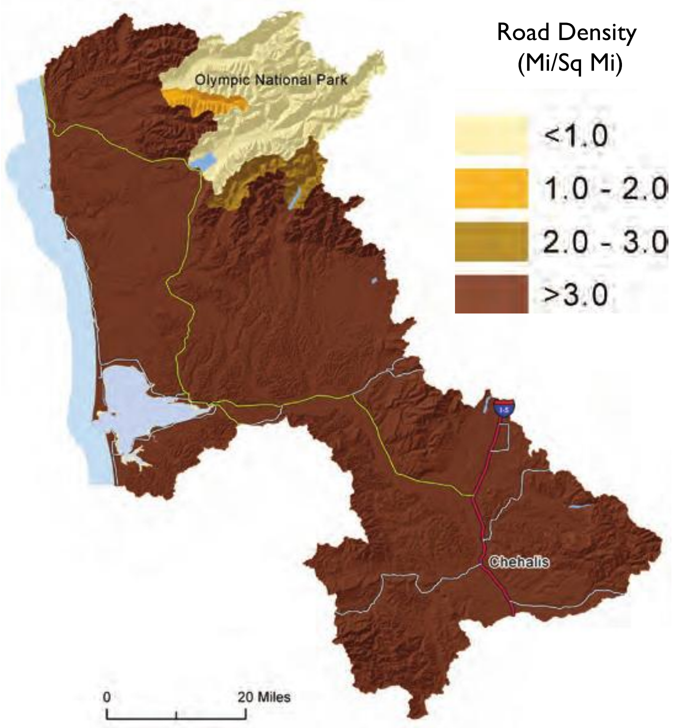
Compared to 83% in 2016, about 87% of the Quinault Area of Interest have road densities of over 3 miles per square mile, the level at which streams cease to function properly. The only exceptions were watersheds in and around Olympic National Park. Road crossings were generally highest with values of over 1 per mile of stream, in the headwaters of the Chehalis and Skookumchuck rivers as well as in watersheds near the twin cities of Chehalis and Centralia.

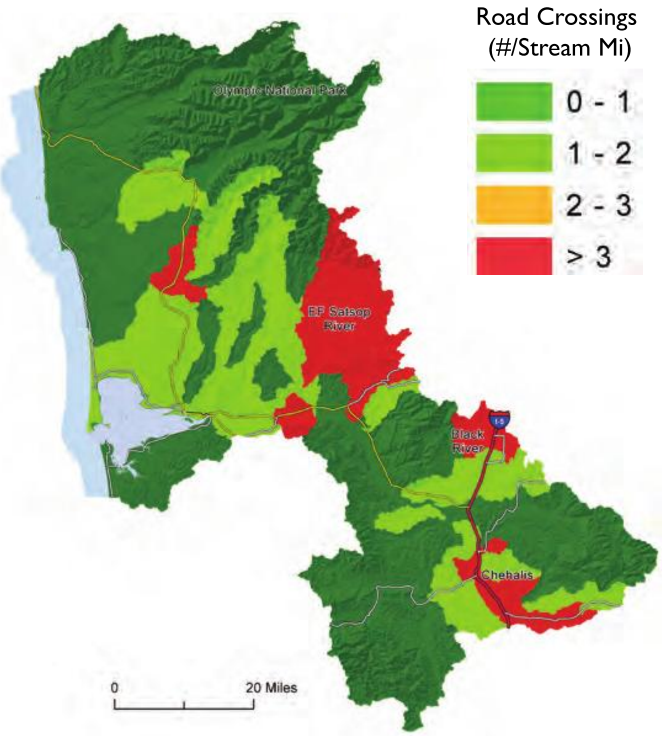
Roads can exert a wide range of ecological effects on stream ecosystems. By contributing to increased imperviousness, roads indirectly bring about increased levels of erosion in watersheds,[1] leading to alterations to hydrological patterns, mass wasting, increased sediment delivery to streams, and degradation of water quality. Elevated fine sediment levels, identified as a limiting factor by the The Chehalis Basin Strategy Aquatic Species Restoration Plan,[2] decrease the quality of spawning gravels.

Road density values were over 3 miles/square mile in virtually all watersheds outside Olympic National Park where the values were generally less than 1 mile/square mile. The trend appears to be that densities have been increasing since 2016 with 4 additional watersheds having densities of over 3 miles/square mile. This is the direct result of the network of roads built outside the Park, notably for timber harvest.

Several studies have correlated road density or indices of roads to fish density or measures of fish diversity.[3] Cederholm et al.[4] found increases in fine sediment in fish spawning habitat when road density exceeded 2.5% of the Clearwater watershed. The proper functioning of salmon-bearing streams may be at risk when road densities exceed 2 miles of road per square mile of area and cease to function properly at densities over 3 miles per square mile.[5] About 87% of watersheds in the Quinault AOI have road densities that exceeded this value.

Stream crossings by roads and other man-made structures can directly impact stream ecosystems, for example, by altering stream geomorphology. Since every intersection of a fish-bearing stream with a road is a potential culvert location, stream crossings also represent potential barriers to fish passage. Stream crossings were generally highest in the East Fork Satsop River and Black River watersheds as well as in watersheds near the twin cities of Chehalis and Centralia along the I-5 corridor. They were lowest in watersheds in and around Olympic National Park. Although there are no known programs to reduce road densities for the sake of improving outcomes for salmon, the Washington State Road Maintenance and Abandonment Plan (RMAP) process is designed to reduce the negative impact of roads on salmon by evaluating forest roads and scheduling needed repairs.





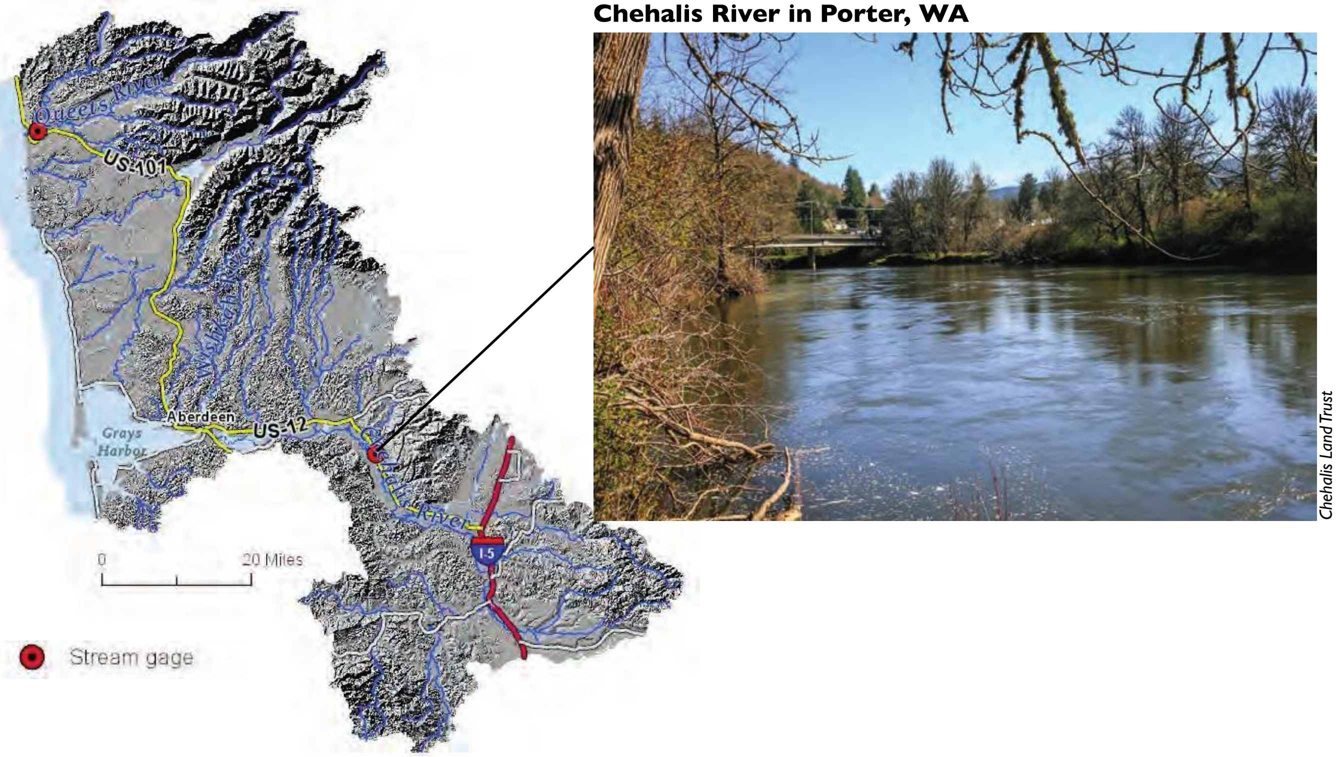
Map Data Sources: SSHIAP 2004,[6] USGS 2014,[7] WADNR 2019,[8] WAECY 2018,[9] WDFW 2019[10]

QUINAULT INDIAN NATION

Streamflow

As in the 2016 State of Our Watersheds Report, peak flows for the Queets River, which is glacier fed, show an increasing trend over time while mean low flows show a decreasing trend. In the Chehalis River, which is rain dominated, both peak flows and mean low flows show an increasing trend.

Chehalis River in Porter, WA



Chehalis Land Trust

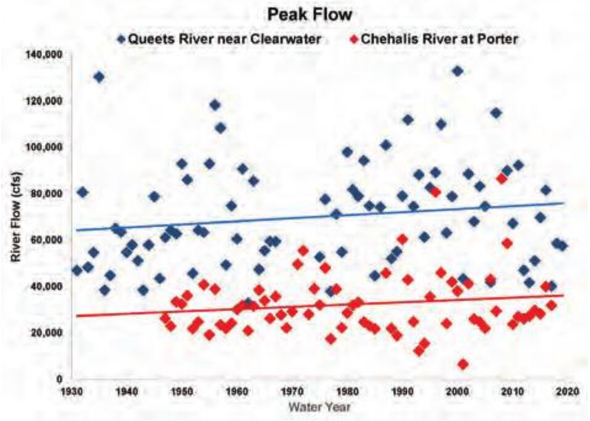
Both adult and young fish need adequate water flow for survival and productivity. Healthy streamflows provide habitat for fish and help maintain healthy and diverse ecosystems. The variation and timing of average stream flows plotted for the Queets River near Clearwater and the Chehalis River at Porter follow the same trend as in the 2016 State of Our Watersheds Report.

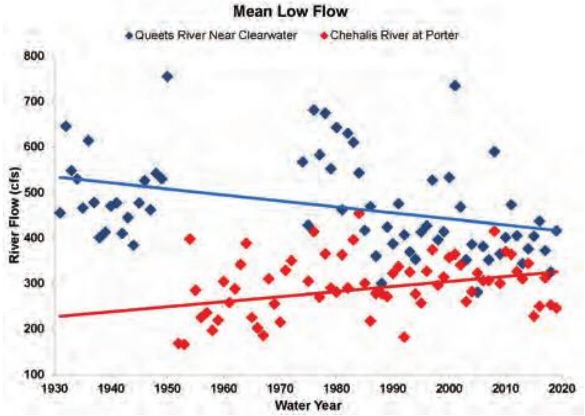
The Chehalis River basin, which is a low-lying coastal watershed, is a rain-dominated basin. Streamflow typically responds quickly and directly to the precipitation that falls as rain with summer low flow periods and winter peak flows.

The Queets River also has peak flows in the winter months and low flows in the summer months. It is a glacier-fed watershed and has streamflow peaks that are generated in early winter primarily by precipitation falling as rain and another later in the spring caused by rain and melting snow.

Seasonal streamflow timing is predicted to change as a result of a climate change. Rain-dominated watersheds like the Chehalis River will respond mainly to changes in precipitation with an increased frequency of very low flows in the drier and warmer summer months. Low streamflows have been identified as a factor limiting salmonid production in the Chehalis. Glacier-fed watersheds, like the Queets, will see the snow zone moving to higher elevations due to warmer temperatures and are projected to become rain-dominated watersheds with more severe summer low flow periods and more frequent days with intense winter peak flows.

If these trends continue as a result of climate change, the altered streamflows (as well as warming summertime stream temperatures) will likely reduce the reproductive success of salmon populations.





Map Data Sources: SSHIAP 2004,[3] USGS 2020a,[4] USGS 2020b,[5] WADOT 2018,[6] WAECY 2018[7]

Water Quality Impairment Increases

In the Quinault Area of Interest (AOI), 53 water bodies are currently placed on the 303(d) list for water pollution, an increase of 22 since 2012. High water temperature is the most common pollutant, although the proportion of stream length impaired by temperature dropped marginally from 49% to 42%. Reduced dissolved oxygen impairs a larger portion of the stream length (31%) as compared to 2012 (12%). This was the second most common pollutant. In the AOI, the Chehalis River is the single most polluted water body by water temperature, dissolved oxygen and turbidity.

Under the Clean Water Act, waters that do not meet water quality standards because they are too polluted are called impaired and are placed on a list for future actions to reduce the pollution.

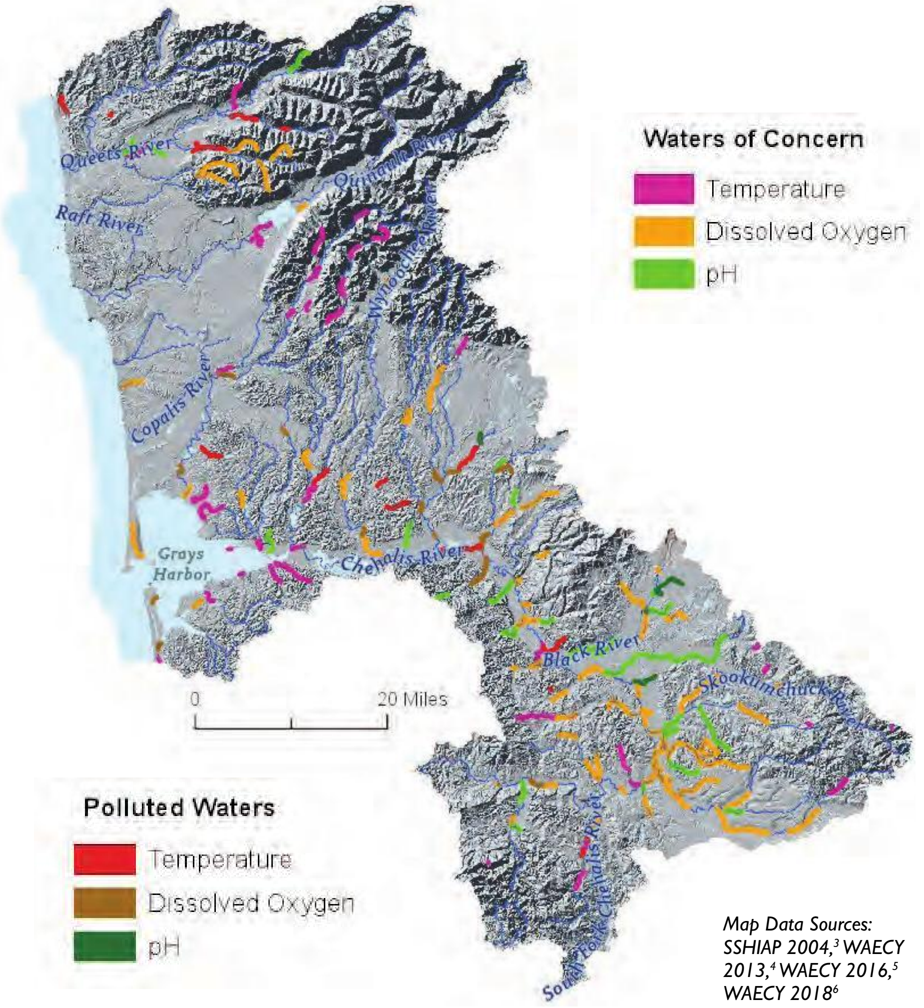
The so-called 303(d) list comprises those waters that require a water quality improvement project or Total Maximum Daily Load (TMDL).

Water quality requirements for salmonids include cool temperatures, high dissolved oxygen, natural nutrient concentrations, and low level of pollutants.[1] If the values of these factors exceed the desired range for a specific location and time of year, the ability of surface waters to sustain these fish populations is impaired.

In the Quinault Area of Interest, there are 53 current 303(d) listings for waters whose beneficial uses are impaired by pollutants. This is an increase of 22 over the 2012 listing. High water temperature is the most common pollutant and is listed in 18 water bodies. For instance, a recent study in the lower Quinault River showed that core summer season (July-Sept) daily minimum temperatures were exceeded for 122 days, and also found no cold water refugia features during August surveys.[2] However, the proportion of stream length impaired by temperature dropped marginally from 49% in 2012 to 42% (present). The second most common pollutant is reduced dissolved oxygen, which is listed in 16 water bodies. Stream lengths impaired by low dissolved oxygen have increased to 31%, compared to 12% in 2012. The other pollutants include pH, bacteria, total phosphorus and turbidity.

There are currently another 308 listings of waters that are either impaired, but do not require a TMDL, or have some evidence of a water quality problems but the pollution levels are not high or persistent enough to violate water quality standards. As in the 303(d) list, the most common pollutants were high water temperature (106), reduced dissolved oxygen (98), and pH (26).

In the AOI, the main stem Chehalis River is the single most polluted water body by total length with 10.1 miles impaired by water temperature, dissolved oxygen and turbidity.



Map Data Sources: SSHIAP 2004,[3] WAECY 2013,[4] WAECY 2016,[5] WAECY 2018[6]

Lower mainstem of Chehalis River

Chehalis Basin Strategy

Water Wells

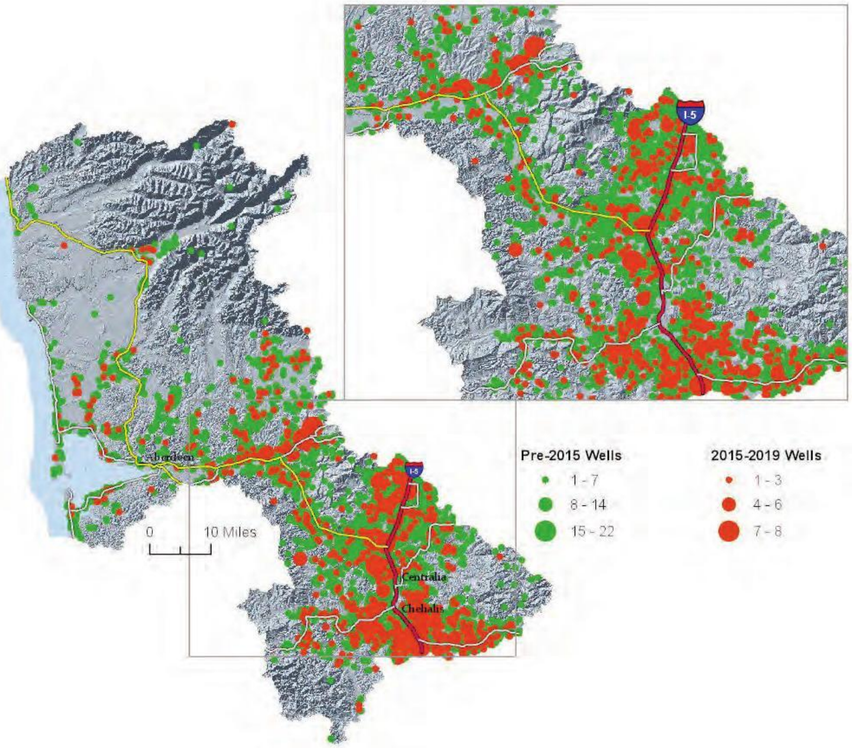
Currently, there are 9,860 water wells which may affect groundwater supply and instream flows in the Quinault Area of Interest. Between 1980 and 2014, a total of 8,764 wells were completed in this area at an average rate of about 250 wells per year. Since 2015, a total of 1,096 wells have been added at a slightly lower average rate of about 219 new wells per year.

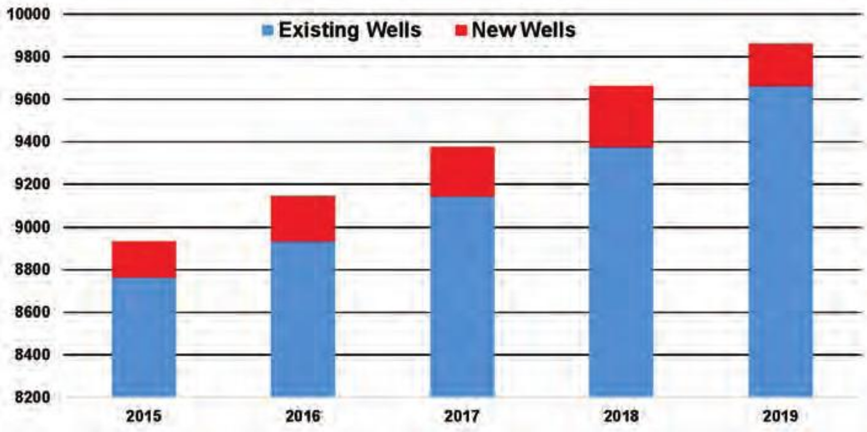
Water wells are a source of water for many landowners. Although each well withdraws a relatively small amount of water, their total combined impact, known as the cumulative impact, can be significant and affect water quality, salmonid habitat and instream flows. The Chehalis Basin Strategy Aquatic Species Restoration Plan1 identified low summertime flows in some sub-basins as a problem. An earlier assessment[2] found that in many streams and rivers, minimum streamflows are not met on many days from July through October. Because very little water is used for agriculture or urban purposes in the Queets-Quinault basin, water withdrawal impacts there are expected to be low.[3]

There are currently 9,860 wells in the Quinault Area of Interest. The majority of wells are in the higher population areas around Aberdeen, Centralia, Chehalis, and the I-5 corridor as well as in agriculture areas, particularly in the upper Chehalis basin. Between 1980 and 2014, 8,764 wells were completed in the Quinault Area of Interest at a rate of about 250 wells per year. Between 2015 and 2019, an additional 1,096 wells were added at a rate of about 219 new wells per year. Although there is a slightly reduced rate of new wells in the last five years, the actual numbers have been increasing each year with the exception of 2019.

In January 2018, the Washington State Legislature passed a law codified as Chapter 90.94 RCW that is intended to stabilize streamflows to levels necessary to support robust, healthy, and sustainable salmon populations while providing water for homes in rural Washington. The law directs local planning groups to develop watershed plans that offset impacts from new domestic permit-exempt wells and achieve a net ecological benefit within the watershed.[4] The law was in response to the Hirst decision, a ruling made by the Washington State Supreme Court in October 2016 that limited a landowner's ability to get a building permit for a new home when the proposed source of water was a permit-exempt well.[5]

Under new regulations, the Lower and Upper Chehalis watersheds have instream flow rules that do not regulate permit-exempt wells and have adopted watershed plans.[6] They are directed by the new law to update their watershed plans by February 1, 2021. New permit-exempt wells for domestic use in these watersheds are capped at 3,000 gallons per day as the maximum annual average and are subject to a $500 fee for overuse.





Map Data Sources: SSHIAP 2004,[7] WADOT 2018,[8] WAECY 2018,[9] WAECY 2019c[10]

QUINAULT INDIAN NATION

Invasive Species and Tribal Control Efforts

*The Quinault Indian Nation has an active invasive species control program both on and off the Quinault Indian Reservation. They have been working to control invasive knotweed species, as well as other invasive species such as Scotch broom (*Cytisus scoparius*), tansy ragwort (*Jacobaea vulgaris*), and herb Robert (*Geranium robertianum*) common in the floodplain of the Quinault and Queets rivers as well as in many timber harvest units. A relatively new invasive species, found in Grays Harbor is the European green crab (*Carcinus maenas*) that occupies what would otherwise be Dungeness crab habitat and have the potential to wipe out the Dungeness crab fishery.*

The Quinault Indian Nation (QIN) began controlling knotweed species in 2008 and have since treated thousands of acres on the reservation. The majority of the infestation is in the floodplain of the Quinault and Queets rivers, but contaminated logging equipment and wildlife have moved it around and it is now found in many timber harvest units. This species is difficult to control in areas where it grows mixed with native vegetation and in difficult to reach areas along the river (Greg Eide, QIN personal communication).

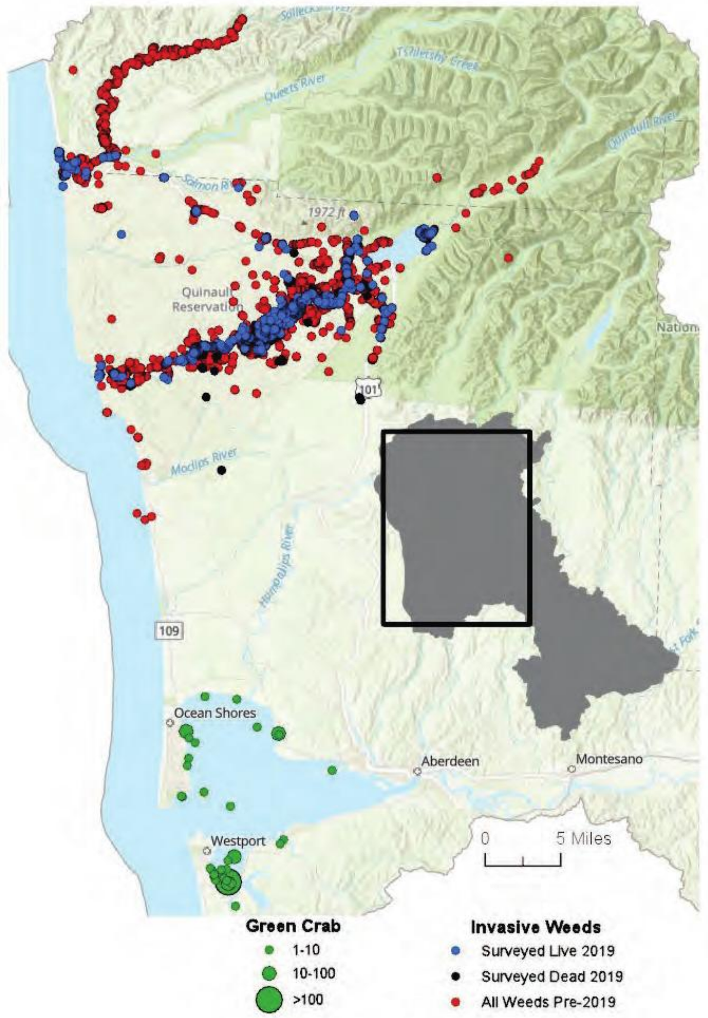
The tribe received grants from the state Salmon Recovery Funding Board and the U.S. Environmental Protection Agency for both initial and follow up treatment of large knotweed patches. Other species that are a problem are Scotch broom (*Cytisus scoparius*) and tansy ragwort (*Jacobaea vulgaris*). Tansy ragwort has taken over in some areas where the knotweed and scotch broom once were, and is prevalent along the floodplains and roadways. It is known to be toxic and QIN staff have observed elk and deer browsing on it. Stinky Bob or herb Robert (*Geranium robertianum*) is spreading like wildfire in Grays Harbor and the Quinault reservation.

QIN is constantly on the lookout for new invaders that are known to be in the county but have not yet been found on the reservation. These include purple loosestrife (*Lythrum salicaria*), European coltsfoot (*Tussilago farfara*), and any others on the state and county noxious weed lists.

The tribe anticipates completing initial treatments of the knotweed infestations within the next few years so it has been expanding efforts to control it off the reservation in its usual and accustomed area including but not limited to the Chehalis River watershed and Grays Harbor County.

QIN is actively working with other jurisdictions to control invasive species, such as Olympic National Park, Olympic National Forest, Washington Department of Natural Resources, Washington Department of Agriculture, Jefferson and Clallam County Noxious Weed Control Boards, and Queets/Quinault and Chehalis Cooperative weed management areas.

A relatively new invasive species in the area is the European green crab (*Carcinus maenas*). The conditions in Grays Harbor and the Pacific coastline are allowing the crab to form self-sustaining populations. They occupy what would otherwise be Dungeness crab (*Cancer magister*) habitat which have been shown to suffer high mortality rates due to green crab predation.[1,2] As a result, if not controlled, European green crab have the potential to severely impact or even wipe out the Dungeness crab fishery which is culturally and economically important to the tribe.



Quinault Indian Nation

Knotweed on the Quinault Reservation.

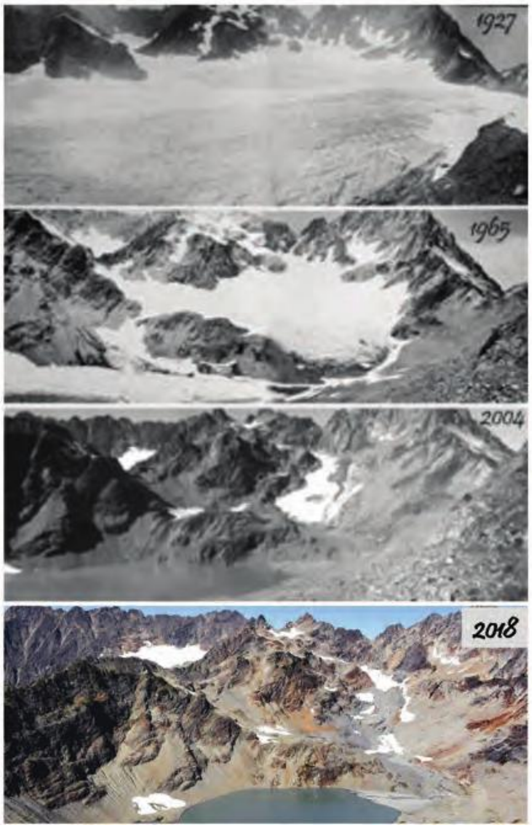
Map Data Sources: ESRI 2020,[3] QIN 2020,[4] WADFW 2019[5]

QUINAULT INDIAN NATION

Climate Change Impacts On Glaciers

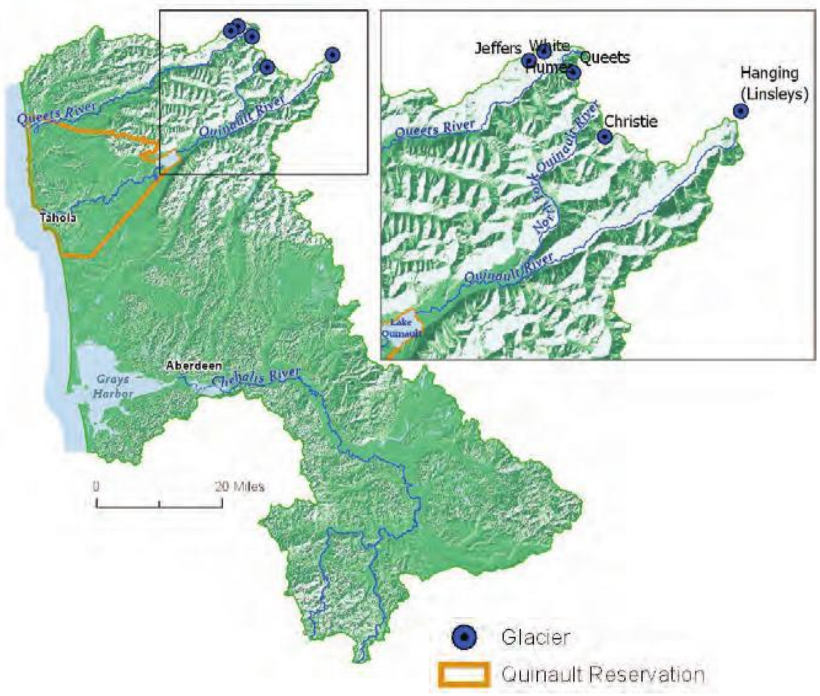
One of the impacts of climate change on the Quinault Reservation has been the loss of glaciers. The Anderson Glacier, which supplied a steady streamflow to the Quinault River, is now gone. Other glaciers are quickly receding, including those which supply a steady streamflow to both the Quinault and the Queets Rivers. The result is less fish habitat, higher stream temperatures and greater sediment load.

Demise of the Anderson Glacier



University of Washington (3)

Larry Workman



One of the impacts of climate change on the Quinault Reservation has been the loss of snow packs and glaciers in Olympic National Park which store excess water in the winter and gradually release the water in the spring and summer.

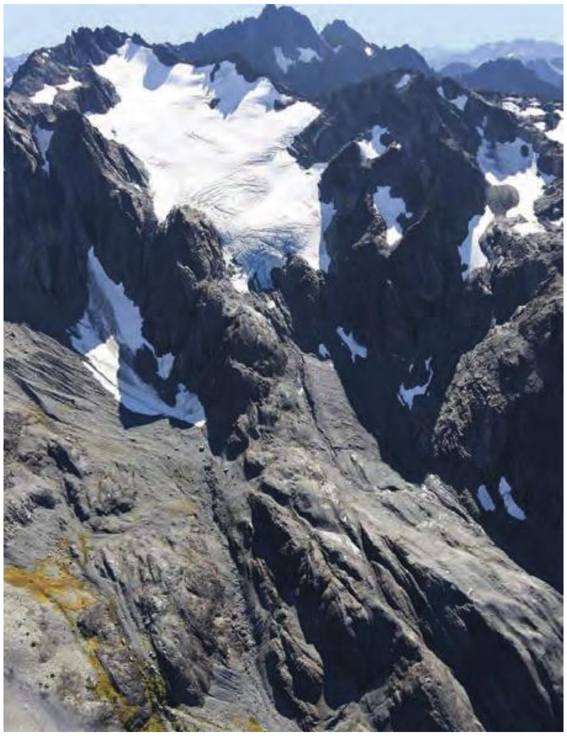
With increases in temperature due to climate change, the glaciers now store less water because they are getting smaller in length and thinner.

The Anderson Glacier, which resided in one of the most geographically important mountain ranges in Olympic National Park, and fed the Quinault River and Lake Quinault, has now disappeared.[1]

Between 1927 and 2009, it had receded to less than 10% of its former size, and was essentially gone by 2015.[2] Other receding glaciers that feed the Quinault include the Linsleys (or Hanging), White and Christie. Those that feed the Queets River are also receding and include the Queets, Humes and Jeffers. The Humes on the south side of Mount Olympus is the largest remaining glacier and probably has more ice than all the others combined (Workman, QIN personal communication, May 18, 2020).

The retreat of glaciers that provide large amounts of cold water year-round likely means reduced accessibility by spring/summer chinook (and possibly bull trout) to side channel networks preferred for spawning.[3] It also results in higher water temperatures and greater stream sediment load as large amounts of sediments once stored in the glaciers are washed onto the floodplain. All these have the effect of limiting salmon productivity, threatening the survival of many species.

The Queets Glacier



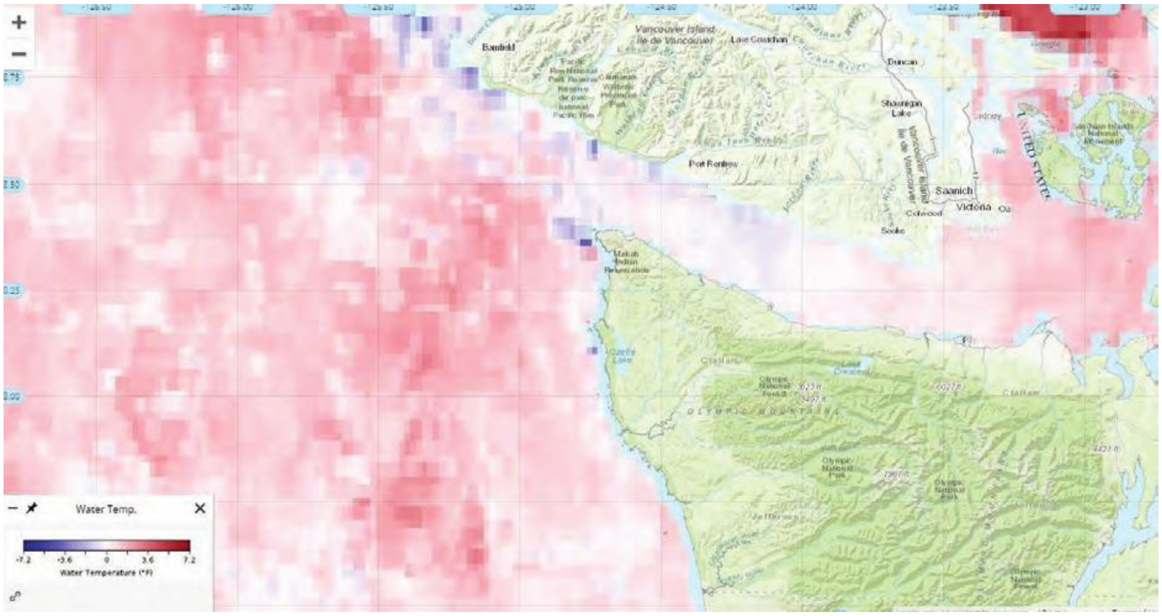
Larry Workman

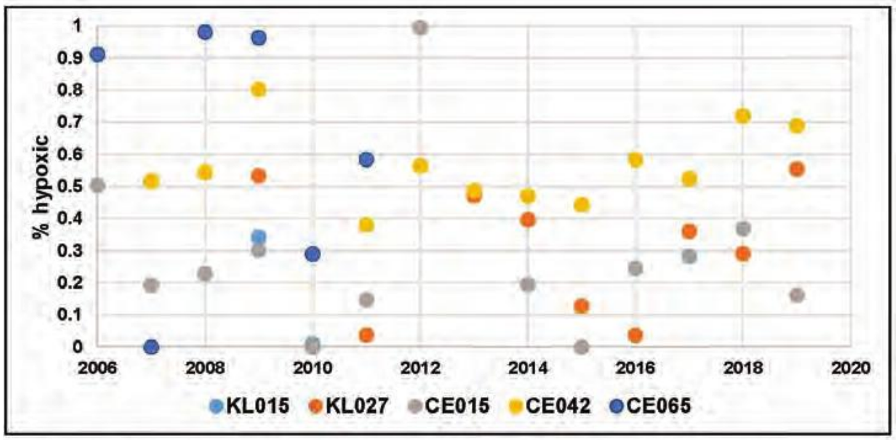
Map Data Sources: SSHIAP 2004,[4] WAECY 2018[5]

Ocean Conditions

The marine Areas of Interest for the Quinault Indian Nation have been heavily impacted by ocean warming, including marine heatwaves, hypoxia and harmful algal blooms. Adverse marine conditions have caused the Quinault Indian Nation to close their Dungeness crab fishery early in 2017 and 2018 due to severe hypoxia. Fish kills have also been observed in recent years.

June 2015 - Sea Surface Temperature Anomaly





Percent of hypoxic measurements from June to September during each deployment. KL = Kalaloch Beach, CE = Cape Elizabeth, numbers indicate depth of deployment.

The marine Areas of Interest for the Quinault Indian Nation have been heavily impacted by ocean warming, including marine heatwaves (MHW), hypoxia and harmful algal blooms (HABs).

In recent years, the California Current System (CCS) has experienced two major MHWs – the 2014-16 “Blob” and the 2019 event. The 2014-16 MHW persisted for multiple years due to weak atmospheric circulation, and the presence of warm waters down to 300m depth. Both events coincided with an El Nino, which further contributed to the warm conditions. In 2015, the CCS experienced a prolonged, severe harmful algal bloom driven by the MHW. McCabe et al. (2016)[1] and McKibben et al. (2017)[2] have found that HABs in the CCS are strongly correlated with El Nino events, with the worst conditions occurring when southward winds drive upwelling of nutrient rich waters, followed by northward winds that drive downwelling and push these waters (and the phytoplankton bloom that can accompany them) onshore.

Summertime bottom water hypoxia has been a growing concern on the Washington continental shelf, with more severe conditions to the south. To assist with monitoring, the Olympic Coast National Marine Sanctuary has deployed seasonal moorings off the Olympic Coast since 2006. Moorings off Kalaloch Beach recorded bottom water hypoxic conditions between June and September for up to 55% of the season (average of 29%), and moorings off Cape Elizabeth recorded hypoxic conditions up to 99% of the season (average of 50%). Adverse marine conditions have caused the Quinault Indian Nation to close their Dungeness Crab fishery early in 2017 and 2018 due to severe hypoxia and to close their coho salmon fishery in 2015 due to poor returns. In recent years, a number of fish kills have also been observed and are attributed to hypoxic conditions.

Map Data Sources: ESRI 2020,[3] NOAA 2015,[4] NOAA 2020[5]

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2020 State of Our Watersheds Report
Skagit River Watershed

To the Sauk-Suiattle Indian people, all living things were given a spirit. It was life and the way the creator made it to be in this world.

Norma Joseph
Chairman

You need to advocate for the salmon, because they cannot speak. It's just like diagnosing a little child. You know when he's crying, he's fever, but he really can't – you can't tell what kind of sickness he's got, whether he's got a flu, cold, fever, whatever or teeth ache, or whatever, you know? You have to troubleshoot him until you figure out what's wrong with that child before you get the right medication. And it's the same thing we're going to have to do with that salmon. We're going to have to treat it like a sick child, sick baby. You have to figure out what's causing this decline. What's causing it to die? Those are the questions that need to be sought answers for.

James L. Joseph
Natural Resources Director (1978-2010)/
Chairman (20 years)

Area of Interest

Sauk-Suiattle Indian Tribe
saʔqʷəbixʷ-suyaƛ̓ʔbixʷ
Sah-Ku-Mehu
Point Elliott Treaty of 1855

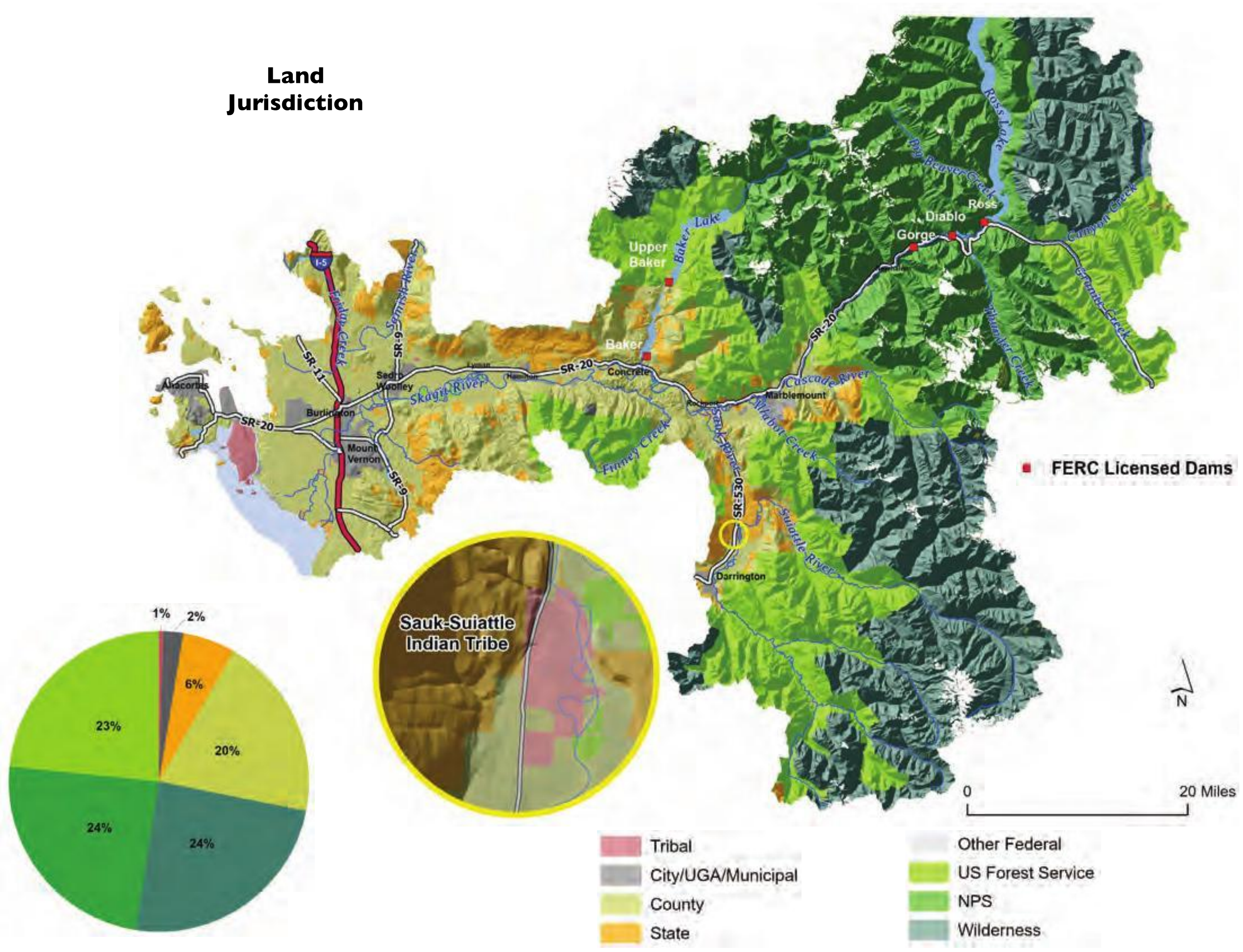
Sauk-Suiattle Indian Tribe

The Sauk-Suiattle Indian Tribe, known traditionally as the *Sah-ku-mehu*, have made their homeland in the Skagit, Sauk, Suiattle and Cascade river watersheds since time immemorial. They have lived as hunters, gatherers and fishermen throughout this region. The tribe had an important village at Sauk Prairie in the Sauk River valley, near the confluence of the Sauk and Suiattle rivers. The tribe's current reservation is also near the confluence of the Sauk and Suiattle rivers, just north of Darrington, WA.

Following the U.S. Homestead Act, the tribe became a landless people, but continued to live in scattered groups close to the traditional homelands. Though many tribal members left the area or joined neighboring tribes, Sauk-Suiattle maintained its tribal government, social structure, identity and hope for the future. Tribal membership numbered around 4,000 before the 1855 Point Elliott Treaty. By 1924, numbers had dwindled to 18 members. Residents of the Sauk-Suiattle Indian Reservation are the surviving descendants of the original peoples who lived in this special valley. Current membership numbers for the tribe are around 310 individuals.

Sauk-Suiattle Indian Tribe

Skagit River Watershed



The Skagit River flows from a 3,100-square-mile watershed that originates in British Columbia and flows south into Washington state before continuing westward through Skagit County and into Puget Sound. It has the largest watershed in Puget Sound, and provides 30% of the sound's freshwater input.[1] There are an estimated 396 glaciers in the watershed, making up one of the largest areas of glacial cover in the United States outside of Alaska.[2] The Baker River, Sauk River and the Cascade River all flow from glaciers within the Skagit River watershed.

The Skagit River watershed has been home to the Sauk-Suiattle Indian Tribe, the Upper Skagit Indian Tribe and the Swinomish Indian Tribal Community since time immemorial. All three tribes have their reservations in the watershed and all have entered into a treaty with the United States guaranteeing them the right to fish at their usual and accustomed places forever. These U&A areas include some or all of the Skagit River watershed, depending on the tribe.

Since European settlement, land use in the watershed has been dominated by natural resources extraction. The foothills and mountains have been mainly used for wood products, mining and outdoor recreation. The river valleys, the delta and the coastal areas have been used for agriculture, industry, commerce and residential development. As of 2019, the U.S. Census Bureau estimates 129,205 residents in Skagit County, a 25% increase in population since the year 2000.[3,4]

The upper watershed is primarily within the National Forest and the North Cascades National Park. The lower watershed mainly comprises state forest, private forest, agriculture, rural residential and urban residential/commercial/industrial lands. There are five Federal Energy Regulatory Commission (FERC) licensed dams in the Skagit River watershed: the lower and upper Baker River dams, and the Gorge, Diablo and Ross Lake dams.

The Skagit River is home to all five species of Pacific salmon, as well as steelhead trout. It has the healthiest and largest runs of wild chinook and pink salmon in Puget Sound.[5] Even so, the last 150 years of human population growth and associated land use has resulted in declines in chinook, a near collapse of chum and declines in other salmonid productivity. The Skagit Chinook Recovery Plan (2005) provides a strategy for both protection and targeted restoration. It will take federal, tribal, state and local leadership to provide a consistent yet adaptive plan to control the future impacts of land use in the watershed.

Map Data Sources: USFWS 2018,[6] WAECY 2018,[7] WAECY 2018,[8] WAECY 1994,[9] WADNR 2014c,[10] WADNR 2014d,[11] WADOT 2013,[12] SSHIAP 2004[13]

Chapter Summary

The Sauk-Suiattle Indian Tribe's watershed is the Skagit River, which includes its largest tributary, the Sauk River, and in turn the Sauk's largest tributary, the Suiattle River. People of the Sauk-Suiattle have hunted, gathered, fished and lived throughout this watershed since time immemorial. Salmon have always been central to their life in the watershed, and the health of salmon are inextricably linked to the health of the watershed and to the health of the Sauk-Suiattle Tribe.

The state of the Sauk-Suiattle Indian Tribe's watershed is similar to many of its neighboring rivers throughout Puget Sound, with myriad concerns from lack of adequate buffers, to rapid human population growth driving increased contamination from stormwater, to agricultural runoff … the list is long.

But the overriding issue that will increasingly subsume all others is global warming.

The Skagit River watershed is the largest glaciated watershed in the lower 48 states, with 394 glaciers, all of which are threatened to melt completely by 2100 unless global carbon emissions are dramatically reduced. Any assessment of the health of the Skagit River watershed must put the detailed list of problems in this broader context. The earth is heating up at an unprecedented rate, and the ecosystems, tribal cultures and society's economies that developed over millennia are going to have to adjust extremely rapidly if we are to mitigate the impacts of this warmer world.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org*.

For this report, the Sauk-Suiattle Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Restoration of Whidbey Basin Pocket Estuaries Is Slowly Progressing

Through 2014, pocket estuary restoration was completed at 5 of the 12 prioritized Skagit Chinook Plan sites. Habitat status and trends monitoring reveals the restoration increased usable pocket estuary habitat area for chinook smolt production by over 240 acres. Since 2014, no additional restoration has occurred at the 12 prioritized sites although Similk Beach has entered an active planning/design phase with restoration anticipated in the near future.

Sauk River Floodplain Forest Is Relatively Healthy and Important to Protect

Almost 97%, or 87 acres, of floodplain riparian forest cover loss is attributed to natural processes. This is considered a healthy reflection of the Sauk River floodplain ecosystem. Protecting the relatively healthy condition of the Sauk River floodplain is critical to salmon habitat in the Skagit River watershed.

Forest Road Maintenance and Abandonment on Schedule

The Washington State Forest Road Maintenance and Abandonment Plan (RMAP) has led to the completed, scheduled repair and/or abandonment of all 1,662 total miles of private and state-owned forest roads and 209 culverts in the Upper Skagit, Sauk-Suiattle, and Cascade watersheds of the Skagit River system.

Illabot Creek Alluvial Fan Restoration Highlights Long-Term Commitment

The Illabot Creek Alluvial Fan Restoration Project has resulted in over 1,900 feet of dike removal, an addition of 0.5 miles of instream habitat, and an addition of 23.4 acres of off-channel habitat. Restoration monitoring is already seeing juvenile salmon populate the newly created habitats.

Monte Cristo Mining Area Removal Actions Complete, Results are Mixed

Monitoring in 2019 showed that arsenic concentrations decreased in Glacier Creek and in groundwater samples throughout the Removal Action area. However, in the South Fork Sauk River, arsenic concentrations in 2019 were measured to be higher than pre-removal action levels. Additionally, a redundant legacy road above the South Fork Sauk River has not yet been decommissioned and continues to impact salmon habitat.

Tidal Habitat Restoration Needs to Accelerate to Reach Desired Future Conditions in a Changing Climate

Habitat restoration resulted in the overall net gain of 83 hectares (13.6 hectares/year) of Skagit River tidal delta habitat between 2003 and 2013. To reach desired future conditions for tidal marsh by 2030 (mid-point of a 50-year recovery plan), the pace of restoration needs to increase, and there must be explicit consideration of sea level rise, storm surge and sediment routing in an update to the current tidal habitat restoration plan.

Glacial Recession Threatens Fish in the Skagit River Watershed

Since 1959, glacier area in the Skagit River watershed has decreased between 30 and 35 km^2 (-19%). This loss of glacial cover in the watershed equals the elimination of an estimated 100 years of cold freshwater supply for Skagit County.

Conclusion

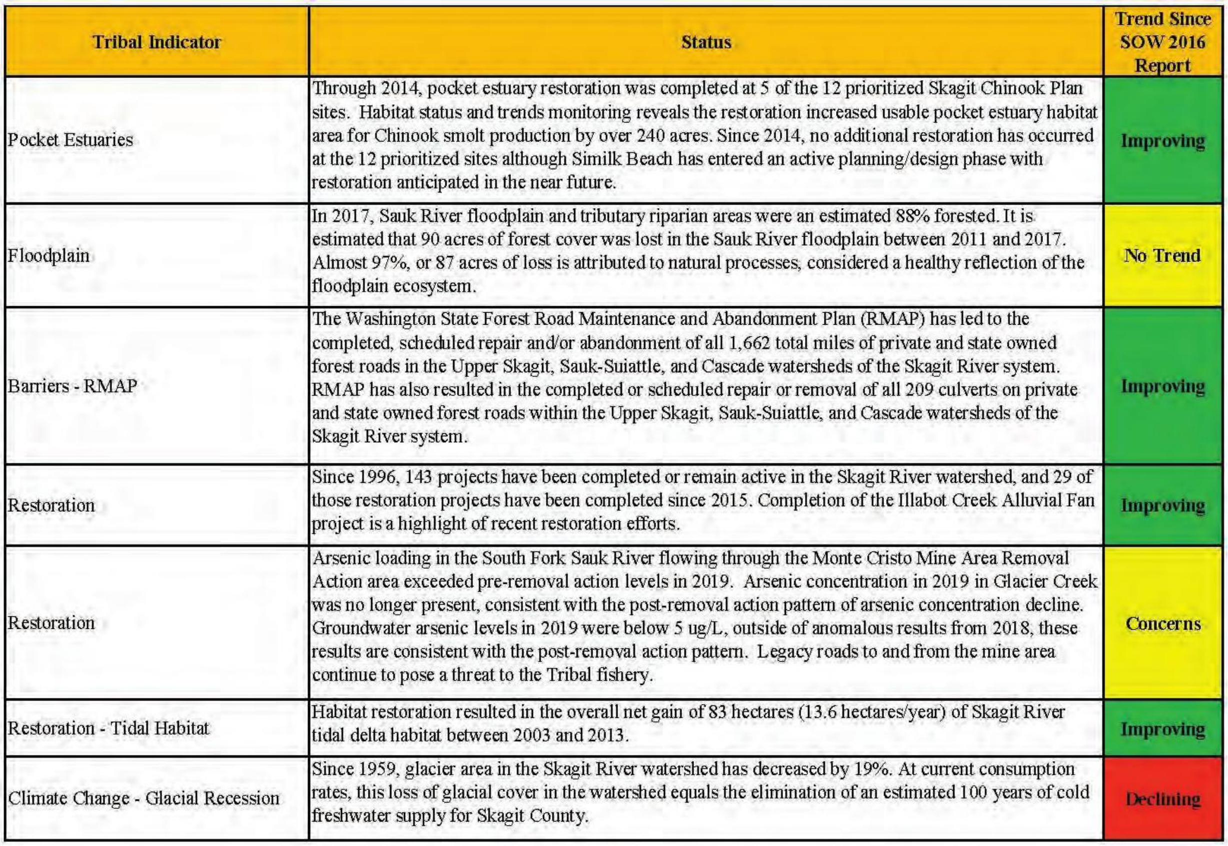
Downstream, the Skagit River and its tributaries are already manifesting the early signs of a warming climate. Tidal marsh in the delta is impacted by sea level rise, and the lower tributaries are exhibiting summer stream temperatures that are harmful or even lethal to juvenile salmon. Upstream, Skagit watershed glaciers have already lost 50% of their area during the 20th century, and if the current rate of carbon emissions continues unabated, the glacial area could be reduced by half again by 2050 and gone by 2100.

A review of key environmental indicators shows steady progress on some fronts, forest road improvements, tidal marsh restoration, pocket estuary, and restoration and protection of off-channel habitats in floodplain areas. On the other hand, riparian forests in the lower Skagit watershed are not meeting the Total Maximum Daily Load (TMDL) requirements for water temperature of the Washington State Department of Ecology, and many more Skagit River tributaries on agricultural lands remain exempt from any requirement of riparian vegetation planning. Recovery of the Skagit watershed requires continued restoration progress and a greater commitment from federal, state and local government regulators to implement the environmental laws required to conserve and protect critical salmon habitat, and tribal treaty resources throughout the Skagit River watershed. People have to be held accountable to protect, conserve and improve fish habitat in their land-use decisions, and federal, state and local governments all have a role in that. Existing land-use and water laws that are meant to protect critical areas and fish habitat need to be implemented. Implementation includes education and voluntary action, but it also needs to include enforcement when those laws are broken. The future of tribal treaty rights in the Skagit River basin depends on it.

Recovery Efforts Show Signs of Improvement But Still Lagging in Key Indicators

At the 15-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Skagit basin area shows improvements for forest road improvements, estuary restoration and ongoing restoration efforts. But degradation has occurred with the continued reduction of the Skagit glaciers, along with concerns about the riparian forest sustainability and clean-up efforts of the Monte Cristo Mine Area. In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trend for these key environmental indicators since the 2016 State of Our Watersheds Report shows improvements where restoration is occurring, no trend, or there is an environmental concern for a couple of indicators and a declining trend with the continued glacier recession:



Tribal Indicator	Status	Trend Since SOW 2016 Report
Pocket Estuaries	Through 2014, pocket estuary restoration was completed at 5 of the 12 prioritized Skagit Chinook Plan sites. Habitat status and trends monitoring reveals the restoration increased usable pocket estuary habitat area for Chinook smolt production by over 240 acres. Since 2014, no additional restoration has occurred at the 12 prioritized sites although Similk Beach has entered an active planning/design phase with restoration anticipated in the near future.	Improving
Floodplain	In 2017, Sauk River floodplain and tributary riparian areas were an estimated 88% forested. It is estimated that 90 acres of forest cover was lost in the Sauk River floodplain between 2011 and 2017. Almost 97%, or 87 acres of loss is attributed to natural processes, considered a healthy reflection of the floodplain ecosystem.	No Trend
Barriers - RMAP	The Washington State Forest Road Maintenance and Abandonment Plan (RMAP) has led to the completed, scheduled repair and/or abandonment of all 1,662 total miles of private and state owned forest roads in the Upper Skagit, Sauk-Suiattle, and Cascade watersheds of the Skagit River system. RMAP has also resulted in the completed or scheduled repair or removal of all 209 culverts on private and state owned forest roads within the Upper Skagit, Sauk-Suiattle, and Cascade watersheds of the Skagit River system.	Improving
Restoration	Since 1996, 143 projects have been completed or remain active in the Skagit River watershed, and 29 of those restoration projects have been completed since 2015. Completion of the Illabot Creek Alluvial Fan project is a highlight of recent restoration efforts.	Improving
Restoration	Arsenic loading in the South Fork Sauk River flowing through the Monte Cristo Mine Area Removal Action area exceeded pre-removal action levels in 2019. Arsenic concentration in 2019 in Glacier Creek was no longer present, consistent with the post-removal action pattern of arsenic concentration decline. Groundwater arsenic levels in 2019 were below 5 ug/L, outside of anomalous results from 2018, these results are consistent with the post-removal action pattern. Legacy roads to and from the mine area continue to pose a threat to the Tribal fishery.	Concerns
Restoration - Tidal Habitat	Habitat restoration resulted in the overall net gain of 83 hectares (13.6 hectares/year) of Skagit River tidal delta habitat between 2003 and 2013.	Improving
Climate Change - Glacial Recession	Since 1959, glacier area in the Skagit River watershed has decreased by 19%. At current consumption rates, this loss of glacial cover in the watershed equals the elimination of an estimated 100 years of cold freshwater supply for Skagit County.	Declining

The Sauk-Suiattle Indian Tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

Climate scientists have warned that deep reductions in global carbon emissions need to be implemented by 2030 to limit warming temperatures to a level that could avoid the more catastrophic impacts predicted by climate models.[1] The early impacts of global warming are already being felt throughout the Skagit River watershed: melting glaciers in the headwaters; warming water temperatures in lower Skagit tributaries and even some of the larger upstream tributaries, such as the Sauk River; changes in timing, frequency and intensity of floods; lower pH levels in the ocean causing brittle shells in oysters and other shellfish; huge areas of warm water in the ocean further depleting cold-water fish species such as salmon; dead zones in Puget Sound with low levels of dissolved oxygen. Somehow these impacts will need to be addressed even while the human population is expected to increase in Skagit County 30 percent by 2036.[2] This rapid development is already pressuring riparian ecosystems throughout the lower Skagit and its tributaries.

Upstream, as the glaciers disappear, so too will 8 to 12% of the Skagit River's summer flows.[3] This will require more conservative management of flows from the three Seattle City Light dams and the two Baker River dams, to make sure salmon redds are not left high and dry during the critical late summer and early fall spawning on the Skagit River. This is especially important looking ahead to the near future as terms of the relicensing of the Seattle City Light dams are being negotiated for a new 20-year license. Also important to keep in mind is that the reservoirs will have less glacial melt to work with, yet more human development downstream will place increasing demands for water and electricity. And the Skagit's main tributary, the Sauk, has no dams on it – once the glaciers are gone, those flows and colder inputs will be lost during the summer months.

In the downstream reaches of the Skagit River watershed, summer water temperatures in many lower Skagit tributaries are already alarmingly high, causing stress and posing barriers to cold-water fish such as salmon. The remedy – planting trees to provide shade in riparian buffers – is going to have to increase dramatically in order to meet the legally required water temperature standards mentioned earlier. At the current rate of riparian restoration, the Lower Skagit tributaries will not be in compliance with the TMDL by the set date of 2080.

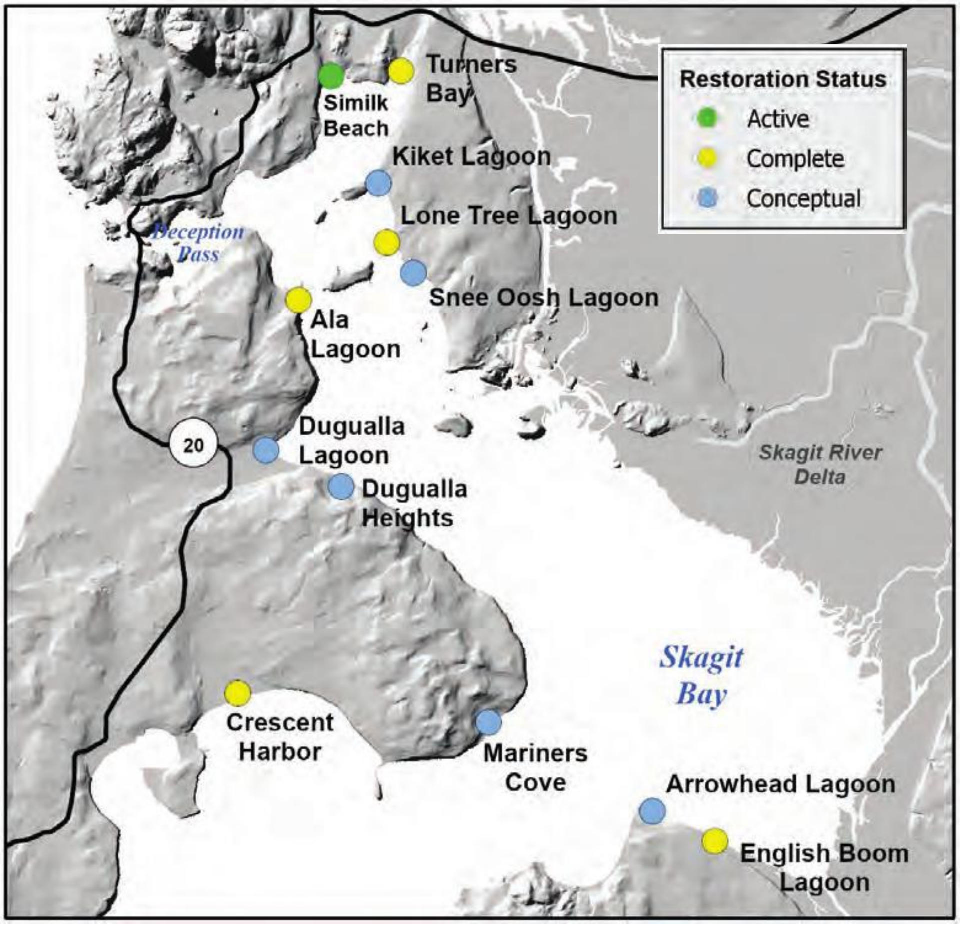
In addition to the slow pace of riparian restoration, agricultural lands still have no requirement to plant buffers on salmon streams, despite the fact that Skagit farms cover almost all of what used to be a very productive estuary for salmon in pre-settlement times. Looking ahead, the agriculture industry will need to agree to plant trees to create shade to lower water temperatures. While the industry has resisted this and insisted on only voluntary measures for implementing buffers, the urgency of the warming climate indicates that a regulatory approach is necessary. A voluntary approach has been tried for the past 20 years, but the pace has been too slow and participation not enough to make a difference.

Simultaneous to these locally scaled efforts, a wholesale transformation of the regional, national and global economies is going to have to be advocated for and implemented as quickly as possible. A shift away from fossil fuels and other sources of carbon emissions must be made, replaced by renewable energy. Tribal, local, state and national governments must show the leadership necessary to make this happen so that the locally scaled impacts of a rapidly warming climate can be mitigated in time to make a difference. For example, regarding the melting of the glaciers in the Skagit River watershed, if carbon emissions are greatly reduced in time, climate models suggest the higher elevation glaciers could be saved. The same logic would apply to sea level rise, ocean acidification, the changing hydrologic cycle and other problems associated with global warming.

Pocket Estuary Restoration Remains Important to Skagit River Chinook Recovery

Through 2014, pocket estuary restoration was completed at 5 of the 12 prioritized Skagit Chinook Plan sites. Habitat status and trends monitoring reveals the restoration increased usable pocket estuary habitat area for chinook smolt production by over 240 acres. The Dugualla Heights restoration site entered the design phase, but was not completed due to concern of the design not having enough salmon habitat benefit. It is still considered as a restoration target, and can be completed with a better design. Since 2014, no additional restoration has occurred at the 12 prioritized sites although Similk Beach has entered an active planning/design phase with restoration anticipated in the near future.[1]

Within the Whidbey basin, modeling and field surveys have led researchers to conclude that over two-thirds of historic pocket estuaries have been completely lost to juvenile salmon use, and the remaining one-third has been reduced in size by approximately 50%. In response, the Skagit Chinook Recovery Plan prioritized the restoration of 12 pocket estuaries, all of which are within a day's swimming distance for Skagit River juvenile chinook. Restoration of these 12 sites is expected to result in the production of over 147,000 additional smolts. Over 63% of the increased production, or over 93,000 smolts will come from the completed restoration of the Dugualla Lagoon project.[2]



There are 12 prioritized pocket estuary restoration projects. 5 have been completed, 2 are active and 5 remain conceptual.

Site	Hectares of habitat			Acres of habitat		
	Year 2005	Year 2014	Change	Year 2005	Year 2014	Change
English Boom Lagoon	1.07	1.35	0.29	2.64	3.34	0.71
Ala Lagoon	8.21	7.05	-1.16	20.28	17.42	-2.86
Crescent Harbor	0.00	94.13	94.13	0.00	232.61	232.61
Lone Tree Lagoon	2.22	2.44	0.22	5.48	6.02	0.55
Turners Bay	18.75	22.49	3.75	46.32	55.58	9.26
Total	**30.23**	**127.46**	**97.23**	**74.71**	**314.97**	**240.26**

Pocket estuary restoration has resulted in over 240 acres of usable pocket estuary habitat area for chinook smolt production.[8,9]

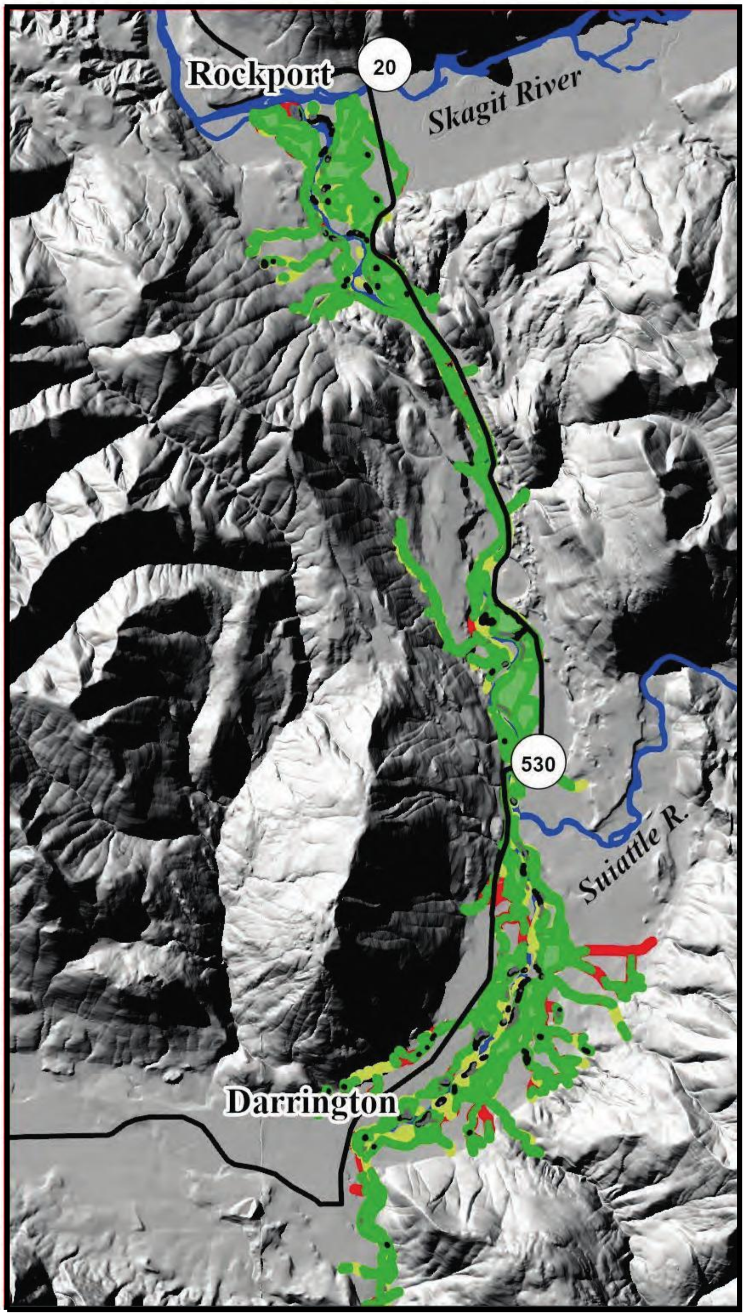
Map Data Sources: SRSC &WDFW 2005,[3] SRSC & WDFW 2012,[4] HWS 2020,[5] SSHIAP 2004,[6] WADNR 2014c[7]

SAUK-SUIATTLE INDIAN TRIBE

Sauk River Floodplain Forest Is Relatively Healthy and Important to Protect

In 2017, Sauk River floodplain and tributary riparian areas were an estimated 88% forested. It is estimated that 90 acres of forest cover was lost in the Sauk River floodplain between 2011 and 2017. Almost 97%, or 87 acres, of loss is attributed to natural processes, considered a healthy reflection of the floodplain ecosystem.[1,2]

Sauk Floodplain Riparian Forest Condition and Change, 2011 to 2017

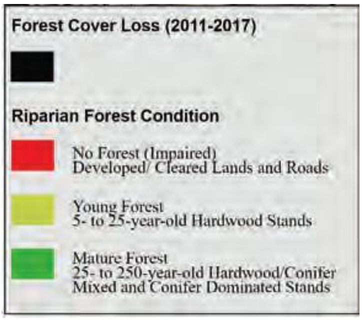


Map Data Sources: Ramsden 2010,[6] Pearce 2020,[7] SSHIAP 2004,[8] WADNR 2014c[9]

The Skagit Chinook Recovery Plan recognizes that riparian forests provide shade, nutrients, large woody debris and streambank stability for spawning and rearing chinook. The plan strongly recommends protecting riparian forests that are healthy and restoring those that are impaired.[3] The Sauk River remains one of healthiest floodplain ecosystems in the Skagit River watershed, but even so, the lower reaches of the Sauk feature younger, smaller trees that indicate a riparian zone still in a state of recovery from past human disturbances.[4] Continued protection of riparian areas in the Sauk River floodplain will require an end to agriculture practices exemptions from the Shoreline Management Act (SMA), and the development of alternative mechanisms to agricultural practices that provide protection equivalent to the SMA. Additionally, the small forestland owners' exemption from the riparian protections of the Forests and Fish Agreement is not consistent with the original agreement, and should be removed to consistently protect riparian resources across all lands regulated through the Forests and Fish Agreement.[5]

Status and Change of Nonforested Riparian Area in the Sauk River Floodplain between 2011 and 2017. [10,11]

Sauk River Floodplain Riparian Forest Area	Non-forested Riparian Area (Acres)	
	2011	*2017*
40 m channel migration zone buffer	119	122
40 m tributary buffer	290	294
Active Sauk River channel migration zone (2009)	103	180
Island within active channel	5	12
Total	518	608



Forest Cover Loss (2011-2017)

⬛

Riparian Forest Condition

🟥 No Forest (Impaired)
Developed/ Cleared Lands and Roads

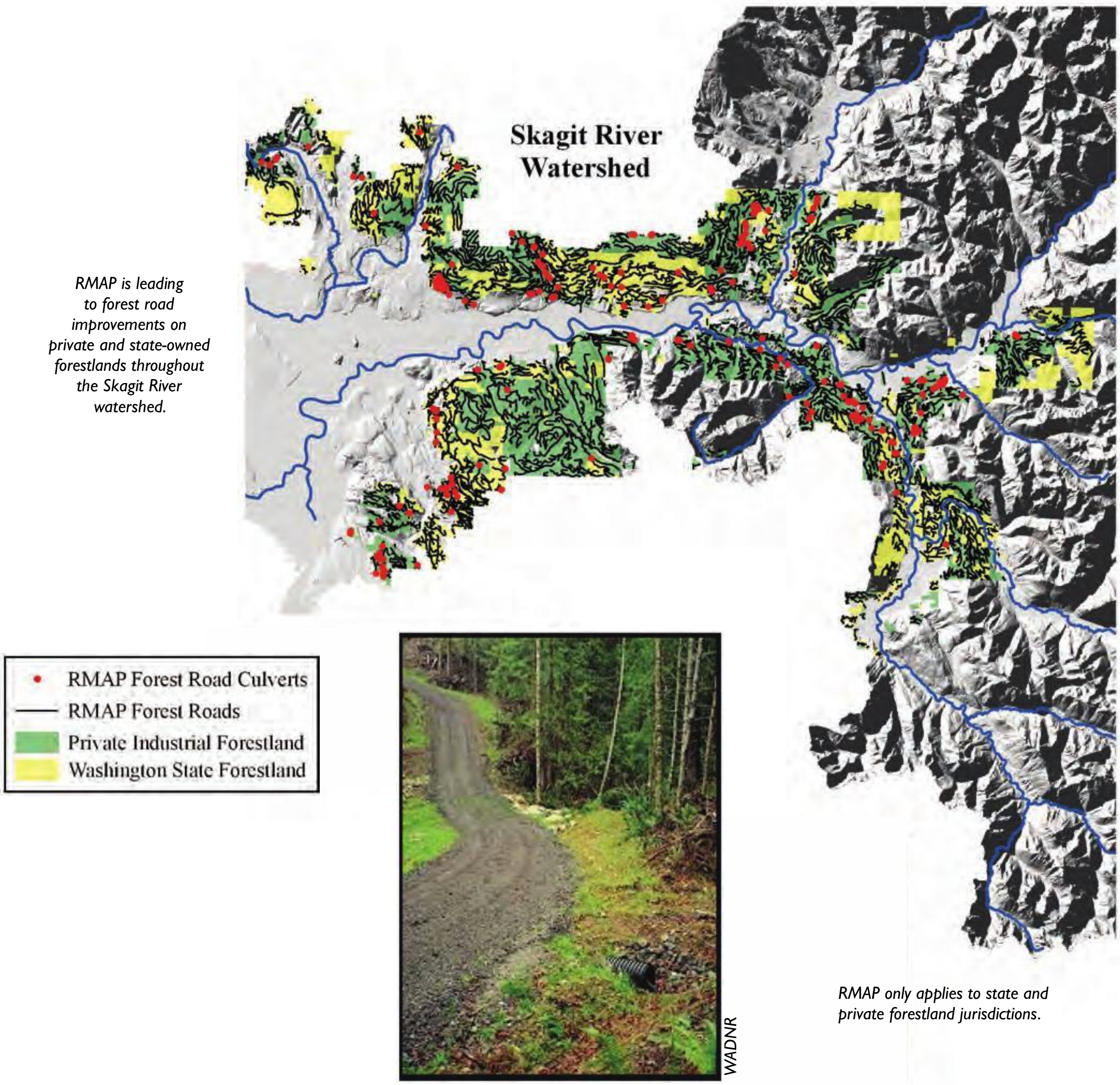
🟨 Young Forest
5- to 25-year-old Hardwood Stands

🟩 Mature Forest
25- to 250-year-old Hardwood/Conifer
Mixed and Conifer Dominated Stands

SAUK-SUIATTLE INDIAN TRIBE

Forest Road Maintenance and Abandonment On Schedule

The Washington State Forest Road Maintenance and Abandonment Plan (RMAP) has led to the repair and/or abandonment of all 1,662 total miles of private and state-owned forest roads in the Upper Skagit, Sauk-Suiattle and Cascade watersheds of the Skagit River system.[1,2] RMAP has also resulted in the repair or removal of 115 of 141 fish barrier culverts on private and state-owned forest roads within the Upper Skagit, Sauk-Suiattle, and Cascade watersheds of the Skagit River system. Remaining scheduled work falls primarily on Weyerhaeuser Corporation and Sierra Pacific owned lands and is on track to be completed by 2021.[3]



RMAP is leading to forest road improvements on private and state-owned forestlands throughout the Skagit River watershed.

RMAP only applies to state and private forestland jurisdictions.

No alteration of the human landscape has a greater and more far-reaching effect on aquatic habitat than roads.[4] Over 1,600 miles of forest road in the Skagit basin are on private industrial and state lands and fall under the RMAP mandate. So far 115 of 141 fish passage barriers have been repaired. The remaining schedule for replacements is for 5 culverts by 2021, 4 culverts on Sierra Pacific lands and 1 culvert on DNR land. The remaining 20 culverts are scheduled to be replaced when the culvert fails or at the end of the "life of the pipe." It is expected that RMAP road repairs and abandonment will improve water quality in the upper Skagit and Samish river watersheds. Considering the role improved water quality plays in chinook habitat, nearing 100% of RMAP roads up to standard or abandoned is good news to salmon recovery in the Skagit and Samish river watersheds.

Map Data Sources: Skagit Co. 2010,[6] WADNR 2014d,[7] WADNR 2014c[8]

SAUK-SUIATTLE INDIAN TRIBE

Regenerating Conifer Forests May Reduce Summertime Low Flows in Important Fish Streams Due to Increased Transpiration

Many critical salmon-bearing tributaries to the Skagit River may experience summertime flow deficits due to increased transpiration (water use by trees) by dense, second-growth conifer forests relative to their more diverse old-growth predecessors. Lower flows may reduce habitat area and exacerbate high stream temperature hazards for some salmon species, which rely on cold water even during the summer. The level of impact differs between tributary basins as shown by a screening tool that accounts for forest age structure. However, large uncertainties remain and are the subject of ongoing research.[1]

It has long been recognized that flow volumes in forested watersheds may be elevated within the first decade or two after timber harvest due to reduced evapotranspiration. More recently, researchers have demonstrated that intermediate-aged Douglas fir stands (10-50+ years) may reduce summertime flow volumes by as much as 50% in experimental basins of uniform age in the Oregon Cascades (Fig. 1).[2] To apply the Oregon results to Skagit River tributaries with a complex harvest history, we modeled stand ages in 58 basins and used the modeled stand age structure to make predictions of flow change due to past forestry practices. Preliminary results suggest that all analyzed tributaries have estimated summertime flow reductions of 1% to 58%, with the greatest deficits in basins where virtually all stands are 10-50 years old (Fig. 2).[3]

However, challenging questions remain: how translatable are the Oregon results to other watersheds with other types of bedrock geology, soils, geomorphology, climate, and forest composition? Do riparian buffers reduce the effect of stand regeneration on low flow hydrology? What is the effect of seasonal snowpack? What forest age or management practices result in flows returning to old-growth levels? These and other issues will need to be resolved before we can confidently and accurately predict summer flow deficits caused by regenerating forests.

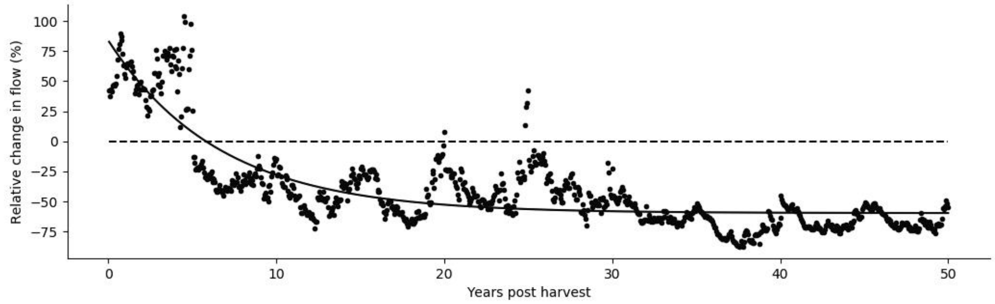


Figure 1. Relative change in flow between a 100% clear-cut basin and an old-growth reference basin in the Oregon Cascades. The solid black line is the exponential model used to extrapolate the Oregon results to the Skagit River tributary basins analyzed here. The dashed line demarcates 0% change.

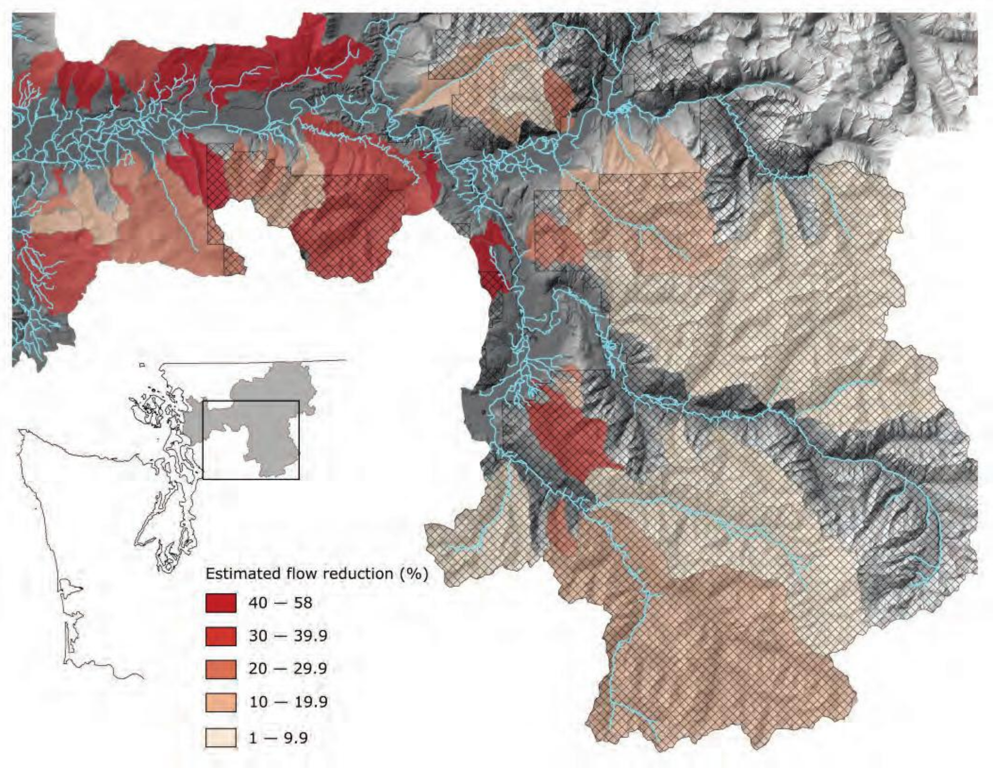
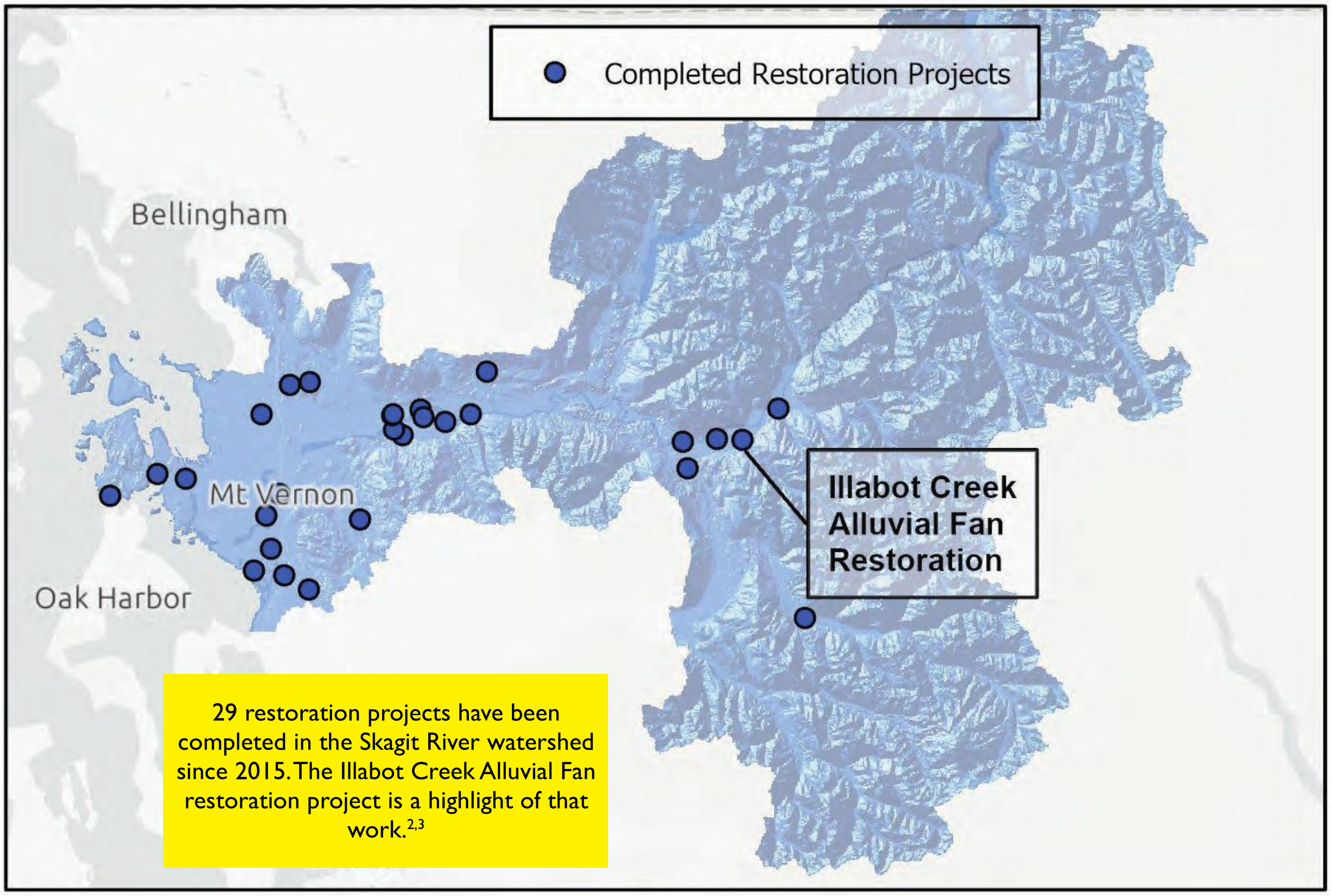


Figure 2. Preliminary results for Skagit River tributaries analyzed for low flow deficits caused by conversion of diverse old-growth forests to uniform, dense conifer forests. Colors represent the estimated percent change in summertime flow (July-September) that can be attributed to denser forests if the Oregon results are valid in these basins. Cross-hatch pattern represents National Forest lands, some of which have experienced partial timber harvest and some of which have had no harvest. Anadromous fish streams are shown in blue.

SAUK-SUIATTLE INDIAN TRIBE

Illabot Creek Alluvial Fan Restoration Highlights Long-Term Commitment

Since 1996, 143 restoration projects have been completed or remain active in the Skagit River watershed, and 29 of those projects have been completed since 2015.[1]



29 restoration projects have been completed in the Skagit River watershed since 2015. The Illabot Creek Alluvial Fan restoration project is a highlight of that work.[2,3]

Completion of the Illabot Creek Alluvial Fan Project through Phase 2 construction is a highlight of recent restoration efforts in the Skagit River watershed. The off-channel and instream habitat associated with the Illabot Creek alluvial fan is highly productive for multiple species of Pacific salmon, and especially important to chinook salmon and steelhead trout. The Skagit River System Cooperative (SRSC) and its member tribes have provided focus and committed leadership to this project throughout. Starting in 2001 with a feasibility study and continuing through construction to current monitoring of restoration results. Overall, the project has resulted in over 1,900 feet of dike removal, an addition of 0.5 miles of instream habitat, and an addition of 23.4 acres of off-channel habitat. Restoration monitoring is already seeing juvenile salmon populate the newly created habitats.[4,5]

Puget Sound Partnership

Illabot Creek reconnected to off-channel habitat within its alluvial fan.[6]

Map Data Sources: HWS 2020,[2] *SSHIAP 2004*[3]

SAUK-SUIATTLE INDIAN TRIBE

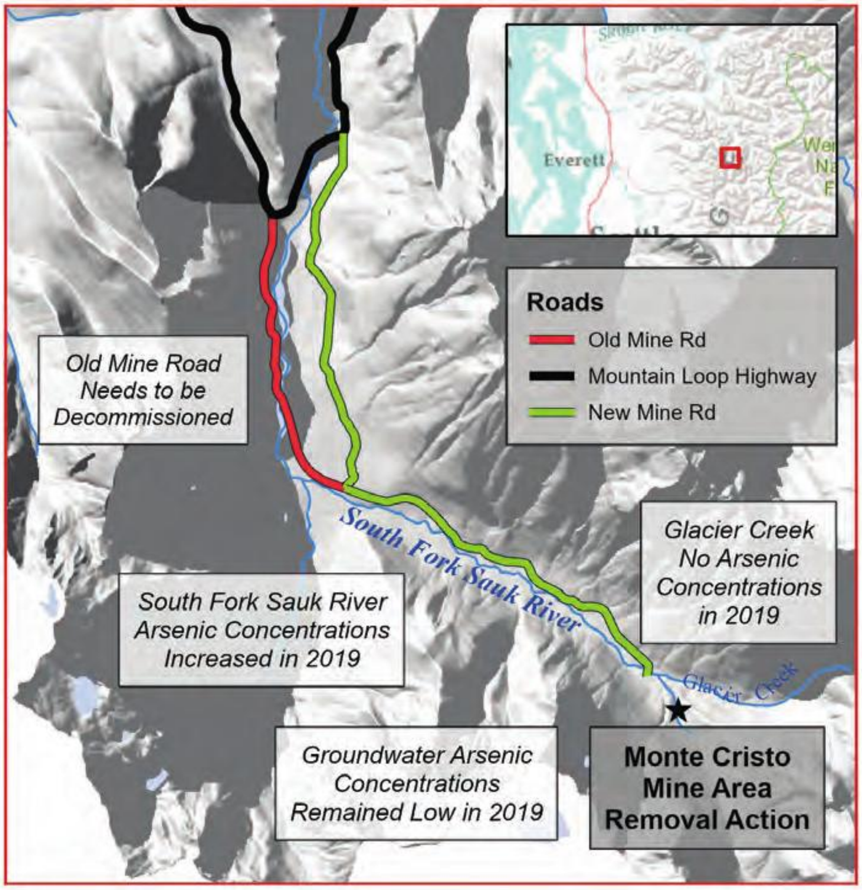
Monte Cristo Mining Area Removal Actions Complete, Results Are Mixed

Arsenic loading in the South Fork Sauk River flowing through the Monte Cristo Mine Area exceeded pre-removal action levels in 2019. Arsenic concentration in 2019 in Glacier Creek was no longer present, consistent with the post removal action pattern of arsenic concentration decline. Groundwater arsenic levels in 2019 were below 5 µg/L. Setting aside anomalous results from 2018, the 2019 levels are consistent with the post-removal action pattern.[1] Legacy roads to and from the mine area continue to pose a threat to the tribal fishery.

In 2009 the U.S. Forest Service and Washington Department of Ecology were awarded $11 million dollars as part of an ASARCO bankruptcy agreement, to fund the Monte Cristo Mining Area (MCMA) Removal Actions (RA) in the upper South Fork Sauk River watershed.[2,3] The mine is close to the South Fork Sauk River, and legacy sediments pose downstream risks to human and ecological health from exposure to high levels of hazardous substances, particularly arsenic.

While post RA monitoring results are showing positive effects of the clean-up in arsenic levels in Glacier Creek and arsenic levels in groundwater at the MCMA site, arsenic levels in the South Fork Sauk River have not been in decline since the RA. It appears that streamflow is influencing arsenic concentrations in the South Fork Sauk River, and that inconsistent measurement of streamflow may also have a role. Monitoring continues in 2020, but there may need to be a different monitoring protocol for the South Fork Sauk River beyond 2020 if consistent streamflow measurements prove too difficult to obtain.[4]

Legacy roads to and from the MCMA continue to pose a threat to tribal fishery interests. The new access road to the Monte Cristo Mine Area cleanup site has made the historic old Monte Cristo Road that originated at Barlow Pass redundant. The old road has a large landslide and a bridge that presents chronic, costly problems for the South Fork Sauk River and tribal fishery interests. The Sauk-Suiattle Tribe would like USFS and WAECY to emphasize to Snohomish County that the old road be decommissioned.



Map Data Sources: WAECY 2018,[5] SSHIAP 2004,[6] WADNR 2014c,[7] CES 2013[8]


USFS

South Fork Sauk River arsenic monitoring site. The braided stream makes flow difficult to measure, which adds uncertainty to arsenic results here.[9]

SAUK-SUIATTLE INDIAN TRIBE

Tidal Habitat Restoration Needs to Accelerate to Reach Desired Future Conditions in a Changing Climate

Habitat restoration resulted in the overall net gain of 83 hectares (13.6 hectares/ year) of Skagit River tidal delta habitat between 2003 and 2013.[1]

Tidal habitat restoration in the Skagit River delta is being successfully implemented. From 2004 to 2013, the tidal habitat footprint in the Skagit River delta increased from 3,184.65 hectares to 3,467.68 hectares, from 80% to 81.9% of the desired future condition (DFC) of the Skagit River Chinook Recovery Plan.[2] A point of concern, the pace of habitat restoration has slowed considerably since 2009. From 2005 to 2009, 103.3 hectares of tidal delta extent were restored, an average of 25.8 hectares per year. Since 2009, another 71.2 hectares has been restored, an average of 10.2 hectares per year.[3]

While the pace of tidal habitat restoration is slowing, sea level rise and associated wave energy are resulting in the natural loss of tidal delta extent, primarily along the Skagit Bay front. In addition, levees within the delta are likely inhibiting habitat formation by creating areas that are sheltered from sediment supply but not from sea level rise or storm surge.[4,5]

To reach DFC for tidal marsh by 2030 (midpoint of a 50-year recovery plan), the pace of restoration needs to increase, and there must be explicit consideration of sea level rise, storm surge and sediment routing in an update to the current tidal habitat restoration plan.[6]

Washington Restoration and Conservation Office

Skagit River Delta

Skagit River Delta Tidal Habitat Restoration Sites from 2005 to 2016

Map Data Sources: GSRO 2019,[8] ESRI 2020[9]

Skagit River Tidal Delta Habitat Restoration 2005 to 2016[7]

Restoration	Year Completed	Hectares Gained
South Fork Dike Setback	2007	8.37
Smokehouse	2008	26.9
Swinomish Channel	2008	3.37
Wiley Slough	2009	64.62
Fisher Slough	2011	18.66
Fir Island Farms	2016	52

Glacial Recession Threatens Fish in the Skagit River Watershed

Since 1959, glacier area in the Skagit River watershed has decreased between 30 and 35km^2 (-19%).[1] At current consumption rates, this loss of glacial cover in the watershed equals the elimination of an estimated 100 years of cold freshwater supply for Skagit County.[2]

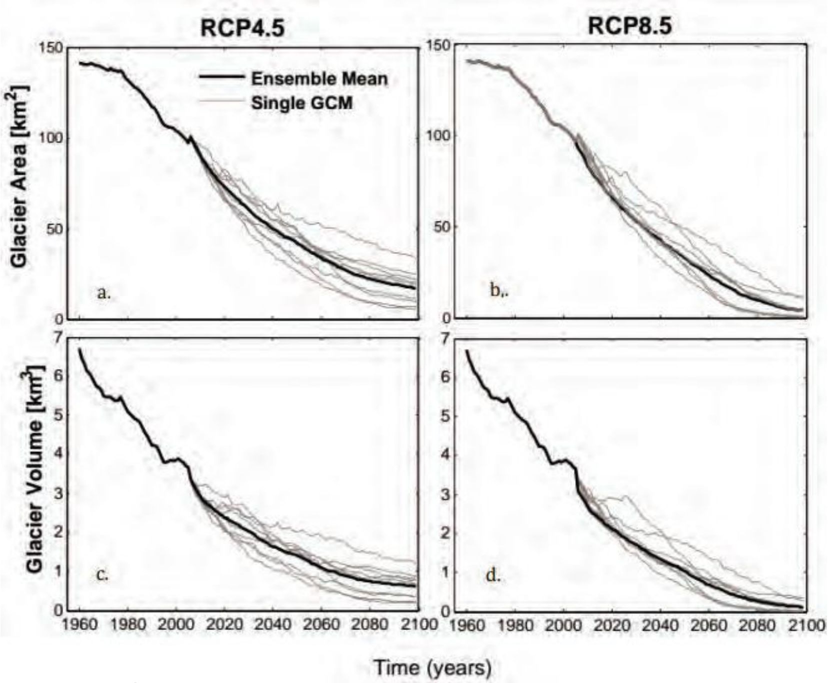
1928

2006

These time series scenes of the South Cascade Glacier in the Skagit watershed illustrate an extensive recession of glacial area.[6]

The Skagit River watershed has the most glacial cover in the contiguous United States, but that cover has been decreasing rapidly since the middle of the 20th century.[3] Skagit River salmon are a cold-water fish that depend on the input of glacial water in their natal streams. Less glacial water means lower summer flows with higher summer stream temperatures.[4] Lower, warmer streamflow threatens the entire freshwater cycle of salmon, migration timing, spawning survival and rearing capacity.

Climate modeling predicts that no reduction in current greenhouse gas emissions (GHGs) (RCP 8.5) will result in the disappearance of all Skagit glacier coverage by the end of this century. More hopefully, the same climate modeling predicts that a decrease in GHG emissions (RCP 4.5) by 2040 may result in retaining some high-elevation glacier area within the watershed.[5]



Some High-Elevation Glaciers Remain by 2100

Glaciers Entirely Gone by 2100

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Regenerating Conifer Forests May Reduce Summertime Low Flows in Important Fish Streams Due to Increased Transpiration

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Glacial Recession Threatens Fish in the Skagit River Watershed

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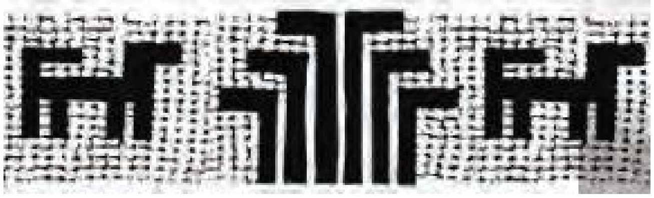
2020 State of Our Watersheds Report
Skokomish-Dosewallips Basin

We have emphasized a Skokomish River whole watershed approach and strategy in our Chinook Recovery Plan, with high expectations and aggressive goals and objectives. Habitat recovery is a fundamental component of the plan. With the support of local stakeholders and the technical and funding assistance of our federal and state partners, we have implemented and completed significant components of the habitat restoration plan. We are grateful for all those who have contributed to the effort. There does remain a lot of work to be done but we are committed to the restoration and enhancement of the Skokomish watershed resources that are vital to the health of our community.

– Joseph Pavel
Director of Natural Resources

Area of Interest



Skokomish Tribe

The Skokomish Indian Tribe is the successor to the Twana people whose aboriginal territory encompasses the entire Hood Canal and tributary watershed basins. There were nine permanent village sites throughout the Hood Canal region, as well as seasonal and temporary encampments, located near streams where they could take advantage of plentiful fish and shellfish resources.

At the signing of the Point No Point Treaty of 1855, the Skokomish Tribe ceded their traditional lands to the U.S. government, and Washington's Gov. Isaac Stevens assured the tribe that they could continue to gather food at the accustomed locations. However, during this period, Euro-Americans began farming the floodplains, cutting the forests, and shellfish and fish resources began to be harvested by settlers.

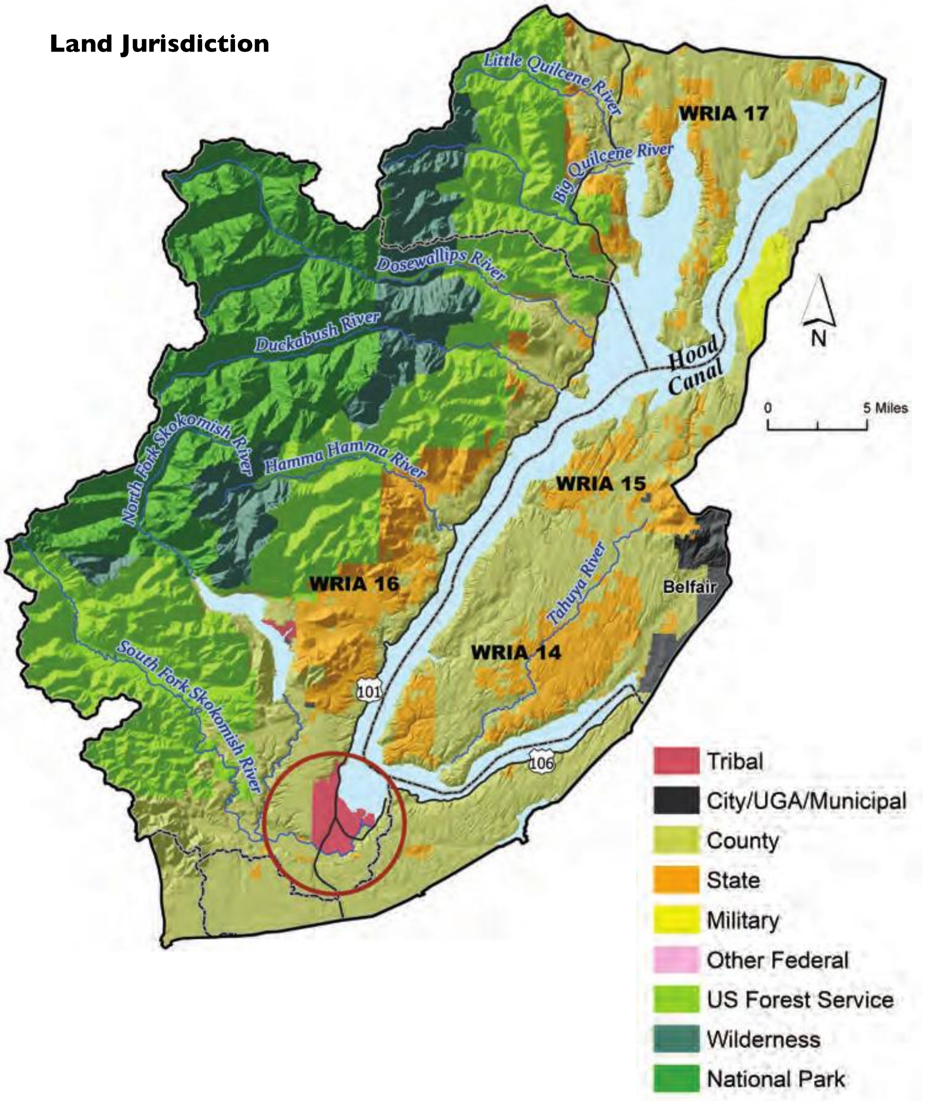
Today, the region is largely rural and forested, and communities still rely on logging, fishing, shellfish and recreation. Unfortunately, there have been major land-use impacts on treaty-protected resources including salmon habitat from dam construction, floodplain and shoreline development, and roads and logging.

The Skokomish Tribe, as natural resource co-manager, is actively engaged in the protection, maintenance, recovery and enhancement of resources throughout Hood Canal. Tribal programs include fish, shellfish, hatchery, wildlife, water quality, habitat and enforcement programs. Resource management and habitat restoration are key to maintaining tribal cultural, subsistence, and economic well-being.

Skokomish Indian Tribe

Hood Canal Watershed

Land Jurisdiction



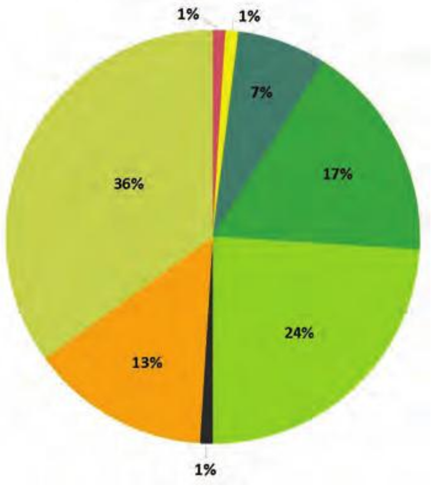
Hood Canal is a natural, glacier-carved fjord separating the Olympic and Kitsap peninsulas. It stretches 68 miles from the northern tip of the Kitsap peninsula to Lynch Cove, forming an L-shape that remains narrow, ranging from 1.5 to 2 miles across. The canal includes portions of Mason, Jefferson and Kitsap counties as well as the Skokomish and Port Gamble S'Klallam tribal reservations. Major rivers entering Hood Canal from the steep eastern slopes of the Olympic Mountains on the west side include the Skokomish, Dosewallips and Big Quilcene. Precipitation is variable – Quilcene receives only 16 inches per year, while 90 inches fall annually at Skokomish.[1]

The average depth of Hood Canal is 177 feet, with a maximum depth of 600 feet, and the circulation is poor, especially in the southern portion. Water from the Strait of Juan de Fuca mixes poorly due to an underwater sill south of the Hood Canal Bridge, and fresh water entering the canal often forms a layer at the surface. Algal blooms reduce dissolved oxygen, providing a poor habitat for marine species. However, fisheries and aquaculture are economically important to the region, and the canal is famous for its oysters and other shellfish.[2]

The principal watersheds – Skokomish, Hamma Hamma, Duckabush and Dosewallips – currently support listed Hood Canal summer chum, steelhead and Puget Sound chinook. Sizable portions of these major watersheds are contained within the Olympic National Park or U.S. Forest Service ownership. The U.S. Forest Service lands were subject to excess resource extraction which caused extreme habitat damage and alterations. Since 1994, these lands have been managed under the U.S. Northwest Forest Plan and are now protected for the long-term health of forests, wildlife and waterways.

At treaty time, the Skokomish River supported large fish runs including all species of Pacific salmon and steelhead. This broad range of species (chinook, coho, chum, sockeye, pink and steelhead) and fish runs returned to the Skokomish River during almost every month of the year. The estuarine and nearshore habitats of Hood Canal provide a critical migration corridor for juvenile salmon of all species.

Today, the region is largely rural and forested, with communities relying on logging, fishing, shellfish and recreation. Major land-use impacts on salmon habitat include activities such as dam construction, floodplain and shoreline development, and roads and logging, especially in steep forested terrain.



Map Data Sources: Skokomish Tribe of Indians 2019,[3] SSHIAP 2004,[4] USFWS 2018,[5] WADNR 2016,[6] WADNR 2018,[7] WADOT 2018a,[8] WADOT 2018b,[9] WAECY 1994,[10] WAECY 2018a,[11] WAECY 2018b,[12]

Chapter Summary

The Twana (ancestors of the Skokomish people) were the first inhabitants of the south Hood Canal region, with villages and fishing camps located near streams where they could take advantage of plentiful fish and shellfish resources. The Skokomish Tribe are leaders in the region's salmon recovery effort. No other people know these watersheds as well as the tribes and none has a greater stake in their future. The tribes believe that if salmon are to survive, real gains in habitat protection and restoration must be achieved.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org.*

For this report, the Skokomish Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Impervious Surface Remains Unchanged

Percentage of impervious surface has been recognized as a key indicator of impacts to watersheds due to urbanization. Development is a direct result of population growth, which in turn leads to increased impervious surfaces. Although the cities/towns in the Hood Canal watershed are small compared to more urbanized areas, they all showed an increase in population from 2016-2019. Even so, the impervious surface growth in the Hood Canal watershed from 2011-2016 was negligible. However, 31% of the impervious surface continues to occur within one mile of the Hood Canal shoreline.

Shoreline Modifications Continue to Threaten Nearshore Habitat

Estuaries and nearshore areas are important for juvenile salmon to rear, feed, migrate and find shelter from predators. Estuary and nearshore habitats often fall victim to human development activities such as shoreline armoring, overwater structures (dock, piers, etc.), diking, dredging and other activities that significantly reduce ecosystem functionality. According to the latest data from the Washington Department of Fish and Wildlife, shoreline armoring is still increasing in the Hood Canal watershed and not meeting the Puget Sound Partnership's goal of the amount of armoring removed exceeding the amount constructed.

The tribe has concerns about existing bulkheads and pier ramp and floats that continue to be "repaired," extending their lifespans another 30-40 years and continuing to be a problem, instead of assuming the structure will be mitigated over time, such as being removed.

In addition, emergencies due to sea level rise/king tides and storms will be permitted as well.

Water Wells Potentially Impact Surface Flows

Hood Canal has experienced substantial population growth, especially along the shoreline the past several decades, bringing an increased demand for water. From 2015-2019, the Hood Canal watershed saw 359 new water wells of which 154 (43%) are within one mile of the Hood Canal shoreline.

It is well established that pumping groundwater, including unregulated water withdrawals by "permit-exempt" wells, reduces streamflow. Rural development using permit-exempt wells has been happening at an accelerating pace, taking more and more water from streams that support endangered salmon. WRIA 16 is not regulated by an instream flow rule but permit-exempt wells are regulated by RCW 90.44.050.

Forest Cover Conditions and Timber Harvest Activities

From 2011 to 2016, the Hood Canal watershed saw an increase of 4,396 acres of trees (6.9 sq mi.), a .9 % gain. Forest Practice Applications are still occurring but the regrowth of forests is surpassing the amount of timber harvested. The Skokomish Tribe is taking steps to maintain and protect its forestlands. The tribe has earned Forest Stewardship Council® certification (FSC®) through Northwest Natural Resource Group (NNRG) for its 2,086-acre forest at the south end of Hood Canal in Mason County. Forest Stewardship Council® (FSC®) certification is a market-based, voluntary system for ensuring that wood products come from well-managed forests. This makes Skokomish the first tribe in Washington state to gain certification for a well-managed forest.

Taking Action on Water Quality in the Hood Canal Watershed

The shellfish growing areas in the Hood Canal watershed saw a net overall gain of 34 acres opened for harvesting from 2014-2018. The Hood Canal Regional Pollution Identification and Correction (HCRPIC) Program partners are working hard to protect public health and shellfish growing areas and restore water quality by correcting fecal pollution sources, restoring, and protecting Hood Canal habitat.

The Skokomish Tribe is making sure that the water emptying into Hood Canal is safe for tribal members and recreational users.

For years, the tribe has been testing for the presence of E. coli and fecal coliform in streams that empty into the Skokomish River and Hood Canal. Nonpoint source pollution primarily is the source, typically coming from failing septic systems, runoff from agriculture, pet waste and even human waste. Polluted water can contaminate shellfish beds along the Hood Canal beaches, impeding tribal harvest opportunities.

Agricultural Land Riparian Management: U.S. Army Corps of Engineers General Investigation Proving to be Successful

Riparian plantings continue following directions from the General Investigation (GI). The Skokomish Tribe is working with Mason County, Mason Conservation District and the U.S. Army Corps of Engineers to help support the riparian protection and restoration needs of the Skokomish watershed.

Riparian habitats are the most fundamental building block for protecting aquatic freshwater and marine ecosystems and the species that depend on them. Virtually all watershed assessments and species recovery plans, from landscape to reach to watershed scales, call for improving riparian habitat quality/quantity and reducing their increasing fragmentation.

The Protection and Restoration of Skokomish River Valley Riparian Areas project focuses on outreach to landowners in a high-priority reach of the Skokomish River identified by the GI. Outreach efforts will lead to the development of a reach scale plan to acquire property to support five large-scale riparian/floodplain restoration actions developed through the GI.

Skokomish River Estuary Restoration Helps Salmon and Steelhead Return Home

For decades, human activity blocked salmon, steelhead and other species from accessing their habitat in the Skokomish River estuary. In recent years, a collaborative partnership has been working to restore this vital habitat. Today, the Skokomish estuary is the most complete estuary restoration project in Puget Sound.

In 2018, spring chinook salmon returned to the watershed to spawn for the first time in nearly a century, after having been reintroduced to the river by the tribe in 2016. Within the first year of monitoring, tribal biologists and technicians recorded 20 fish species using the estuary's restored channels, including chinook and chum salmon. In addition to fish, vegetation surveys, water quality testing, and bird and wildlife observations are completed to continue to track the estuary's journey toward recovery.

Weaver Creek Reconnection Project Reconnects Salmon Habitat

Both manmade alterations to Weaver Creek and streambed aggradation in the Skokomish River had created a barrier for fish passage in the lower reaches of Weaver Creek. This project restored a free-flowing outlet for Weaver Creek that alleviated the degraded water quality conditions that characterized this reach. The project including installing 25 logs and creating a 100-foot native riparian buffer on both banks, totaling 4 acres.

Conclusion

There have been a number of successes in the Skokomish watershed in recent years, including forest cover that is increasing, riparian plantings that continue to follow directions from the GI, restoration projects that are underway and increasing shellfish growing area acreage.

Impervious surface growth in the Hood Canal watershed from 2011-2016 was negligible but the work is not done. Shoreline armoring is still increasing, which is not meeting the Puget Sound Partnership's goal of the amount of armoring removed exceeding the amount constructed. Hood Canal has experienced substantial population growth, especially along the shoreline over the past several decades, bringing an increased demand for water. From 2015-2019, the Hood Canal watershed saw 359 new water wells of which 154 (43%) are within one mile of the Hood Canal shoreline and 31% of the impervious surface continues to occur within one mile of the Hood Canal shoreline.

Today, the Skokomish watershed is the most complete estuary restoration project in Puget Sound. In 2018, spring chinook salmon returned to the watershed to spawn for the first time in nearly a century, after having been reintroduced to the river by the tribe in 2016.

People need to be held accountable to protecting, conserving and improving fish habitat in their land use decisions and federal, state and local governments all have a role in that. Land use and water laws that are in place and meant to protect critical areas and fish habitat need to be implemented. Implementation includes education and voluntary action, but it also needs to include enforcement when those laws are broken. The future of tribal treaty rights in the Skokomish watershed depends on it.

Recovery Efforts Improving but More Actions Are Needed

At the 15-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Skokomish-Dosewallips Basin area shows that priority concerns continue to be around the degradation of marine shoreline habitat conditions and an increase in water wells.

Little change has occurred in the amount of impervious surface, but there has been improvements to the watershed's forest cover and marine water quality, represented by the net gain of shellfish harvest acres.

In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat, and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trends for these key environmental indicators since the 2016 State of Our Watersheds Report shows an improvement in forest cover, shellfish harvest areas being re-opened and restoration efforts:

Tribal Indicator	Status	Trend Since SOW 2016 Report
Impervious Surface	Impervious surface growth in the Hood Canal watershed from 2011-2016 was negligible. Thirty-one percent of the impervious surface continues to occur within one mile of the Hood Canal shoreline.	No Trend
Shoreline Modifications / Forage Fish	From 2015-2018 in Mason County, 54 Hydraulic Project Approvals (HPAs) were issued resulting in an additional 1,576 feet of armored shoreline while only 164 feet was removed. Twenty-nine percent of the Hood Canal Watershed remains modified.	Declining
Water Wells	The Hood Canal watershed has seen an 8.4% growth in the number of water wells from 2015-2019. Of these 359 new wells, 154 (43%) are within one mile of the Hood Canal shoreline.	Declining
Forest Cover	From 2011 to 2016, the Hood Canal Watershed saw an increase of 4,396 acres of trees (6.9 sq mi.), a .9 % gain. Forest Practice Applications (FPAs) are still occurring but the regrowth of forests is surpassing the amount of timber harvested.	Improving
Water Quality - Shellfish	The shellfish growing areas in the Hood Canal watershed saw a net overall gain of 34 acres opened for harvesting from 2014-2018. The Hood Canal Regional Pollution Identification and Correction Program partners are working hard to protect public health and shellfish growing areas, and restore water quality by correcting fecal pollution sources, restoring, and protecting Hood Canal habitat.	Improving
Restoration	Riparian plantings continue following directions from the GI. The Skokomish Tribe is working with their partners Mason County, Mason Conservation District and the U.S. Army Corps of Engineers to help support the riparian protection and restoration needs of the Skokomish watershed.	Improving
	Skokomish river estuary restoration has helped salmon and steelhead return to historical channels by reopening agriculgural lands.	
	The Weaver Creek reconnection project reconnected Weaver Creek to Purdy Creek, restoring an outlet of Weaver Creek.	

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

Examples of issues and opportunities that may affect the future of watershed health in Hood Canal include management of the following:

Water quality monitoring and remediation will continue to be focused activities of the Skokomish Tribe. Septic system failures are an ongoing threat to water quality and resource health. We have been successful at identifying and correcting failing systems, increasing the acreage of clean beaches, and availability of safe shellfish products. The increasing number of septic system installations and the ongoing burden of maintaining the functionality of existing systems is an ongoing threat to any progress we have made.

Climate change effects have contributed to increasing threats of harmful algal blooms which contribute to hypoxic conditions in Hood Canal, and beach closures with prohibitions on shellfish harvest due to harmful algal toxins in shellfish. We continue to monitor these conditions, contributing to the body of information needed to mitigate and adapt to climate change.

Animal manure and pet waste also contribute to the fouling of our waters and we continue to strive for the control of these inputs and the maintenance of water quality. We look to our partners at the Washington State Department of Ecology, and the county Departments of Health to be vigilant in enforcing the existing standards and improving water quality protection standards and capabilities.

We will continue to conduct an active habitat maintenance, protection and restoration program. We have accomplished a tremendous amount of active restoration in the Skokomish River Basin and currently have significant projects in the planning and implementation phases. The United States Army Corp of Engineers (USACE) General Investigation Study has provided a main stem Ecosystem Recovery Plan. The Skokomish Tribe, Mason County and the USACE have obtained funding and are in the process of implementing a $19 million dollar restoration project. We have and will continue to work with Mason Conservation District to design, fund and implement additional restoration projects in the basin. Riparian vegetation recovery efforts continues to be a focus in the watershed.

We work with the city of Tacoma and other partners (WDFW, NOAA Fisheries, USFWS, BIA, WDOE, USFS and NPS) to implement the conditions of a settlement between the parties which also include the issuance of a FERC license to operate hydroelectric facilities. The conditions include a program to reintroduce spring chinook and sockeye in the Skokomish River. North Fork Skokomish River habitat restoration planning, design and funding also are included in the conditions. We look forward to implementing these components along with our partners in the watershed.

We continue to develop and implement our Chinook Recovery Plan with WDFW, city of Tacoma and NOAA Fisheries, and the Summer Chum Recovery Plan with HCCC, WDFW, HCSEG and NOAA fisheries. We are looking ahead to recovery of these species in the watershed, as well as maintaining and enhancing existing resources. These efforts require an ongoing commitment of funding. Education, communication, and outreach are necessary to achieve the required level of commitment.

SKOKOMISH TRIBE

Impervious Surface Remains Unchanged

Impervious surface growth in the Hood Canal watershed from 2011-2016 was negligible. Thirty-one percent of the impervious surface continues to occur within one mile of the Hood Canal shoreline.[1]

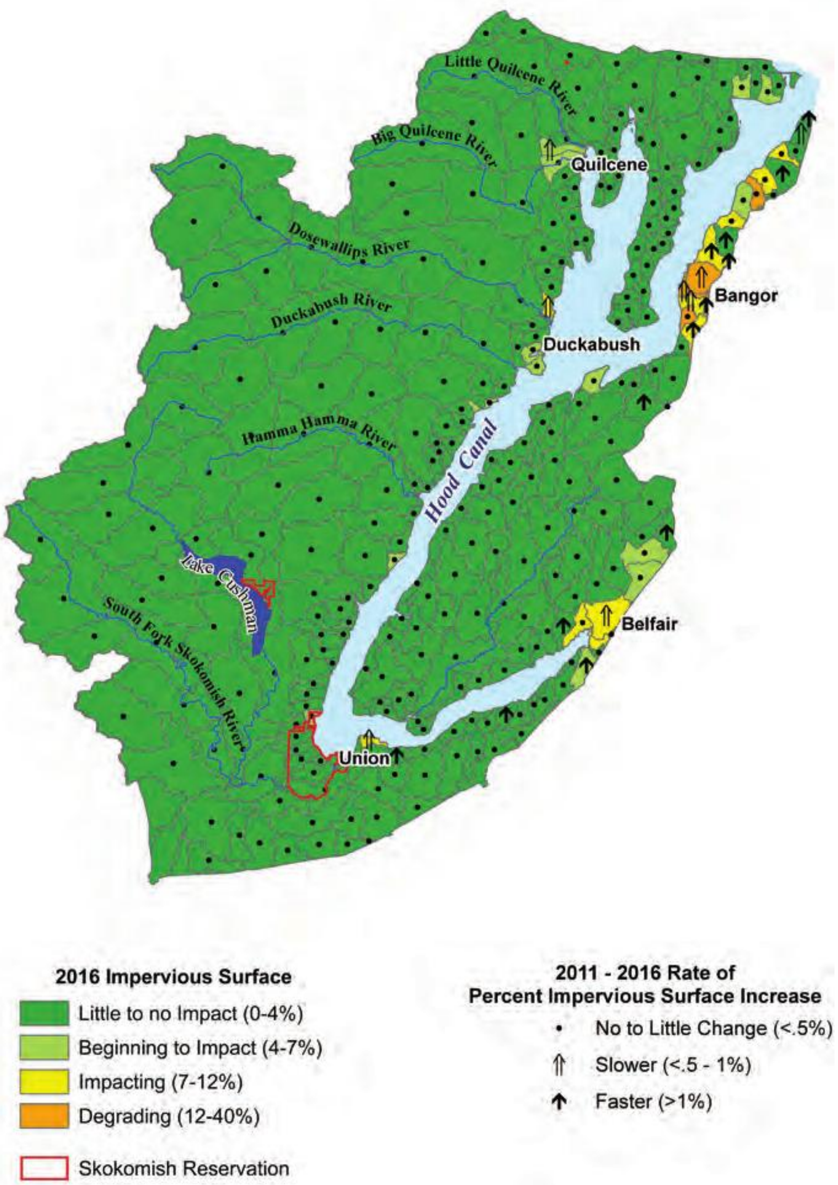
The Hood Canal watershed's rivers, streams and nearshore environment provide important habitat for chinook, chum, coho, and pink salmon, steelhead and cutthroat trout, and associated aquatic species. Habitat quality has diminished due to multiple causes including roads and land development, stream modifications, shoreline development and water pollution from sediment, nutrients and pathogens.[2]

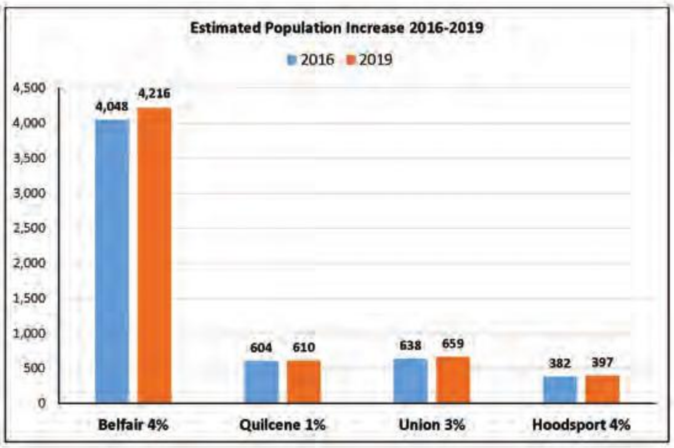
The natural resources most directly affected by the current pattern of watershed land use are small streams and associated wetlands. These stream ecosystems are critical spawning and rearing habitat for several species of native salmonids (both resident and anadromous) including cutthroat trout, steelhead trout, coho salmon, chum salmon, chinook salmon, pink salmon and sockeye salmon. These fish, especially the salmon species, hold great ecological, cultural and socio-economic value to the peoples of the Pacific Northwest. Despite this value, the wild salmonid resource is in considerable jeopardy of being lost to future generations. Over the past century, salmon have disappeared from about 40% of their historical range and many of the remaining populations (especially in urbanizing areas) are severely depressed. There is no one reason for this decline. The cumulative effects of land-use practices including timber harvest, agriculture and urbanization have all contributed significantly to this widely publicized "salmon-crisis." [3]

Percent of impervious surface has been recognized as a key indicator of impacts to watersheds due to urbanization.[4] The frequency and intensity of peak flows and the volume of stormwater runoff all increase when natural cover is removed from developing areas and then converted to impervious surfaces, such as pavement, homes, buildings and non-native landscapes like lawns that reduce surface perviousness relative to natural forest cover.[5]

Development is a direct result of population growth, which in turn leads to increased impervious surfaces. Although the cities/towns in the Hood Canal watershed are small compared to more urbanized areas, they all showed an increase in population from 2016-2019.[6]

One of the four goals of the Skokomish Chinook Recovery Plan identifies the need to protect the ecological processes, functions and forms of the Skokomish watershed from ongoing land and water uses, specifically the protection of water quality from further degradation from nonpoint and point pollution souces.[7] How the state and local governments manage urban/rural sprawl as more people move into the area will have a direct impact on the quality of salmon and steelhead habitat.





Map Data Sources: WAECY 2017,[8] NLCD 2011, [9] NLCD 2016[10]

Skokomish Tribe

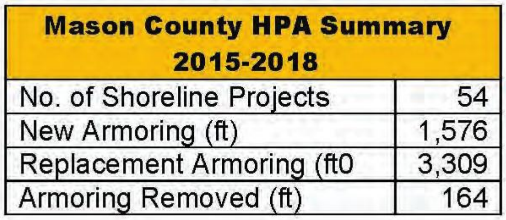
Shoreline Modifications Threaten Nearshore Habitat

From 2015-2018 in Mason County, 54 Hydraulic Project Approvals (HPAs) were issued resulting in an additional 1,576 feet of armored shoreline while only 164 feet was removed.[1] Twenty-nine percent of the Hood Canal watershed remains modified.[2]

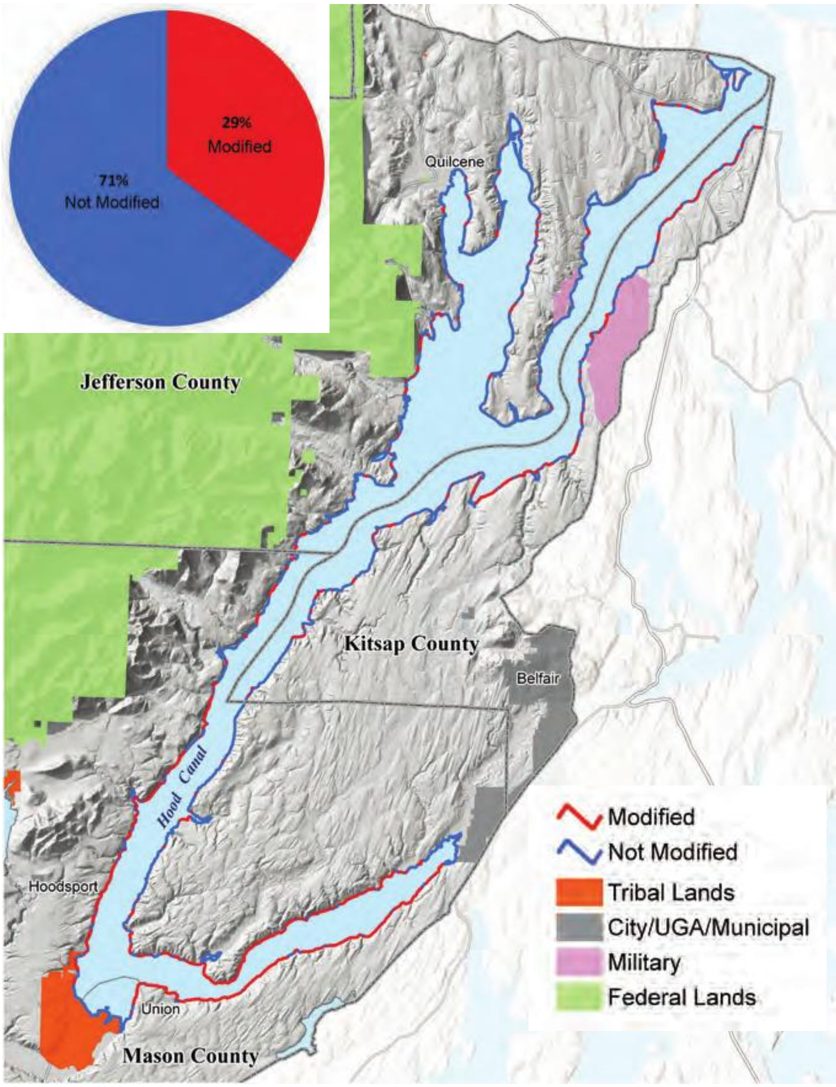
Nearshore habitat in the saltwater environment refers to the shallow waters near the shoreline, including the beach, intertidal, and subtidal zones. Estuaries and nearshore areas are important for juvenile salmon to rear, feed, migrate and find shelter from predators. Estuary and nearshore habitats often fall victim to human development activities such as shoreline armoring, overwater structures (dock, piers, etc.), diking, dredging and other activities that significantly reduce ecosystem functionality.[3] According to the latest data from Washington Department of Fish and Wildlife, shoreline armoring is still increasing in the Hood Canal watershed and not meeting the Puget Sound Partnerships goal of reducing the amount of armoring in Puget Sound.

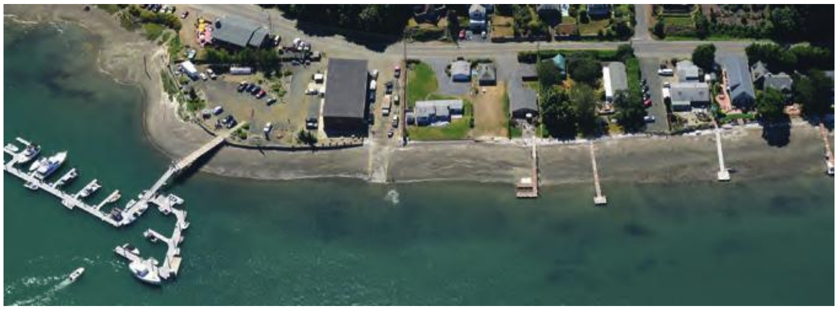
The Hood Canal Coordinating Council Salmon Habitat Recovery Strategy has identified habitat in the nearshore marine waters as a high priority.[4] The intent is to protect and restore what is presently documented as the chinook and chum habitat, and the watershed processes that support and maintain that habitat. The Mid-Hood Canal Chinook Recovery Planning Chapter identified the key to recovery of productive, sustainable natural chinook is the habitat in the watersheds and estuaries.[5]

The Skokomish Tribe is concerned about the amount of overwater structures in their watershed. Examples of overwater structures are bridges, docks, piers, buoys and floats. These structures negatively affect salmon in several ways. Changes to light affect the behavior of salmon. Salmon fry have been seen avoiding travel under docks and piers during daylight hours. As they move away from the shore, they become subject to attack by larger predators that typically stay in deeper waters. The amount of light also affects salmon feed – with less light, they eat less. With less light, there are fewer small species available for salmon to eat. Reduction in light affects the growth of sea grasses such as eelgrass, which provides a rich feeding area for marine birds and fish, and offers shelter to species such as salmon.[6]



Mason County HPA Summary 2015-2018	
No. of Shoreline Projects	54
New Armoring (ft)	1,576
Replacement Armoring (ft0	3,309
Armoring Removed (ft)	164





WA Dept. Ecology Coastal Atlas

Example of shoreline armoring and overwater structures in the Hood Canal watershed.

Map Data Sources: SSHIAP 2004,[7] WAECY 2019,[8] WADNR 2012,[9] SSHIAP 2019,[10]

SKOKOMISH TRIBE

Water Wells Potentially Impact Surface Flows

The Hood Canal watershed has seen an 8.4% growth in the number of water wells from 2015-2019. Of these 359 new wells, 154 (43%) are within one mile of the Hood Canal shoreline.

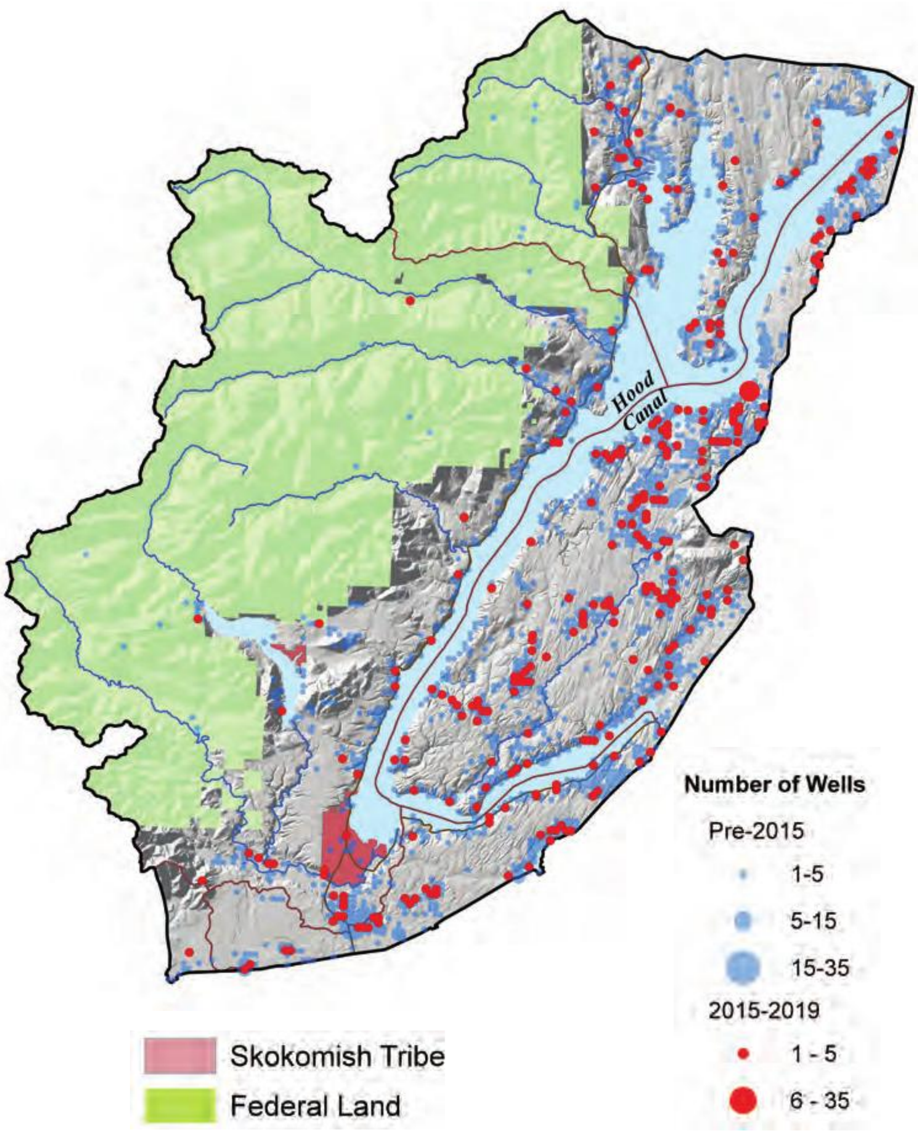
Hood Canal has experienced substantial population growth, especially along the shoreline over the past several decades,[1] bringing an increased demand for water.

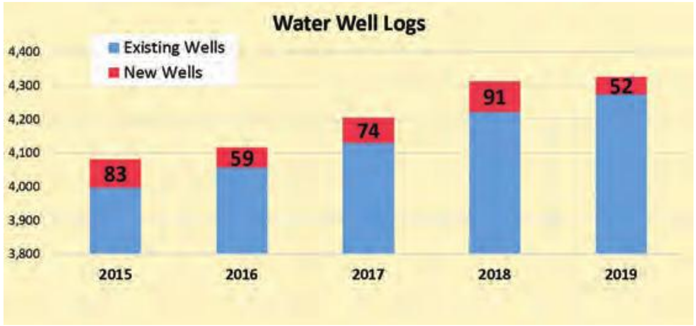
From 2015-2019, the Hood Canal watershed saw 359 new water wells. This is a 29% increase from the 2010-2014 time period. It is well established that pumping groundwater, including unregulated water withdrawals by "permit-exempt" wells, reduces streamflow. Rural development using permit-exempt wells has been happening at an accelerating pace, taking more and more water from streams that support endangered salmon. Following the 2016 *Whatcom County v. Hirst* decision, the Washington State Legislature recently passed the Streamflow Restoration Act in January 2018, known as a "fix" to the Hirst decision.

While this bill is styled as a "fix," its real effect will be to allow more and more unmitigated water use. The results are predictable: lower streamflows, higher water temperatures and fewer fish in the rivers.[2]

Of the 359 new water wells, 154 (43%) fall within one mile of the Hood Canal shoreline. Saltwater intrusion threatens drinking water along the shores of Hood Canal, especially in the South Shore sub-basin. Saltwater intrusion is the seeping of saltwater into freshwater aquifers. Areas where freshwater aquifers are at or below the water level of Hood Canal – and where groundwater-pumping rates are high – are particularly susceptible to saltwater intrusion.[3]

The Detailed Implementation Plan for the Skokomish-Dosewallips Watershed recommends that the Department of Ecology, Mason and Jefferson counties, and water purveyors encourage the development and/or consolidation of small public water systems over the proliferation of exempt wells in areas: a) where appropriate zoning exists; b) where growth is anticipated by county planning efforts; and c) when it is fiscally feasible.[4] WRIA 16 is not regulated by an instream flow rule but permit-exempt wells are regulated by RCW 90.44.050.





Map Data Sources: SSHAIP 2004,[5] USGS 2018,[6] WADNR 2016,[7] WADOT 2018b,[8] WAECY 2000,[9] WAECY 2018b,[10] WAECY 2019[11]

SKOKOMISH TRIBE

Forest Cover Conditions Improve

From 2011 to 2016, the Hood Canal watershed saw an increase of 4,396 acres of trees (6.9 sq mi.), a .9 % gain. Forest Practice Applications are still occurring but the regrowth of forests is surpassing the amount of timber harvested.[1]

Healthy forests provide for healthy watersheds. Through photosynthesis, trees remove carbon dioxide from the air, produce oxygen, and store carbon as wood. Forests preserve water, soils, plants and wildlife. Their destruction aggravates droughts, soil erosion, and pollution of watercourses, causes extensive flooding, and increases pest populations due to the ecological imbalance. Forests are natural dams that catch rainwater in their canopies and in leaves and litter on the forest floor, retaining and purifying rainwater. Forest logging allows rapid run-off and destroys the ability of the soil to absorb water.[2]

From 2011-2016, the Hood Canal watershed saw an increase in forest cover (4,396 acres). Forest Practice Applications are still occurring but forest regrowth is surpassing the amount of timber harvested.

The Skokomish Tribe is taking steps to maintain and protect its forestlands. The tribe has earned the Forest Stewardship Council® certification (FSC®) through the Northwest Natural Resource Group (NNRG) for its 2,086-acre forest at the south end of Hood Canal in Mason County.

Forest Stewardship Council® (FSC®) certification is a market-based, voluntary system for ensuring that wood products come from well-managed forests. This makes the Skokomish Tribe the first tribe in Washington State to gain certification of a well-managed forest.[3]

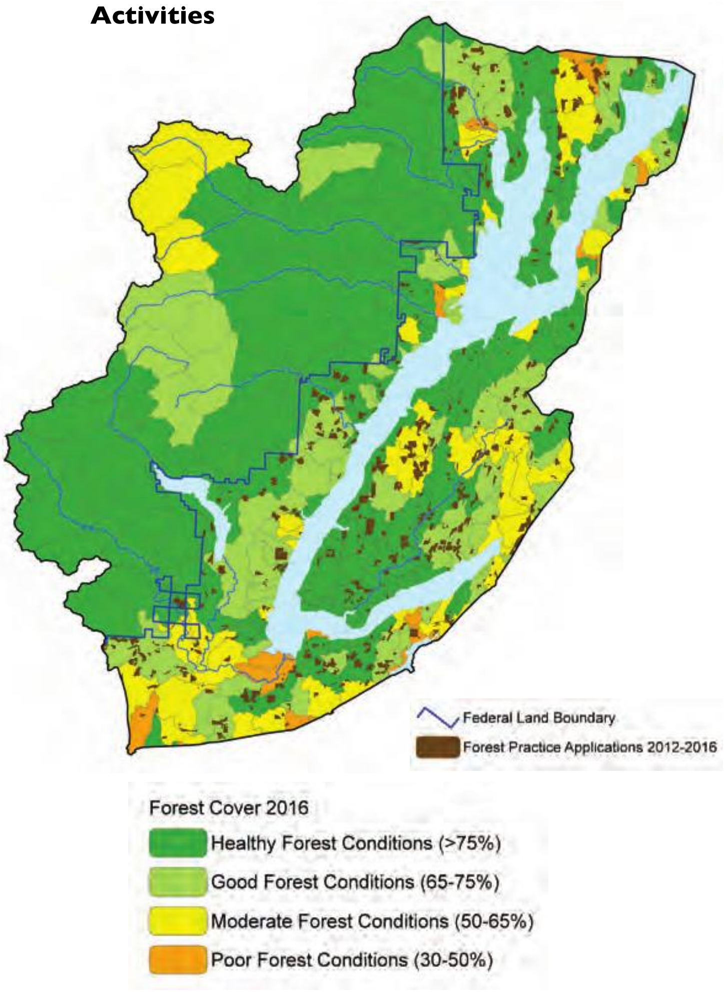
The Skokomish Tribe has joined three other tribes in the United States in maintaining FSC® certification: the Coquille Tribe in Oregon, the Hoopa Valley Tribal Council in California, and the Menominee in Wisconsin. The Skokomish Tribe hired NNRG to help steward its forests in 2014 and to develop a management plan for its forest holdings. Those forests — including more than 1,500 acres on the reservation and about 500 acres at Skokomish Park by the shores of Lake Cushman — hold great potential for ecological forestry after maturing largely on their own for the last 80 to 100 years. The forests have become more structurally complex and thus able to provide habitat for a wider diversity of creatures.[4]

The Skokomish Tribe's forests present a fantastic opportunity for the opportunity to manage for multiple ages and species of trees. By thinning the mature Douglas fir that is dominant across the forest, they can make room for other tree species that are beginning to naturally emerge in the understory, such as maple, cedar and even new generations of Douglas fir.[5]

The tribe saw active forest stewardship as a promising tool to simultaneously support the health of the forest for cultural resources and biodiversity, as well as derive sustainable income from the land.

"Recognizing that many tribal members may have concerns about active forest management practices," says a recent article in the tribe's monthly newspaper, The Sounder, "the Tribe wanted to have a third-party review of its plans and management operations to assure the community that forest practices would meet the highest environmental standards."[6]

Timber Harvest Activities



Forest Practice Applications near the Skokomish River show forest cover loss.

Map Data Sources: NOAA 2016,[7] USFWS 2018,[8] WADNR 2016,[9] WAECY 2011d,[10] WAECY 2018b,[11]

Taking Actions on Water Quality to Protect Shellfish

The shellfish growing areas in the Hood Canal watershed saw an overall net gain of 34 acres opened for harvesting from 2014-2018.[1] The Hood Canal Regional Pollution Identification and Correction Program partners are working hard to protect public health and shellfish growing areas, restore water quality by correcting fecal pollution sources, and restoring and protecting Hood Canal shellfish habitat.[2]

The Hood Canal has great cultural, economic and subsistence value to Washington state residents and tribes. The Hood Canal region is home to more than 29,000 on-site sewage systems (OSS), which can fail as they age, contributing bacterial pollution to Hood Canal streams and beaches. Many OSS are in close proximity to water bodies.[3]

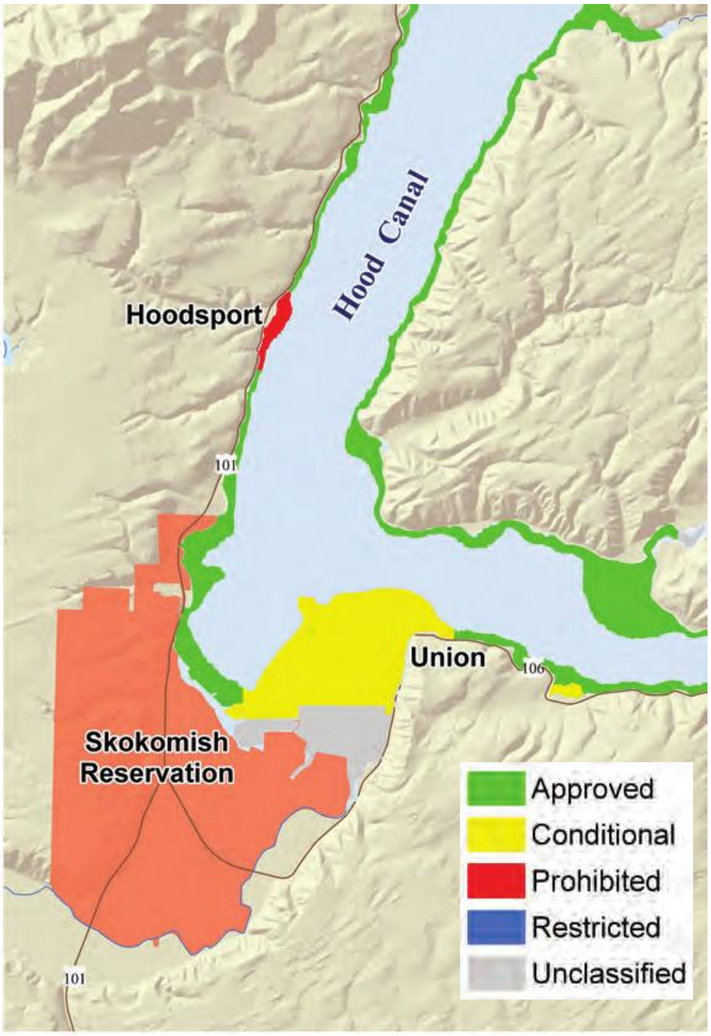
The Hood Canal Regional Pollution Identification and Correction (HCRPIC) Program partners include Jefferson, Kitsap, and Mason counties, the Port Gamble S'Klallam and Skokomish tribes, the Hood Canal Salmon Enhancement Group, Jefferson, Kitsap and Mason conservation districts, and the Hood Canal Coordinating Council (HCCC).

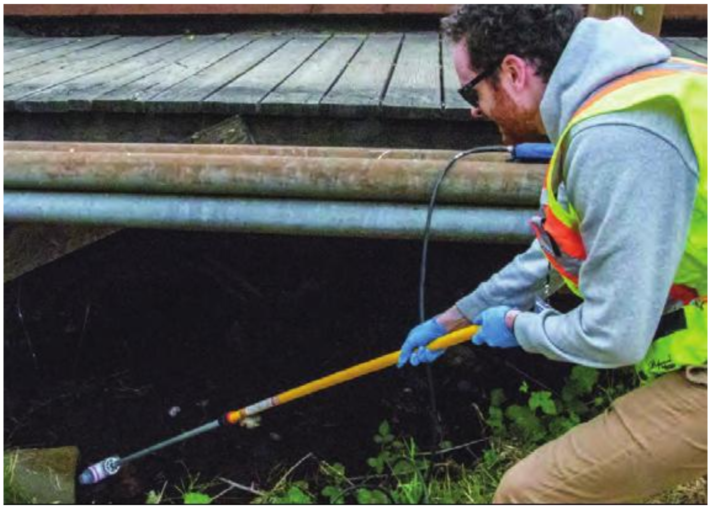
Mason County's Health Department (MCHD) has focused its efforts in high priority shellfish closure areas like Big Bend, Union and the Annas Bay threatened area, plus the rich shellfish resource in Hoodsport. The Hoodsport area was selected based on the Skokomish Tribe's interest in shellfish resources in the area.

The HCRPIC field work resulted in WSDOH upgrading individual shoreline parcels at the following locations: Upgrade of one closed parcel in Lilliwaup, and MCHD reported the corrections and post-corrective monitoring of two OSS failures in the Big Bend shellfish bed closure area to WSDOH.[4]

The Skokomish Tribe is making sure that the water emptying into Hood Canal is safe for tribal members and recreational users. For years, the tribe has been testing for the presence of E. coli and fecal coliform in streams that empty into the Skokomish River and Hood Canal. Nonpoint source pollution is the primary source, typically coming from failing septic systems, runoff from agriculture, pet waste, and even human waste. Polluted water can contaminate shellfish beds along Hood Canal beaches, impeding tribal harvest opportunities, said Julian Sammons, the tribe's water quality specialist.[5]

(Continued next page)





Julian Sammons, the tribe's water quality specialist, takes a sample from a creek in Hoodsport that drains into Hood Canal. The sample will be tested for E. coli and fecal coliform.

Tiffany Royal, NWIFC

Map Data Sources: SSHIAP 2004,[7] WAECY 2018b,[8] WADOT 2018b,[9] WADOT 2018a,[10] WADOH 2018[11]

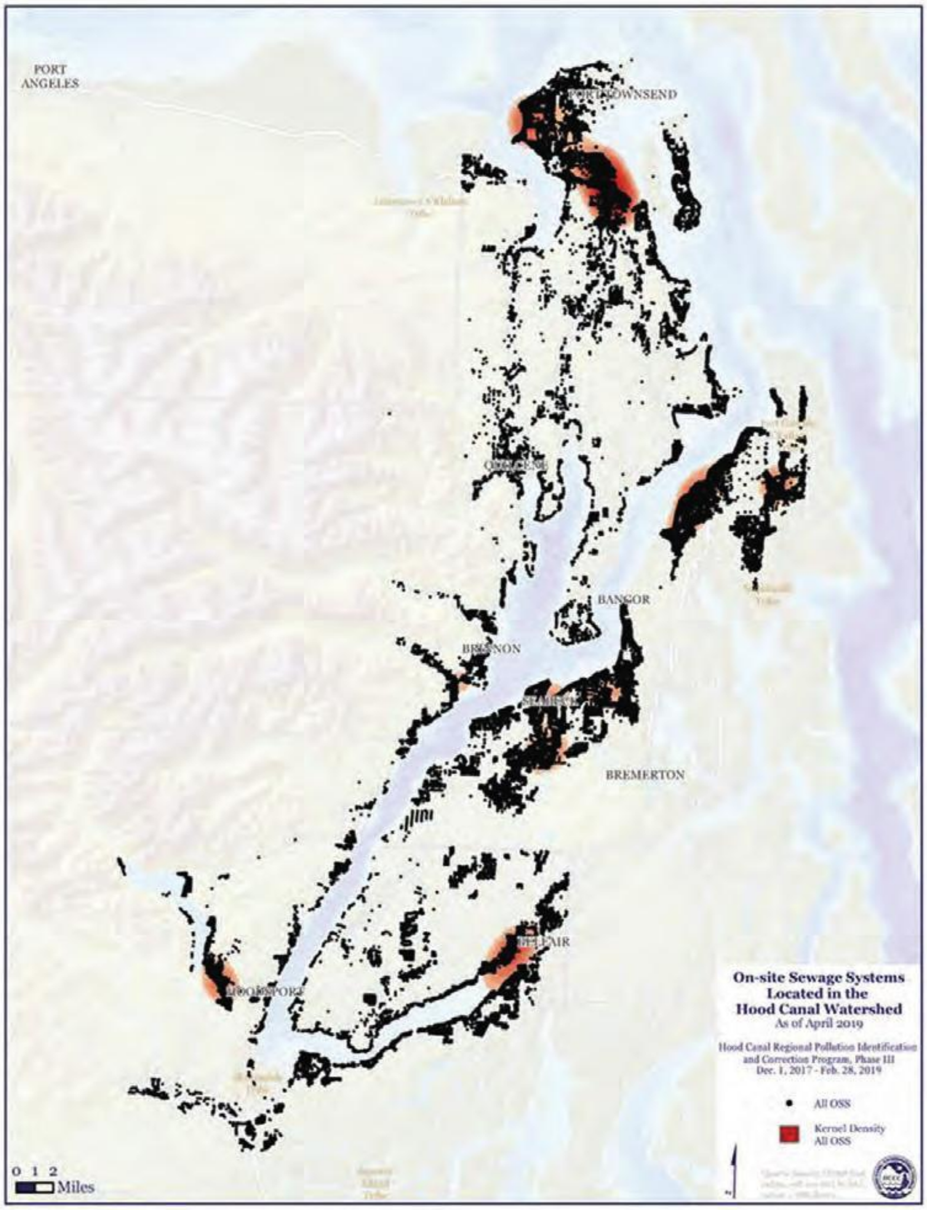
SKOKOMISH TRIBE

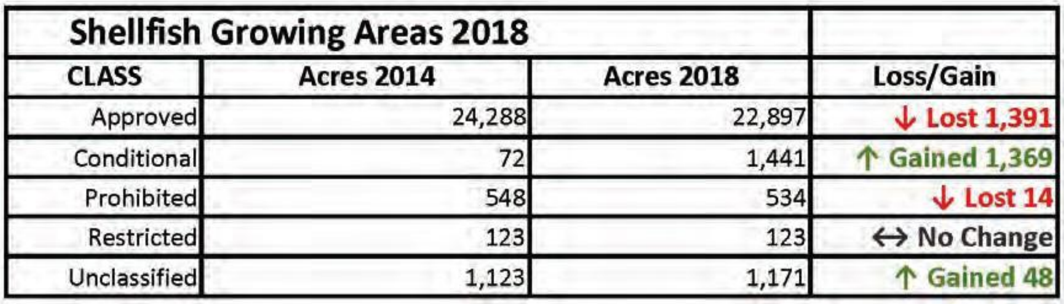
(Continued from previous page)

Sammons samples numerous locations twice a month, year-round, on the Skokomish Reservation, in the Skokomish River Valley and in Hoodsport. At each location, he collects a sample and takes measurements such as temperature, dissolved oxygen and pH. The samples are sent to the water quality lab at the Thurston County Public Health Department. The results are evaluated to assess the severity of pollution and potential cause, he said.

"High levels of pollution during a long dry period with no rain indicates a source other than surface runoff, such as a failing septic," he said. "High levels after the first rain after a long dry period are a strong indicator of surface runoff pollution, which happens almost every time we have an event like that. There is a significant amount of runoff pollution from the land use practices in Skokomish Valley."

The tribe's natural resources department works with local and state governments to investigate these issues when they are outside of the reservation boundaries, which is often the case, Sammons said.[6]





Shellfish Growing Areas 2018			
CLASS	Acres 2014	Acres 2018	Loss/Gain
Approved	24,288	22,897	↓ Lost 1,391
Conditional	72	1,441	↑ Gained 1,369
Prohibited	548	534	↓ Lost 14
Restricted	123	123	↔ No Change
Unclassified	1,123	1,171	↑ Gained 48

Agricultural Land Riparian Management – USACE GI Proving to be Successful

Riparian plantings continue following directions from the GI. The Skokomish Tribe is working with their partner organizations, Mason County, Mason Conservation District and the U.S. Army Corps of Engineers, to help support the riparian protection and restoration needs of the Skokomish watershed.

The Protection and Restoration of Skokomish River Valley Riparian Areas project primarily focuses on targeted outreach to landowners in a high-priority reach of the Skokomish River identified by the U.S. Army Corps of Engineers through the General Investigation (GI). Outreach efforts will lead to development of a reach scale plan to acquire property to support five large scale riparian/floodplain restoration actions developed through the GI. The plan also will explore options for additional riparian restoration actions not included in the GI.[2]

The Skokomish River ecosystem, including critical salmon habitat, in the Skokomish Valley has been degrading for many years. For this reason, Mason County and the Skokomish Tribe requested the USACE carry out a GI of the Skokomish ecosystem.

This investigation, completed in April 2015, determined the Skokomish ecosystem will continue to degrade unless restoration actions are taken, and that it is in the national interest for the USACE to develop and implement five ecosystem restoration projects. It is the responsibility of local partners to secure all real estate necessary for the implementation of these projects.

In 2016, the Mason Conservation District received a grant from the Washington State Department of Ecology to develop a reach scale plan, in partnership with Mason County and the tribe, which identifies riparian protection and restoration needs to support the five federal projects.[3]

Riparian habitats are the most fundamental building block for protecting aquatic freshwater and marine ecosystems and the species that depend on them. Virtually all watershed assessments and species recovery plans from landscape to reach to watershed scales call for improving riparian habitat quality/quantity and reducing their increasing fragmentation.[4]

Mason County

22.73 acres planted in Mason County, near the Skokomish River and Purdy Creek. Expected project end date is October 2020. (Habitat Work Schedule *hws.ekosystem.us/project/170/19135*)

Trees intercept stormwater and can retain a significant amount of captured water on their leaves and branches, allowing for evaporation and dissipation of runoff energy. Their root structures absorb and uptake runoff and associated pollutants. The shade provided by trees keeps the ground under the trees cooler, thereby reducing the amount of heat gained in runoff as it flows over the surface and into the storm drain. In turn, this helps keep stream temperatures cool and healthy for fish and other aquatic life.[1]

Map Data Sources: WAECY 2016,[4] NAIP 2017[5]

Skokomish Tribe

Skokomish River Estuary Restoration Helps Salmon and Steelhead Return Home

In the Puget Sound region, reopening abandoned agricultural land back to nature will allow young salmon, steelhead and other fish species room to access their historical habitats. For decades, human activity blocked salmon, steelhead and other species from accessing their habitat in the Skokomish River estuary. In recent years, a collaborative partnership has been working to restore this vital habitat. Today, the Skokomish is the most complete estuary restoration project in Puget Sound and fish are taking notice. In 2018, spring chinook salmon returned to the watershed to spawn for the first time in nearly a century, after having been reintroduced to the river by the Skokomish Tribe in 2016.[1]

As it weaves through western Washington, the Skokomish River flows from Olympic National Park, through Olympic National Forest, and past miles of agricultural landscape before meeting Hood Canal, an arm of Puget Sound. At its mouth, the river forms a nearly 1,000-acre estuary that serves as an important nursery for young fish to eat, grow and take refuge.[2]

Within the first year of monitoring, tribal biologists and technicians recorded 20 fish species using the estuary's restored channels, including chinook and chum salmon. In addition to fish, vegetation surveys, water quality testing, and recording bird and wildlife sightings are completed in order to continue to track the estuary's journey toward recovery.[3]

After restoring tidal flow to the Skokomish River estuary, natural channels began forming again.

The Skokomish estuary serves as important nursery habitat for juvenile chinook salmon, among other species.

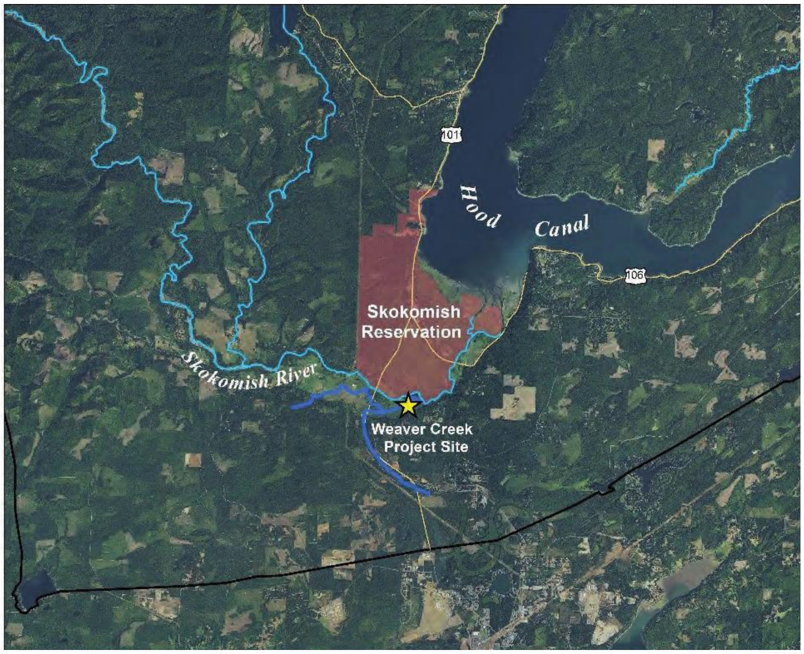
NOAA Fisheries (2)

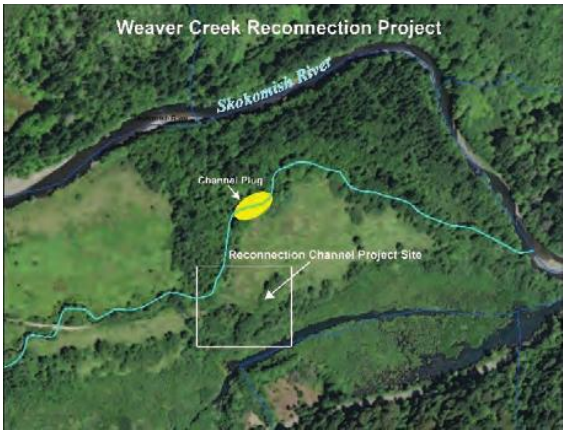
SKOKOMISH TRIBE

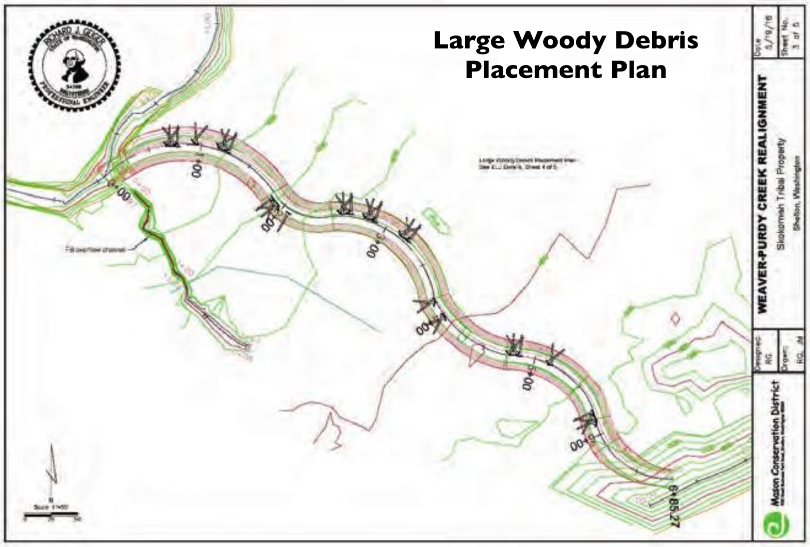
Weaver Creek Reconnection Project – Reconnecting Weaver Creek to Purdy Creek

Manmade alterations to Weaver Creek and streambed aggradation in the Skokomish River created a sediment plug in the lower reaches of Weaver Creek.[1] The sediment plug has resulted in stagnant flows in lower Weaver Creek, creating water quality conditions that are harmful and sometimes lethal to juvenile and adult salmon. The objective of this project is to restore a free-flowing outlet for Weaver Creek that will alleviate the degraded water quality conditions that currently characterize this reach.[2]

The instream and riparian habitat of the newly created reconnection channel will be enhanced by installing 25 habitat logs along the meander beds of the channel and creating a 100-foot native riparian buffer on both banks, totaling 4 acres. The Skokomish Tribe will continue to monitor dissolved oxygen levels in the project area to ensure that the post-restoration water quality conditions reflect restoration goals and objectives.[3]






Large Woody Debris Placement Plan

Map Data Sources: NAIP 2013,[4] NAIP 2017,[5] WADOT 2018a,[6] WADOT 2018b,[7] WAECY 2018b[8]

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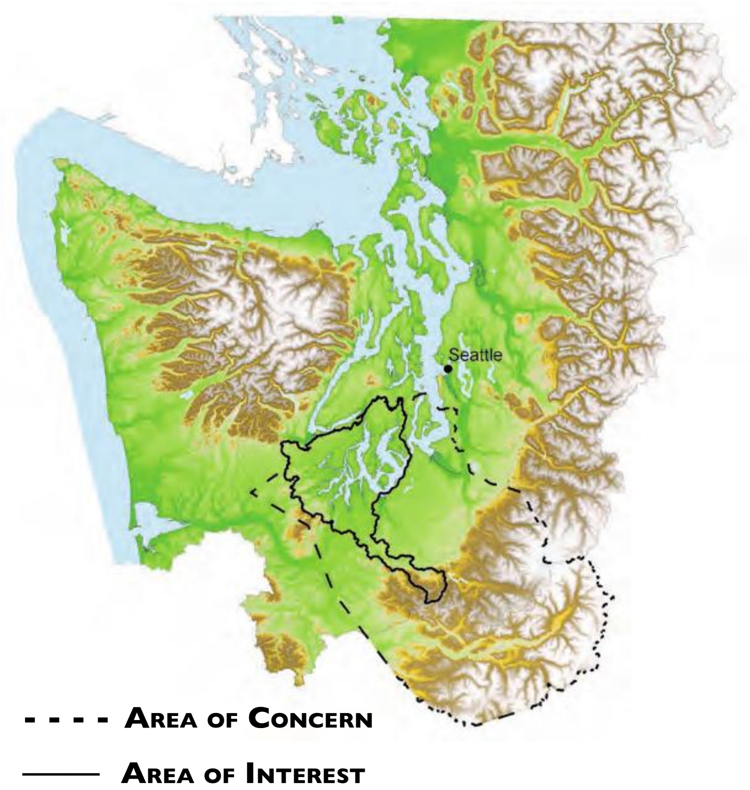
2020 State of Our Watersheds Report
Headwaters of the Salish Sea

> *We are the People of the Water. The Squaxin Island Tribe and its partners work every day to protect and restore the natural resources of the South Salish Sea. I have lived on its shores my entire life, eating of its bounty every day, and heard the stories passed down for generations. In the words of a great friend: "Our ancestors would say, 'When the tide is out the table is set.' The table is dirty right now." We need to educate people now to do the right thing and continue to collaborate on our shared goal of sustaining fisheries and a healthy environment for all peoples. Time is running out.*

ANDY WHITENER
NATURAL RESOURCES DIRECTOR



Squaxin Island Tribe

We are the *Noo-Seh-Chatl* of Henderson Inlet, *Steh Chass* of Budd Inlet, *Squi-Aitl* of Eld Inlet, *Sawamish/T'Peeksin* of Totten Inlet, *Sa-Heh-Wa-Mish* of Hammersley Inlet, *Squawksin* of Case Inlet, and *S'Hotle-Ma-Mish* of Carr Inlet.

The ancestral lands ceded to the federal government in the 1854 Treaty of Medicine Creek included 4,000 square miles. Only one small island, 4.5 miles long and .5 mile wide, was reserved as the main area for all of our people to live.

Our people gradually left the island to take up permanent residence near their original homes. Although there are no year-round residents on Squaxin Island today, it is looked upon as the bond that unites our past, present and future generations. Squaxin Island is used for fishing, hunting, shellfish gathering, camping and other activities.

Tribal headquarters are now located in Kamilche, between Little Skookum and Totten inlets, where hundreds of acres of land have been purchased and a thriving community has been established.

Squaxin Island Tribe

Headwaters of the Salish Sea

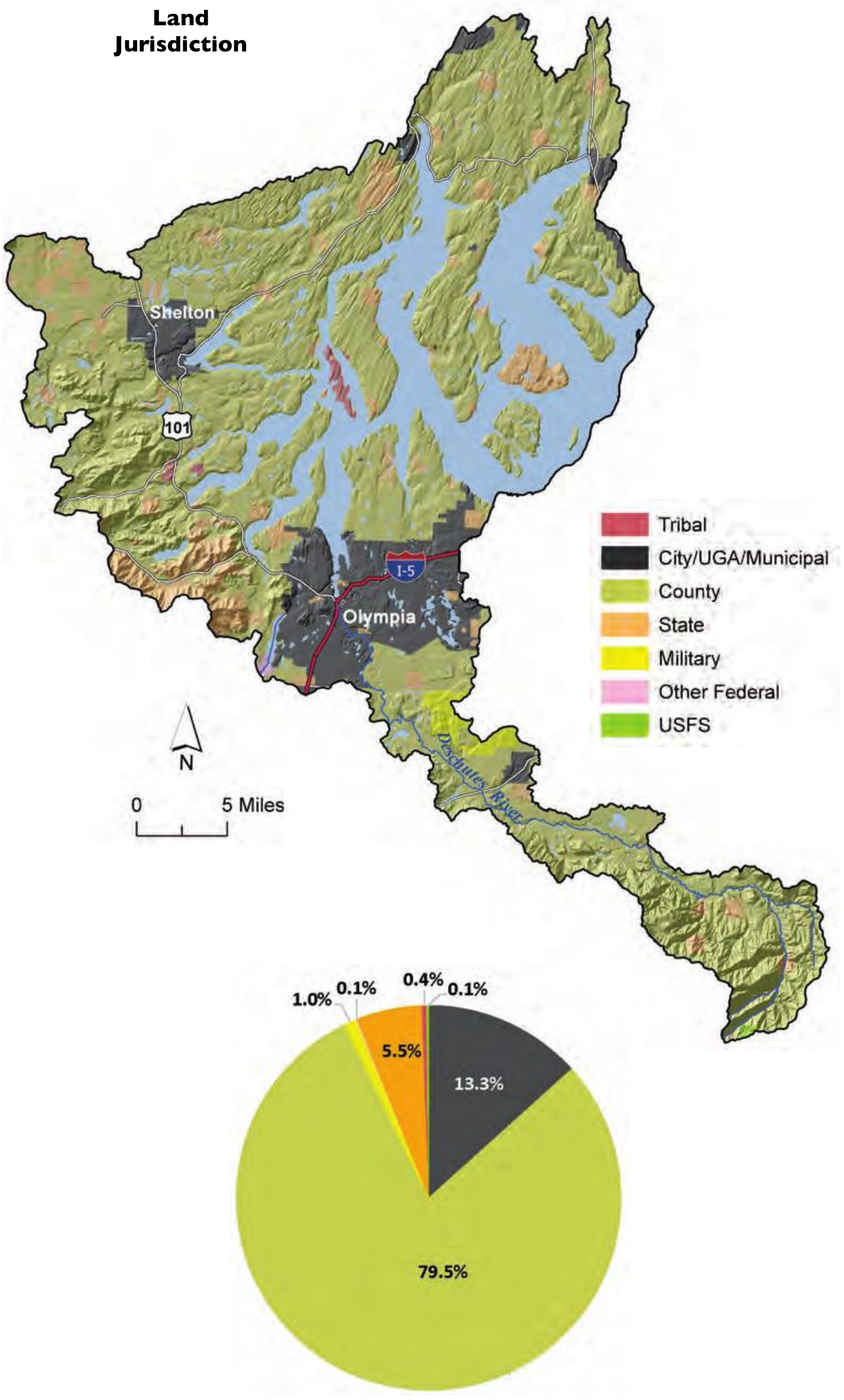
The Squaxin Island Tribe's Area of Focus is the headwaters of the Salish Sea, which includes the marine waters south of the Tacoma Narrows and all freshwater rivers and streams flowing into it.

The topography is generally low relief and composed of glacial till and outwash deposits from the Vashon Stade, which ended about 11,000 years ago. This geology has resulted in a landscape abundant in low gradient streams with many lakes and wetlands, especially in the headwaters. Nearer the marine waters, these independent streams typically cut down several aquifers in a "canyon reach" where there is significant influx of groundwater resulting in a substantial downstream cooling of water temperatures, especially notable in the summer.

The independent streams are well suited for coho, chum and coastal cutthroat, but in recent memory anadromous salmonids could not pass Tumwater Falls at the lower end of the Deschutes River. In 1952, a fish ladder was installed to allow fish passage, and a run of coho has become naturalized, although recent numbers are dwindling.[1]

The stream deltas empty into numerous biologically productive inlets that provide a diversity of estuarine and marine habitats for juvenile and migrating salmonids. A tremendous amount of marine shoreline and diversity of habitats support rearing and migrating salmonids in the region. Smolts from elsewhere in the Salish Sea, like the Puyallup River, frequently visit South Sound before heading to the open ocean.

Since the arrival of Euro-Americans, the late-serial coniferous forests that once dominated the region have been logged and the landscape is today primarily early and mid-serial forest. Predominant land use within the basin is gradually shifting from being undeveloped or under commercial timber production to small-scale agricultural, residential and urban uses. The major threats to salmon habitat include land-use impacts on hydrology, instream and riparian habitat, and the marine shoreline.



Map Data Sources: SSHIAP 2004,[2] WADNR 2016,[4] WADNR 2018,[5] WADOT 2018,[6] WAECY 1994,[7] WAECY 2018a,[8] WAECY 2018b,[9] USFWS 2018,[10] UW 2004[12]

Chapter Summary

We are the *Noo-Seh-Chatl* of Henderson Inlet, *Steh Chass* of Budd Inlet, *Squi-Aitl* of Eld Inlet, *Sawamish/T'Peeksin* of Totten Inlet, *Sa-Heh-Wa-Mish* of Hammersley Inlet, *Squawksin* of Case Inlet, and *S'Hotle-Ma-Mish* of Carr Inlet. The Squaxin Island Tribe are descendants of the maritime people who lived and prospered along the shores of the southernmost inlets of the Salish Sea for untold centuries. Because of our strong cultural connection with the water, we are also known as the People of the Water. The Squaxin Island Tribe are leaders in the region's salmon recovery effort. No other people know these watersheds as well as the tribes and none has a greater stake in their future. The tribes believe that if salmon are to survive, real gains in habitat protection and restoration must be achieved.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org.*

For this report, the Squaxin Island Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Nearshore Marine Shoreline Modifications: Vital Signs Indicator for Puget Sound

From 2015-2018 in Pierce, Mason and Thurston counties, 167 Hydraulic Project Approvals were issued, resulting in 4,084 feet of new bulkhead; 2,779 feet of bulkhead were removed for a gain of 1,305 feet of additional bulkhead. Thirty two and a half percent of the shoreline in the Squaxin AOI remains modified.

Urban Sprawl Continues while Forest Cover Shows Slight Improvement

The Squaxin Area of Interest showed a slight increase in forest cover (2.3%) from 2011-2016, and a gain in developed land (2.2%). Since 1992, forest cover lost stands at 11.4% and developed land has grown by 19.7% in the Squaxin Area of Interest.

Impervious Surface Increases Slightly Outside Cities & UGAs

From 2011-2016 there was an increase of 151 acres (.3%) of impervious surface outside of cities and Urban Growth Areas in the Squaxin Area of Focus. Impervious surfaces increase runoff of contaminants like fertilizers and pesticides to rivers, lakes and the ocean, reducing the amount and quality of water that is available for people, aquatic life and wildlife.

Shellfish Growing Areas Continue to Show Slight Improvement

From 2014-2018, there were an additional 291 acres of shellfish growing areas within the Squaxin Island Area of Interest made available for harvesting. The Squaxin Island Tribe worked cooperatively with neighbors and government partners to improve water quality to open shellfish harvest near Church Point outside Shelton after a three-year closure.

Restoration Efforts to Restore and Protect Habitat Continue

Beginning in the fall of 2017, Shelton's downtown waterfront will become the first industrial harbor in Puget Sound restored to protect and enhance salmon. The Squaxin Island Tribe, South Puget Sound Salmon Enhancement Group, Mason Conservation District, Port of Shelton, Capitol Land Trust, Sierra Pacific and Simpson Timber Co. are working together to restore salmon habitat in the town of Shelton.

Low Streamflow and Elevated Water Temperatures

From 2015-2019 there were 364 new water wells in WRIA 14. This is up from the 259 water wells in the 2010-2014 period. Ten streams in WRIA 14 are currently listed as temperature impaired (exceeding 16 C 7-Day Average Daily Max.) by the Washington State Department of Ecology.

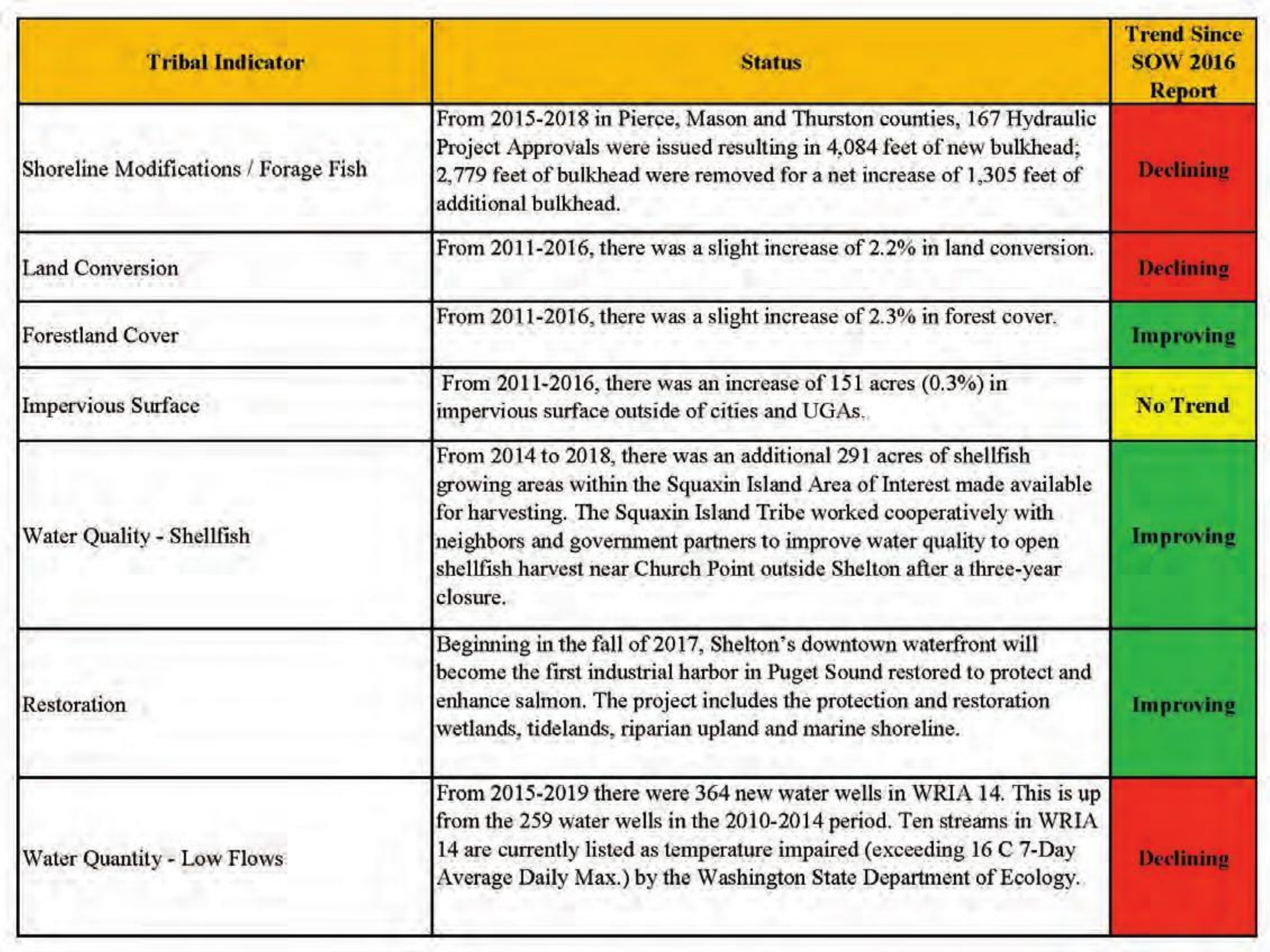
Conclusion

During the past five years, the Squaxin Island watersheds have seen a few habitat recovery successes with the increase in forest cover, opening of shellfish growing areas due to the improvement to the local water quality and restoration projects continuing. However, there was a net increase of 1,305 feet of additional bulkhead and an increase in land conversion. From 2011-2016 there was an increase of 151 acres (.3%) of impervious surface outside of cities and Urban Growth Areas in the Squaxin Area of Interest. This is only a slight increase but the concern is that the continued increase in population will make the increase in impervious surface and the runoff that impacts our waterways inevitable. Even though restoration is occurring, it is not enough to keep up with the impacts of a growing population and their land-use decisions. Land use and water laws that are in place and meant to protect critical areas and fish habitat need to be implemented. Implementation includes education and voluntary actions, but it also needs to include enforcement when those laws are broken. The future of treaty rights in the Squaxin Island watersheds depend on it.

Recovery Efforts Lagging

At the 15-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Squaxin Island Tribe's area shows that priority issues continue to be degradation of water quantity and quality, degradation of floodplain and riparian processes, and degradation of marine shoreline habitat conditions. In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trend for these key environmental indicators since the 2016 State of Our Watersheds Report shows an upgrade in shellfish growing areas but a steady loss in habitat status:



Tribal Indicator	Status	Trend Since SOW 2016 Report
Shoreline Modifications / Forage Fish	From 2015-2018 in Pierce, Mason and Thurston counties, 167 Hydraulic Project Approvals were issued resulting in 4,084 feet of new bulkhead; 2,779 feet of bulkhead were removed for a net increase of 1,305 feet of additional bulkhead.	Declining
Land Conversion	From 2011-2016, there was a slight increase of 2.2% in land conversion.	Declining
Forestland Cover	From 2011-2016, there was a slight increase of 2.3% in forest cover.	Improving
Impervious Surface	From 2011-2016, there was an increase of 151 acres (0.3%) in impervious surface outside of cities and UGAs.	No Trend
Water Quality - Shellfish	From 2014 to 2018, there was an additional 291 acres of shellfish growing areas within the Squaxin Island Area of Interest made available for harvesting. The Squaxin Island Tribe worked cooperatively with neighbors and government partners to improve water quality to open shellfish harvest near Church Point outside Shelton after a three-year closure.	Improving
Restoration	Beginning in the fall of 2017, Shelton's downtown waterfront will become the first industrial harbor in Puget Sound restored to protect and enhance salmon. The project includes the protection and restoration wetlands, tidelands, riparian upland and marine shoreline.	Improving
Water Quantity - Low Flows	From 2015-2019 there were 364 new water wells in WRIA 14. This is up from the 259 water wells in the 2010-2014 period. Ten streams in WRIA 14 are currently listed as temperature impaired (exceeding 16 C 7-Day Average Daily Max.) by the Washington State Department of Ecology.	Declining

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

Using sound science, the Squaxin Island Tribe will advocate for habitat restoration, better resource management, and land conservation and preservation. We will push for cleanup of toxins in the environment, so that all people can consume fish and shellfish without threats to their health. We will advocate for the highest standards in wastewater management. We will advocate for timber harvest practices that retain the function of riparian forests.

We will seek the removal of bulkheads on shorelines and blocking culverts in streams in order to provide sediment supply and fish passage. And we will advocate for land-use planning to minimize impact of development on groundwater and surface water resources. Climate change and sea level rise will present new challenges to our efforts.

Squaxin Island Tribe

Marine Shoreline Modifications Continue to Increase

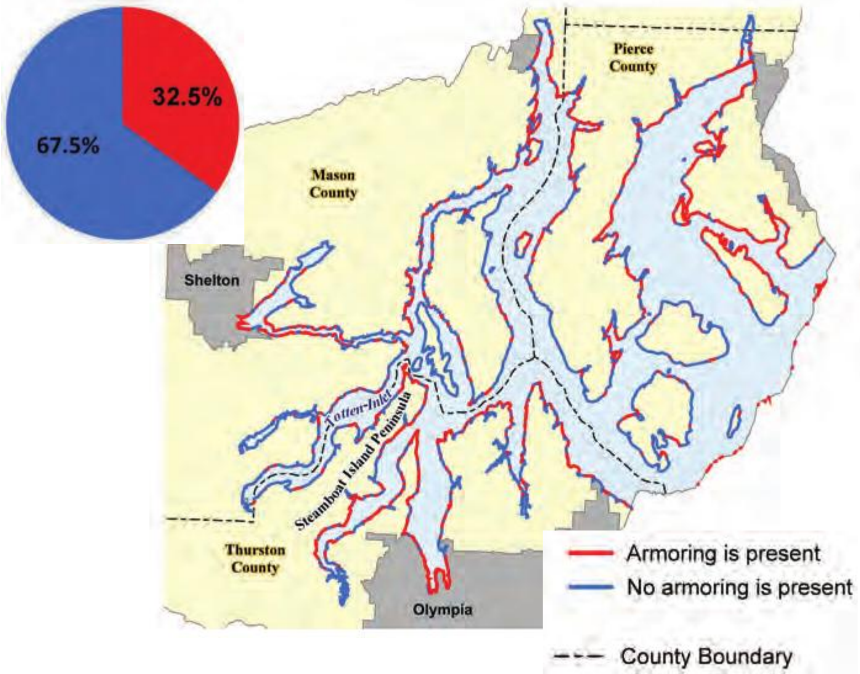
From 2015-2018, 167 Hydraulic Project Approvals were issued in Pierce, Mason and Thurston counties, resulting in 4,084 feet of new bulkhead; 2,779 feet of bulkhead were removed for a net increase of 1,305 feet of additional bulkhead.[1]

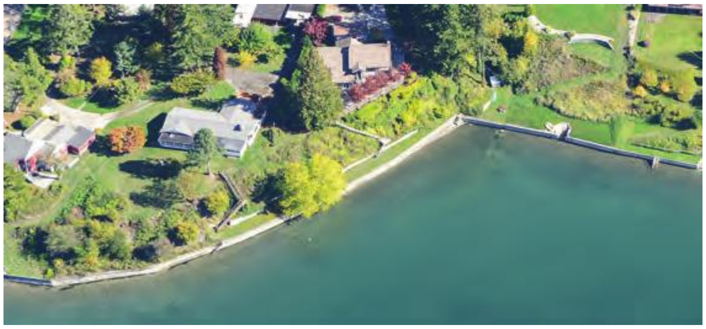
Puget Sound's 2,500 miles of shoreline are among the most valuable and fragile of our natural resources. A dynamic area where land and marine ecosystems meet, the shoreline is constantly changing with the action of wind, waves, tides and erosion. These forces are also the reason why people often build bulkheads or other structures to harden the shoreline. Shoreline armoring, the practice of constructing bulkheads (also known as seawalls) and rock revetments, disrupts the natural process of erosion, which supplies much of the sand and gravel that forms and maintains our beaches. Erosion also creates habitat for herring, surf smelt, juvenile salmon and many other species in Puget Sound.[2]

Shoreline armoring is one of the "vital signs indicators" and a priority focus area for the Puget Sound Partnership's 2018 Action Agenda. The Shoreline Armoring Vital Sign indicator tracks changes in the total amount of shoreline armor in the nearshore, marine environment. Preventing new armor and restoring natural shorelines through armor removal is a priority to sustain the physical processes that sustain shoreline structure and function. Protection and restoration of feeder bluffs are one of the highest priorities due to their important sediment supply role.[3] To meet the Partnership's goal, the total amount of armoring removed must exceed the total amount of armoring constructed during the period from 2011 to 2020.[4]

A challenge for Fish and Wildlife and the Puget Sound Partnership is to account for new armoring built without permits. Limited studies involving shoreline surveys in King, Kitsap and San Juan counties revealed numerous armoring projects completed without approval. Many of the unpermitted projects fail to meet state or local construction standards. Even when permits are obtained, contractors may build structures longer than allowed by the permit. Further studies have revealed that cities and counties generally place a low priority on tracking down shoreline violations and checking on compliance. Many rely on complaints from neighbors. A lack of enforcement was found to encourage further violations.[5]

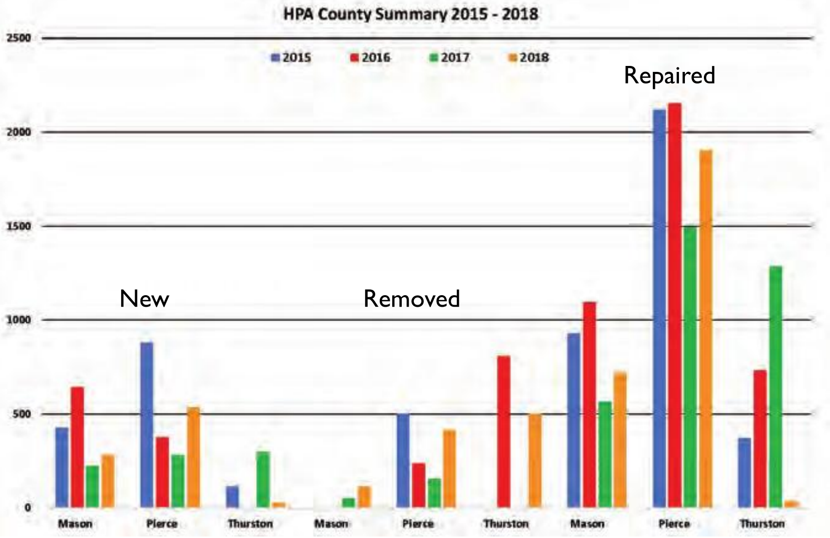
Map Data Sources: CGS 2017,[7] WADOE 2018a,[8] WAECY 2018b,[9] WADNR 2012[10]





WAECY Coastal Atlas

Thirty two and a half percent of the shoreline in the Squaxin AOI remains modified. [6]



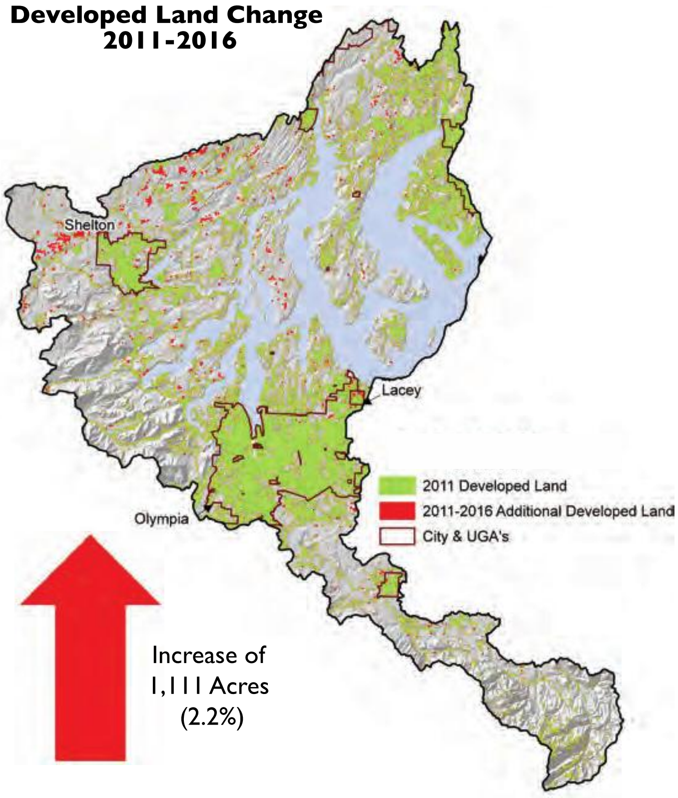
Urban Sprawl Continues while Forest Cover Shows Slight Improvement

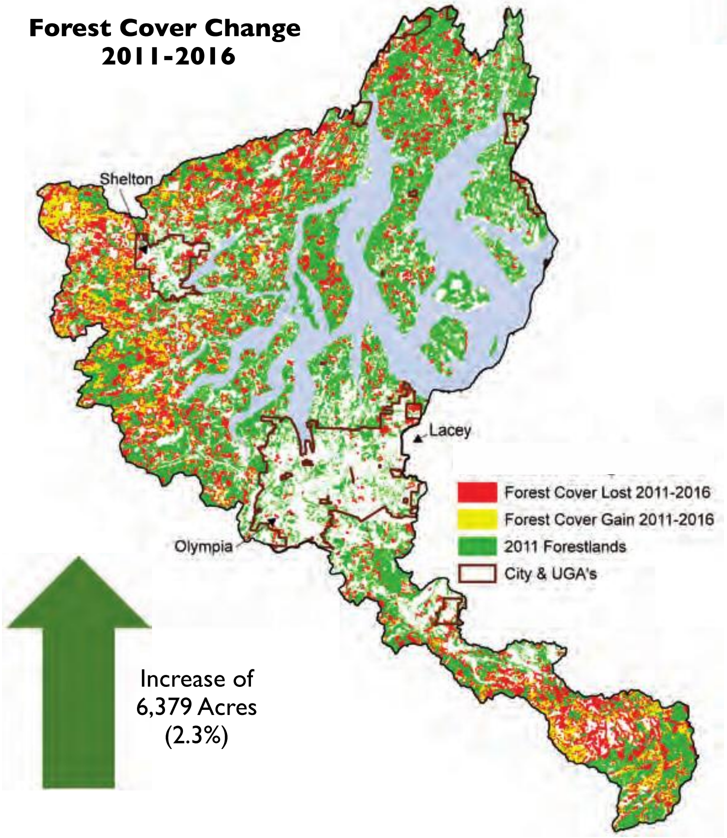
The Squaxin Area of Interest showed a slight increase in forest cover (2.3%) from 2011-2016, and a gain in developed land (2.2%). Since 1992, forest cover lost stands at 11.4% and developed land has grown by 19.7% in the Squaxin Area of Interest.[1,2]

Watershed processes such as water flow are often altered by human activities that change features such as land cover, topography, or soils, which in turn, control the structure and function of habitats. Some common human activities that degrade water flow processes include impervious surfaces, forest clearing, filling and draining/diking wetlands and floodplains, roads and associated storm drainage systems, and removal of riparian vegetation.[3]

Since the early 1990s, effort has been placed on protecting and restoring critical riparian and wetland habitat. By the late 1990s, research in the greater Puget Sound was showing that retention of a wide, nearly continuous riparian buffer of native vegetation was important to maintaining stream biologic integrity (Horner and May, 1999). The importance of upland forest retention was also shown to offer valuable benefits, especially in undeveloped or lightly developed watersheds, and the cumulative effects of basin urbanization on stream health were better understood (Horner and May, 1999; Booth et al., 2002).[4]

Many of Thurston County's well-functioning basins are zoned to remain rural in the future. In some of these basins, there are concerns over loss of forest cover to rural residential development. In the partially rural/partially urban basins that are already impacted by urbanization, there are concerns regarding impacts of continued development.[5]


Developed Land Change 2011-2016

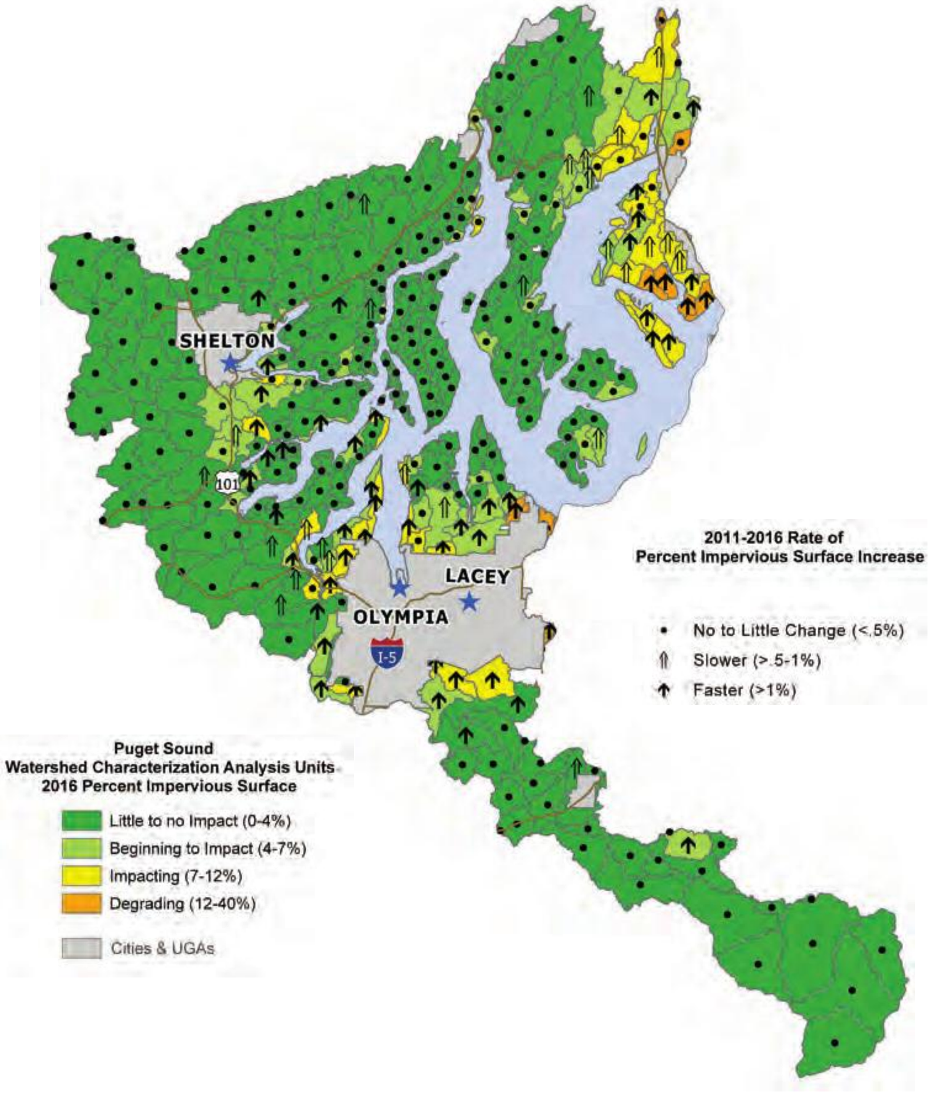

Forest Cover Change 2011-2016

Pink polygons indicate areas of continued forest cover conversion to development from 2011 to 2016 within Thurston County.

Map Data Sources: WAECY 2018a,[6] SSHIAP 2004,[7] WAECY 2018b,[8] NOAA 2011.[9,10]

Impervious Surface Increases Slightly Outside Cities & UGAs

From 2011 to 2016, there was an increase of 151 acres (.3%) of impervious surface outside of cities and Urban Growth Areas in the Squaxin Area of Interest.



Increasing populations and development typically results in loss of vegetation and increased impervious surfaces (pavement and buildings). Increases in impervious surfaces reduce the amount of water that is naturally absorbed into the ground, and reduce the amount of ground water available for drinking.

Impervious surfaces also increase runoff of contaminants like fertilizers and pesticides to rivers, lakes and the ocean, reducing the amount and quality of water that is available for people, aquatic life and wildlife. Threats to water quality challenge our best efforts to reduce impacts of urbanization.[1]

One of the Puget Sound Partnership's Vital Signs recovery targets for 2020 is to focus at least 85% of regional growth within urban areas (and to protect rural areas by limiting rural development to less than 15% of the overall total). As of 2017, the region is meeting this goal, with less than 10% of growth occurring in rural areas over the past few years. However, recently, as growth continues to increase, development is starting to shift to rural areas, and some counties are experiencing rural development rates at or above the Puget Sound target.[2]

In 2016, approximately 4.6% of Thurston County consisted of impervious surfaces. If all the land in Thurston County were developed to the maximum permitted under current zoning and development regulations, the total impervious surface coverage would be 8%.[3]

Watersheds or basins that have an impervious land cover of more than 10% are generally assumed to have degraded water quality. Two watersheds in Thurston County were near or above this level in 2016: Henderson Inlet, with approximately 17.0% impervious surface coverage; and Budd/Deschutes with 9.0%.[4]

Example of the increase of impervious surface just outside of cities and UGA

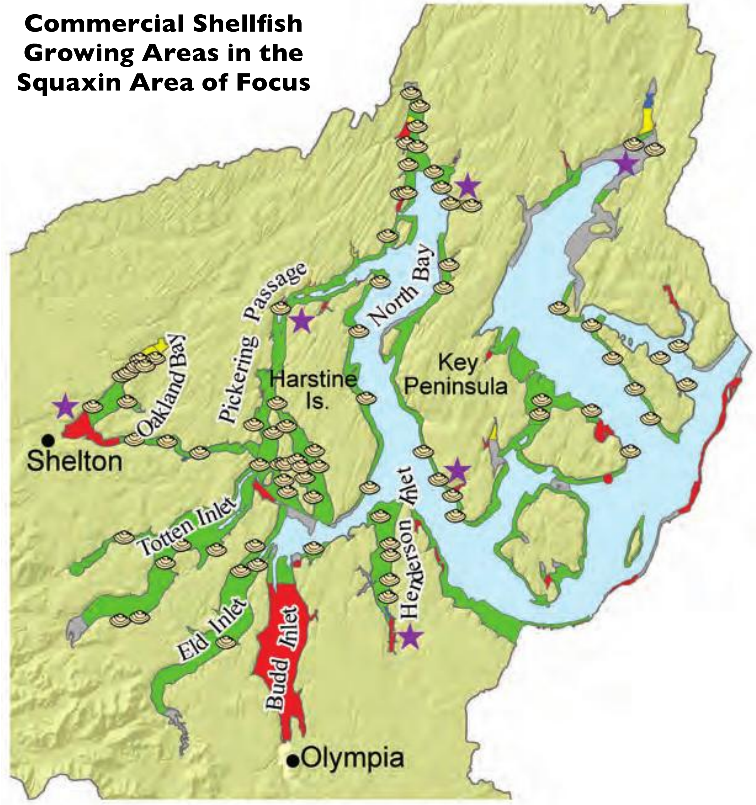
2013 **2017**

Map Data Sources: NLCD 2011,[5] NLCD 2016,[6] WAECY 2018a,[7] WAECY 2018b,[8] WAECY 2011d,[9] NAIP 2013,[10] NAIP 2017[11]

SQUAXIN ISLAND TRIBE

Shellfish Growing Areas Show Improvement

From 2014 to 2018, there were an additional 291 acres of shellfish growing areas within the Squaxin Island Area of Interest made available for harvesting.[1] The Squaxin Island Tribe worked cooperatively with neighbors and government partners to improve water quality to open shellfish harvest near Church Point outside Shelton after a three-year closure.[2]



🟩 Approved
🟨 Conditional
🟥 Prohibited
🟦 Restricted
⬜ Unclassified
⬜ Puget Sound

Tribal Shellfish Harvest Sites (Clams, geoducks and dungeness crab)

★ 2019 Threatened Shellfish Growing Areas (Based on 2018 Water Quality)


NWIFC

Rana Brown, shellfish biologist for the Squaxin Island Tribe, talks to a commercial shellfish grower while surveying the beach that community effort helped reopen by improving water quality.

Shellfish have been a mainstay for the Squaxin Island people for thousands of years. They remain important today for subsistence, economic and ceremonial purposes. As with salmon, the tribe is guaranteed the right to harvest shellfish in the Medicine Creek Treaty.[3] In addition to economic and cultural benefits from harvest, shellfish – whether harvestable or not – provide significant water quality benefits.

There are approximately 40,000 acres of commercial and recreational shellfish beds in South Sound, and nearly 80% of these beds are open for harvest (both approved and conditional). However, pollution from stormwater runoff and failing on-site sewage systems impair marine water quality and can lead to frequent harvest restrictions and closures of shellfish beds.[4]

Shellfish growing areas are monitored for water quality by the Washington State Department of Health (DOH) and classified based on monitoring results. If water quality has improved in a shellfish growing area then it has the potential to be upgraded in classification, allowing for greater accessibility.[5]

The Squaxin Island Tribe worked cooperatively with neighbors and government partners to improve water quality to open shellfish harvest near Church Point outside Shelton after a three-year closure. Clean water is necessary for harvest, and it can be increasingly difficult to maintain water quality as rural populations expand rapidly. The Washington State DOH detected high fecal coliform bacterial counts in shoreline freshwater surveys in 2016. A group effort narrowed down the suspected causes. There was no need for major repairs on septic systems or enforcement action. Over a period, the water quality readings improved and the DOH was satisfied that harvest could again occur on the beach. The first harvest in nearly three years occurred in October 2019.[6]


Squaxin Island Tribe

Shellfish also play a large role in the tribe's economy. Twenty percent of Squaxin tribal members actively harvest shellfish commercially.

Map Data Sources: SSHIAP 2004,[7] Squaxin Island Tribe 2015,[8] WAECY 2018b,[9] WADOH 2018[10]

Restoration Efforts to Restore and Protect Habitat Continue

Sheltonharbor.org

Beginning in the fall of 2017, Shelton's downtown waterfront became the first industrial harbor in Puget Sound restored to protect and enhance salmon. The Squaxin Island Tribe, South Puget Sound Salmon Enhancement Group, Mason Conservation District, Port of Shelton, Capitol Land Trust, Sierra Pacific and Simpson Timber Co. worked together to restore salmon habitat in the town of Shelton.

The first phase of the project was the protection of 14 acres of salmon habitat on Eagle Point. The property includes a 2-acre freshwater wetland, 4 acres of tideland, 8 acres of riparian upland and 1,600 feet of marine shoreline.[1] The next phase of the project will involve the construction of logjams at the mouth of Goldsborough Creek. These log structures are designed to capture sediment, which would correct a massive incising of the creek that began in the 1990s when a ferry dock was removed from the waterfront.[2]

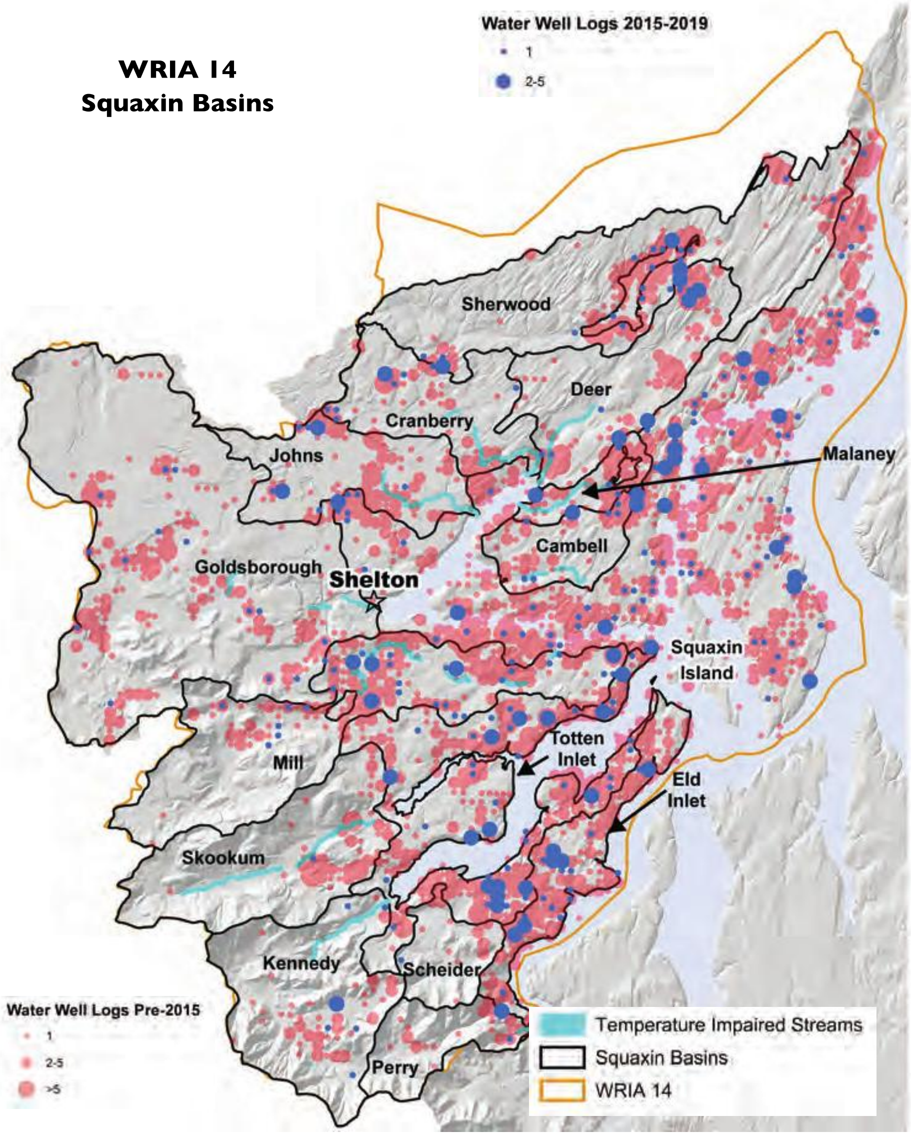
The Washington State Department of Ecology (DOE) removed almost 100 creosote pilings before moving on to cap contaminated sediment north of the mouth of Goldsborough Creek. After DOE finished capping, the Squaxin Island Tribe and the South Puget Sound Salmon Enhancement Group planned to bring in tons of sand and gravel to build up estuary habitat that degraded in recent years, building 25 acres of new estuary habitat at the mouth of Goldsborough Creek.[3]

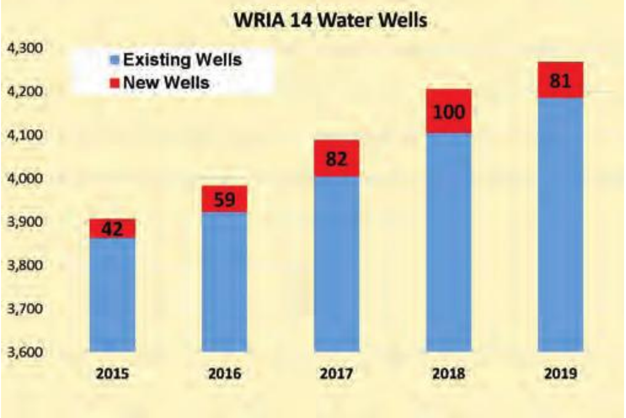
Sheltonharbor.org

Several of the 9 logjams that were built in 2019 at the mouth of Goldsborough Creek.

Low Streamflow and Elevated Water Temperatures

From 2015-2019 there were 364 new water wells in WRIA 14.[1] This is up from the 259 water wells in the 2010-2014 period.[2] Ten streams in WRIA 14 are currently listed as temperature impaired (exceeding 16 C 7-Day Average Daily Max.) by the Washington State Department of Ecology.[3]





The watersheds of Mason County, Washington are important producers of coho and chum salmon. In 1984, the Washington State Department of Ecology established an Instream Resources Protection Program for Water Resource Inventory Area (WAC 173-514) to retain sufficient instream flow to protect fish and wildlife, scenic, aesthetic and other environmental values. This rule seasonally closed multiple WRIA 14 streams to consumptive appropriations and established minimum instream flows for the rest of the year. These streams are also listed on the Ecology 303 (d) list of impaired water bodies for temperature. Sections of these streams exceed water quality standards and are considered too warm. Ecology has initiated a temperature TMDL for Oakland Bay-Hammersley Inlet and associated tributaries. Despite these protections, the average daily flows of many creeks in WRIA 14 are frequently below established instream flow rules in summer. Available stream gauge data suggest that many listed streams fail to meet statutory minimum flows in late summer.

One cause of these insufficient flows is the dramatic increase in the number of water wells constructed in the last 30 years (some wells shown in the map may not be permit-exempt). This became the subject of a recent State Supreme Court Case, known as the Hirst Case[4] and the Washington state Legislature passed RCW 90.94[5] in response to the Supreme Court's decision. RCW 90.94 made allowances for permit-exempt well development in WRIA 14, provided that new watershed planning develop plans to offset the new water use with streamflow restoration projects. RCW 90.94 also limited permit-exempt well use to "domestic use only, with a maximum annual average withdrawal of 950 gallons per day per connection," and to 350 gallons per day per connection during times of drought.

(Continued on next page)

Map Data Sources: Squaxin 2019,[10] SSHIAP 2004,[11] WAECY 2000,[12] WAECY 2018b,[13] WAECY 2019[14]

SQUAXIN ISLAND TRIBE

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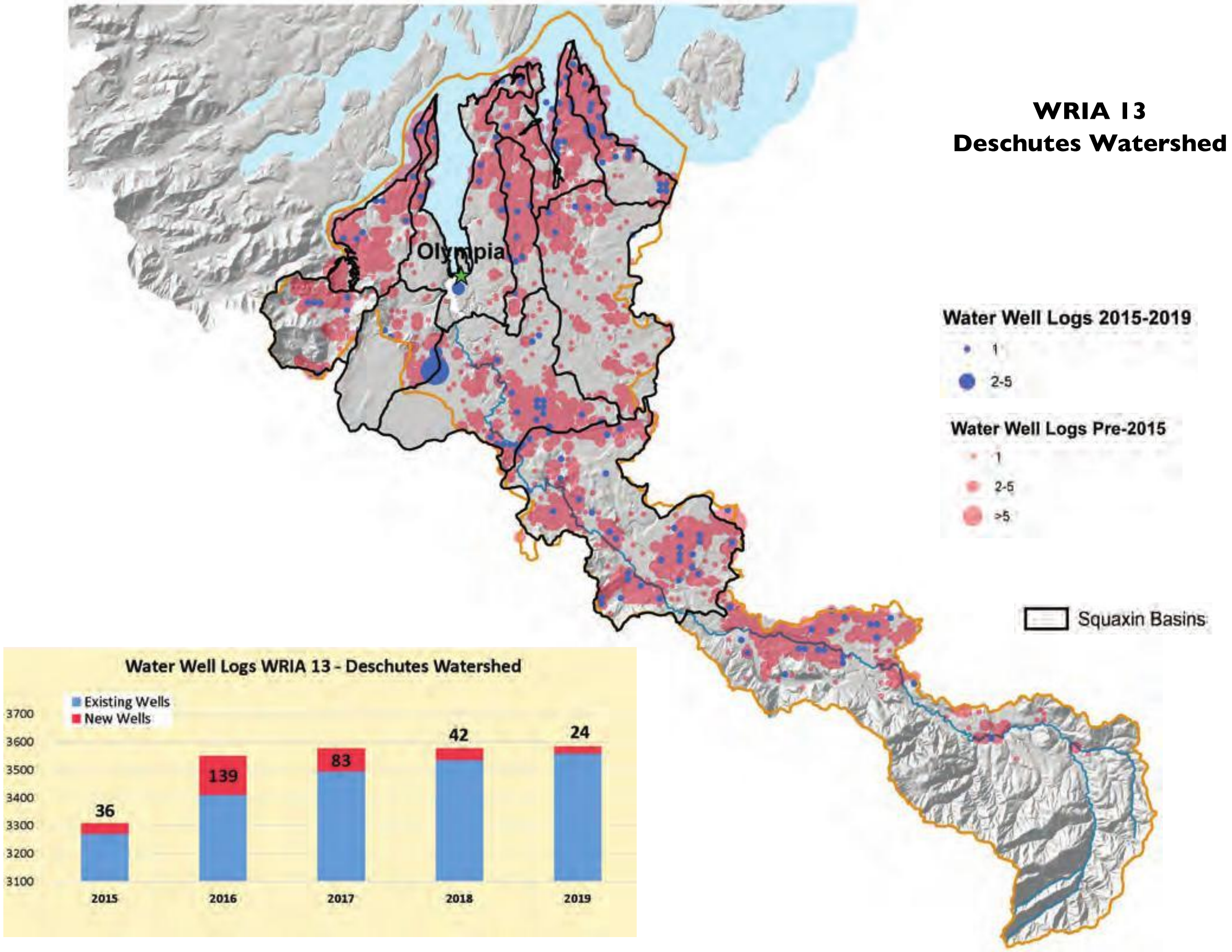
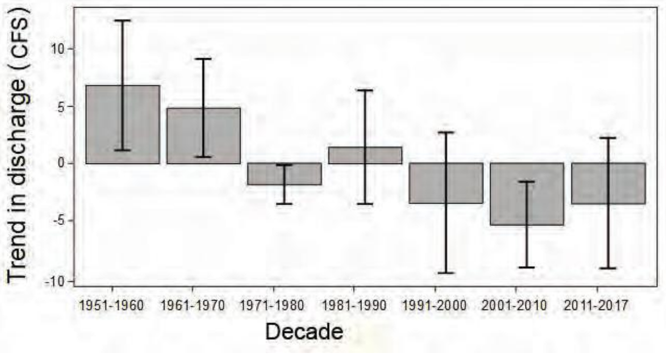


Since the 1940s, Mason, Thurston and Kitsap counties have seen some of the greatest increases in wells among Washington counties.[6] Thurston County has the second highest number of wells of any county in the state, and is seeing particular pressure for growth and development in rural areas where permit-exempt wells are used most often.[7] There are 7,336 permit-exempt wells in the Deschutes watershed.[8] Approximately 3,478 of those were drilled before 1978, and 3,858 were drilled after 1978. Although the water volume a single exempt well uses is small, the cumulative effect of wells in close proximity can be significant. Exempt groundwater withdrawals do not require a water right permit, but they are always subject to state water law.

The proliferation of wells in the Deschutes watershed has coincided with a decline in Deschutes River flow over the past decades. Focusing on the US Geological Survey's Rainier gauging station on the Deschutes, we have looked at trends in flow since 1950. For a given amount of total rainfall in September, we estimate that the mean daily flow in September for recent years is about 10 cubic feet per second smaller compared to the earliest years in the 1950-2016 time period. The September median daily discharge at Rainier is estimated to be 34 cubic feet per second. Therefore, a 10 cubic feet per second decrease is significant. Well pumping contributes to the decline, but we do not know how much. Such declines in flow decrease the amount of habitat physically available for fish. Furthermore, less flow in the river is more easily warmed by the sun,[9] which also physically degrades fish habitat. Less water and warmer water means fewer fish.



Discharge in the Deschutes River has been decreasing since the 1950s. There is less river flow in response to rainfall.[10]

Map Data Sources: Squaxin 2019,[11] SSHIAP 2004,[12] WAECY 2000,[13] WAECY 2018b,[14] WAECY 2019[15]

SQUAXIN ISLAND TRIBE

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Shellfish Growing Areas Show Improvement

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8 Keta Waters clip from Thurston County well data. Thurston County Water Resources Technical Memorandum Methods Used to Calculate the Pumping Rates, Locations, and Open Intervals of Active Groundwater Wells in Thurston County, Washington. 2018 Clip for WRIA 13 done by Keta Waters Memorandum Groundwater withdrawals from the Deschutes Watershed **DRAFT** (WRIA 13). 2020

9 Deschutes River, Percival Creek, and Budd Inlet Tributaries Temperature, Fecal Coliform Bacteria, Dissolved Oxygen, pH, and Fine Sediment Total Maximum Daily Load: Water Quality Improvement Report and Implementation Plan, 2015 (Washington State Department of Ecology, https://fortress.wa.gov/ecy/publications/SummaryPages/1510012.html)

10 Mean decadal trend (+ one standard error) of residuals from a linear model predicting minimum 5-day rolling sums of discharge (in cubic feet per second) at the USGS gauge near Rainier, WA (#12079000), in response to minimum 5-day rolling sums of precipitation (in inches) measured at the Olympia Airport. The residuals were adjusted to minimum 5-day rolling means through division by 5. Residuals were averaged for seven time periods: 1951-1960, 1961-1970, 1971-1980, 1981-1990, 1991-2000, 2001-2010 and 2011-2017. (“Analysis of discharge data for the Deschutes River (1950-2016) and an assessment of long-term trends” 2018. R. Conrad and O. Miler. NWIFC)

11 Squaxin Island Tribe.2019. Natural Resources. Basins Shapefile.

12 SSHIAP. 2004. Hillshade derived from University of Washington Digital Elevation Model (DEM). Olympia, WA: Northwest Indian Fisheries Commission.

13 WAECY. 2000. WRIA Boundaries. Polygons. Olympia, WA: Washington Department of Ecology.

14 WAECY. 2018b. NHD Major Areas, Streams, and Waterbodies. 1:24000. From U.S. Geological Survey (in cooperation with others) National Hydrography Dataset. Washington Department of Ecology.

15 WAECY. 2019. Water Well Logs Points. Olympia, WA: Washington Department of Ecology.

2020 State of Our Watersheds Report
Stillaguamish River Basin

> *We continue not to fish for chinook commercially and to focus on the recovery of our salmon. But even with the nets out of the river, our fish numbers are not increasing. We work hard to restore habitat and recover Stillaguamish chinook, but in the meantime, our culture faces extinction. We are a living culture and we must have salmon to harvest.*
>
> **– Shawn Yanity**
> **Stillaguamish Tribe**

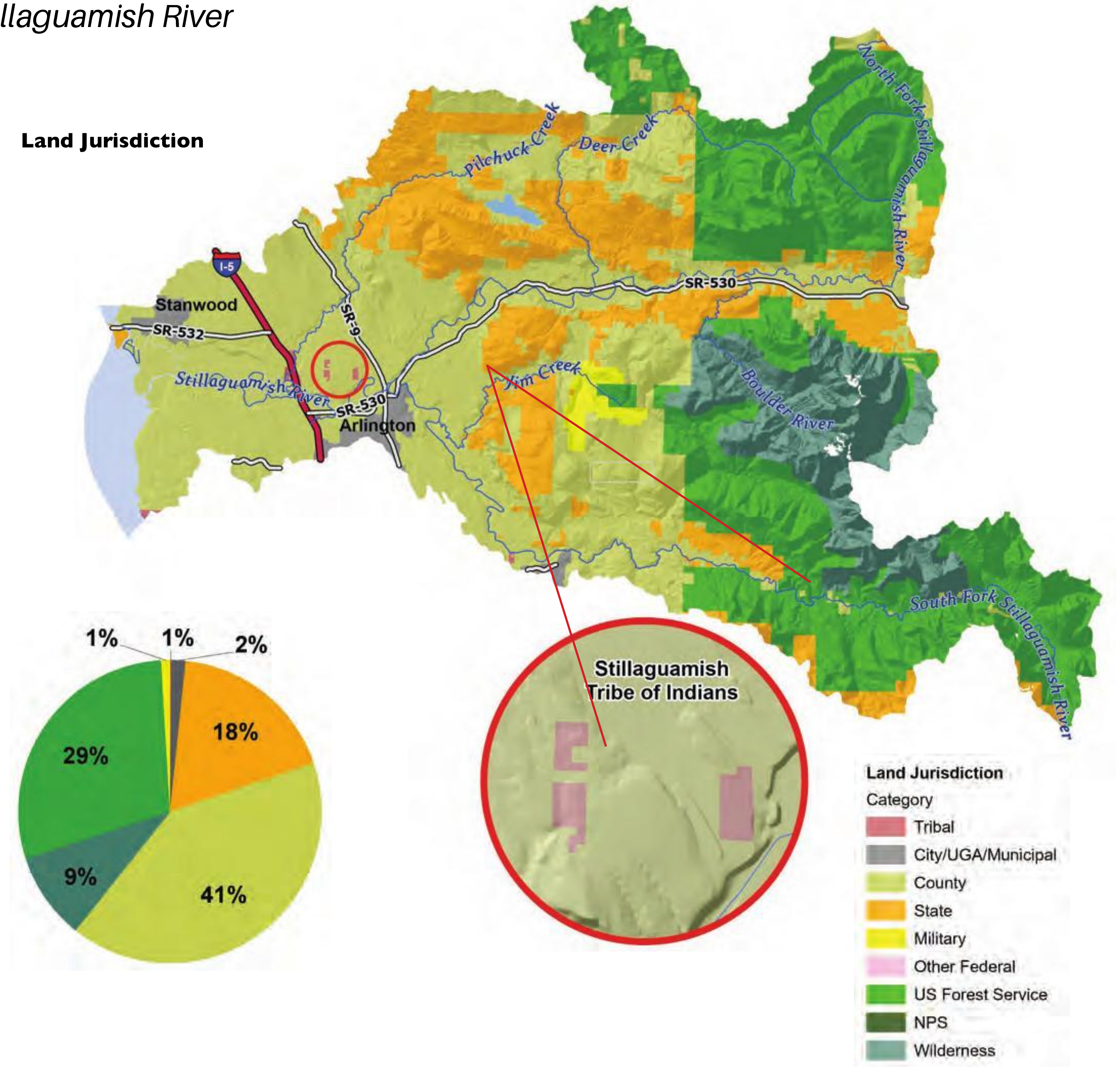
Area of Interest

Stillaguamish Tribe

The Stillaguamish Tribe is composed of descendants of the *Stoluck-wa-mish* River Tribe. In 1855 the population resided on the main branch of the river, as well as the North and South Forks. The name Stillaguamish, under various spellings, has been used since around 1850 to refer to those Indians who lived along the Stillaguamish River and camped along its tributaries. They were a party to the Treaty of Point Elliott of Jan. 22, 1855. No separate reservation was established for the *Stoluck-wa-mish* Indians. Some moved to the Tulalip Reservation, but the majority remained in the aboriginal area along the Stillaguamish River. Tribal headquarters are located in Arlington, Wash.

Stillaguamish Tribe

Stillaguamish River



Land Jurisdiction

At 694 square miles, the Stillaguamish River is the fifth largest drainage basin in the Puget Sound region, and includes portions of both Skagit and Snohomish counties. The basin extends to the headwaters of its two major forks in the North Cascade Mountains. The two major forks of the Stillaguamish are the North Fork, which drains approximately 284 square miles, and the South Fork, which drains approximately 255 square miles. The Stillaguamish supports both wild and hatchery stocks of anadromous salmonids and trout. These include chinook, coho, pink, chum and sockeye salmon, and steelhead and cutthroat trout.

The Stillaguamish River basin is within the ancestral home of the *Stoluck-wa-mish* River Tribe, whose descendants are the Stillaguamish Tribe of present. Traditionally, people of the Stillaguamish fished, hunted and gathered their food, medicines, clothes and building materials from within and around the watershed's boundary.

Since European settlement, land use in the watershed has continued to be dominated by physical geography. The foothills and mountains are mainly used for wood products and outdoor recreation. The more fertile and developable lowlands are primarily used for agriculture and rural residential development. Most of the basin's human population is centered in and around the towns of Granite Falls, Stanwood, Arlington and Darrington.

The last 150 years of human land use has left the natural ecology of the Stillaguamish watershed stressed and depleted. The future of the watershed will require significantly better protection of existing natural resources, and a greater commitment to actively restoring, as well as changing, land-use behavior within the landscape.

Map Data Sources: SSHIAP 2004,[1] USFWS 2018,[2] WADNR 2016,[3] WADNR 2018,[4] WAECY 1994,[5] WADOT 2018a,[6] WADOT 2018b,[7] WAECY 2018a,[8] WAECY 2018a[9]

Chapter Summary

The Stillaguamish Tribe are descendants of the *Stoluck-wamish* River Tribe. They have fished, hunted, gathered and handcrafted along the rivers and tributaries of the Stillaguamish River watershed since time immemorial. No one on this earth is more connected to the Stillaguamish River watershed, its water, plants, fish and animals than the Stillaguamish Tribe. At the heart of that connection is salmon which has always been a primary source of life for the tribe.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org*.

For this report, the Stillaguamish Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Rural Population Growth Continues in the Stillaguamish Watershed

As of 2017, there were an estimated 52,906 people living in the Stillaguamish River watershed, an increase of nearly 2,000 people since 2010. In 2010, 64% were living outside of the UGA and in 2017 that percentage remained the same.

Conversion Out of Forest Practices Has Slowed Since 2010

From 2000 through 2009 approximately 1,208 acres of land was converted from forest practices to nonforest practices, an average of 121 acres of land converted per year. Since 2010, around 373 acres of forestland was converted to nonforestry use, an average of 37 acres of land converted per year. That is a 70% decrease in average annual acres of converted forestland when compared to the previous decade of 2000 to 2009.

Permit-Exempt Well Groundwater Reserves in the Stillaguamish Watershed Fail to Protect Summer Streamflow in Small Tributaries

From 2005 through 2018, 992 permit-exempt wells have been developed in the Stillaguamish Groundwater Reserve, and 174 of those wells have been developed since 2014. The well development limits of the reserve are set for the mainstem, North Fork and South Fork Stillaguamish River sub-basins. This potentially allows small tributary basins within the larger sub-basins to be impacted by permit-exempt well development before the larger sub-basins has reached their well limits.

Floodplain Restoration and Acquisition Remains a Focus of Salmon Recovery

Restoration toward salmon recovery continues in the Stillaguamish River floodplain with restoration occurring in all targets (restored acres, bank armoring removal, riparian forest planted). Acquisition strategy progress is also being made. Through 2019, 1,201 acres of floodplain were in conservation ownership, and 910 acres were set to close by the end of 2020. Over the same time frame, percent riparian forest cover in the Stillaguamish River floodplain has increased slightly from near 23% to just under 24%.

Estuary Restoration Nearing 10-year Target of the Salmon Recovery Plan

Estuary habitat restoration has continued with an additional 330 acres restored between 2014-2019, bringing the total restored acres to 480, which represents 88% of the Stillaguamish Salmon Recovery Plan's 10-year target. In addition, 250 estuary acres have been acquired for future restoration.

Nonpoint Pollution and Wastewater Treatment Lead to More Commercial Shellfish Closures

Nonpoint source pollution and wastewater treatment are causing 838 acres of commercial shellfish growing area to be prohibited from harvest in Port Susan and South Skagit bays. This is an increase of 538 acres from 300 acres prohibited in Port Susan and South Skagit bays in 2016.

Shoreline Armoring Threatens Erosional Drift Cells Critical to the Ecology of Port Susan Bay

Since 2015, marine shoreline armoring has increased by 6% (3/4 mile) within Port Susan Bay.

Conclusion

The Stillaguamish Watershed Chinook Salmon Recovery Plan's stated goal is to maintain and restore natural ecosystem conditions that sustain salmon productivity. While habitat improvement is a major component of the recovery strategy, it is recognized that without protecting existing habitat function, restoration activities cannot reverse the decline of chinook populations within the watershed. In this regard, conclusions on the state of the watershed in 2020 are mixed.

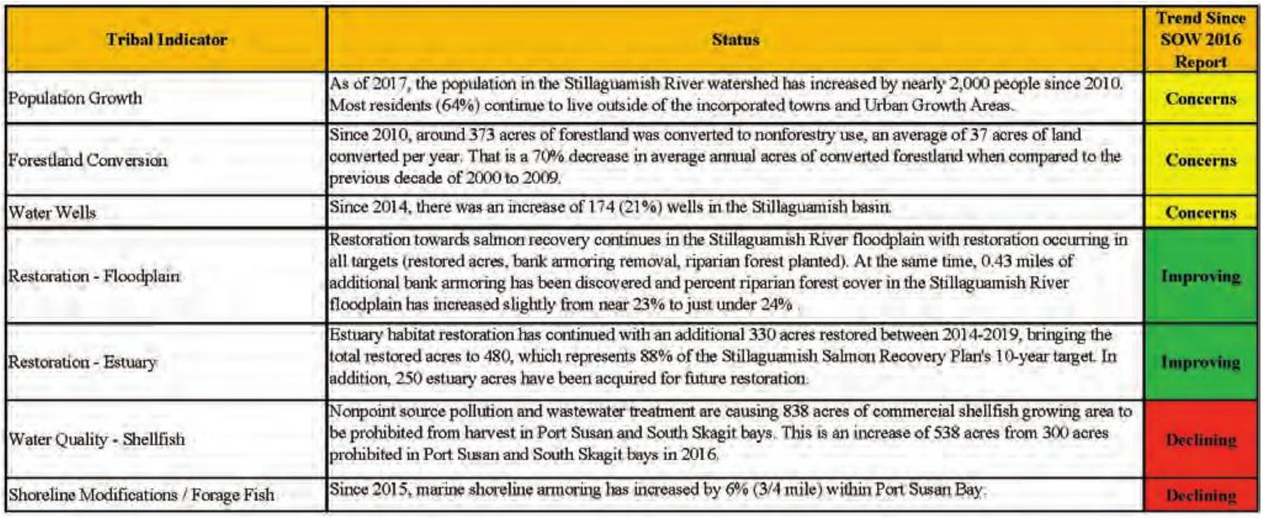
There is a clear strategy for estuary and floodplain restoration in place, and it is resulting in the acquisition and restoration of critical salmon habitats in these areas. However, restoration in these areas is expensive, and funding remains a challenge. As well, this type of restoration requires willing landowners, and finding willing landowners is also a challenge. Restoration and acquisition continue, but these two factors greatly affect the pace at which it occurs.

The legacy of European colonization of the landscape remains largely unchanged. Floodplain riparian forest cover is in poor condition, too much of the marine nearshore remains armored, and nonpoint pollution continues to threaten shellfish harvest. People continue to move into the watershed, either reinforcing development patterns of the past, or bringing new development to previously undeveloped areas. Changing this legacy of land use is a long, slow and very contentious process. It requires adherence to the laws and regulations of federal, state and local governments. Implementation of those laws, which happens locally, is often left to volunteerism on the part of the landowner. Politically, this is most palatable, but it has proven inadequate for the needs of salmon habitat recovery. Moving forward, as more people move into the watershed, better enforcement of the regulatory framework will become even more necessary.

Recovery Efforts Lagging

At the 15-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Stillaguamish basin shows that priority issues continue to be degradation of water quantity and quality, degradation of floodplain and riparian processes, and degradation of marine shoreline habitat conditions. In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trend for these key environmental indicators since the 2016 State of Our Watersheds Report shows an improvement occurring with the restoration of habitat but a steady loss in habitat status:



Tribal Indicator	Status	Trend Since SOW 2016 Report
Population Growth	As of 2017, the population in the Stillaguamish River watershed has increased by nearly 2,000 people since 2010. Most residents (64%) continue to live outside of the incorporated towns and Urban Growth Areas.	Concerns
Forestland Conversion	Since 2010, around 373 acres of forestland was converted to nonforestry use, an average of 37 acres of land converted per year. That is a 70% decrease in average annual acres of converted forestland when compared to the previous decade of 2000 to 2009.	Concerns
Water Wells	Since 2014, there was an increase of 174 (21%) wells in the Stillaguamish basin.	Concerns
Restoration - Floodplain	Restoration towards salmon recovery continues in the Stillaguamish River floodplain with restoration occurring in all targets (restored acres, bank armoring removal, riparian forest planted). At the same time, 0.43 miles of additional bank armoring has been discovered and percent riparian forest cover in the Stillaguamish River floodplain has increased slightly from near 23% to just under 24%	Improving
Restoration - Estuary	Estuary habitat restoration has continued with an additional 330 acres restored between 2014-2019, bringing the total restored acres to 480, which represents 88% of the Stillaguamish Salmon Recovery Plan's 10-year target. In addition, 250 estuary acres have been acquired for future restoration.	Improving
Water Quality - Shellfish	Nonpoint source pollution and wastewater treatment are causing 838 acres of commercial shellfish growing area to be prohibited from harvest in Port Susan and South Skagit bays. This is an increase of 538 acres from 300 acres prohibited in Port Susan and South Skagit bays in 2016.	Declining
Shoreline Modifications / Forage Fish	Since 2015, marine shoreline armoring has increased by 6% (3/4 mile) within Port Susan Bay.	Declining

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

While the Salmon Recovery Plan represents a well-organized, scientifically based plan, and by its own accounting, a largely successful approach to restoration in the Stillaguamish watershed, overall land use of the watershed continues to place a countervailing pressure on the natural ecology of the watershed. The sustained legacy of past drainage and clearing of the estuary and the floodplain for agriculture and infrastructure, the maintained harvesting intensity of state and private industrial forests, and the growing popularity of the watershed with rural residents are all continuing to impact restoration gains. The largest factors affecting the recovery of Stillaguamish chinook salmon are in order: funding for acquisition and restoration (currently around 5-10% of what is needed to implement our recovery plan), political will, permitting and endless capacity building at the expense of actions leading to recovery. Through both incentive-based programs and regulatory enforcement, people within the watershed will have to make some changes to their natural resource use behaviors if the full benefits of the Salmon Recovery Plan are to be met any time soon.

If the trends continue, the status of Stillaguamish salmon will continue to stay at very low abundance and productivity or worse, decline precipitously, directly impacting the Stillaguamish Tribe's treaty rights. It is time for elected officials and scientists to have a frank discussion of the true cost of continuing on the current societal pathway. The data presented in the State of Our Watersheds Report indicate that it will lead to the extinction of fisheries (if not populations themselves) as surely as it did for Atlantic salmon in Europe and on the East Coast. Though written in 1861, the words of Charles Dickens in *All the Year Round: A Weekly Journal* should cause us pause in the Stillaguamish today:

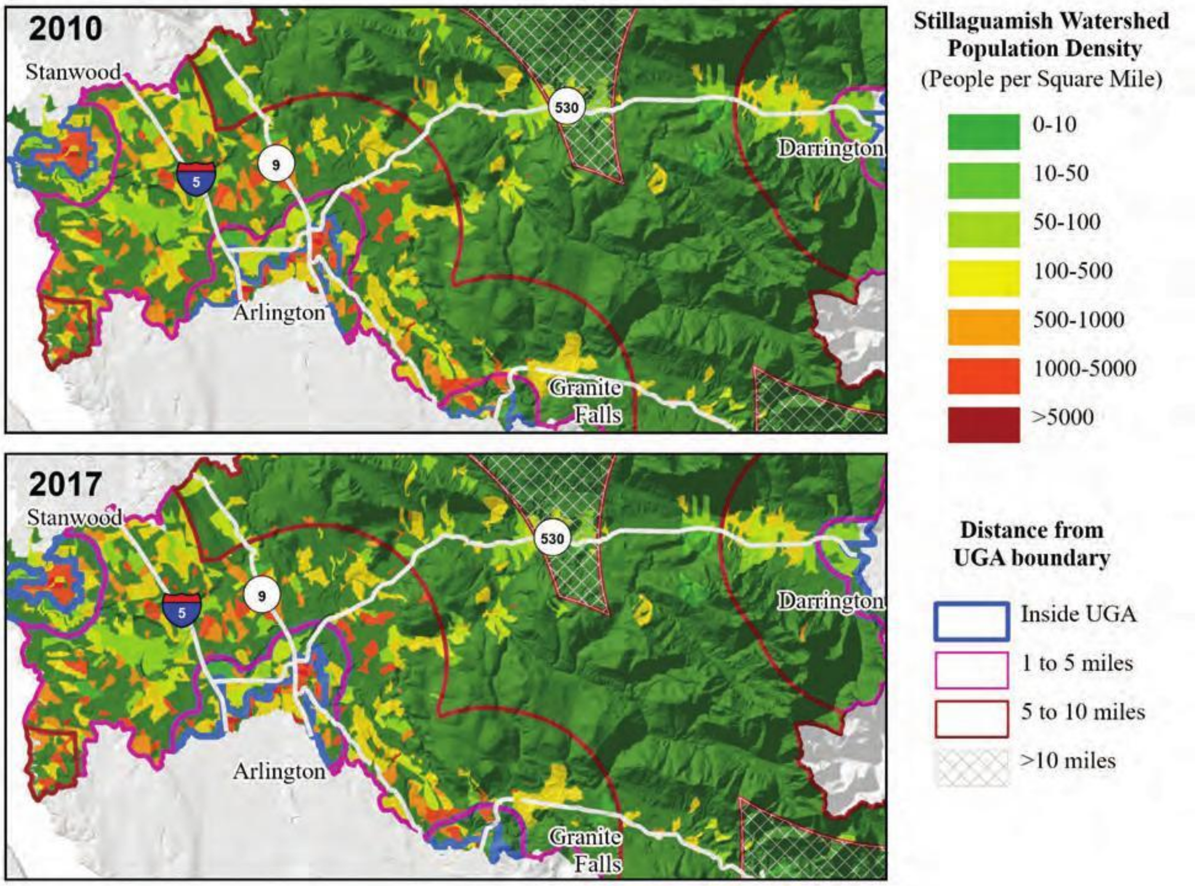
"The cry of 'Salmon in Danger!' is now resounding throughout the length and breadth of the land. A few years, a little more over-population, a few more tons of poison, a few fresh poaching devices ... and the salmon will be gone – he will become extinct."

To counteract the continued pressures on salmon habitat in the Stillaguamish and the overall lack of any meaningful enforcement, the tribe has been working with other watershed stakeholders to acquire and restore a corridor of lands along the main salmon-bearing waters of the Stillaguamish. Over time these efforts will link quality habitats from the tidewater to the mountains and provide locations for the ambitious floodplain and estuary projects needed to meet recovery goals. The tribe plans to complete the purchase of several hundred acres of riparian lands in the next five years, while working to restore lands it already owns. The ongoing restoration work includes engineered logjams, riparian planting, bank armoring removal and the restoration of tidal influence to diked lands in the estuary. A sustained effort across thousands of acres is needed if we are to bring back harvestable populations of salmon to the tribe's nets.

Rural Population Growth Continues in the Stillaguamish Watershed

As of 2017, there were an estimated 52,906 people living in the Stillaguamish River watershed, an increase of nearly 2,000 people since 2010.[1,2] Most residents in the Stillaguamish watershed continue to live outside of incorporated towns and Urban Growth Areas (UGA). In 2010, 64% were living outside of the UGA and by 2017 that percentage remained the same.[3,4,5,6,7,8,9]

Arlington, Stanwood and Granite Falls all experienced increased population densities and sprawl between 2010 and 2017.[11,12]



Population Change in the Stillaguamish Watershed (2010 to 2017)[11, 12]

Distance from UGA	Estimated Population in 2010	Estimated Population in 2013	Estimated Population in 2017	Percent Change in Population from 2010 to 2017
Inside UGA	18,489	19,447	19,295	4.2%
0 to 1 mile from UGA	4,496	4,691	4,732	5.0%
1 to 5 miles from UGA	22,633	22,445	23,396	3.3%
5 to 10 miles from UGA	4,168	4.320	4,388	5.0%
>10 miles from UGA	309	293	315	2.2%

From 1990 to 2010, it is estimated that the Stillaguamish watershed saw an 85% increase in population.[10] From 2010 to 2017, population growth within the basin was 3.7%. An estimated 55% of watershed residents continue to live farther than a mile from incorporated areas.

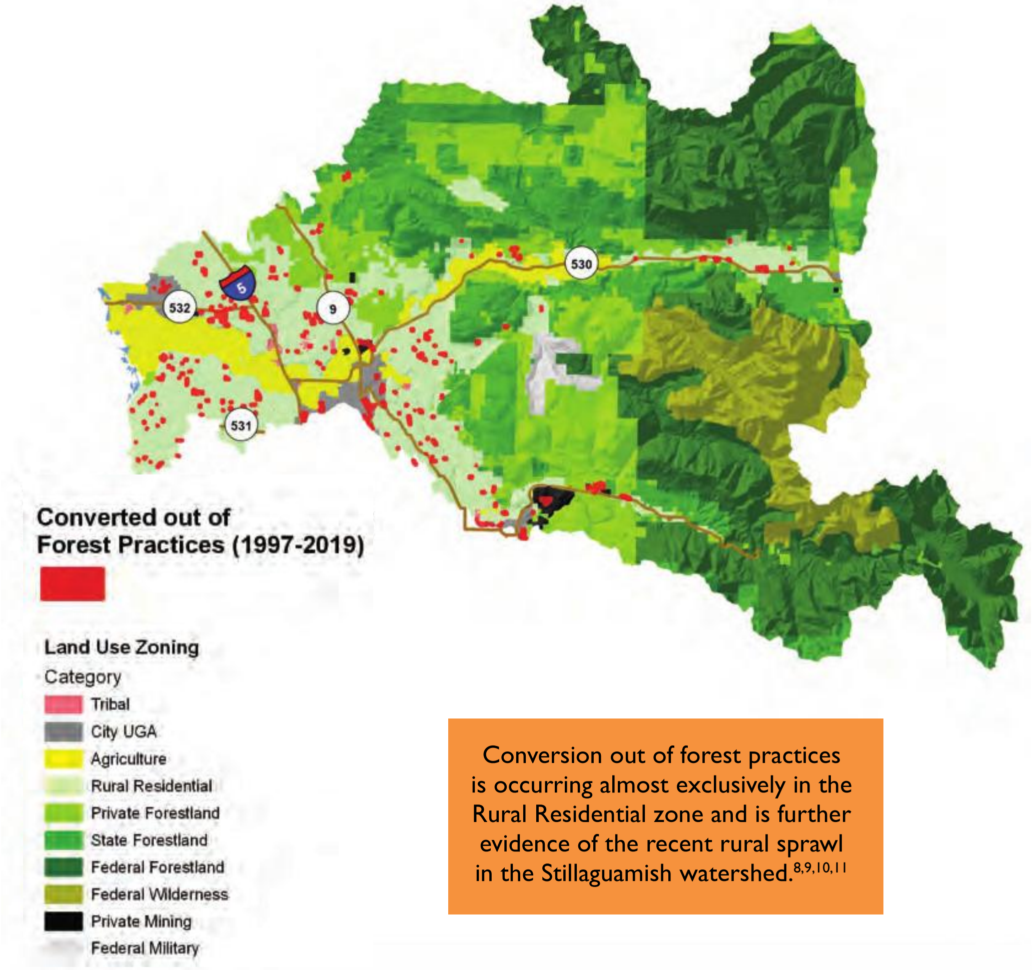
Map Data Sources: USFWS 2014,[3] WAECY 2011b,[4] WAECY 2013a,[5] WAECY 1994,[6] WADNR 2014c,[7] WADNR 2014d,[8] WADOT 2013[9] NWIFC 2012,[10] USCB 2015,[11] USCB 2019[12]

Conversion Out of Forest Practices Has Slowed Since 2010

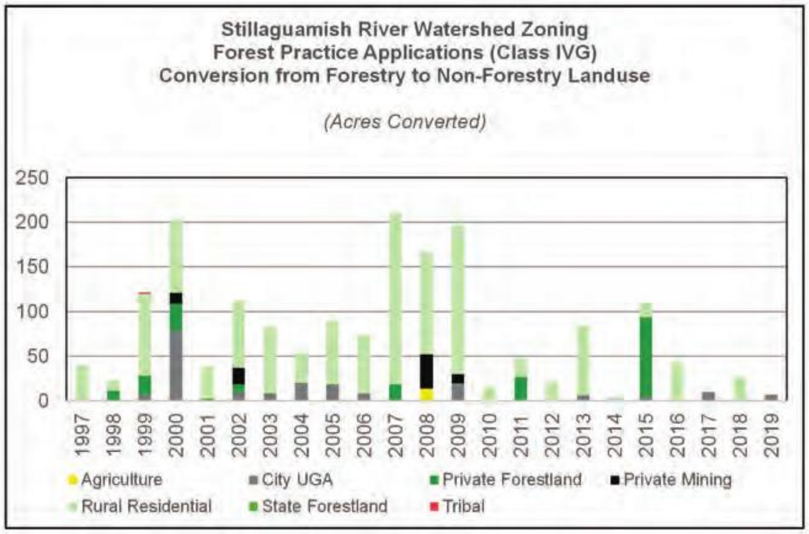
From 2000 through 2009 approximately 1,208 acres of land was converted from forest practices to nonforest practices, an average of 121 acres of land converted per year. Since 2010, around 373 acres of land was converted from forest practices to nonforest practices, an average of 37 acres of land converted per year. That is a 70% decrease in average annual acres of converted forestland between the two decades.[1]

Since 2000, an estimated 1,581 acres of forestland has been converted out of forest practices in the Stillaguamish River watershed.[2] Evidence suggests the primary motivation for conversion out of forest practices is residential development. To this point, over 572 acres or 36% of forestland conversion since 2000 occurred between 2007 and 2009, coinciding with the region's housing boom. Additionally, 83% of all forestland conversion since 2000 has occurred on Rural Residential or Urban Growth Area parcels, strongly suggesting that the majority of forestland conversion is for residential or commercial property development.[3,4,5]

Only 64% of private forestland in the Stillaguamish basin is signed up for the "Designated Forestland Program" meant to incentivize nonconversion of forestland. The 36% of private forestland that is not signed up is considered to be at a higher risk for permanent conversion to residential land uses.[6] Land in working forests are protected by the Washington State Forests and Fish Rules, a law designed to comply with the Endangered Species Act (ESA) and the Clean Water Act (CWA) to protect native fish and assure clean water compliance.[7] Once land is converted out of working forests, not only do the trees disappear, but so do the fish protection and clean water guarantees of the Forests and Fish law. In their place is a residential landscape with greater pollution and less protection.



Conversion out of forest practices is occurring almost exclusively in the Rural Residential zone and is further evidence of the recent rural sprawl in the Stillaguamish watershed.[8,9,10,11]



Over the past 20 years, 71% of all conversions out of forest practices have been Rural Residential parcels outside of Urban Growth Area boundaries.[12,13,14]

Map Data Sources: WADNR 2020,[9] Skagit County 2020,[10] Snohomish County 2020[11]

STILLAGUAMISH TRIBE

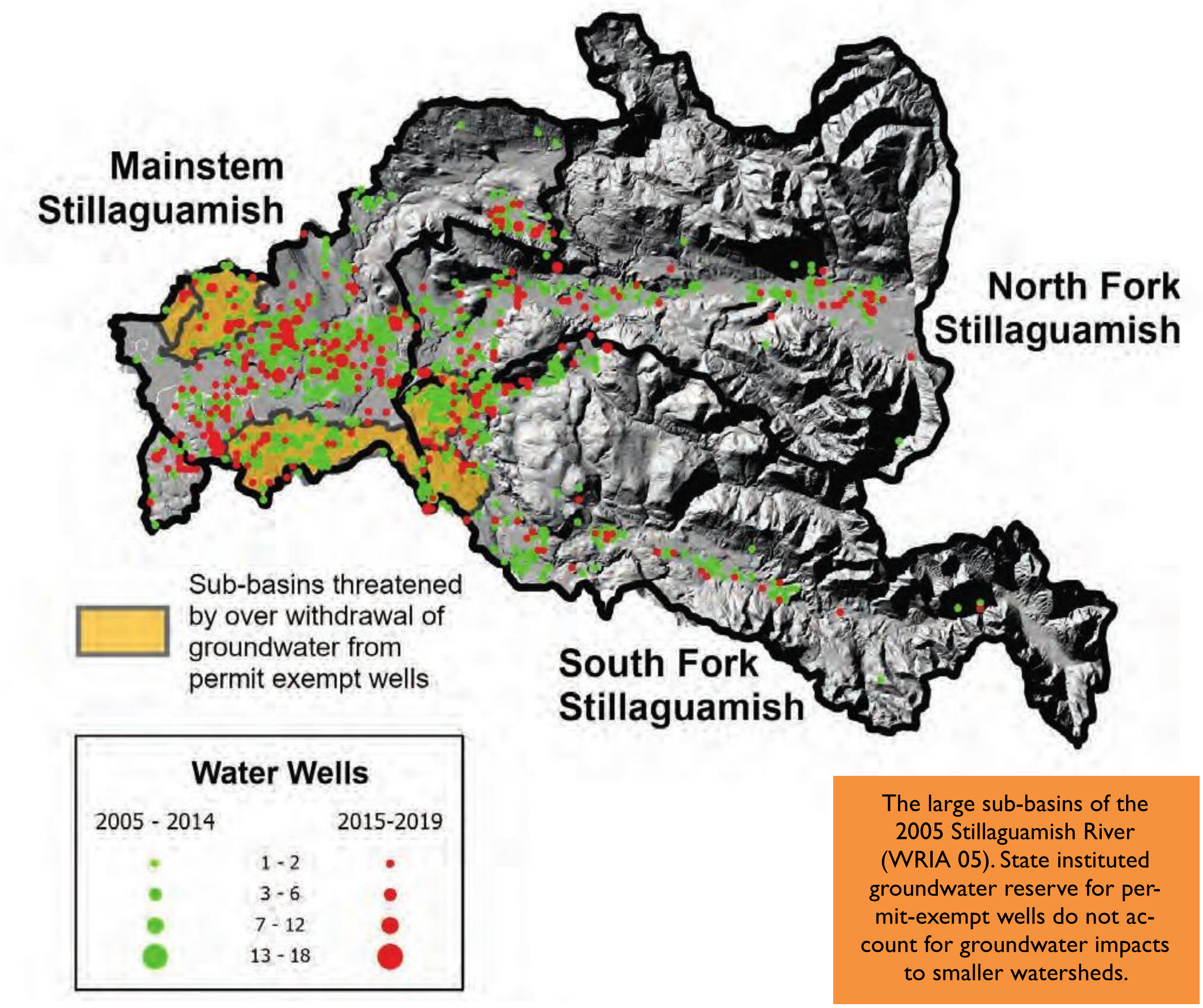
Permit-Exempt Well Groundwater Reserves in the Stillaguamish Watershed Fail to Protect Summer Streamflow in Small Tributaries

Through 2014, Ecology reported that 818 permit-exempt wells had been added within the reserve watersheds of the Stillaguamish basin since 2005. By the end of 2016 the number reported by Ecology had increased to 997 wells.[1] In 2018, Ecology adjusted the 2016 reported well number to 992 wells, based on their correction of the data from 2016. This is an increase of 21% in number of wells since 2014.

In the 2018 Stillaguamish Water Reservations Report, Washington Department of Ecology (WAECY) estimated that 992 wells were withdrawing 174,125 gallons of water per day from the groundwater reserve for permit-exempt wells that was established in 2005. Accounting for the reserve is done for three sub-basins: the mainstem Stillaguamish, the North Fork Stillaguamish and the South Fork Stillaguamish.[2] At the sub-basin scale, there is still well over 90% of water in the reserve available for exempt well development.[3]

WAECY does not account for groundwater impacts to tributaries smaller than the mainstem, the North Fork, and the South Fork sub-basins of the Stillaguamish River. In 1999, five separate small tributaries within those larger Stillaguamish sub-basins were found to be over consuming groundwater, at a rate of 5% or more of groundwater recharge per year.[4]

The Streamflow Restoration Act of 2018 did not include any water management changes for the Stillaguamish watershed, because the groundwater reserve system from 2005 was already in place. The 174,125 gallons per day estimated to be drawn from the 992 wells is a conservative estimate of groundwater withdrawal, based on 350 gallons per day for wells with no associated septic and 175 gallons per day for wells with an associated septic. Each permit-exempt well developed within the reserve can legally withdraw as much as 5,000 gallons per day.



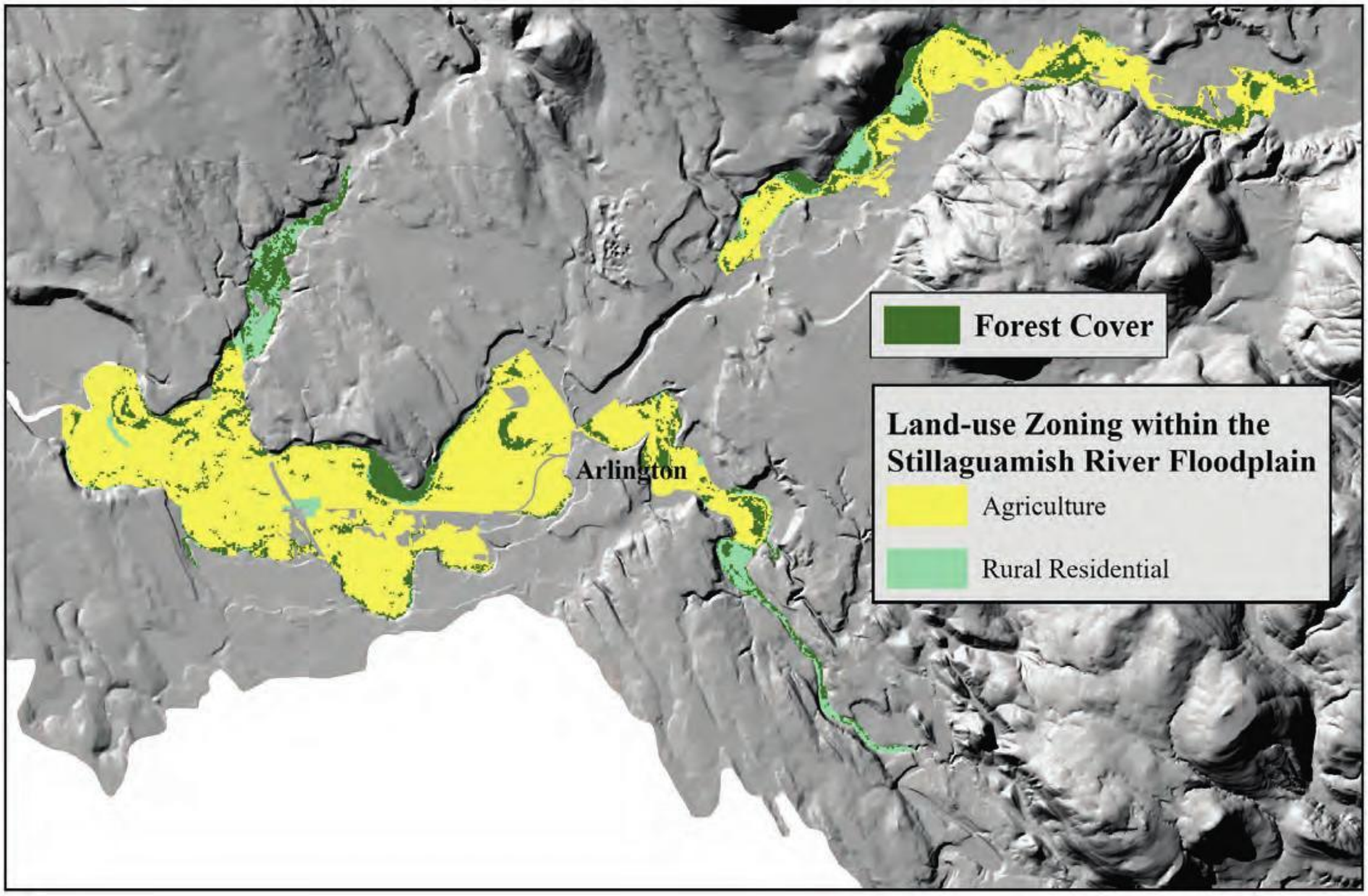
The large sub-basins of the 2005 Stillaguamish River (WRIA 05). State instituted groundwater reserve for permit-exempt wells do not account for groundwater impacts to smaller watersheds.

Map Data Sources: USGS 2014,[7] WAECY 2019[8]

STILLAGUAMISH TRIBE

Floodplain Restoration and Acquisition Remains a Focus of Salmon Recovery

Restoration toward salmon recovery continues in the Stillaguamish River floodplain. 22.66 of a targeted 30 acres of floodplain area have been restored, 0.24 miles of a targeted 4.1 miles of bank armoring has been removed , 367 acres of a targeted 400 acres of riparian forest has been planted.[1,2,3,4] *At the same time, 0.43 miles of additional bank armoring has been discovered and percent riparian forest cover in the Stillaguamish River floodplain has increased slightly from near 23% to just under 24% .* [5]



Riparian forest cover remains less than a third of the 80% riparian forest cover considered a long-term Properly Functioning Condition (PFC) in the Stillaguamish Salmon Recovery Plan.[9] Largely due to maintained forest clearing on agricultural and rural residential lands, which combined, are over 98% of the total floodplain area.[10,11,12,13]

Draining and clearing of the Stillaguamish River floodplain began in the 1860s. Since that time, the floodplain has been deliberately managed in a state of permanent ecological disturbance. Resulting in the long-term absence of mature riparian vegetation throughout the floodplain coupled with the straightening and armoring of floodplain channels and huge deficits to habitat area and quality.[6]

The Stillaguamish Watershed Council (SWC) recognizes that chinook salmon recovery will not occur without the restoration of floodplain habitat. They also recognize that asking landowners to voluntarily protect their floodplain parcels is not the most effective restoration strategy. As a result, SWC has formulated a floodplain acquisition strategy to identify floodplain parcels that are of the highest priority in restoring the Stillaguamish floodplain corridor critical to chinook salmon recovery.[7] Acquisition strategy progress is also being made. Through 2019, 1,201 acres of floodplain were in conservation ownership, and 910 acres were set to close by the end of 2020.[8]

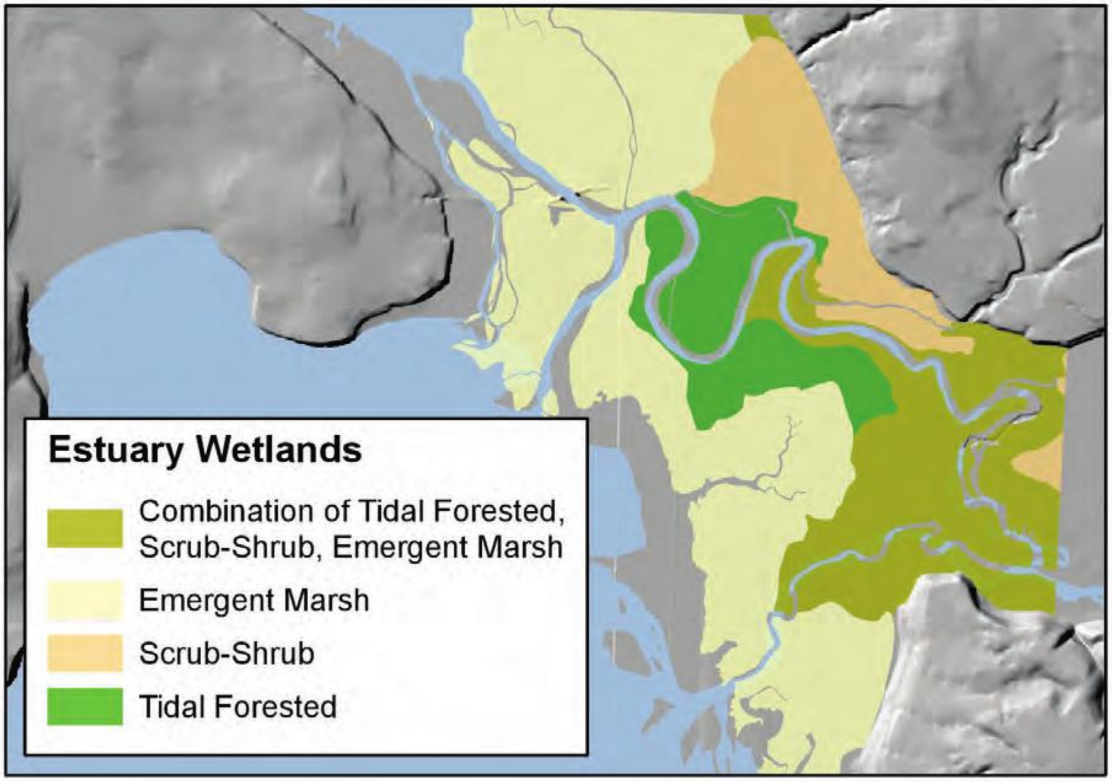
Map Data Sources:WAECY 2011,[10] *Stillaguamish Implementation Review Committee 2005,*[11] *Snohomish County 2010,*[12] *SSHIAP 2004,*[13] *WAECY 2018b*[14]

STILLAGUAMISH TRIBE

Estuary Restoration Nearing 10-year Target of the Salmon Recovery Plan

The Stillaguamish Salmon Recovery Plan's 10-year target for estuary habitat restoration is 548 acres.[1] From 2014 through 2019, 330 acres of estuary habitat were restored bringing the total restored to 480 acres.[2] In addition, 250 estuary acres have been acquired for future restoration.[3]

Historic wetland conditions in the Stillaguamish River estuary[8,9]



Current mapping shows that there has been a 99% loss of tidal scrub-shrub wetland, a 96% loss of tidal forested wetland in the Stillaguamish watershed, and a 57% loss of emergent marsh wetland.[4] Updated targets for properly functioning conditions (PFC) call for restoration of the 80% of historic estuarine wetland habitat or 4,039 acres, to comprised these three wetland types. Over 50% of that restoration, 2,191 acres is targeted for 11 to 50 years of the recovery plan.[5]

Over 92% of the land in the Chinook Recovery Plan's Estuary Priority Area is zoned Agriculture, which means every future restoration opportunity in the estuary has a good potential of being scrutinized by the Ag. Advisory Board and the local Farm Bureau. Regional help from the Puget Sound Partnership and NOAA Fisheries remains necessary to reconcile salmon habitat restoration with agricultural land conservation.[6,7]

Final estuary restoration targets approved by Stillaguamish Watershed Council in 2014[10]

Estuary Acres	Estimated Historic Acreage	PFC * (80% of historic)	Needed to meet PFC (PFC minus	10-Year Target	11 to 50-Year Target
Emergent Marsh	2878	2302	1052	210	842
Scrub-Shrub	1120	896	887	177	710
Tidal Forested	1050	840	800	160	640
Total	**5048**	**4039**	**2739**	**548**	**2191**

Map Data Sources: Griffith & Fuller 2012,[8] WWU 2014[9]

*PFC: Properly Functioning Condition (based on 80% of historic)

Stillaguamish Tribe

Nonpoint Pollution and Wastewater Treatment Lead to More Commercial Shellfish Closures

Nonpoint source pollution and wastewater treatment are causing 838 acres of commercial shellfish growing area to be prohibited from harvest in Port Susan and South Skagit bays.[1] This is an increase of 538 acres (179%) from 300 acres prohibited in Port Susan and South Skagit bays in 2016.[2]

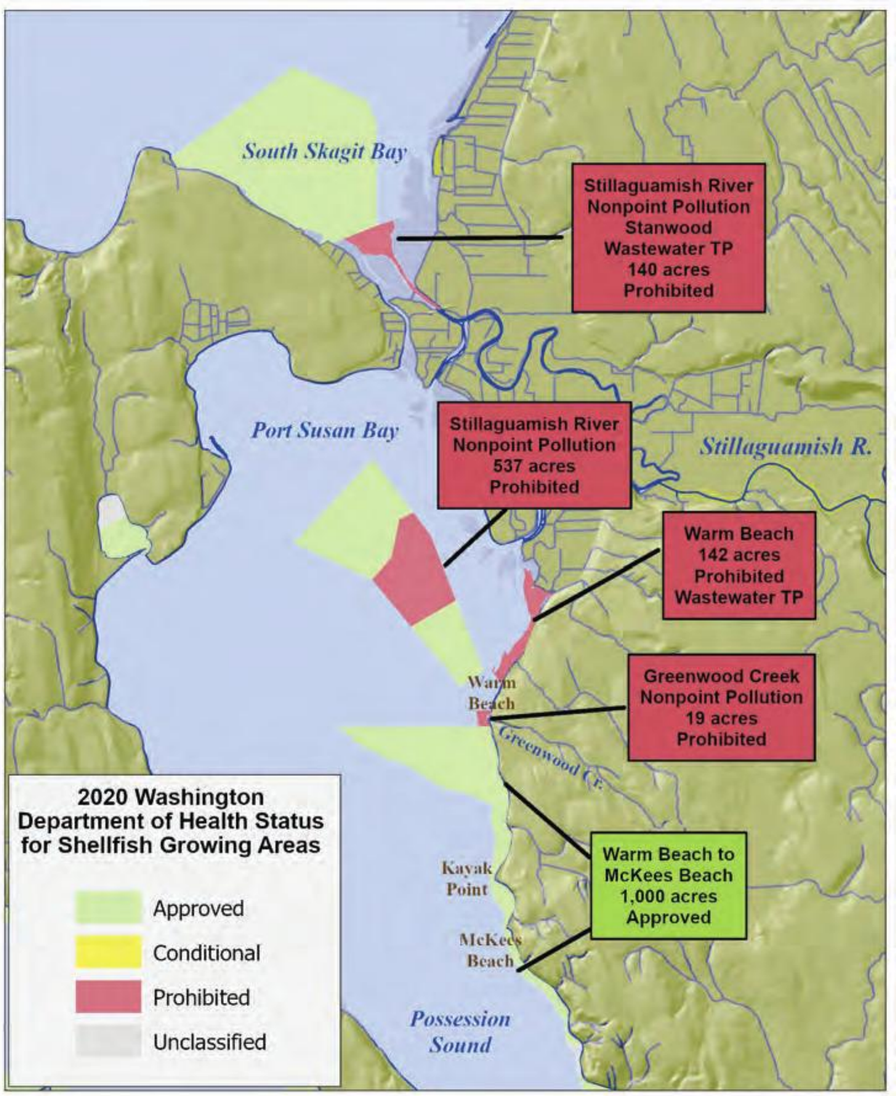
Fecal coliform counts in Port Susan and South Skagit bays are currently high enough to require the Washington Department of Health to prohibit commercial shellfish harvest on over 840 acres between the two areas.[3] Nonpoint source fecal coliform pollution from the Stillaguamish River degrading water quality in both Port Susan Bay and South Skagit Bay has been a management challenge since late 1980s, when access to 18,000 acres of commercial shellfish harvesting in both bays was closed due to high counts of fecal coliform.[4]

In 1993, the South Skagit Bay commercial harvest area was reopened for 2,280 acres, in 2006 that area was reduced to 1,344 acres and in 2009 re-expanded to 2,200 acres. In 2010, 1,800 acres of commercial shellfish acres in Port Susan were approved for commercial shellfish harvest.[5]

The current prohibited status of 678 acres in Port Susan Bay is not a return to the conditions of the late 1980s, but it does reflect a degrading trend since 2010. On a positive note, in 2014 approximately 1,000 acres of previously unclassified commercial shellfish harvest areas of McKees Beach and Warm Beach in Possession Sound were approved upon a study encouraged by the Stillaguamish Tribe.[6,7]

The cooperative effort involving the Stillaguamish Tribe, and state and county agencies to clean up Stillaguamish River water quality has not wavered. A return to an Approved rating will require continued vigilance in all of the areas of nonpoint source pollution control, as onsite septic, livestock, and pet pollution remain persistent nonpoint pollution sources.

Current Status of Commercial Shellfish Growing Areas in Port Susan Bay and South Skagit Bay to McKees Beach in Possession Sound



Map Data Sources: WADOH 2020,[8]

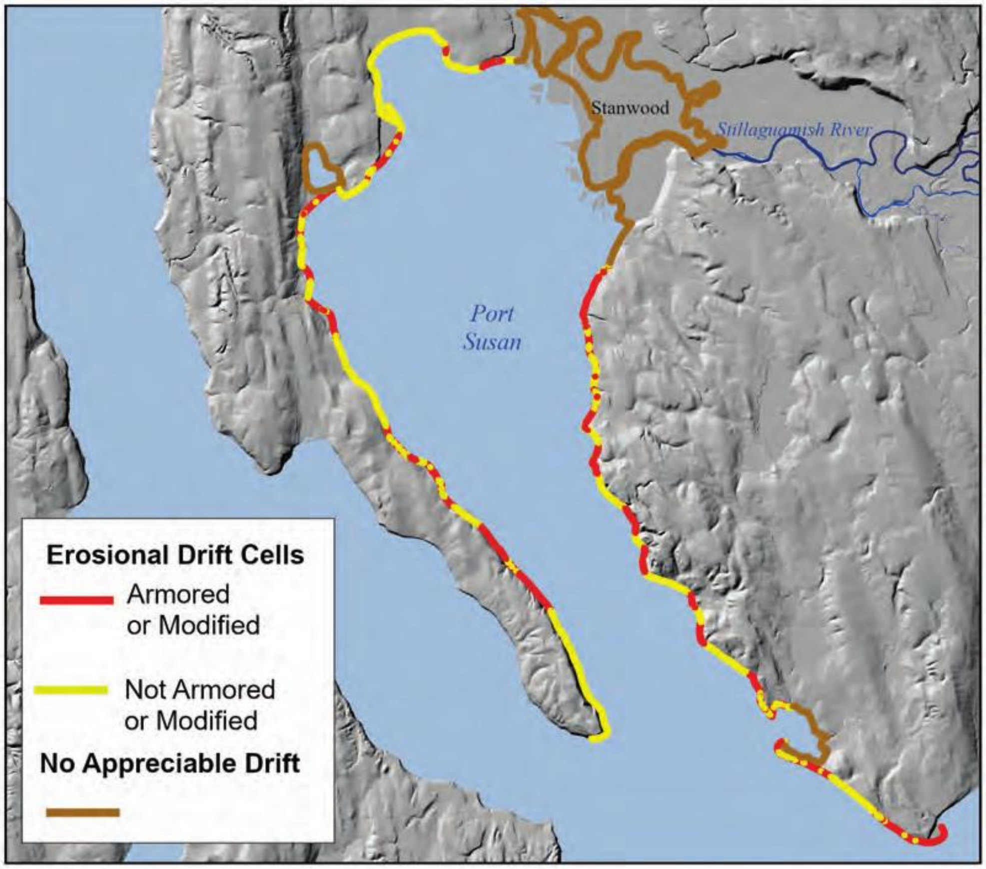
STILLAGUAMISH TRIBE

Shoreline Armoring Threatens Erosional Drift Cells Critical to the Ecology of Port Susan Bay

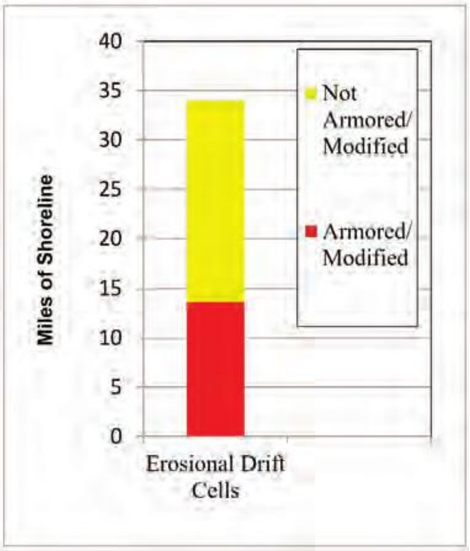
Since 2015, marine shoreline armoring has increased by 6% (3/4 mile) within Port Susan Bay.[1]

The greatest impact to forage fish habitat on erosional drift cells is shoreline armoring, as it interrupts erosion, distribution and accretion of sediment.[2] Impacts to forage fish are felt directly by federally listed Puget Sound chinook salmon, as they feed on forage fish. Forage fish spawning beaches are protected through the state's Hydraulic Code Rules, the Growth Management Act (GMA), and Priority Habitats and Species (PHS) Program, yet these habitats remain vulnerable to shoreline armoring and modification.[3] Considering the critical ecological role of erosional drift cells for forage fish spawning and the equally critical role forage fish have in Puget Sound chinook salmon ecology, no more armoring can be allowed along them, and every opportunity to remove armoring must be taken.

Since 2015, there have been 32 Hydraulic Permit Applications (HPA) for marine shoreline armoring along the Port Susan shoreline, 29 applications have been permitted, 1 application has been rejected, and 2 applications are on hold.[4] Of the permitted applications, 28 were for replacement of failing shoreline armoring, and one was for new shoreline armoring. Soft shore armoring or other environmental mitigation were included in 5 of the 29 applications.[5] The last five years of shoreline permitting activity have not resulted in decrease in shoreline armoring, but in a reinforcement of shoreline armoring through replacement structures that are meant to extend the armored condition of the Port Susan Bay shoreline longer into the future.



99% of documented forage fish spawning in Port Susan Bay occurs along erosional drift cells (yellow lines), and 40% of the shoreline of these drift cells (red lines) are already armored or otherwise modified.



13 of the 34 miles of erosional drift cells in Port Susan Bay are already armored or modified.

Map Data Sources: CGS 2017,[6] WDFW 2006,[7] PSNERP 2008[8]

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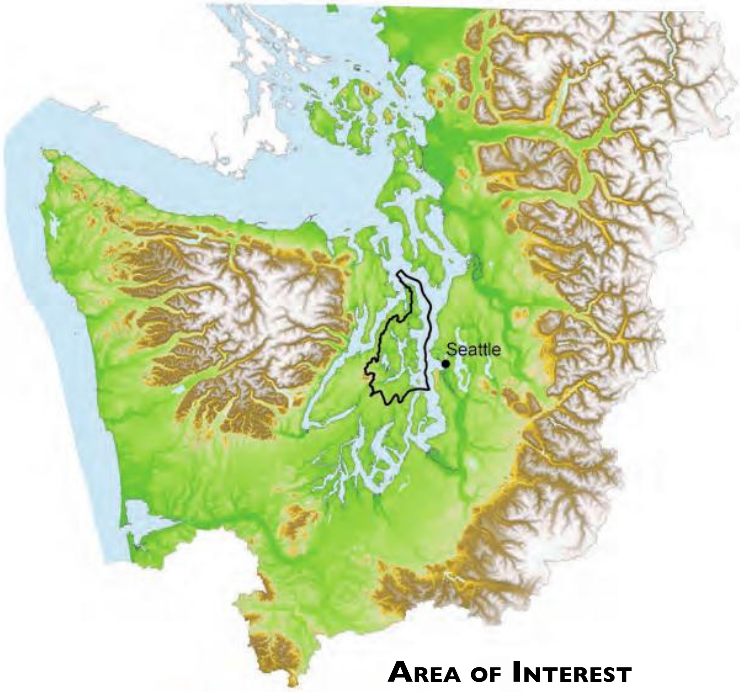
2020 State of Our Watersheds Report
Kitsap Basin

Respect for the land and waters, the abundant natural resources, and a deep understanding of the delicate supportive relationships of the natural systems were central themes in all Northwest Indian cultures. It is still true to this day for the Suquamish people. The tribe continues to be a good steward, managing, honoring and enhancing the resources, and guarding habitat and wildlife. Despite encroachments, the Suquamish people are still committed to steadfastly protecting areas and resources of cultural and traditional significance.

– Rob Purser
Fisheries Director



Area of Interest

Suquamish Tribe

The Suquamish Tribe has inhabited the Kitsap Peninsula since time immemorial. They are party to the Point Elliott Treaty of 1855, when tribes ceded their traditional lands to the U.S. government. This report will focus on the watersheds and nearshore/marine waters of the East Kitsap area, one of many areas within the Suquamish Tribe's adjudicated Usual and Accustomed fishing area. The East Kitsap marine shoreline and its dozens of streams provides vital habitat for salmonid production.

Cumulative impacts to salmonid habitat continue as a result of residential and commercial land use development, including clearing of vegetation and removal of native soil, groundwater extraction, and encroachment into riparian corridors, floodplains and marine shorelines. The loss of forest cover and increased impervious surfaces negatively impact streamflows and water quality, including water temperatures, and the ecological health of watersheds. These land use impacts will likely be amplified by climate change in the coming decades.

Suquamish Tribe

Portion of East Kitsap Area

The Suquamish Tribe's Usual and Accustomed fishing area (U&A) includes marine waters from the northern tip of Vashon Island to the Fraser River, including but not limited to Haro and Rosario straits, the San Juan Islands, the streams draining into the western side of Puget Sound and also Hood Canal. This report focuses on the East Kitsap area, a small portion of the tribe's extensive U&A and home to the Port Madison Indian Reservation.

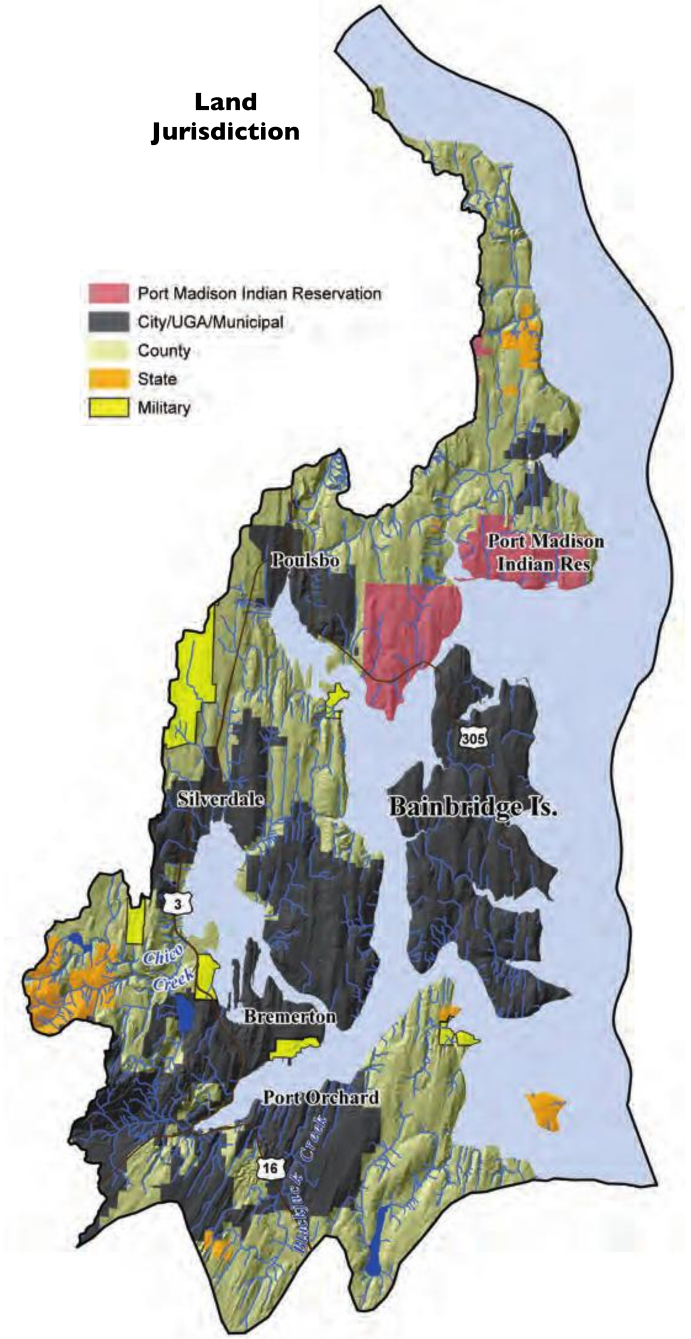
The shorelines of East Kitsap area form the eastern portion of Kitsap County, including Bainbridge Island, and its streams flow to central or southern Puget Sound. These lowland streams provide ideal spawning and rearing habitat for multiple species of salmonids. Many of them originate from lakes, springs, or headwater wetlands.[1] Streamflows are dependent on rainfall and groundwater contribution.

The entire Kitsap Peninsula (including the East Kitsap area) is 400 square miles in size, with 360 miles of marine shoreline, which accounts for nearly half of the nearshore habitat in south and central Puget Sound and is vital for threatened chinook, as well as for chum, coho, steelhead and cutthroat trout from watersheds throughout Puget Sound.[2]

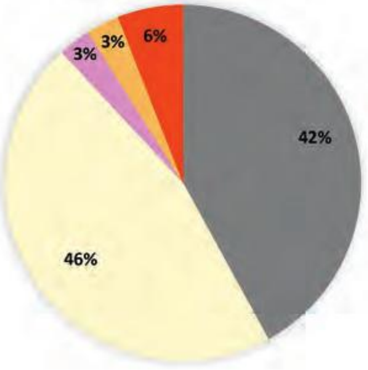
The U.S. Navy owns most of the federal land in the East Kitsap area, and some of these lands contain valuable habitat. These Navy installations occupy significant stretches of developed shoreline and nearshore marine areas (e.g., Puget Sound Naval Shipyard in Bremerton) and present significant challenges to protecting and restoring habitat. Navy operations have left a legacy of contaminated sites in the East Kitsap area, in upland, nearshore and sub-tidal marine waters with the transport of toxins potentially impacting receiving waters. Although the Navy's internally developed Integrated Natural Resource Management Plans (INRMPs) provide environmental guidance, they do not ensure the protection of treaty-reserved rights and resources or consistency with state and local land use and other environmental laws designed to protect habitat.

East Kitsap area salmon recovery has been implemented with the recognition of the critical role played by the nearshore and marine areas in providing support for salmon species originating from all portions of Puget Sound.[3] The tribe led a collaborative effort with local governments and other salmon recovery partners in developing the East Kitsap Demographically Independent Population Steelhead Recovery Plan (EK DIP Plan) to guide local recovery of steelhead as part of Puget Sound Steelhead recovery.[4]

Completed in 2020, the EK DIP Plan emphasizes strategies to protect and restore watershed processes that ensure adequate cool clean water for steelhead, including protection and restoration of wetlands and both riparian and upland forest conditions, opening access to stream habitats through removal of fish passage barriers and reconnecting floodplains. The plan calls for property acquisitions and easements to protect key habitats and improved land use regulatory protections and compliance where needed. The plan identifies critical data gaps in monitoring steelhead population and habitat trends in the East Kitsap area. The overall goal is to protect, restore and enhance watershed natural processes and habitat in order to contribute to Puget Sound-wide salmon recovery.



Jurisdiction Percentages



Map Data Sources: SSHIAP 2004,[5] USFWS 2018,[6] WADNR 2016,[7] WADNR 2018,[8] WADOT 2018a,[9] WADOT 2018b,[10] WAECY 1994,[11] WAECY 2018a,[12] WAECY 2018b[13]

Chapter Summary

The Suquamish Tribe has inhabited the Kitsap Peninsula and surrounding areas since time immemorial. They are party to the Point Elliott Treaty of 1855, when tribes ceded their traditional lands to the U.S. government. The Suquamish Tribe are leaders in the region's salmon recovery effort. No other people know these watersheds as well as the tribes and none has a greater stake in their future. The tribes believe that if salmon are to survive, real gains in habitat protection and restoration must be achieved.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds and poor early marine survival, where salmon begin and end their lives. The tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling and 1994 Rafeedie decision upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the fisheries resource.

The goal of this report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org.*

For this report, the Suquamish Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing a metric for assessing changes in salmon habitat. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Population Growth and Impact on Habitat

The human population continues to rise (4%) in Kitsap County, from 2014-2019 with the highest growth rate of 11% in the city of Poulsbo. Population growth has historically resulted in habitat loss, a major factor contributing to the decline of salmon stocks in the Salish Sea. A fundamental challenge is to develop the land and use resources far more sensitively in the future than has been done in the past.

Increasing Urbanization Degrades Habitat

Impervious surface increased slightly (2%) from 2011-2016, slowing the conversion of forestland and the impacts that come with development.

Upland and Riparian Land Cover Conditions

From 2011 to 2016, the upland and riparian land cover conditions remained about the same, with forest cover losing about 380 acres (0.5% of the area)[1] and the riparian area losing about 1% to development. The management and protection of forestland cover is vital to the recovery of salmon and with the threat of an increasing population, we need to focus our efforts on protecting what remains and restoring a fully functional riparian zone where possible.

Stormwater Runoff Factors Connected with Coho Pre-Spawning Mortality (PSM)

In the Pacific Northwest, adult coho salmon returning from the ocean to spawn in urban basins of the Puget Sound region have been prematurely dying at high rates for more than a decade. Based on NOAA's latest 2017 model, of the 107 miles of known coho distribution in the East Kitsap area, 96 miles (90%) are predicted to have a PSM rate of 15% or more.

Wells Potentially Impact Low Flows

As the population grows, so will the demand for groundwater. The East Kitsap area saw an increase of 9.1% in the number of water well logs from 2015-2019. The quantity of usable groundwater in the area is likely limited, mostly due to the peninsula's geography, but as groundwater usage increases there is a potential for water level declines, seawater intrusion and critical decreases in the groundwater discharge contributing to streamflows.

Shoreline Modifications Continue to Threaten Salmon Rearing and Forage Fish Spawning Habitat

Fifty-six percent of the East Kitsap Area of Interest shoreline remains armored. However, from 2015-2018 habitat restoration progress occurred by the removal of 462 feet of armoring. During this same time period however, there were 35 projects to replace bulkheads, totaling 4,508 feet. These repair projects extend the impacts of the structures instead of restoring the natural functions of the shoreline. In addition to outright burial of forage fish spawning habitat, bulkheads and other shoreline modifications over time can cause gravel and sandy beaches to become rocky and sediment starved, reducing the quality and quantity of habitat for many native species like herring, surf smelt, sand lance and salmon.

Impacts of Culverts and Roads

Barrier culverts partially or fully block at least 155 miles of known fish habitat in East Kitsap area, which prevents salmon from accessing spawning and rearing habitat. The area also is impacted by a high density of roads, with no detectable change from the 2016 analysis. Along with the high density of roads comes the negative impacts of stream crossings which increased to 44% of the area during the same time period.

Chico Creek Restoration

Since the 1960s, the mouth of Chico Creek, a sprawling delta where the stream meets Puget Sound, has been restricted into two concrete boxes but beginning in 2022 will be replaced with a bridge. In 2019-2020, the Suquamish Tribe and Kitsap County Public Works joined forces on a project that replaced a narrow 36-foot box culvert that spanned Chico Creek underneath Golf Club Hill Road with a 140-foot bridge, improving access to miles of habitat for salmon.

Watershed Restoration and Salmon Recovery Planning

The Suquamish Tribe has been instrumental in the effort to develop several watershed assessment and restoration plans in the East Kitsap area in recent years and the implementation of these plans is critical to the successful recovery of the salmon and steelhead of the area.

Marine Water Quality Threatened at Important Shellfish Growing

Following improvements to the City of Bremerton's wastewater treatment facilities beginning in the 1990s, portions of Dyes Inlet were approved for tribal shellfish harvesting. However, recent water quality monitoring in the Chico Bay area shows degraded conditions, resulting in the downgrade of shellfish beds in this area to "prohibited." The tribe continues to work to re-open this and other beaches in East Kitsap area to shellfish harvest.

Importance of Eelgrass in Puget Sound

Eelgrass provides multiple important ecosystem functions, including foraging and shelter habitat to young salmon and Dungeness crab, and spawning surfaces for species such as Pacific herring. Eelgrass abundance, distribution and depth data identify sensitive habitat areas for consideration in land-use planning. Given the recognized ecological importance of eelgrass, regional planning efforts should explicitly consider the location of eelgrass beds, its environmental requirements and potential habitat.

Climate Change

Warmer temperatures and changes in precipitation patterns associated with climate change will drive shifts in ecosystems that will impact watersheds, Puget Sound and oceanic conditions, with major implications for the Suquamish Tribe and traditional foods.

Conclusion

The East Kitsap area has seen some successes in habitat recovery in recent years but some key habitat indicators have not improved or worsened. Tribal leadership have concerns with the increase in population and the impacts that come from it. The loss of riparian and aquatic habitat are major factors contributing to the decline of salmon stocks in the Salish Sea. Since the last State of Our Watersheds Report in 2016, there have been slight changes to key indicators, but overall habitat is not improving, except a measurable reduction (462 feet) in shoreline armoring.

Impervious surfaces have increased slightly. The forest cover lost in the East Kitsap area between 2011-2016 was negligible. The East Kitsap area saw an increase of 9.1% in the number of water well logs from 2015-2019. Fifty-six percent of the East Kitsap Area of Interest shoreline remains armored. From 2015-2018, Kitsap County had 8 new bulkhead projects for an additional 973 feet, ten projects to remove bulkhead (1,435 feet) and 35 projects to replace bulkhead (4,508 feet). Even though restoration is occurring, it is not enough to keep up with the impacts of a growing population and their land use decisions. Land use and water laws that are in place and meant to protect critical areas and fish habitat need to be implemented.

Salmon recovery includes education and voluntary actions that support habitat protection and restoration, but it also needs to include enforcement when those laws are broken. The future of treaty rights in the East Kitsap area depend on it.

Recovery Efforts Show Signs of Improvement But Still Lagging in Key Indicators

At the 15-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Kitsap basin planning area shows that priority issues continue to be degradation of water quantity and quality, floodplain and riparian processes, marine shoreline habitat conditions, and fish habitat blockages from culverts and other human-made structures. In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations.

In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress. Although habitat degradation continues, there are some positive developments that we hope gain traction.

Review of the trends for these key environmental indicators since the 2016 State of Our Watersheds Report shows a positive trend when looking at the continued efforts in the restoration of the Chico Creek watershed and the reduction of new shoreline armoring. However, there is a concern with the increase in replacement of failing shoreline armoring as opposed to removal or requiring soft armoring. Overall, the trends of these key environmental indicators show a continued decline in habitat status.

Tribal Indicator	Status	Trend Since SOW 2016 Report
Population Growth	The population estimate for Kitsap County showed a growth of 4.4% from 2014-2019. Bremerton's growth rate for this same time was 6.4%; Port Orchard was 6.1% while Poulsbo grew by 11%. Along with this population growth comes habitat loss which is a major factor contributing to the decline of salmon stocks in the Salish Sea.	**Declining**
Impervious Surface	Impervious surface increased slightly from 2011-2016 with an additional 366 acres (.6 sq. mi) added to the Suquamish Area of Interest.	**Declining**
Upland and Riparian Land Cover	The forest cover lost in East Kitsap area between 2011-2016 was minimal – 384 acres (.5%). According to the latest 2016 National Land Cover Database, only 1% of the riparian zones in the marine and freshwater shorelines of the watersheds showed an increase in developed areas.	**No Trend**
Water Quality - PSM	Based on NOAA's latest 2017 model, of the 107 miles of known coho distribution in the East Kitsap area, 96 miles are predicted to have a Pre-Spawn Mortality (PSM) rate of 15% or more.	**Declining**
Water Wells	The East Kitsap area saw an increase of 9.1% and the Port Madison Water Resource area a 7.1% increase in the number of water well logs from 2015-2019.	**Declining**
Shoreline Modifications	From 2015-2018, Kitsap County shoreline armoring was reduced by 462 feet, while 4,508 feet of bulkhead was replaced. Fifty-six percent of the shoreline in the Suquamish Area of Interest remains armored.	**Improving**
Culverts	The 2016 State of Our Watershed report reported 78 miles of known fish habitat was partially or fully blocked to fish passage. In 2019, the barriers of the East Kitsap area was reassessed, resulting in a 99% increase of known fish habitat being partially or fully blocked to at least 155 miles.	**Declining**
Road Densities and Stream Crossings	The drainage units impacted by high road densities (>3 miles of road per square mile) remain at 94%, while there was an increase of 19% of the area negatively impacted by stream crossings .	**Declining**
Restoration	Suquamish teamed with Kitsap County in 2019-20 in replacing barrier culverts with a 140-foot bridge span and channel restoration on Chico Creek. In addition, construction is scheduled to begin in 2022 on replacement of barrier culverts under State Route 3 with a wide bridge span at the mouth and upper estuary of Chico Creek.	**Improving**
Shellfish	Following improvements to the City of Bremerton's wastewater treatment facilities and on-going monitoring, portions of Dyes Inlet are approved for tribal shellfish harvesting. Recent water quality degradation in the Chico Bay area resulted in downgrades to "prohibited." Suquamish continues efforts to re-open Chico and other beaches in East Kitsap.	**Improving**

The Suquamish Tribe continues to work toward the protection and restoration of healthy and functional watersheds, streams, nearshore and estuarine habitat.

Looking Ahead

The Suquamish Tribe's activities in the near future will emphasize, but are not limited to, the following:

- Continue working with entities to upgrade shellfish growing area classifications in the East Kitsap area, as there was a downgrade of conditions in 2018 in Chico Bay;
- Analyzing shellfish tissue in order to extend shellfish growing areas in Dyes Inlet into Ostrich Bay, and the Liberty Bay growing area through Keyport;
- Continue working with WADOH on water quality assessments and identification and tracking water pollution sources at Richmond Beach in order to meet the criteria to classify and re-open beaches to shellfish harvest;
- Restoration of depressed native oyster, sea cucumber and cockle populations;
- Conducting actions to prevent further habitat and water quality degradation through review of land-use plans and development project permits;
- Continue working with WDFW on baseline forage fish surveys, expanding in 2021-2022 to include acoustic and trawl surveys for herring in the Port Orchard/Port Madison waters and other parts of Puget Sound;
- Participation in the review of response actions at Superfund and other contaminated sites;
- Continue working with the UW-Climate Impacts Group on climate resilience studies in the Chico Creek watershed, including streamflow and temperature modeling and identification of coldwater refugia;
- To facilitate the exchange of climate change and technology knowledge, the tribe is forming a Suquamish student climate change task force to gather and present climate change information to Suquamish staff and community and co-facilitate working groups addressing different climate-related impacts. The goal of these working groups is to identify impacts and opportunities as they emerge and design strategies to address them.
- Complete water type surveys in the Chico Creek watershed;
- Assess fish passage barriers in the Blackjack and Chico Creek watersheds, focused primarily on private stream crossings;
- Conduct riparian assessments using remote sensing, focused on the East Kitsap area as baseline for evaluating salmon recovery progress and identification of habitat conservation and restoration priorities.

Population Growth and Impact on Habitat

Population growth typically results in the conversion of land and habitat loss, a major factor contributing to the decline of salmon stocks in the Salish Sea. The population of Kitsap County grew 4.4% from 2014-2019.[1] Bremerton's growth rate was 6.4%; Port Orchard 6.1%, and Poulsbo grew by 11%.[2] The East Kitsap area contains Kitsap County's main population centers, including all the incorporated cities, several towns, and urban growth areas (UGAs).

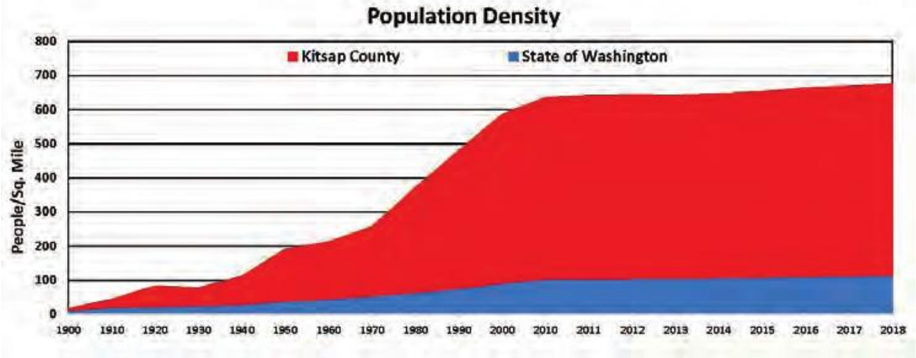
Land-use development affects many streams draining to the Salish Sea, including those in the East Kitsap area. Development has detrimental impacts on habitat and salmon populations that will likely increase with the expected rise in human population predicted for the next century.[3] Kitsap County is one of the smallest counties in the state in terms of land area at about 395 square miles. However, it ranks third in terms of population density, with 636 people per square mile.[4]

Increased development results in multiple water quality concerns, including impacts from fine sediment, fertilizers, pesticides, nutrients, bacteria, heavy metals and other chemicals. Low dissolved oxygen can result from a combination of high stream temperatures and eutrophication resulting from development. Untreated runoff in areas of high road densities adversely affects salmon. In marine waters, excessive amounts of nitrogen and phosphorus contribute to eutrophication and algal blooms in marine waters, which can degrade water quality and result in fish kills, toxic algal blooms, and impacts to eelgrass and kelp.[5] As population density grows, pollutant loads will generally tend to increase.

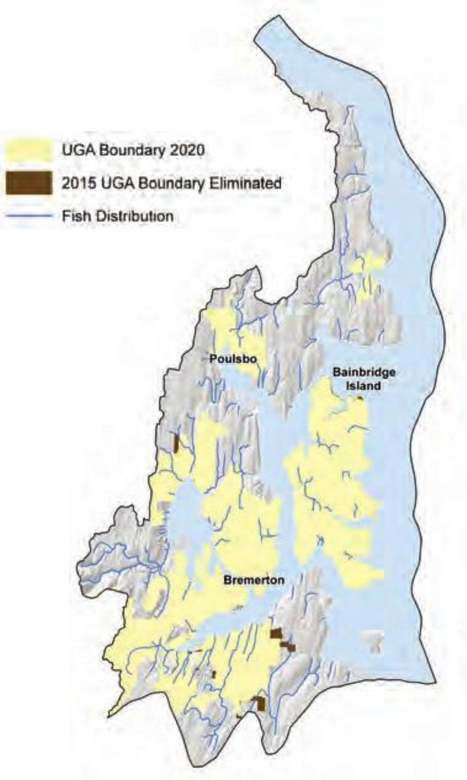
Groundwater storage, provided by aquifers and wetlands, contributes clean cool water to stream flows.[6] However, the risk of contamination of critical aquifer recharge areas may increase with intensification of land uses. As development occurs in more rural areas, the increase in impervious surfaces and conversion from septic to community sewer systems will reduce natural infiltration to groundwater and surface waters.[7]

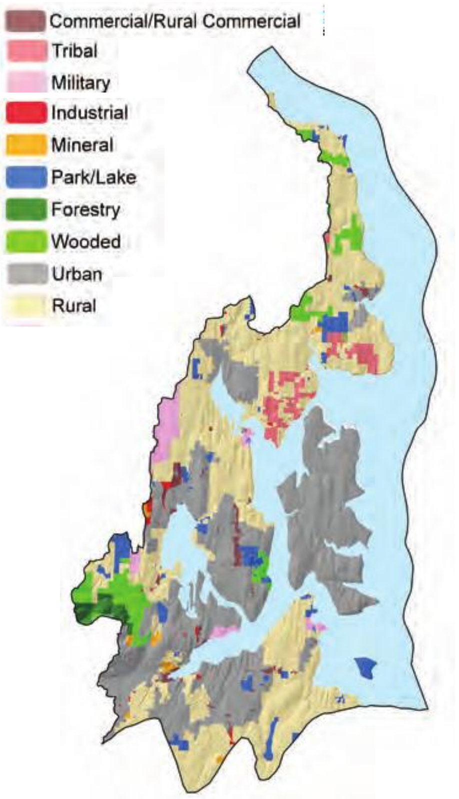
Wetlands (especially those in headwater areas) help control sediments and pollutants, and moderate floodwaters. Reducing the amount of surface water storage available within a wetland can result in increased peak flows, flooding and excessive sediment downstream. Healthy headwaters provide cool water to the system, which is imperative for fish health and survival. Properly functioning headwaters also provide essential food supply for salmon including living organisms like insects and decaying organic matter.

As the population increases in the East Kitsap area, local governments need to avoid increases in impervious surface and removal of native vegetation, particularly near sensitive stream and wetland habitats through increased zoning densities, infill, innovative re-development, and retrofitting stormwater facilities. Development practices that retain or restore vegetation and conserve water and energy also can help address issues related to climate change[8] (see Climate Change in this chapter).



Note: The time changes on the X axis are condensed from 1900-2010.





Map Data Sources: Kitsap Co. 2015,[9] Kitsap Co. 2019,[10] SSHIAP 2004,[11] WAECY 2019,[12] SWIFD 2019[13]

SUQUAMISH TRIBE

Increasing Urbanization Degrades Habitat

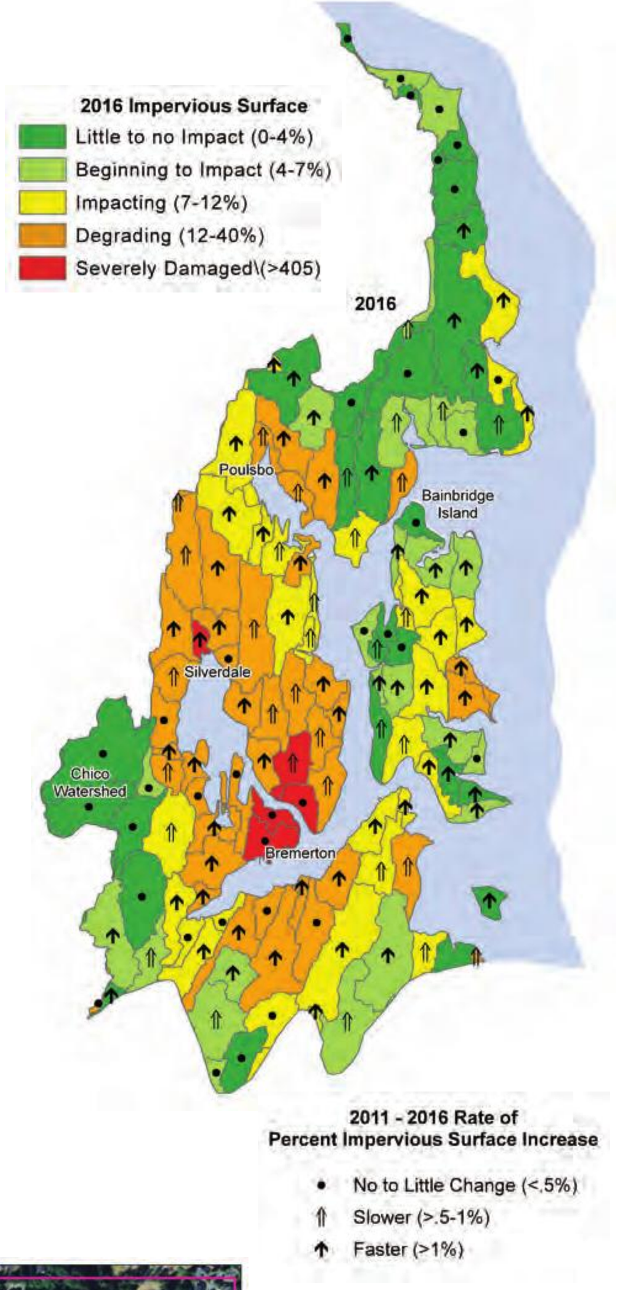
Impervious surfaces increased slightly (1%) from 2011-2016 with an additional 366 acres (.7 sq. mi) added to the Suquamish Area of Interest.[1,2]

Increasing urbanization has resulted in increased amounts of impervious surfaces: roads, parking lots, buildings, and a decrease in the amount of forested lands, wetlands, and other forms of open space that absorb and clean stormwater in the natural system and provide fish and wildlife habitat. This change in the impervious-pervious surface balance has caused significant changes to both the quality and quantity of stormwater runoff, leading to degraded stream systems. Impervious surfaces collect pathogens, heavy metals, sediment and chemical pollutants, and quickly transport them to streams, rivers, estuaries and Puget Sound during rain.[3]

Stream habitat quality starts to degrade when greater than 10 percent of the watershed is impervious.[4] As the amount of impervious cover increases, watersheds may experience an increase of storm flow and flood frequency, a decline in the abundance and diversity of fish and macro invertebrate populations, and an overall decrease of groundwater recharge and stream base flow. Less recharge means less ground water discharges to streams during dry periods.[5] With increased runoff and streamflows during storms, stream banks erode, more sediment is carried into streams from surrounding lands, and aquatic habitats suffer.

Impervious surfaces both absorb and reflect heat. During the summer months, impervious areas can have local air and ground temperatures that are 10 to 12 degrees (°F) warmer than the fields and forests that they replace. The trees that could have provided shade to offset the effects of solar radiation are absent as well. Water temperature in headwater streams is strongly influenced by local air temperatures. Stream temperatures throughout the summer are increased in urban watersheds, and the degree of warming appears to be directly related to the imperviousness of the contributing watershed.[6]

A number of land-use planning mechanisms are being used in the East Kitsap area to avoid the conversion of natural landscapes to developed and more impervious surfaces. These include acquiring properties that are likely to be developed in locations and at scales that provide high conservation values, and working with landowners to protect streams, wetlands and other sensitive habitats through conservation easements. Additional measures such as the use of transferred development rights, aggregating legacy parcels, and eliminating non-conforming uses could also be effective means of minimizing or reducing impervious surfaces over time. Enforcement of existing land use regulations, and improvements to regulations over time, including minimizing variances and exemptions, also would help slow the loss of forestlands and conversions to impervious surfaces.



Area of increased impervious surface resulting from build-out from 2011-2016 just northeast of Silverdale.

Map Data Sources: NAIP 2013,[8] NAIP 2017,[9] NLCD 2011,[10] NLCD 2016,[11] WAECY 2011d,[12] WAECY 2018b[13]

Upland and Riparian Land Cover Conditions

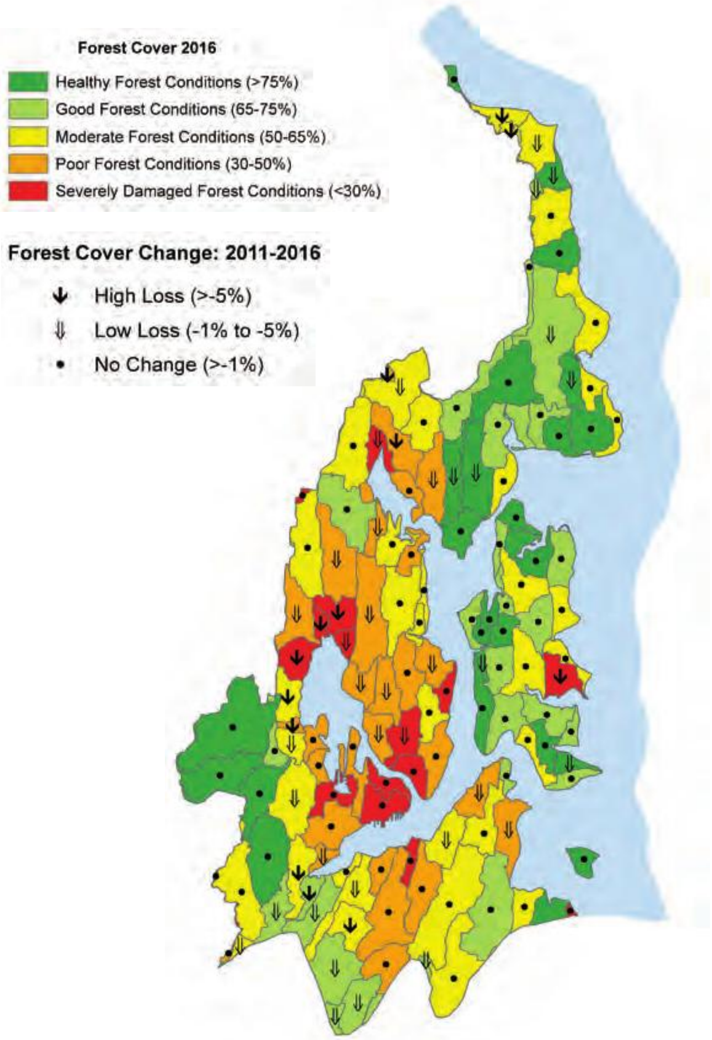
The forest cover lost in the East Kitsap area between 2011-2016 was minimal – 384 acres (.5%).[1] According to the latest 2016 National Land Cover Database, only 1% percent of the riparian zones in the marine and freshwater shorelines of watersheds showed an increase in developed areas.[2]

The goal of the East Kitsap area salmon recovery plan is to restore healthy self-sustaining salmon populations. One of the key objectives is to protect and restore marine nearshore areas, which is considered a priority based on benefits to all salmon stocks using these waters.[3] The recently completed steelhead recovery plan emphasizes protecting and restoring watersheds, including stream riparian corridors and wetlands.

Vegetation along the shoreline provides a myriad of benefits for the water body, the upland area and shoreline residents and users. Vegetation helps to stabilize soils, filters pollutants and fine sediments, contributes to improved water quality and provides shade necessary to maintain the cool temperatures required by salmonids and spawning forage fish. More stable banks reduce occurrences of landslides, damage to structures and threats to human safety. The most effective ways to conserve vegetation are to acquire property for conservation purposes and to implement and enforce fully functional riparian regulatory buffers.

These protections provide shoreline ecological functions (notably shade, wood and other organic inputs, and complex and diverse habitat structure) and help local governments achieve the no net loss standard and other requirements of Shoreline Master Program comprehensive updates.[4] Large woody debris is the primary structural element that helps moderate flows and sediment deposition while forming pools and complex habitat, providing critical salmonid rearing and refuge habitat. Abundant large woody debris increases aquatic diversity and stabilization.[5]

From 2011-2016, the amount of forest cover lost in the East Kitsap area was only 384 acres (.5%). According to the latest 2016 National Land Cover Database, only 1% of riparian zones in marine and freshwater shorelines showed an increase in developed areas. In addition to forest cover, future assessments should measure status and trends in "mature" forest cover. Research shows that young forests evapotranspire at much higher rates (potentially affecting adjacent stream flows) than more mature forest stands.[6] Mature forests also tend to support other watershed processes and functions, including erosion control, diverse fish and wildlife structure, and moderation of high flows.



Forest Cover Lost, North of Poulsbo, Wash.

2011 **2016**

Trees and vegetation along the shoreline were retained when this house was built in Kitsap County, providing a buffer between the house and the water.

Map Data Sources: NOAA 2019,[6] WAECY 2011,[8] WAECY 2018b[9]

Suquamish Tribe

Stormwater Runoff Factors Connected with Coho Pre-Spawning Mortality (PSM)

Based on NOAA's latest 2017 model, 96 of 107 miles (90%) of known coho habitat distribution in the East Kitsap area are predicted to have a PSM rate of 15% or more.[1]

In the Pacific Northwest, adult coho salmon returning from the ocean to spawn in urban basins of the Puget Sound region have been prematurely dying at high rates for nearly 20 years.

The current weight of evidence indicates that coho deaths are caused by toxic chemical contaminants in land-based runoff to urban streams during the fall spawning season. Non-point source pollution in urban landscapes typically originates from discrete urban and residential land use activities. Studies have found that spawner mortality was most closely and positively correlated with the relative proportion of local roads, impervious surfaces and commercial property within a basin.[2]

Researchers are trying to determine which chemicals in stormwater are contributing to the deaths of large numbers of coho salmon in Puget Sound. Stormwater may be Puget Sound's most well-known pollutant, and at the same time, its least known. While the state has called stormwater Puget Sound's largest source of toxic contaminants, scientists are still having a tough time answering two basic questions about it: What is stormwater exactly and what does it do?[3]

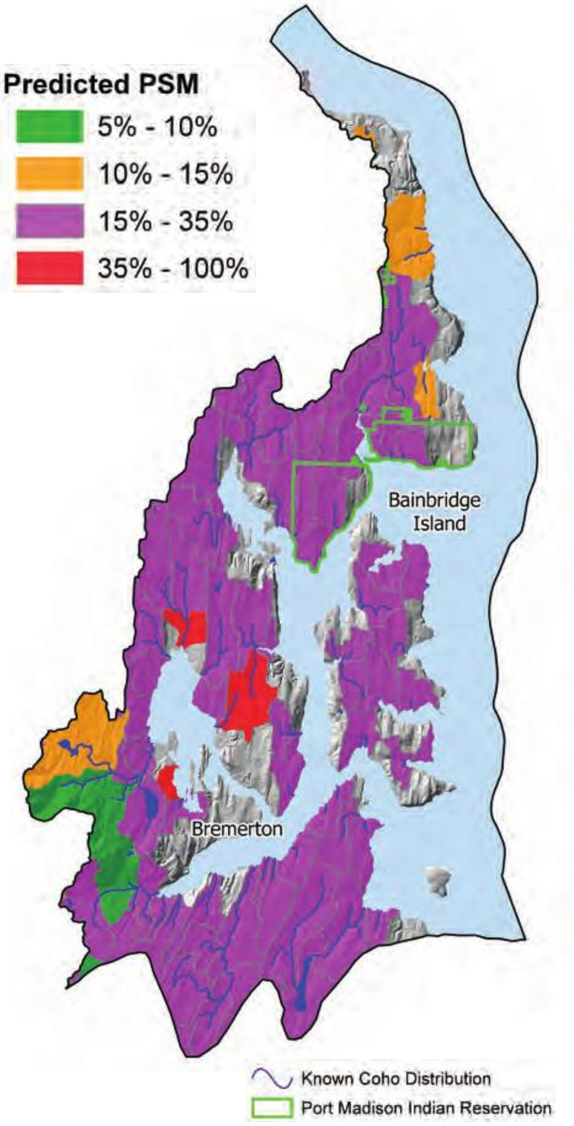
The annual pre-spawning salmon mortality study at the Suquamish Tribe's Grovers Creek Hatchery takes a different twist each year. After six years of learning how coho and chum salmon are affected by runoff from urban streets, scientists are narrowing down which pollutant is killing fish. In 2017, they focused on how tire residue in water affects juvenile and adult coho and chum salmon.

The yearly work at Grovers Creek is part of a larger effort to understand the causes and consequences of coho pre-spawn mortality in urban watersheds.

"A major take-home of the work is that it looks like the chemical causing the most problems are coming from motor vehicles," said Nat Scholz, lead for the Ecotoxicology Program at NOAA's Northwest Fisheries Science Center. "Put simply, the greater the traffic density within a given geographic area, the stronger the association with the mortality syndrome. Rainfall appears to be playing a role, but in the more urban areas this influence is swamped out by vehicles."[4]

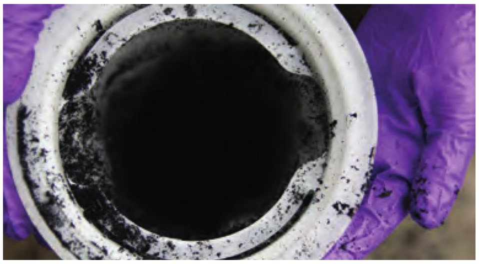
Scientists who have identified possible toxins are testing those and other substances, but their precise origin remains as murky as the stormwater itself, at least in the published literature. Researchers were able to reduce the runoff's toxicity simply by running it through a vertical soil treatment column: essentially, a barrel full of sand, shredded bark and compost. After that exposure, coho were fine. Scientists also are testing different lengths of swale for the extra removal of metals, running gallons of stormwater over a mix of Dutch clover and red fescue.

The goal is to learn what the minimum effective length of swale might be, so Washington Department of Transportation engineers will know how much to plant next to roads. Once we have a better idea of the contaminants in stormwater, people can start to recommend changes in a policy sphere.[5]



A pre-spawn mortality case in a female coho salmon.

Puget Soundkeeper



Tiffany Royal, NWIFC

After six years of learning how coho and chum salmon are affected by runoff from urban streets, scientists are narrowing down which pollutant is killing fish, including how tire residue in water affects juvenile and adult coho and chum salmon.

Map Data Sources: PSM Predictions 2017,[6] SSHIAP 2004,[7] SWIFD 2019[8]

SUQUAMISH TRIBE

Wells Potentially Impact Low Flows

The East Kitsap area saw an increase of 9.1% and the Port Madison Water Resource Area (PMWRA) saw a 7.1% increase in the number of water well logs from 2015-2019.[1]

Larry Stegall, Kitsap Sun

A chum salmon heads upstream at Chico Creek at Chico Salmon Park. Salmon are waiting for a healthy rain to help them through the last long shallow stretches of Kitsap's creeks and streams.

Groundwater is the primary source of water for Kitsap Peninsula residents and businesses.[2] Eighty percent (80%) of the Kitsap County population uses groundwater that is pumped from wells.

As the population grows, so does the demand for groundwater. The quantity of usable groundwater is limited. As a result of the peninsula geography, the potential for water level declines, groundwater discharge to streams decreases, and seawater intrusion as groundwater usage increases.[3]

Groundwater is restored by rainfall and infiltration, so during dry periods people need to conserve and minimize consumptive water use.[4] Groundwater tends to maintain streamflows on the Kitsap Peninsula through summer and early fall until rains replenish flows. A fundamental challenge is how to reduce water demand/consumption despite a continuing increase in population. It's been done in other regions and is possible here.

In January 2018, the state Legislature passed the Streamflow Restoration Act (SRA) to help restore streamflows to levels necessary to support robust, healthy and sustainable salmon populations while providing water for homes in rural Washington.

The law was in response to the Hirst decision, a 2016 Washington State Supreme Court decision that limited a landowner's ability to get a building permit for a new home when the proposed source of water was a permit-exempt well. The law clarifies how counties issue building permits for homes that use a permit-exempt well for a water source. The law directs local planning groups to develop watershed plans that offset impacts from new domestic permit-exempt wells and achieve a net ecological benefit within the watershed.[5]

Coho salmon, steelhead and cutthroat trout are the most vulnerable to low stream flows (and warm waters) because they rear in freshwater in the summer when low flow/high temperature conditions can constrain habitat and stress fish in some streams. The Suquamish Tribe and partners completed the East Kitsap Demographically Independent Population (DIP) Steelhead

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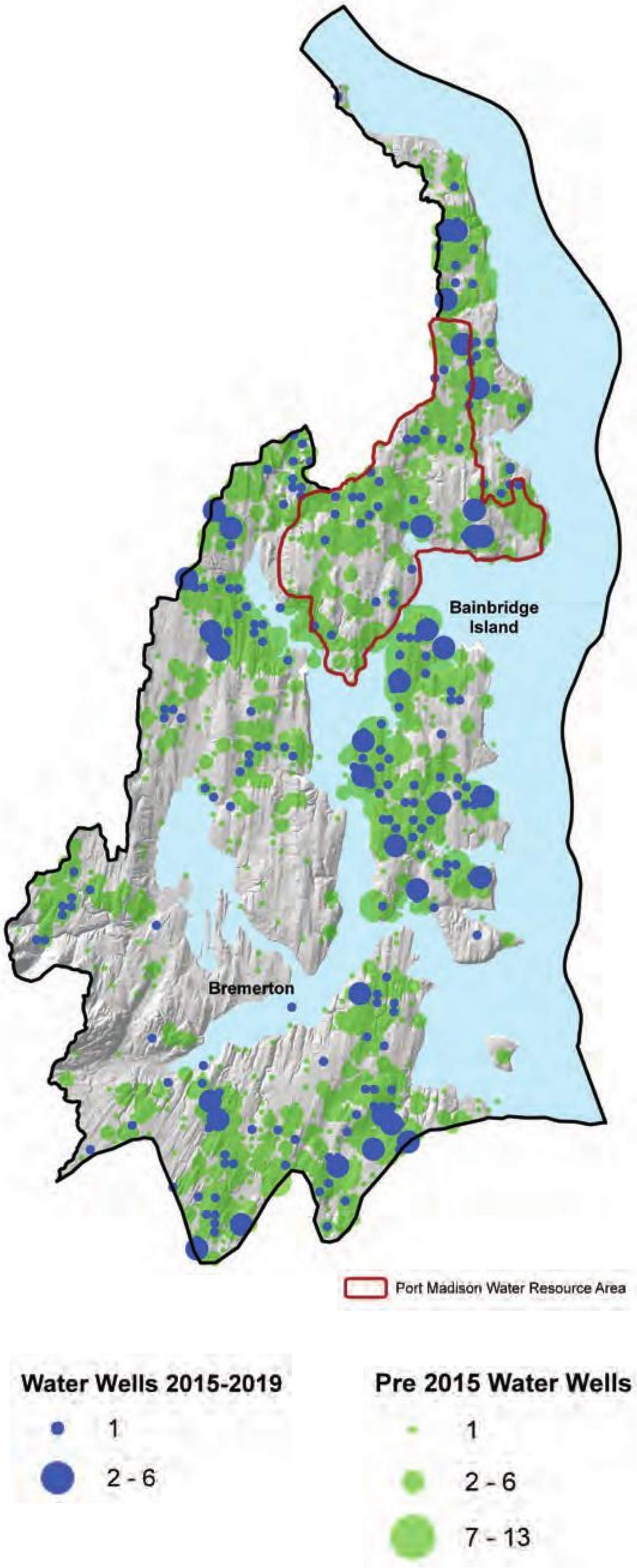

Map Data Sources: SSHIAP 2004,[7] Suquamish Tribe 2011,[8] WAECY 2018b,[9] WAECY 2019[10]

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Recovery Plan in June 2020.[6] The plan recognizes the bottleneck effect of low flows on steelhead productivity and capacity in the East Kitsap area and identifies various strategies to address water withdrawals and low streamflows for steelhead and their habitat:

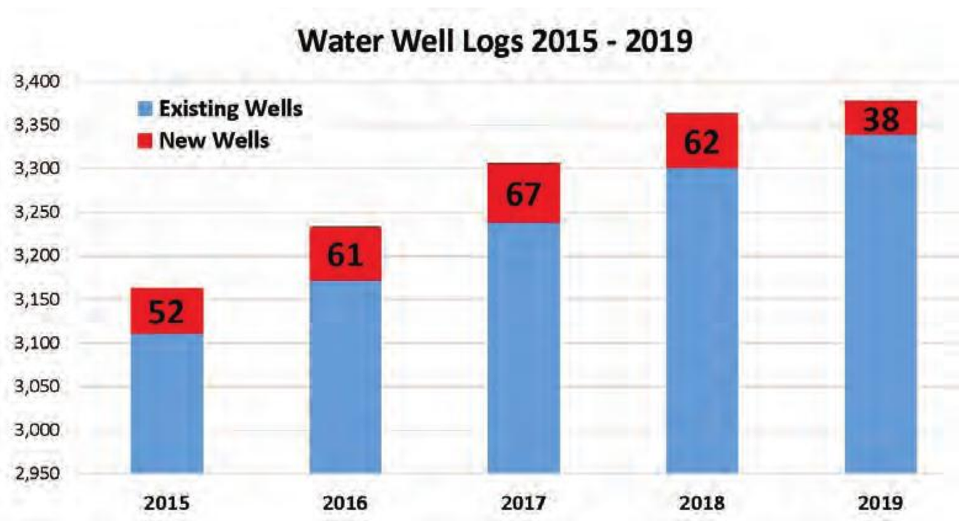
- Acquire and conserve high priority steelhead habitat, including headwater wetlands and riparian corridors
- Enforce and improve land-use regulations that protect hydrology, including aquifer recharge areas
- Protect and restore floodplain connectivity and promote connectivity with side channels and wetlands
- Protect beaver and their dams from removal to promote groundwater interaction, habitat complexity and water storage
- Restore wetlands on former and existing agricultural land
- Ensure that Ecology's WREC projects for offsetting exempt well impacts address steelhead habitat needs for groundwater
- Acquire water rights where instream flows are insufficient for steelhead due to water withdrawals
- Extinguish water rights if not used in five years, unless this results in perverse incentives
- Encourage jurisdictions and water districts to develop and implement water recovery and reuse strategies
- Use existing water reclamation infrastructure and develop new reclamation projects and infrastructure where feasible and a high priority for steelhead and other salmon
- Promote public education of water conservation (e.g., lawn and domestic use) and reclamation

In fall 2019, salmon managers reported dismal returns of chum and coho salmon to Puget Sound streams. Low rainfall in November led to low streamflows in the upper portions of many streams, where the water levels were often too low to allow passage of chum and coho. The fish were forced to lay their eggs in the larger channels, where heavy rains this winter may have washed the eggs out of the gravel before they hatched.

"The run (of chum) was pretty darn small," said Jon Oleyar, salmon biologist for the Suquamish Tribe who walks many streams in the East Kitsap area. His surveys of living and dead salmon are used to estimate escapement — the number of migrating salmon that return to their home streams.

"Some of the streams had no fish at all in them and many of the fish did not get very far up into the system," he said.

However, Oleyar observed a few positive features, such as beaver dams on Chico Creek — the largest producer of chum salmon on the Kitsap Peninsula. Although beaver dams can impede the movement of chum during low flows, they also can hold backwater during high flows, reducing the risk of extreme currents that can scour salmon eggs out of the gravel. Beaver ponds, in addition to helping store water and recharge groundwater, provide resting spots for migrating adult salmon and complexity of productive rearing habitat for juvenile salmon and steelhead.

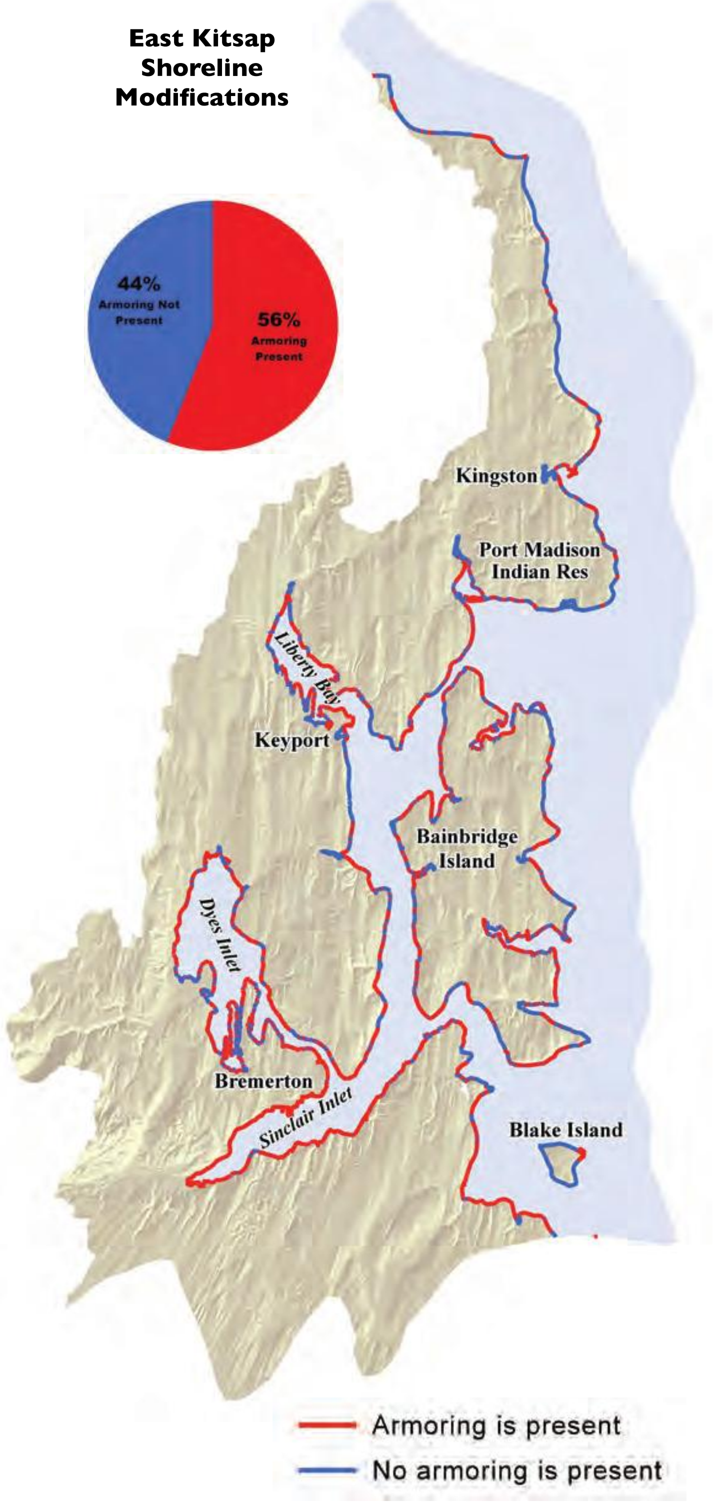


SUQUAMISH TRIBE

Shoreline Modifications Continue to Threaten Salmon Rearing and Forage Fish Spawning Habitat

Fifty-six percent of the Suquamish Area of Interest shoreline remains armored.[1] From 2015-2018, Kitsap County had 8 new bulkhead projects for an additional 973 feet, 10 projects to remove bulkheads (1,435 feet) and 35 projects to replace existing bulkheads (4,508 feet), achieving a net reduction of 462 feet of shoreline armoring.[2]


WA Dept. Ecology Coastal Atlas



Kitsap County geographically straddles the Central and Hood Canal basins of Puget Sound. It boasts 228 miles of shoreline, of which on average more than one third is armored with hard structures such as rock or timber bulkheads. The Suquamish Tribes AOI for this report includes a portion of the East Kitsap area.

The entire eastern portion, which drains to the Central basin, is more developed, and 42% of this shoreline is armored.[3] The east side of the Kitsap Peninsula constitutes almost half of the nearshore habitat in central and south Puget Sound.[4] Kitsap County has the highest number of residential parcels (7,806) on the shore of all Puget Sound counties.[5]

Shoreline armoring is the practice of using physical structures such as bulkheads to protect shorelines from coastal erosion.[6] Constructing bulkheads and rock revetments disrupts the natural process of erosion, which supplies much of the sand and gravel that maintains our beaches. Over time, shoreline armor may cause sand and gravel beaches to become rocky and sediment starved, reducing the quality and quantity of habitat for many native species like herring, surf smelt, sand lance and salmon.[7]

Reduction in shoreline armoring is one of the vital signs selected by the Puget Sound Partnership to indicate nearshore health and recovery in Puget Sound. The target is to have more armoring removed than have new armor installed in Puget Sound from the year 2011 to 2020.[8]

This goal has not been met but there are indications in recent years of a trend moving in the right direction. The majority of shoreline restoration opportunities in Kitsap County occur on private land. Kitsap County started Shore Friendly Kitsap, a program that offers financial incentives and other assistance for bulkhead removal in unincorporated Kitsap County, as well as public education and outreach activities.

Shore Friendly Kitsap has had 15 properties and their associated landowners participate in removing hard armor on

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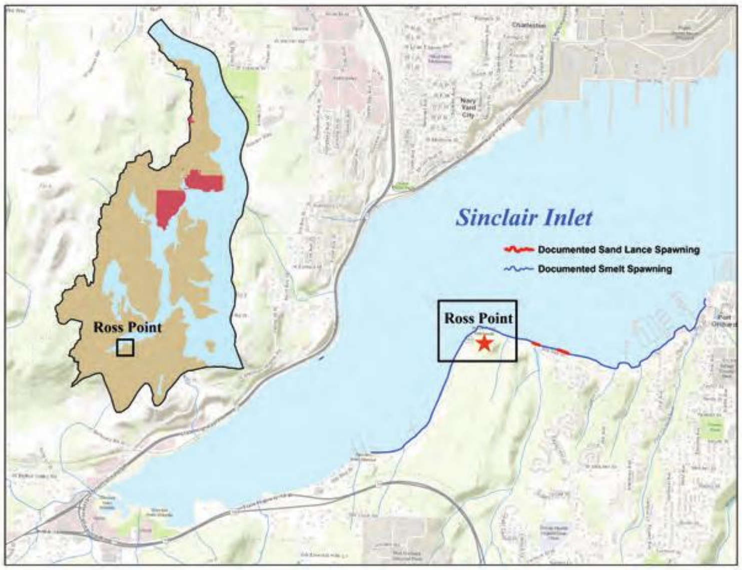
Map Data Sources: Coastal Geological Services 2017,[11] WDFW 2017,[12] SSHIAP 2004,[13] WAECY 2018[14]

SUQUAMISH TRIBE

Ross Point Bulkhead Removal Project



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their beaches. This has translated to a total of 1,149 feet of hard armor (i.e. bulkheads) removed or soft-shore beaches created.[9] The Suquamish Tribe is generally supportive of Shore Friendly and other programs that help landowners remove hard armoring. What is needed is to use these programs as a model and vastly scale up the efforts so that more shoreline habitat can be restored.

Ross Point and nearby Ross Creek, like many other Kitsap County shoreline areas, have been important to Native Americans long before the arrival of settlers. According to Leonard Forsman, Chairman of the Suquamish Tribe, the area was called *Scusad*, meaning "Star" in the Lushootseed language.

The tribe recently supported the removal of a bulkhead at Ross Point. The bulkhead removal in August 2019 restored spawning habitat for surf smelt and improved shoreline habitat for multiple marine species, including salmon.

Like most bulkheads built in the tidal zone, the 84-foot-long structure forced juvenile salmon to swim into deeper water, making them more vulnerable to predators. The bulkhead at Ross Point also disrupted natural shoreline erosion, which is how the beach maintains a continuous supply of sand and gravel, materials essential for spawning by forage fish.


Christopher Dunagan

Concrete bulkhead to be removed from Ross Point along the shore of Sinclair Inlet.


WDFW


WDFW

After bulkhead removal.

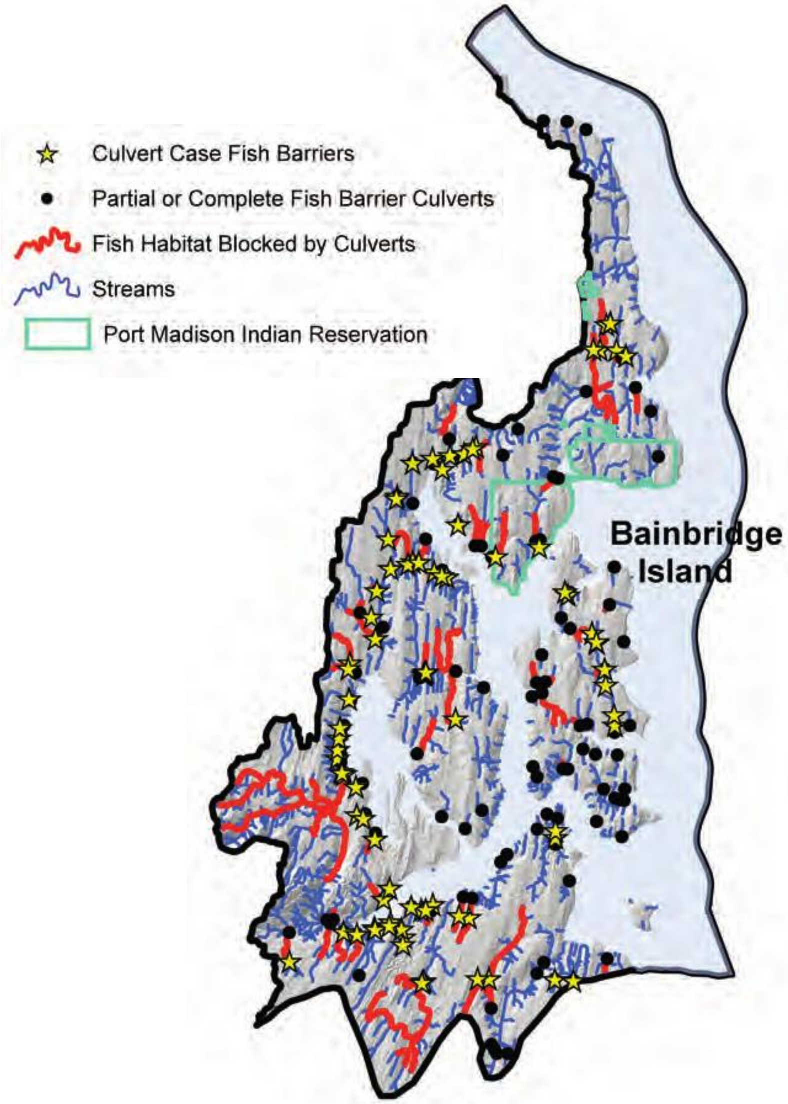

WDFW

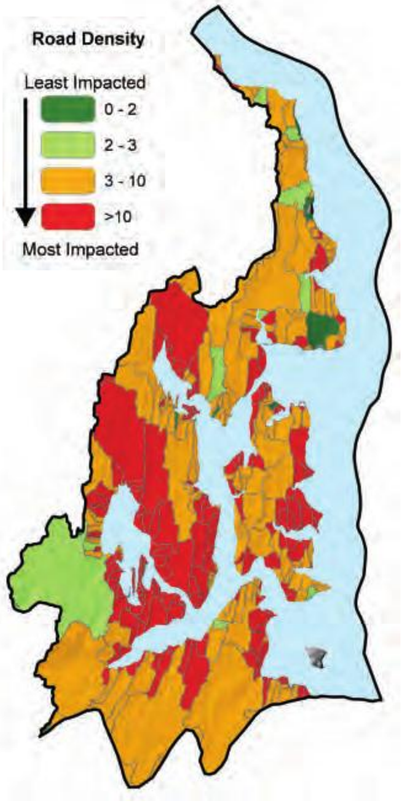
Surf smelt and sand lance

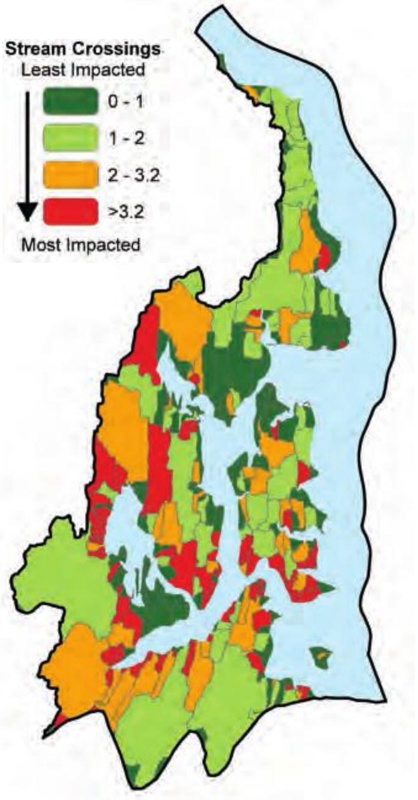
Forage fish include surf smelt, Pacific sand lance, herring and Northern anchovy. Surf smelt and Pacific sand lance lay their eggs intertidally on sand and fine gravel beaches. Many of these beaches are disappearing due to shoreline development and modification. The Suquamish Tribe received an EPA grant for tribal fisheries staff to work with Washington Department of Fish and Wildlife scientists and have been sampling East Kitsap area beaches since 2017 for forage fish eggs. This information will lead to better protection of these habitats by state, county and local cities and guide prioritization of shoreline restoration. Surf smelt are particularly important to the Suquamish people, both as food and to trade since time immemorial.[10]

Impacts of Culverts and Roads

Barrier culverts partially or fully block at least 155 miles of known fish habitat in the East Kitsap area;[1] 94% of the drainage units are impacted by high road densities (>3 miles of road per square mile),[2] and 44% are negatively impacted by stream crossings[3].







Urbanization typically results in the construction of road networks, which can be significant stressors to stream health. High road densities require stream crossings, culverts and other structures that remove riparian vegetation and constrain stream channels.[4] Culverts, when not adequately designed and built, can also prevent salmon and other fish species from accessing spawning and rearing habitats. The removal of fish passage restrictions in streams that provide important salmon habitat was identified as a high priority in the East Kitsap Salmon Recovery Plan.[5] Barrier culverts partially or fully block at least 155 miles of known fish habitat in the East Kitsap area.

The proper function of salmon-bearing streams may be at risk when road densities exceed 2 miles of road per square mile of watershed area and cease to function properly at densities over 3 miles/square mile.[6] Streams also have been shown to approach poor biological conditions when exceeding 3.2 crossings per mile of stream length.[7] High road densities affect almost every watershed in the East Kitsap area and a signif-

(Continued next page)

Map Data Sources: SSHIAP 2004,[10] WAECY 2018b,[11] SWIFD 2019,[12] WDFW 2019,[13] WDFW 2018,[14] Kitsap Cty 2004-2008,[15] WDNR 2019[16]

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Steve Todd

A triple-box culvert underneath Golf Club Hill Road, ranked as the county's top barrier to fish migrations, was replaced with a 140-foot bridge in 2019 and 2020.

icant number of watersheds are impacted by high numbers of stream crossings.

In 2019-2020, Kitsap County Public Works and the Suquamish Tribe partnered on a $4.4 million project that replaced the narrow 36-foot box culvert that spanned Chico Creek underneath Golf Club Hill Road with a 140-foot bridge, improving passage and access for salmon and steelhead spawning and rearing habitat. Officials have long ranked this narrow, undersized culvert as the worst impediment to salmon migration in Kitsap County, funneling water at a high velocity and making it difficult for salmon to get upstream. It was considered one of the worst offenders because it is located far down in the watershed, cutting off a large swath of salmon habitat. By replacing the culverts with a bridge, the project will allow more natural stream channel migration processes to take place and facilitate passage of all fish species at all life stages. Work also included streambed restoration, including removing weirs downstream and adding natural wood debris.[8]

This project builds on other important fish passage and habitat restoration actions that have taken place in the Chico Creek watershed the past several years, including removal of the Kitty Hawk Road crossing in the upper estuary, and fish passage and restoration upstream at the Dickerson Creek crossings at David and Taylor roads.

The next big fish passage improvement project on Chico Creek is to remove four culverts at the stream mouth under State Route 3 (SR 3) and replace one of these culverts with a long bridge. This will open and improve fish access to 21 miles of habitat and restore natural tidal exchange and channel migration. Design for the new bridge and channel restoration at SR 3 is underway from 2019-2021.

In 2018, the Mid Sound Fisheries Enhancement Group replaced a failing 24-inch concrete fish blocking culvert on a small stream draining into Sinclair Inlet in Gorst. The culvert was on a private driveway, and for several years, the landowners had not been able to access their house because a flood had washed away part of their driveway. The new culvert is 16 feet wide, with a natural stream bottom that will allow fish to freely pass. Though small, this stream may support coho, steelhead and possibly chum salmon. However, there are additional blockages that still need to be addressed on the creek.[9] Additional key fish barrier replacements in the East Kitsap area include the WSDOT culvert replacement at Anderson Creek. Fish passage designs are in progress for replacements on Salmonberry, Wright (Bremerton), and Blackjack creeks (2019-2021). The Family Forest Fish Passage Program is another funding source for removing private fish passage barriers.

Mid Sound Fisheries Enhancement Group

An eroded driveway (left) replaced with a 16-foot wide steel arch culvert (right).

Chico Creek Restoration

WSDOT

For more than 50 years, the mouth of Chico Creek, a sprawling delta where the stream meets Puget Sound, has been stuffed into two concrete boxes, which serve as a barrier to fish. During heavy rains, the creek rages like a fire hose through the twin culverts, which carry the stream underneath the constant traffic of State Route 3.[1]

The mouth of the creek is known to the Suquamish as the "Place of Chum Salmon." It is one the largest native salmon-producing creeks in Puget Sound. An average of 30,000 fish spawn in the watershed each year.

"The Suquamish people have relied on the dog salmon of Chico Creek for thousands of year as a source of food for the winter season," said Suquamish Tribal Chairman Leonard Forsman. We look forward to giving these ancestral fish a fighting chance for survival."[2]

Over the years, millions of dollars have been invested rehabilitating the rest of Chico Creek, Kitsap Peninsula's most productive salmon stream.

Nevertheless, biologists say removal of the highway culverts is the last barrier to unleashing the creek's full potential. The difficulty lies in the complexity and size of the project — one that state planners estimate will cost $55 million and include a new 400-foot-long bridge.

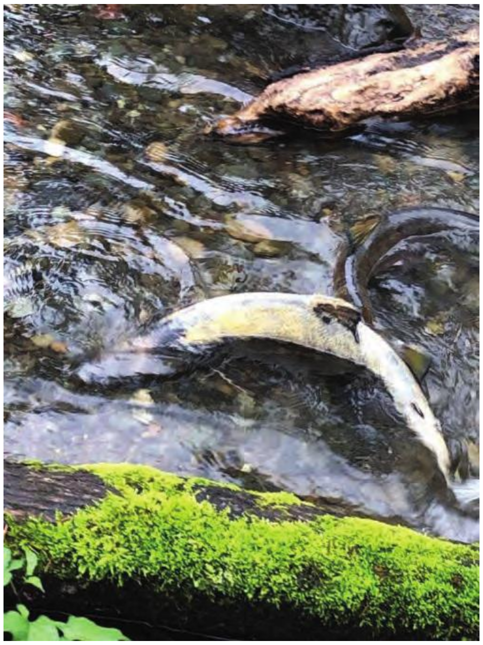
"I would say this is the monumental project for the east side of Kitsap," said Tom Ostrom, salmon recovery manager for the Suquamish Tribe.

In addition to improving fish passage, a new bridge would restore the natural movement of the stream's flow, including sediment and woody debris.

"It's a choke point," said Chris Waldbillig, a marine biologist with the state's Department of Fish and Wildlife (WDFW). "The fish have a really hard time migrating through, even under ideal conditions."

The state, which is under pressure to replace hundreds of culverts around the state that impede fish passage, has begun preliminary work on the project. State officials believe that if the mouth and estuary were free to meander under a new bridge, the creek would revert to its original route south of its current channel through the culvert.[3]

The enhancements for Chico Creek at this location will improve access to 21 miles of habitat and leverage similar efforts by Kitsap County to remove other barriers that impede fish migration. This work is part of Washington State Department of Transportation's (WSDOT) Fish Passage Barrier Removal Program. Working with WDFW, WSDOT identifies barriers to fish passage caused by culverts under state highways. Chico Creek has undersized culverts that serve as barriers to fish. Crews plan to remove the undersized culverts that carry Chico Creek under both directions of SR 3 at this interchange. Crews also plan to remove similar barriers to fish migration under both highway on- and off-ramps and Chico Way at this interchange. Construction on this project is scheduled to begin in Spring 2022 and be completed in Fall 2024.[4]



Noah Hlavaty

Kitsap Sun

Above, Chico Creek flows through two small culverts under State Route 3. Left, a female chum salmon returns to Chico Creek to spawn in late November 2019.

Suquamish Tribe

Watershed Restoration and Salmon Recovery Planning

The Suquamish Tribe has completed several watershed assessment and restoration plans in the East Kitsap area in recent years – Chico Creek (2014), Curley Creek (2017) and Blackjack Creek (2017) (*https://suquamish.nsn.us/home/departments/fisheries/environment/restoration-protection/*).

Developing these assessments and plans involved working with technical staff from local governments and other stakeholders to identify human pressures and stressors to salmonids in these watersheds, and provide recommendations for actions to protect and restore habitat functions. Priority recommendations emphasize the following (not necessarily in order of priority):

1. Dedicating land within stream and riparian corridors to allow for riparian processes, flood conveyance and storage, and geomorphic processes such as channel migration;
2. Improving compliance and/or strengthening land-use regulations;
3. Restoring and/or protecting forest conditions within the stream corridor;
4. Improving habitat conditions within and adjacent to former and current agricultural lands;
5. Managing forestry practices and development in upland areas outside of the stream corridor to ensure at least 65% of the land area in any sub-basin remains forested with hydrologically mature vegetation;
6. Improving fish passage at road and railroad crossings that pose barriers to fish passage (e.g., decommission roads, install wider bridge spans, replace culverts with bridges or larger culverts);
7. Removing artificial constraints (e.g., fill, revetments) to floodplain connectivity and channel migration;
8. Restoring wetland and floodplain water storage processes;
9. Restoring in-stream habitat conditions and reversing channel incision through placement of wood;
10. Protecting and restoring instream flows;
11. Retrofitting/improving stormwater attenuation in existing developed areas; and,
12. Engaging the public in watershed protection and restoration strategies and actions.

Long Live the Kings

Female steelhead on the Kitsap Peninsula

East Kitsap Steelhead Recovery Plan

In addition to individual watershed restoration plans, the tribe led the effort to develop the East Kitsap Demographically Independent Population (EK DIP) Steelhead Recovery Plan (completed in June 2020), in response to the 2007 listing of Puget Sound Steelhead under the Endangered Species Act (ESA). See links to the EK DIP steelhead recovery plan and the Puget Sound Steelhead recovery plan.[1]

The EK DIP Steelhead Recovery Plan was modeled in part and prepared in parallel with the Puget Sound Regional Steelhead Recovery Plan that was completed in Dec. 2019. However, there are differences between East Kitsap and the broader Puget Sound region with respect to the relative importance of some land use/habitat pressures and stressors on steelhead. The East Kitsap Steelhead Recovery Plan identified steelhead population and habitat recovery goals, the major pressures and stressors responsible for the depressed status of steelhead in East Kitsap, and the recovery strategies and actions intended to address those pressures and stressors. The recovery plan also provides guidance on implementing actions, data gaps and monitoring needs, and adaptive management.

Although nearshore habitats (e.g., eelgrass beds) are critical to chinook salmon and other salmon species along East Kitsap shorelines, there are no independent populations of chinook recognized in East Kitsap streams.

With a steelhead recovery plan now in place, the tribe, state and local governments, and non-profit conservation organizations will have better guidance on protecting and restoring entire watershed processes – from headwaters to estuaries – in the East Kitsap area than there was with chinook recovery planning alone, where more of the emphasis has been on nearshore habitat. Steelhead have more complex life histories and are different from chinook in this respect, using many parts of East Kitsap watersheds, from lower mainstems to accessible headwater areas where there is adequate cool clean water. Unlike most chinook in Puget Sound, steelhead use these watersheds year round, including during warm and low flow summer conditions and through winter floods. Therefore, steelhead are vulnerable to multiple habitat pressures associated with human land-use development as well as shifts in hydrology and increased water temperatures resulting from climate change.

The following strategies from the East Kitsap Steelhead Recovery Plan, if implemented, would address human pressures and improve habitat conditions to support increases in local steelhead populations:

- Protect the best (most intact) habitat;
- Manage for hydrologic maturity at watershed and drainage scales;
- Restore access and connectivity to freshwater habitats, both longitudinal (passage) and lateral (floodplains and wetlands);
- Protect and restore habitat with a focus on larger parcels (often former agricultural lands) that are vulnerable to conversion to residential and commercial development; and,
- Ensure adequate stream flows critical to steelhead freshwater life histories.

Suquamish Tribe

Marine Water Quality Threatened at Important Shellfish Grounds

Shellfish growing areas in Dyes Inlet have been open to bivalve harvest since 2004, following improvements in water quality. Recent routine sampling results show water quality degradation in several previously approved areas, jeopardizing shellfish harvest.

Intertidal areas along the extensive East Kitsap area shoreline and protected bays support an abundance of species that play important ecological roles, including creating nursery habitat and food for species at higher trophic levels.

Suquamish families have harvested clams, oysters and other shellfish from the intertidal for millennia, providing food and income throughout the year. Over the past 100 years of human population growth and development, pollution from stormwater runoff and failing septic systems has degraded habitat and water quality, causing human health concerns for those swimming in local waters or eating shellfish from impacted beaches. However, through considerable efforts by the tribe working with other entities and long-term monitoring, several areas, including parts of Liberty Bay and Dyes Inlet, have been restored and are now approved or conditionally approved for harvest.

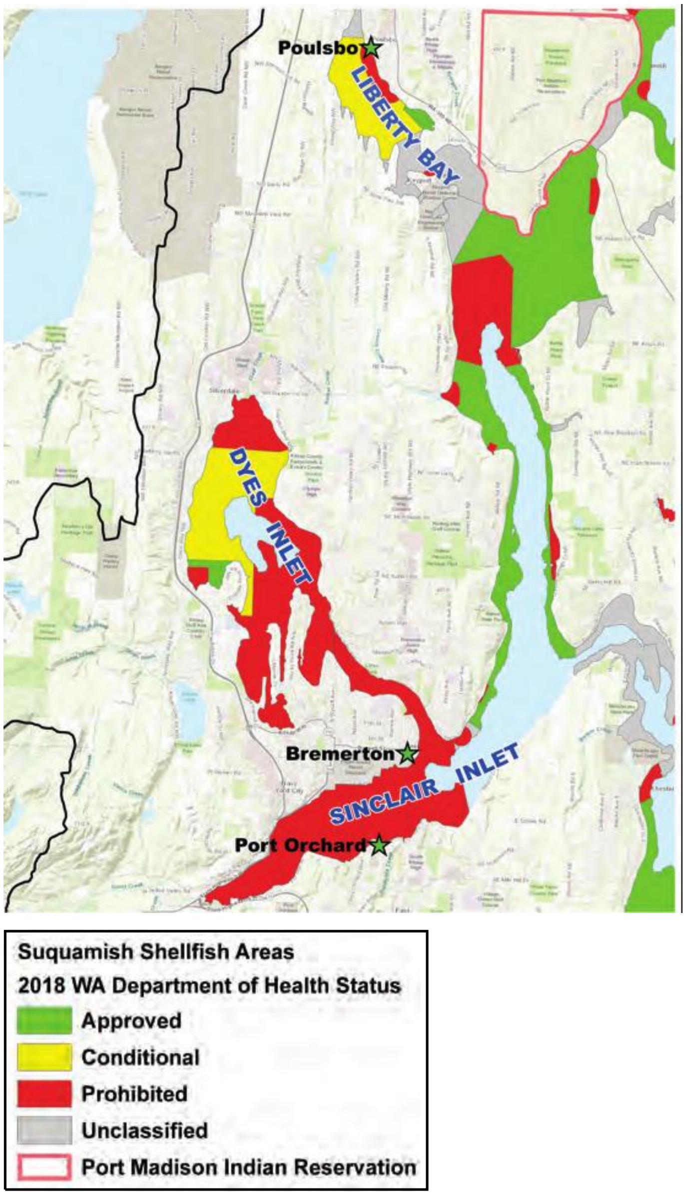
In the 1990s, the City of Bremerton completed extensive upgrades to its wastewater treatment facilities, resulting in improved stormwater treatment and significant reduction of combined sewer overflow events. A partnership comprised of the City of Bremerton, the Navy, Kitsap County Department of Health (KCH), state Department of Health (WADOH) and the tribe was formed to assess if these improvements could lead to certification of areas within Dyes Inlet for shellfish harvest. Drogue and dye studies identified areas on the north and west sides of Dyes Inlet, including Erlands Point, that would not be impacted in the event of a failure of the Bremerton treatment plant. After two years of water sampling to ensure the waters were clean, these areas were approved for shellfish harvest.

Over the past 20 years, clam and oyster harvest and production has significantly increased in Dyes Inlet. The tribe harvests the treaty share of clams on hundreds of tideland parcels. The tribe also leases beaches from owners of adjacent homes where all clams are targeted for harvest, then replanted with small clam seed. Over the years, the tribe also has purchased tideland properties where they are the sole management entity. One of these properties, located near Chico Creek in Dyes Inlet, spans 120 acres and supports rich habitat for natural and enhanced shellfish.

In addition to clam harvest, the tribal seafood enterprise started a Pacific oyster farm in 2016. This property also serves as a prized location for Olympia oysters. The tribe has partnered with Puget Sound Restoration Fund to restore beds on the property.

Shellfish harvest around the mouth of Chico Creek is now once again in jeopardy. In 2018, the WADOH Shellfish Division downgraded half of the Chico parcels from Approved to Prohibited. Continued routine sampling for fecal coliform (an indicator of human waste), found elevated levels at a marine water sampling station near the oyster farm, triggering a closure on the remaining eastern parcels. This downgrade forced the tribe to close its oyster farm and the only tribal beach designated solely for tribal elder shellfish harvesting. An investigation by KCH identified several faulty septic systems that were the likely culprits upstream in the Chico Creek watershed.

Those septic problems were repaired, however, many homes in the area were built prior to modern septic system requirements and the potential for future failures remain. The tribe urges a more proactive approach by KCH to actively evaluate and consider additional point and nonpoint sources in the local area that are likely discharging fecal coliform to Chico Bay. To reopen the area, bi-monthly samples taken over the next year will have to show no or very low levels of fecal coliform.



Map Data Sources: WAECY 2000,[1] WAECY 2018b,[2] WADOH 2018[3]

SUQUAMISH TRIBE

Importance of Eelgrass in Puget Sound

Eelgrass provides multiple important ecosystem functions, including foraging and shelter habitat to young salmon and Dungeness crab, and spawning surfaces for species such as Pacific herring.

Eelgrass forms the base of a highly productive marine food web. Eelgrass beds produce food and oxygen, improve water quality by filtering polluted runoff, absorb excess nutrients, store greenhouse gases like carbon dioxide, and protect the shoreline from erosion. Many people are unaware of the vital role this plant plays in the marine environment. As a result, there has been significant degradation of eelgrass from human impacts such as urban development, dredging, pollution and sediment runoff from upland areas.[1]

In 2014, the Suquamish Tribe signed an interagency agreement with DNR to collect baseline eelgrass area and depth distribution data within their usual and accustomed fishing area, including 62 sample sites along eastern Kitsap Peninsula and Bainbridge Island, using methods standardized by DNR's Submerged Vegetation Monitoring Program (SVMP). In 2016, the tribe and DNR amended this contract to include an additional 50 sample sites. That same year, DNR also signed a contract with the City of Bainbridge Island to sample an additional 19 sites along the shoreline of Bainbridge Island.[2]

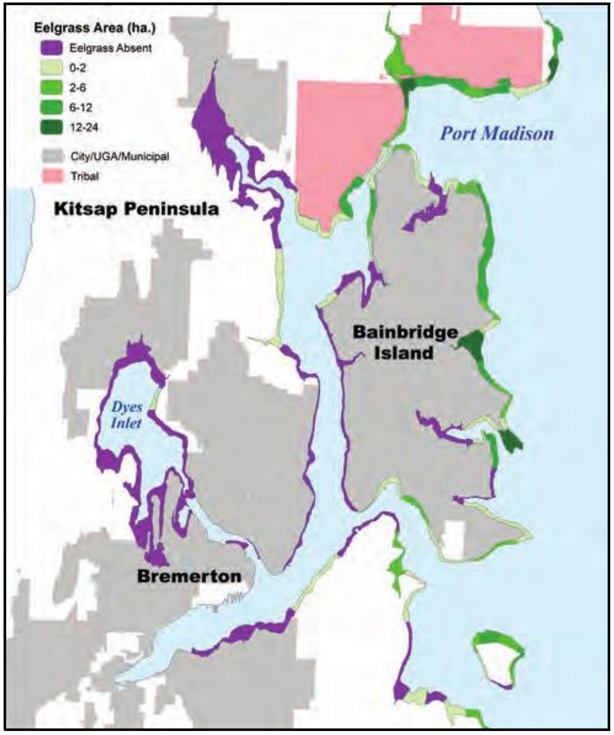
The current best estimate is that there is approximately 598 hectares of eelgrass along the shoreline in the East Kitsap area. This is roughly 18.5% of the current best estimate for eelgrass area in Central Puget Sound, and less than 3% of all eelgrass in greater Puget Sound.

Eelgrass is most abundant in the East Kitsap area along the northeastern Kitsap Peninsula and the eastern shore of Bainbridge Island. Out of the 190 sites sampled in the study area, there are 111 sites (58%) with eelgrass. Sites without eelgrass are predominantly located in the major bays and inlets, including Port Orchard Bay, Sinclair Inlet, Dyes Inlet and Liberty Bay. Eelgrass grows to greater maximum depths along the eastern shores of Bainbridge Island and Kitsap Peninsula, as compared to sites near Port Orchard and Sinclair Inlet. However, there is variability in maximum eelgrass depth among individual sites.[3]

As a result of the interagency agreements between DNR, the City of Bainbridge Island and the tribe, the shoreline of the Kitsap Peninsula has become one of the most densely sampled areas for eelgrass status in greater Puget Sound. Surveying large contiguous stretches of shoreline has generated detailed estimates of eelgrass area and depth distribution for the entire shoreline of the East Kitsap area. These data provide a good overview of the current extent of both native eelgrass (*Zostera marina*) and the non-native *Zostera japonica*, and can be used as a baseline for future studies on trends in eelgrass area and depth distribution.[4]

Eelgrass abundance, distribution and depth data identify sensitive habitat areas for consideration in land-use planning. Given the recognized ecological importance of eelgrass, planning should explicitly consider the location of eelgrass beds, its environmental requirements and potential habitat. DNR's stewardship responsibilities include protection of native seagrasses such as eelgrass (*Zostera marina*), an important nearshore habitat in greater Puget Sound.[5] In addition to eelgrass, kelp beds are vitally important to the Puget Sound ecosystem. A kelp conservation and recovery plan was recently developed (*https://nwstraits.org/our-work/kelp/*). So far, however, kelp has received less attention by conservationists than other species and habitats such as eelgrass, which is listed as a 'Vital Sign' of Puget Sound health by the state's Puget Sound Partnership.[6]

Eelgrass Abundance and Depth Distribution in East Kitsap Area[1]



Note: This map view does not include the NE part of East Kitsap, from Kingston north to Foulweather Bluff.

Adam Obaza, NOAA

Encyclopedia of Puget Sound

Eelgrass bed near Bainbridge Island.

Map Data Sources: WADNR 2019,[7] WADOT 2018b,[8] WAECY 2018a,[9] WAECY 2018b[10]

Climate Change

Warmer temperatures and changes in precipitation patterns associated with climate change will drive shifts in ecosystems that will impact watersheds, estuaries and oceanic conditions, with major implications to the Suquamish Tribe and traditional foods, including salmon.

The following are among the important climate change impacts recognized by the tribe:

- Warmer stream temperatures and lower flows in summer with impacts to salmonids and freshwater ecosystems;
- More frequent and intense winter rain events that may result in more channel scour, sedimentation and flooding;
- Ocean acidification and warming of marine waters, negatively affecting recruitment of shellfish organisms including bivalves and crustaceans, fish behavior, and the prey base for many higher trophic species;
- Impacts to the long-term persistence, geographical distribution, and health of traditional plants used for food, medicine and materials (including cedar);
- Decoupling in the timing of food availability and need for migrating species due to earlier start of growing season (shifts in phenology);
- Loss of intertidal habitat due to sea level rise ("coastal squeeze"); and
- Damage to infrastructure due to sea level rise.

To adapt to these changes and impacts from climate change, the tribe is monitoring environmental conditions to detect vulnerable habitats and species, protecting and restoring habitats to increase ecosystem resilience, and building capacity in all tribal government and community sectors to respond to impacts as they emerge. The tribe is fostering tribal community understanding of the threats and opportunities emerging from climate and other changes through community workshops.

Workgroups are engaged in key sectors of tribal society, including cultural resources, natural resources, community health, economic development, wellness and emergency services. These efforts involve tribal youth in all activities directly and through age appropriate K-12 educational content.

Paul Williams, Suquamish Tribe

Crystal Boure and Caitlin Roberts host the Suquamish Tribe's ocean acidification outreach tent at the Quinault 2013 Tribal Canoe Journey.

Looking ahead, to increase the resilience of the tribe and the surrounding ecosystem to climate and other impacts to the changing environment, the different sectors of the tribal government and community need to be informed and involved in developing solutions.

To start, a Suquamish student climate change task force is being formed to create community outreach materials and co-facilitate staff/community climate change working groups within the tribe.

Students at Chief Kitsap Academy learn from their teachers, tribal scientists and community elders and spread that knowledge to the community through their friends and families. That perpetual flow of information to and from school, community and tribal staff will provide continued information as well as prepare future workers to help the tribe identify and address impacts and opportunities as they emerge.

In addition, the tribe is engaged in the following:

- Long-term stream temperature monitoring of dozens of salmon streams in the East Kitsap area;
- Chico Creek-focused studies on climate resilience, including identifying cold water refugia for salmon and modeling streamflows and temperatures under projected climate change scenarios;
- Completion of the East Kitsap Demographically Independent Population Steelhead Recovery Plan that includes strategies and actions for protecting and restoring watershed function and habitat conditions for salmonids; and
- Restoration of depressed native oyster, sea cucumber and cockle populations.

The tribe's ongoing monitoring of summer stream temperatures since 2003 indicates which streams are naturally cooler and which are more susceptible to warming with climate change. Unusually warm summers in recent years result in warmer streams, often to levels considered stressful to fish, a likely harbinger of a pattern that will become more common with future climate change.

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2 NW Treaty Tribes. July 10, 2010. Suquamish Tribe Closer to Chico Creek Estuary Restoration with Culvert Removal. News.

3 Ibid.

4 Washington State Department of Transportation. SR 3 – Chico Creek - Remove Fish Barriers. from https://www.wsdot.wa.gov/projects/sr3/chico-creek/home

Watershed Restoration and Salmon Recovery Planning

1 EK-DIP Steelhead Recovery Plan and the Puget Sound steelhead recovery plan. (http://westsoundwatersheds.org/pdfs/East%20Kitsap%20Steelhead%20Recovery%20Plan%20with%20Appendices%20May%202020.pdf. https://www.fisheries.noaa.gov/resource/document/esa-recovery-plan-puget-sound-steelhead-distinct-population-segment-oncorhynchus)

Marine Water Quality Threatened at Important Shellfish Grounds

1 WAECY. 2000. Water Resource Inventory Area (WRIA) Polygons. Olympia, WA: Washington Department of Ecology.

2 WAECY. 2018b. NHD Major Areas, Streams, and Waterbodies. 1:24000. From U.S. Geological Survey (in cooperation with others) National Hydrography Dataset. Washington Department of Ecology.

3 WADOH. 2018. Shellfish Growing Areas. 2018. Polygons. Olympia, WA.

Importance of Eelgrass in Puget Sound

1 NOAA Fisheries. National Oceanic and Atmospheric Administration U.S. Department of Commerce. West Coast Regional Office. News. November 07, 2014. The Importance of Eelgrass. From https://www.fisheries.noaa.gov/feature-story/importance-eelgrass

2 Eelgrass abundance and depth distribution in East Kitsap. Final report to the Suquamish Tribe. DNR IAA 15-17 Amendment 1. 10 Aug 2018. WA. State Department of Natural Resources. Puget Sound Ecosystem Monitoring Program (PSEMP)

3 Ibid.

4 Ibid.

5 Ibid.

6 DeWeerdt. November 21, 2019. Encyclopedia of Puget Sound. Salish Sea Currents Magazine. Kelp crisis? Decline of underwater forest raises alarms.

7 WADNR. 2019. Submerged vegetation Monitoring Program 2000-2017 Site Polygons. Washington Department of Natural Resources.

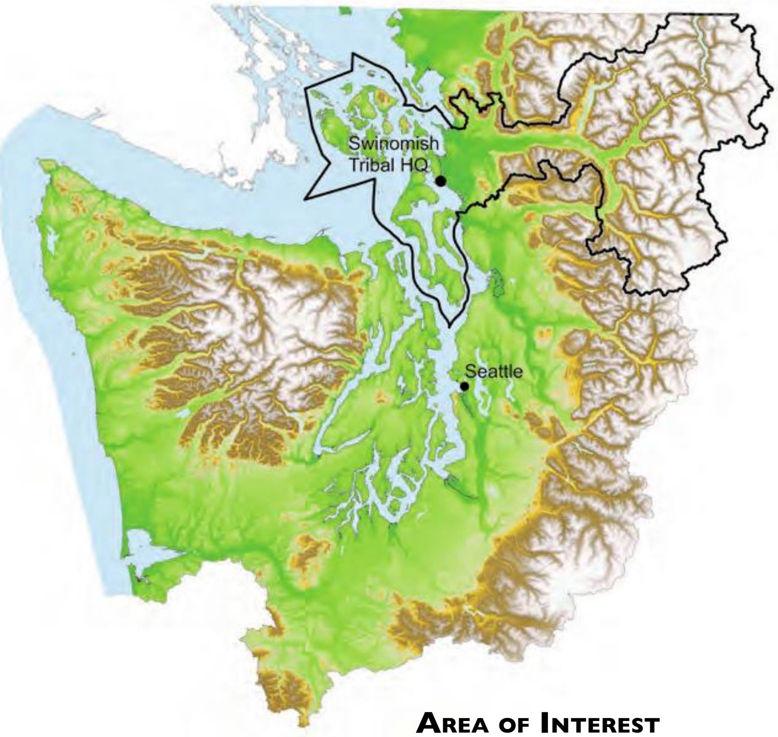
8 WADOT. 2018b. Polygons depicting the boundaries of Tribal Lands in Washington State. Olympia, WA: Washington Department of Transportation.

9 WAECY. 2018a. City Boundaries and Urban Growth Areas Polygons. Washington Department of Ecology.

10 WAECY. 2018b. NHD Major Areas, Streams, and Waterbodies. 1:24000. From U.S. Geological Survey (in cooperation with others) National Hydrography Dataset. Washington Department of Ecology.

2020 State of Our Watersheds Report
Skagit River Basin

> *Our watersheds are on the front line of the battle to restore salmon, but we are losing that habitat faster than it can be restored. Both hatchery and naturally spawning salmon depend on the same habitat for their survival. It is critical that we protect existing habitat as we continue our work to restore our watersheds.*
>
> – **Lorraine Loomis**
> **Fisheries Manager**



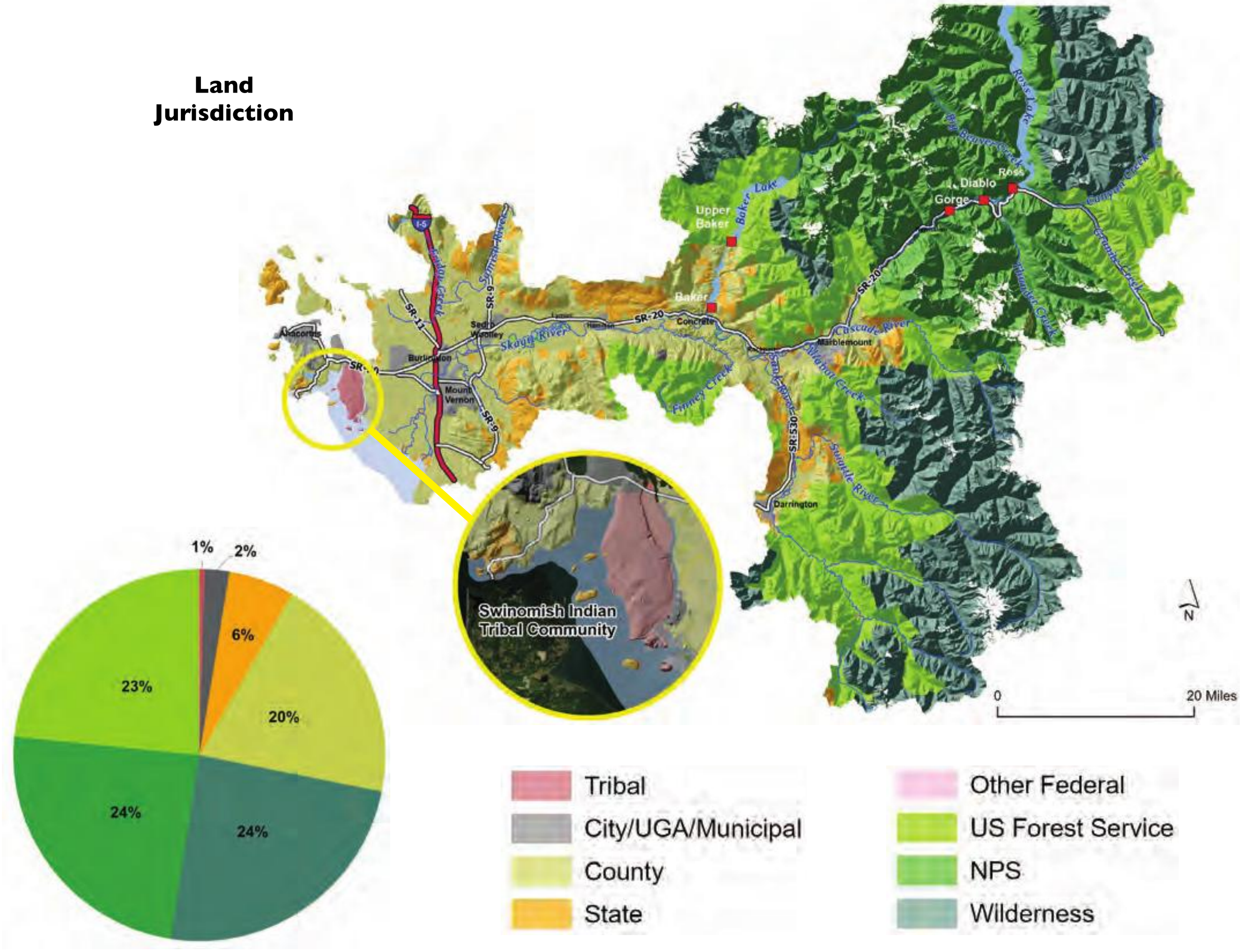
Area of Interest

Swinomish Indian Tribal Community

The Swinomish Indian Tribal Community is made up of Coast Salish people descended from groups and bands originating from the Skagit and Samish river valleys, coastal areas surrounding nearby bays and waters, and numerous islands including San Juan, Whidbey and Camano islands. The Swinomish reservation on the southeastern end of Fidalgo Island is surrounded by 27 miles of saltwater shoreline. It is bounded on the west by Skagit Bay, the east by Swinomish Channel and the north by Padilla Bay. The reservation is about 15 square miles in size and includes 7,450 acres of upland and approximately 2,900 acres of tidelands.

Swinomish Indian Tribal Community

Skagit River and Nearshore


Land Jurisdiction

The Skagit River flows from a 3,100-square-mile watershed that originates in British Columbia and flows south into Washington state before continuing westward through Skagit County and into Puget Sound. It has the largest watershed in Puget Sound, and provides 30% of the sound's freshwater input.[1] There are an estimated 396 glaciers in the watershed, making up one of the largest areas of glacial cover in the United States outside of Alaska.[2] The Baker River, Sauk River and the Cascade River all flow from glaciers within the Skagit River watershed.

The Skagit River watershed has been home to the Swinomish Indian Tribe, the Upper Skagit Indian Tribe and the Sauk-Suiattle Indian Tribe since time immemorial. All three tribes have their reservations in the watershed and all have entered into a treaty with the United States guaranteeing them the right to fish at their usual and accustomed places forever. These U&A areas include some or all of the Skagit River watershed, depending on the tribe..

Since European settlement, land use in the watershed has been dominated by natural resources extraction. The foothills and mountains have been used mainly for wood products, mining and outdoor recreation. The river valleys, the delta and the coastal areas have been used for agriculture, industry, commerce and residential development. As of 2019, the U.S. Census Bureau estimates 129,205 residents in Skagit County, a 25% increase in population since the year 2000.[3,4]

The upper watershed is primarily within the National Forest and the North Cascades National Park. The lower watershed is mainly composed of state forest, private forest, agriculture, rural residential and urban residential/ commercial/industrial lands. There are five Federal Energy Regulatory Commission (FERC) licensed dams in the Skagit River watershed: the lower and upper Baker River dams, and the Gorge, Diablo and Ross Lake dams.

The Skagit River is home to all five species of Pacific salmon, as well as steelhead trout. It has the healthiest and largest runs of wild chinook and pink salmon in the Puget Sound.[5] Even so, the last 150 years of human population growth and associated land use has resulted in declines in chinook, a near collapse of chum and declines in other salmonid productivity. The Skagit Chinook Recovery Plan (2005) provides a strategy for both protection and targeted restoration. It will take federal, tribal, state and local leadership to provide a consistent yet adaptive plan to control the future impacts of land use in the watershed.

Map Data Sources: USFWS 2018,[6] WAECY 2018a,[7] WAECY 2018b,[8] WAECY 1994,[9] WADNR 2014c,[10] WADNR 2014d,[11] WADOT 2013,[12] SSHIAP 2004[13]

Chapter Summary

The Swinomish Indian Tribal Community is primarily made up of descendants of four treaty-time groups: the aboriginal Swinomish, the Lower Skagit, the Kikiallus and the aboriginal Samish. They all came together to sign the Treaty of Point Elliott with the United States in 1855. The treaty established a reservation for future use. The Swinomish Reservation is on Fidalgo Island surrounded by the Swinomish Tribal Community's ancestral homelands, including the Skagit Valley and Samish River Valley, the coastal areas surrounding Skagit, Padilla and Fidalgo bays, Saratoga Passage and numerous islands including Fidalgo, Camano, Whidbey and the San Juan Islands.

For thousands of years, the people of the Swinomish Indian Tribal Community maintained a culture centered on abundant saltwater resources that included salmon, shellfish and marine mammals, as well as upland resources such as cedar, camas, berries and wild game. Since European settlement began in the middle of the 19th century, the landscape has changed to support cities, residences and agriculture, and not to support the natural estuaries, large floodplains and riparian-lined tributaries needed for healthy populations of salmon, shellfish and all the resources the Swinomish people relied upon historically. That pattern continues today, and with a growing population of people, the degrading impact it has on salmon habitat has intensified.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org*.

For this report, the Swinomish Indian Tribal Community has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Habitat Mitigation Is Offsetting the Negative Impact of Riprap Repair to Riverine Edge Habitat

As part of the 2011 Environmental Assessment (EA) for the batched 2007 and 2011 repairs at 60 sites along the lower Skagit River mainstem, the U.S. Army Corps of Engineers was required to complete habitat mitigation. Monitoring was conducted at 13 of the 60 sites, and when compared with baseline riprap conditions, the mitigation sites as a whole were found to have offset impacts to riparian vegetation, rearing habitat, refuge habitat and forage habitat for fish. This should not be interpreted as restoration or recovery of habitat, this mitigation only means that the riprap repair actions taken by the Corps that negatively impacted riverine edge habitat and riparian habitat in the lower Skagit River were at least partially offset by habitat mitigation.

Skagit River Tidal Delta Habitat Restoration Successful, but the Pace Has Slowed Since 2009

From 2004 to 2013, the tidal habitat footprint in the Skagit River delta increased from 3,384.65 hectares to 3,467.68 hectares, from 80% to 81.9% of the desired future condition (DFC) of the Skagit River Chinook Recovery Plan. Continued focus is necessary, as the pace of habitat restoration has slowed considerably since 2009. From 2005 to 2009,103.3 hectares of tidal delta extent were restored (25.8 hectares per year) and since 2009, only 71.2 hectares have been restored (10.2 hectares per year).

Pocket Estuary Restoration Remains Important to Skagit River Chinook Recovery

Through 2015, pocket estuary restoration was completed at 6 sites totaling 33.6 acres of usable habitat area and chinook smolt production was estimated to have increased by 48,457 smolts. Since 2015, there has been a small amount of active restoration in Dugualla Lagoon, and Similk Beach has entered a more active restoration phase, but nothing has been completed.

Nearshore Armoring Continues to Impact the Intertidal Zone

Continued survey of the shoreline in the Skagit and Samish marine nearshore areas has found an additional 5 miles of nearshore armoring since 2008. Current estimates are that 118 miles of this area are armored or modified. Marine shoreline restoration that removes shoreline armoring to restore the nearshore to its natural condition is the best option for salmon recovery. Another opportunity to improve shoreline condition is to prioritize "soft armoring" options when existing "hard armoring" is being permitted to be repaired or replaced along the shoreline.

High Stream Temperatures Remain a Limiting Factor for Skagit River Chinook and Steelhead Recovery

The 2004 Lower Skagit tributaries temperature TMDL failed to meet its goal of "100 percent of all stream miles of these creeks to be protected by riparian shade or enrolled as part of larger creek restoration and improvement projects by 2020." In March 2020, Washington Department of Ecology published guidance on a renewed effort to revitalize action on the TMDL.

The renewed effort continues to emphasize voluntary actions and relies on financial incentives to achieve riparian planting on private properties. Sole reliance on voluntary efforts will never be sufficient to meet water quality standards for salmon streams or the needs of Skagit chinook or steelhead recovery in a timely manner, particularly as climate change creates warmer, drier and longer summers. This is an urgent issue about which Swinomish and its treaty tribe partners have been sounding the alarm for two decades and Ecology must take action far beyond its sole, passive reliance on voluntary measures.

Public and Private Culverts in the Skagit River Watershed Continue to Block Anadromous Salmon Habitat

A recent comprehensive survey of culvert barriers to anadromous fish passage in the Skagit watershed documented 443 culverts on anadromous fish-bearing streams. Of these, 352 culverts are fish-passage blockages and 91 culverts are unknown but may be fish-passage blockages. Over 74% of the blocking and unknown culverts are either privately owned (204 culverts, 46%) or county owned (122 culverts, 28%). The remaining 117 culverts (26%) are spread across other public ownerships.

Climate Change Impacts to Streamflow Will Threaten Steelhead Recovery in the Skagit

Results from climate change modeling for a collection of sites throughout the Skagit River system show increasing winter peak flow and decreasing summer low flow as more future annual precipitation is expected to fall as rain than snow. By 2099, results from an ensemble of models forecast that the 2-year high flow event will increase from its historic average by 22% under a low emission scenario, and by 33% under a high emission scenario. The same ensemble of climate models forecast that by 2099, the lowest 7-day 2-year low flow event will decrease from its historic average by 33% under a low emission scenario and by 45% under a high emission scenario.

Conclusion

Restoration of salmon habitat continues to occur in the Skagit River freshwater and intertidal environments. However, the pace of restoration has slowed in the last five years, and this is compounded by a rapidly changing climate and continued discovery of habitat impairments. For restoration to lead to recovery, the schedule needs to accelerate.

While it does not carry the positive impact of restoration, mitigation does at least partially offset the negative impacts to habitat of infrastructure maintenance within the Skagit River system. Monitoring mitigation showing some success and failure should lead to increased mitigation success in the future.

Enforcement of the regulatory framework that is in place to protect salmon habitat continues to be greatly lacking in the Skagit River system. There continues to be a reliance on volunteerism towards compliance of environmental laws and regulations, and the result is much less habitat being protected and/or restored than needs to be. Salmon habitat is in critical condition in many areas within the Skagit River system, and the urgency of regulation enforcement is needed to move quickly out of that critical condition.

Recovery Efforts Show Improvement But Still Lagging in Key Indicators

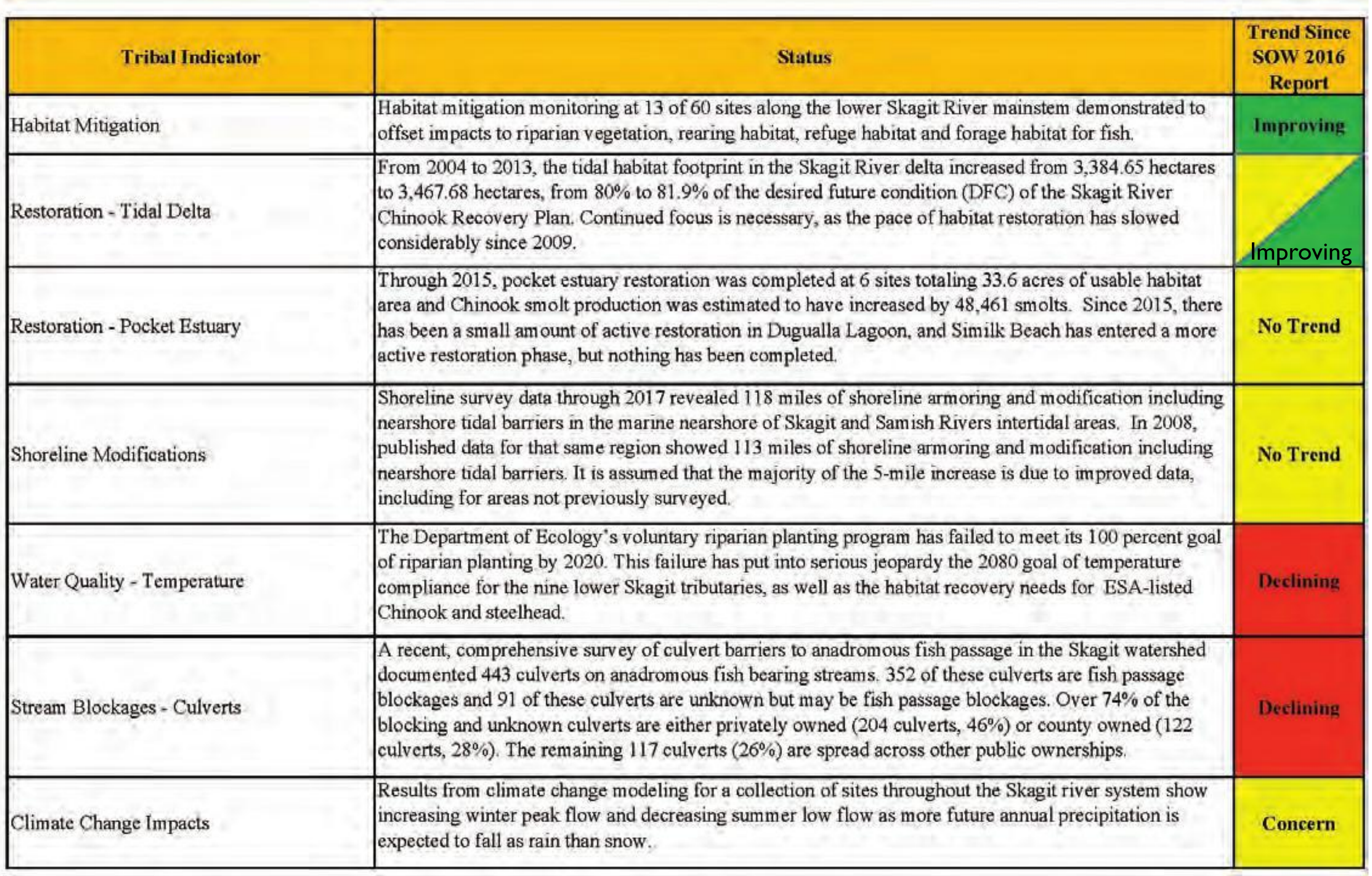
At the 15-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Skagit basin reveals mixed results in progress toward the recovery plan's goals and objectives. Priority issues continue to be improving degradation of water quantity, repair of fish-passage barriers and shoreline conditions. There has been progress in two indicators: restoration of tidal deltas and positive signs from monitoring of habitat mitigation sites.

Stepping back and looking at the big picture, there is still a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow the pace of progress.


Kari Neumeyer, NWIFC

Illabot Creek

Review of the trend for these key environmental indicators since the 2016 State of Our Watersheds Report shows improvement for some indicators, no trend for a few and a steady loss for others in habitat status:



Tribal Indicator	Status	Trend Since SOW 2016 Report
Habitat Mitigation	Habitat mitigation monitoring at 13 of 60 sites along the lower Skagit River mainstem demonstrated to offset impacts to riparian vegetation, rearing habitat, refuge habitat and forage habitat for fish.	Improving
Restoration - Tidal Delta	From 2004 to 2013, the tidal habitat footprint in the Skagit River delta increased from 3,384.65 hectares to 3,467.68 hectares, from 80% to 81.9% of the desired future condition (DFC) of the Skagit River Chinook Recovery Plan. Continued focus is necessary, as the pace of habitat restoration has slowed considerably since 2009.	Improving
Restoration - Pocket Estuary	Through 2015, pocket estuary restoration was completed at 6 sites totaling 33.6 acres of usable habitat area and Chinook smolt production was estimated to have increased by 48,461 smolts. Since 2015, there has been a small amount of active restoration in Dugualla Lagoon, and Similk Beach has entered a more active restoration phase, but nothing has been completed.	No Trend
Shoreline Modifications	Shoreline survey data through 2017 revealed 118 miles of shoreline armoring and modification including nearshore tidal barriers in the marine nearshore of Skagit and Samish Rivers intertidal areas. In 2008, published data for that same region showed 113 miles of shoreline armoring and modification including nearshore tidal barriers. It is assumed that the majority of the 5-mile increase is due to improved data, including for areas not previously surveyed.	No Trend
Water Quality - Temperature	The Department of Ecology's voluntary riparian planting program has failed to meet its 100 percent goal of riparian planting by 2020. This failure has put into serious jeopardy the 2080 goal of temperature compliance for the nine lower Skagit tributaries, as well as the habitat recovery needs for ESA-listed Chinook and steelhead.	Declining
Stream Blockages - Culverts	A recent, comprehensive survey of culvert barriers to anadromous fish passage in the Skagit watershed documented 443 culverts on anadromous fish bearing streams. 352 of these culverts are fish passage blockages and 91 of these culverts are unknown but may be fish passage blockages. Over 74% of the blocking and unknown culverts are either privately owned (204 culverts, 46%) or county owned (122 culverts, 28%). The remaining 117 culverts (26%) are spread across other public ownerships.	Declining
Climate Change Impacts	Results from climate change modeling for a collection of sites throughout the Skagit river system show increasing winter peak flow and decreasing summer low flow as more future annual precipitation is expected to fall as rain than snow.	Concern

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

The Swinomish Tribe has prioritized restoration and protection efforts throughout the Skagit River watershed to recover all six species of wild salmon for current and future generations. Unfortunately, many exemptions exist for ongoing land uses, and the state has been unwilling to ensure that there is sufficient cold, clean water in all of our salmon streams. This has hindered the pace of restoration, causing salmon recovery to be behind schedule in meeting the Recovery Plan goals.

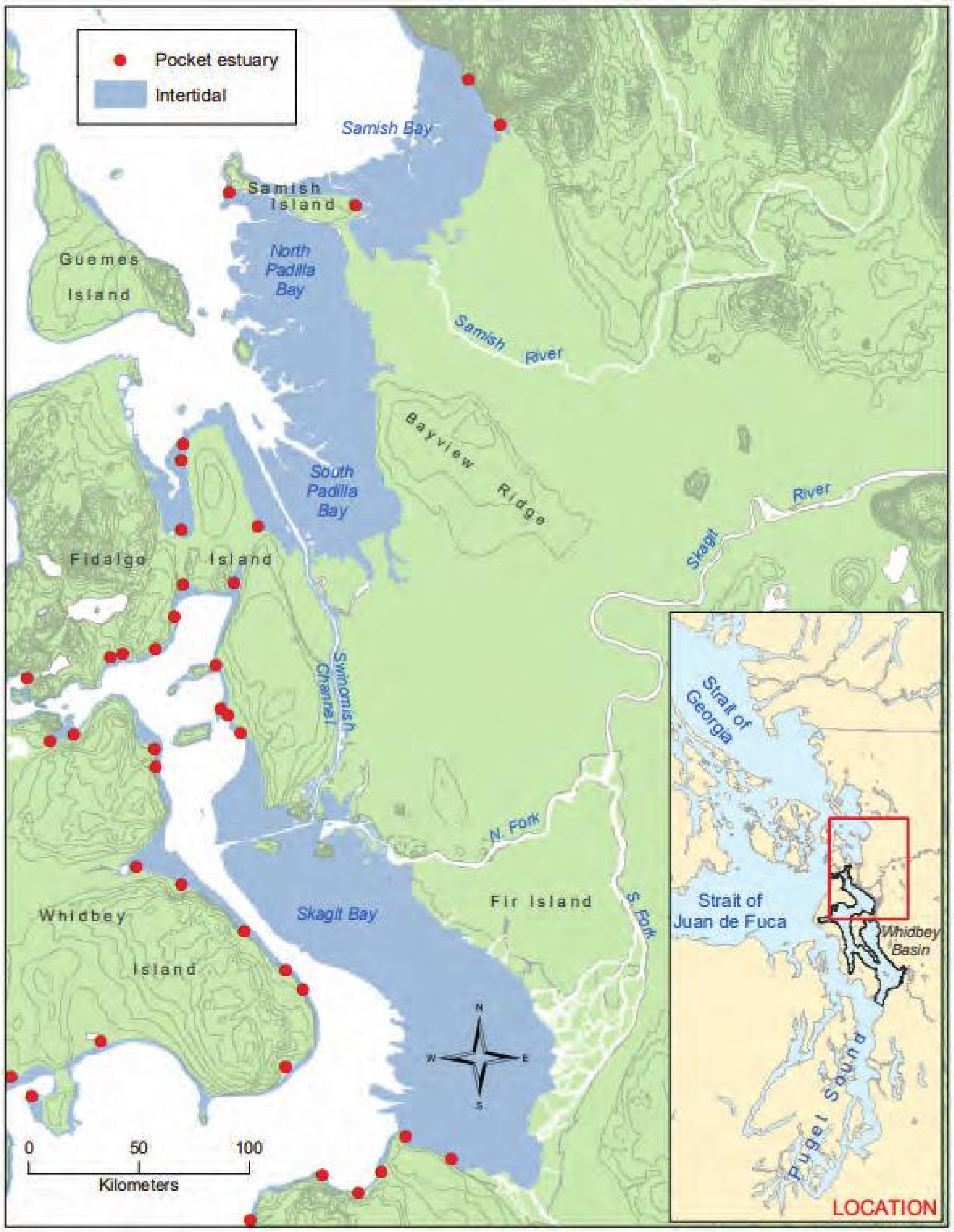
The state needs to adopt and expeditiously implement a regulatory framework that serves to protect and restore salmon habitat if the recovery goals for chinook, steelhead and other wild Skagit River salmonids are to be realized. Federal agencies with a trust responsibility need to exert leadership to ensure that the spirit and letter of environmental protection laws are implemented as fully and equitably as possible.

Climate change will continue to exacerbate many of the long-standing recovery challenges in the Skagit basin, especially without adequate riparian habitat. We and our state co-managers and federal trustees need to redouble our efforts to enforce existing habitat protection laws, create and implement innovative new programs that restore full function to our watershed, and continue to do the hard work necessary to achieve salmon recovery goals for current and future generations.

SWINOMISH INDIAN TRIBAL COMMUNITY

Critical Chinook Habitat Restoration in the Skagit River Intertidal Zone Continues, but the Pace Has Slowed

Skagit River Nearshore and Intertidal Region[5]



Nearshore and estuarine habitats throughout the Skagit River intertidal zone provide juvenile Skagit chinook forage for growth, refuge from predators, a transition zone for physiological change from a freshwater fish to a saltwater fish, and migratory routes to more food in the ocean.[1] These habitats have been greatly impacted through agricultural and residential development since the late 19th century, and these land-use impacts have directly impacted Skagit River chinook productivity. How well the nearshore and estuarine habitats of the Skagit River Intertidal Zone support these four functions directly influences the recovery and future viability of Skagit River chinook.[2]

Skagit River delta habitat, preferred for rearing by tidal delta rearing juvenile chinook, has decreased by 87.9%.[3] Pocket estuary habitat in the intertidal zone, preferred for rearing by fry migrant ocean type juvenile chinook salmon, has decreased by roughly 80% in area.[4] The construction of bulkheads and tidal barriers along the intertidal shorelines has had a significant impact on chinook rearing habitat in the tidal delta and pocket estuaries, as well as an impact on chinook forage by impacting beach spawning habitats of surf smelt and Pacific sand lance (forage fish).

Restoration in each of these areas of the intertidal zone has been ongoing for over two decades. There have been significant strides made since 2005, through implementation of the scientifically based and well-coordinated Skagit River Chinook Recovery Plan. However, restoration progress has slowed in recent years. When this is coupled with climate based changes in the sea level of the intertidal zone, and with improved survey methods discovering more impacts than previously expected, it becomes clear that restoration of the intertidal zone will need to accelerate into the future if chinook recovery is to occur.

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Skagit River Tidal Delta Habitat Restoration Successful, but the Pace Has Slowed Since 2009

From 2004 to 2013, the tidal habitat footprint in the Skagit River delta increased from 3,384.65 hectares to 3,467.68 hectares, from 80% to 81.9% of the desired future condition (DFC) of the Skagit River Chinook Recovery Plan.[6] Continued focus is necessary, as the pace of habitat restoration has slowed considerably since 2009.[7] From 2005 to 2009, 103.3 hectares of tidal delta extent were restored (25.8 hectares per year) and since 2009, only 71.2 hectares have been restored (10.2 hectares per year).

Skagit River Tidal Delta Restoration Sites (2004-2016)

Tidal delta marsh grows naturally through a process of progradation, which is the result of river sediment input depositing within the delta over time. In the Skagit River delta, progradation rates have been declining since the early 1970s, with marsh loss already occurring in the Skagit Bay frontal marsh and to a lesser degree in the South Fork marsh.[8] The Skagit River remains leveed in many places and peak water and sediment-moving flows occur with stream power like a "fire hose" that pushes sediment further into Skagit Bay instead of depositing it into the delta to create tidal marsh. As well, sea level rise is creating periods of higher wave energy, which in some instances, is beginning to erode marshlands that aren't naturally protected, especially along the Skagit Bay frontal marsh.

If tidal habitat restoration continues at the pace that has been occurring since 2009, it will take until 2096 (90 years in total) to reach the desired future conditions (DFC) laid out in the 50-year Skagit River Chinook Recovery plan. To reach DFC for tidal marsh by 2030 (midpoint of a 50-year recovery plan), the pace of restoration needs to increase, and there must be explicit consideration of sea level rise, storm surge and sediment routing as an update to the current tidal habitat restoration plan.[9]

Skagit River Tidal Delta Habitat Restoration between 2004 and 2016[12,13]

Restoration	Year	Hectares Gained
Fisher Slough	2011	18.66
South Fork Dike Setback	2007	8.37
Smokehouse	2008	26.9
Swinomish Channel	2008	3.37
Wiley Slough	2009	64.62
Fisher Island Farms	2016	52

Map Data Sources: GSRO 2019,[10] ESRI 2020[11]

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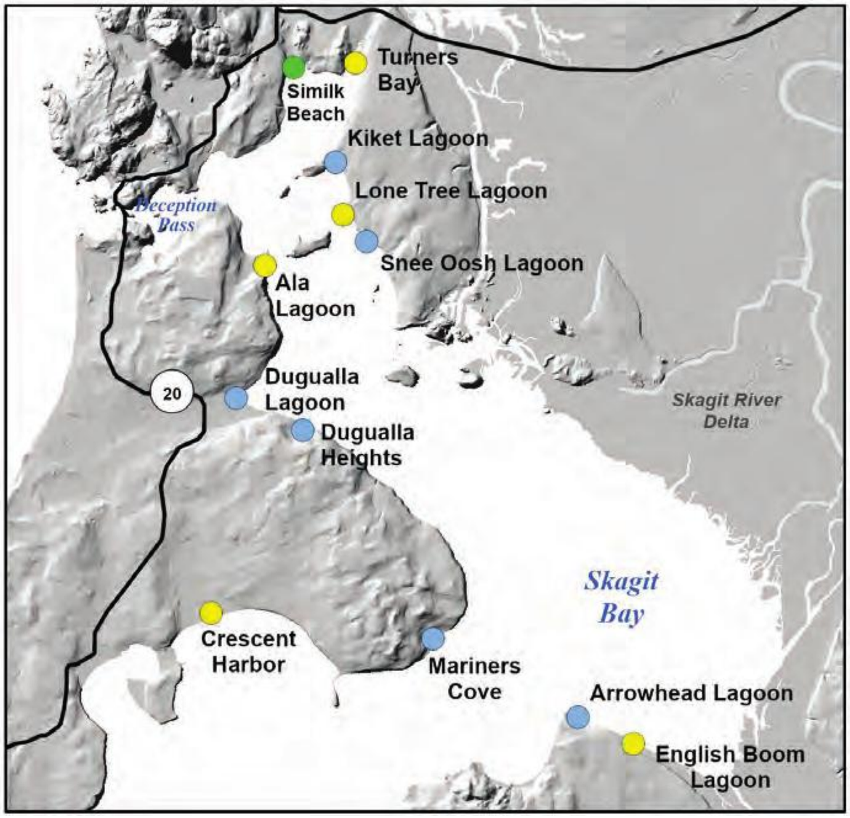
Pocket Estuary Restoration Remains Important to Skagit River Chinook Recovery

Through 2014, pocket estuary restoration was completed at 5 of the 12 prioritized Skagit Chinook Plan sites. Habitat status and trends monitoring reveals the restoration increased usable pocket estuary habitat area for chinook smolt production by over 240 acres. The Dugualla Heights restoration site entered the design phase, but was not completed due to concern of the design not having enough salmon habitat benefit. It is still considered as a restoration target, and can be completed with a better design. Since 2014, no additional restoration has occurred at the 12 prioritized sites although Similk Beach has entered an active planning/design phase with restoration anticipated in the near future.[14]

Within the Whidbey basin, modeling and field surveys have led researchers to conclude that over two-thirds of historic pocket estuaries have been completely lost to juvenile salmon use, and the remaining one-third has been reduced in size by approximately 50%.

In response, the Skagit Chinook Recovery Plan prioritized the restoration of 12 pocket estuaries, all of which are within a day's swimming distance for Skagit River juvenile chinook. Restoration of these 12 sites is expected to result in the production of over 147,000 additional smolts. Over 63% of the increased production, or over 93,000 smolts will come from the completed restoration of the Dugualla Lagoon project.[15]



There are 12 prioritized pocket estuary restoration projects. 5 have been completed, 1 is active and 6 remain conceptual.

Restoration Status

🟢 Active
🟡 Complete
🔵 Conceptual

Site	Hectares of habitat			Acres of habitat		
	Year 2005	Year 2014	Change	Year 2005	Year 2014	Change
English Boom Lagoon	1.07	1.35	0.29	2.64	3.34	0.71
Ala Lagoon	8.21	7.05	-1.16	20.28	17.42	-2.86
Crescent Harbor	0.00	94.13	94.13	0.00	232.61	232.61
Lone Tree Lagoon	2.22	2.44	0.22	5.48	6.02	0.55
Turners Bay	18.75	22.49	3.75	46.32	55.58	9.26
Total	**30.23**	**127.46**	**97.23**	**74.71**	**314.97**	**240.26**

Pocket estuary restoration has resulted in over 240 acres of usable pocket estuary habitat area for chinook smolt production.[21]

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Map Data Sources: SRSC and WDFW 2005,[16] SRSC and WDFW 2012,[17] HWS 2020,[18] SSHIAP 2004,[19] WADNR 2014c[20]

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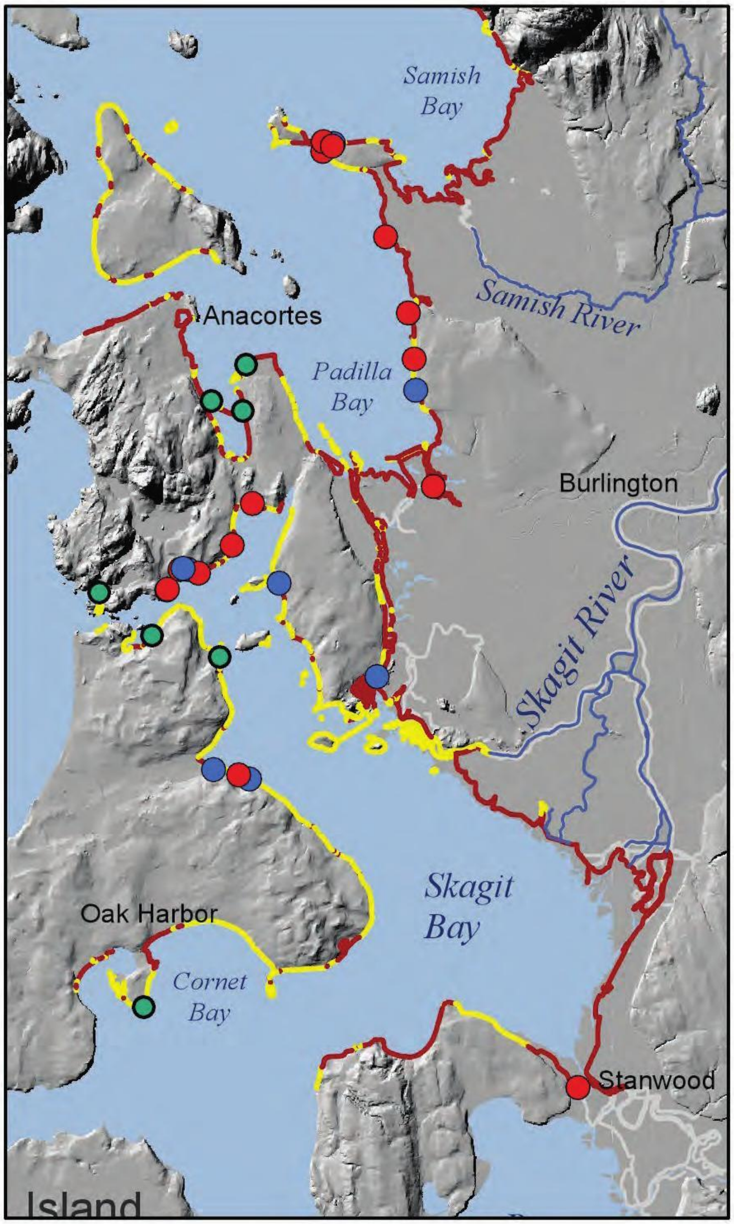
Nearshore Armoring Continues to Impact the Intertidal Zone

Shoreline survey data through 2017 revealed 118 miles of shoreline armoring and modification including nearshore tidal barriers in the marine nearshore of Skagit and Samish river intertidal areas. In 2008, published data for that same region showed 113 miles of shoreline armoring and modification including nearshore tidal barriers.[22,23] *It is assumed that the majority of the 5-mile increase is due to improved data, including for areas not previously surveyed.*

Skagit and Samish River Marine Nearshore Projects 2014 through 2019: WDFW Permitted Projects and PSEMP Monitored Restoration Projects



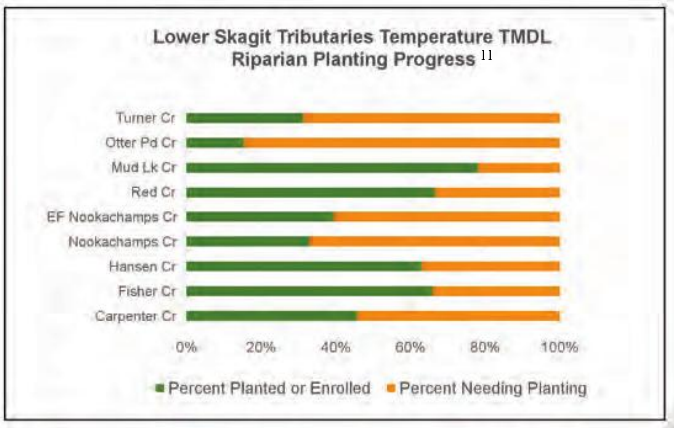
Since 2015, WDFW has issued marine shoreline armoring permits for 22 Hydraulic Permit Applications (HPA) within the Skagit chinook intertidal area. Of those permits, 4 were for new armoring and 18 were for repair or replacement of existing armoring. More ecologically suitable or soft armoring was included in 40% (9 of the 22 projects), and removed in 1 of the 22 projects.[24] Since 2015, there have been 4 nearshore restoration projects resulting in the removal of 4,295 feet of shoreline armoring.[25]

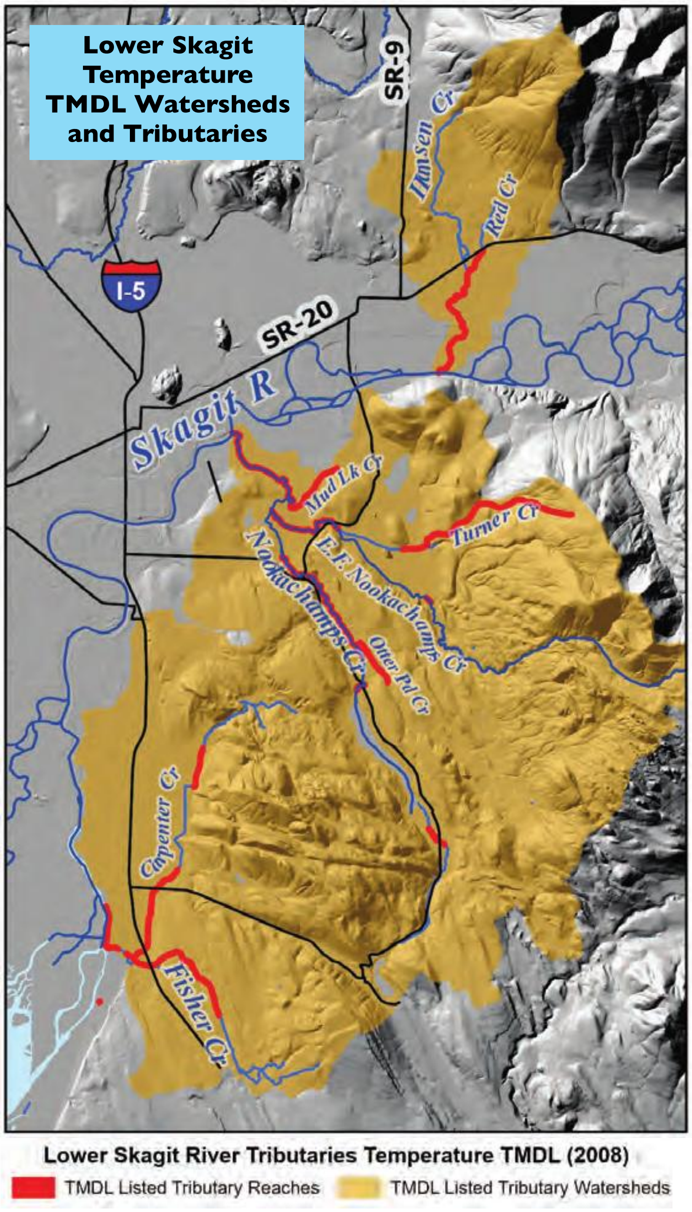
The best opportunity for improving the shoreline is through armoring removal as part of nearshore restoration projects. Another opportunity is the repair/replacement of existing shoreline and these efforts will require continued coordination between state and local permitting agencies to prioritize soft armoring replacement as the repair/replacement option.

Map Data Sources: CGS 2017,[26] *PSEMP 2020,*[27] *WDFW 2020,*[28] *SSHIAP 2004*[29]

High Stream Temperatures Remain a Limiting Factor for Skagit River Chinook and Steelhead Recovery

The Department of Ecology's voluntary riparian planting program has failed to meet its 100 percent goal of riparian planting by 2020. This failure has put into serious jeopardy the 2080 goal of temperature compliance for the nine lower Skagit tributaries, as well as the habitat recovery needs for ESA-listed chinook and steelhead.





Map Data Sources:WADNR 2014c,[7] WAECY 2018,[8] WAECY 2014b,[9] SSHIAP 2004[10]

In 2004, Washington State Department of Ecology established total maximum daily load (TMDL) limits for high stream temperatures on nine tributaries, including chinook, coho and steelhead streams, in the Lower Skagit Tributaries Temperature TMDL. The 2008 Lower Skagit TMDL Improvement Plan charted a path for these nine tributaries to become temperature compliant by 2080 if the TMDL implementation goal was met that "100 percent of all stream miles of these creeks to be protected by riparian shade or enrolled as part of larger creek restoration and improvement projects by 2020."[1] Unfortunately, Ecology has failed to meet its 100 percent goal of riparian planting by 2020.

Ecology has relied entirely on voluntary programs to recover the water quality of these important salmon streams. For two decades, Swinomish has pointed out the insufficiency of this, noting that voluntary programs are part of the solution but alone would never be adequate to reach water quality standards within sufficient time for restoring degraded salmon habitat. Based on a recent LIDAR technical analysis, approximately 50% of overall stream length within the nine-tributary watershed is currently forested or planted in trees. In Nookachamps Creek, the largest salmon stream in the sub-basin that historically has been home to chinook and steelhead, only 30% of creek miles have been planted. That's far short of the 100% goal that was supposed to be reached this year.[2]

What is the consequence of this failure to be only halfway toward meeting its 2020 goal of 100% planting to implement the Lower Skagit Temperature TMDL? It puts into serious jeopardy the 2080 goal of temperature compliance for the nine lower Skagit tributaries, as well as the habitat recovery needed for Endangered Species Act-listed chinook and steelhead. It also makes it far less likely that Lower Skagit salmon streams can achieve the level of climate resiliency needed as temperatures warm and summers become longer and drier. High stream temperatures were identified as a limiting factor to Skagit River chinook survival and recovery in the 2005 Skagit River Chinook Recovery Plan and to Puget Sound steelhead recovery in the 2019 Puget Sound Steelhead Recovery Plan.[3,4]

The 2004 Lower Skagit Temperature TMDL called for average riparian buffers of a minimum 100 feet in width on either side of the stream, assuming water quality would not be further degraded by reduced streamflows.[5] The degradation of riparian vegetation throughout the Lower Skagit river system, and a lack of regulato-

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ry framework to require tree planting for compliance with water quality standards, has allowed higher water temperatures throughout the system to persist, to the peril of salmon and treaty rights.

Efforts to restore riparian vegetation are ongoing, and with some clear successes throughout the Skagit watershed as a result of tribal, conservation district and local nonprofit leadership and partnership. **The real problem, though, is that the pace of restoration has been far too slow – largely because Ecology has been unwilling to create a regulatory framework for enforcing water quality standards for temperature in salmon streams – and so no regulatory action has been taken.** Sole reliance on voluntary efforts has been and will continue to be insufficient to meet water quality standards for salmon streams or the needs of Skagit chinook or steelhead recovery in a timely manner, particularly as climate change creates warmer, drier and longer summers. This is an urgent issue about which Swinomish and its treaty tribe partners have been sounding the alarm for two decades, and the time for regulatory action is undeniable.

Unfortunately the Skagit is not alone – approximately 1,800 miles of salmon streams throughout western Washington are not meeting water quality standards from temperature pollution. To compound this, climate change is forecast to cause dramatic increases in stream temperatures throughout our region over the next 20 to 60 years, without urgent action to plant trees, climate change is going to wreak havoc on recovering salmon for decades and generation to come.

Ecology's new voluntary plan

As a result of Swinomish's efforts, the Puget Sound Partnership's Leadership Council passed a resolution in March 2019 urging Ecology to use all available tools at its disposal, including regulatory tools, to remedy the Lower Skagit Temperature TMDL expeditiously. Swinomish was hopeful that real change was on the way.

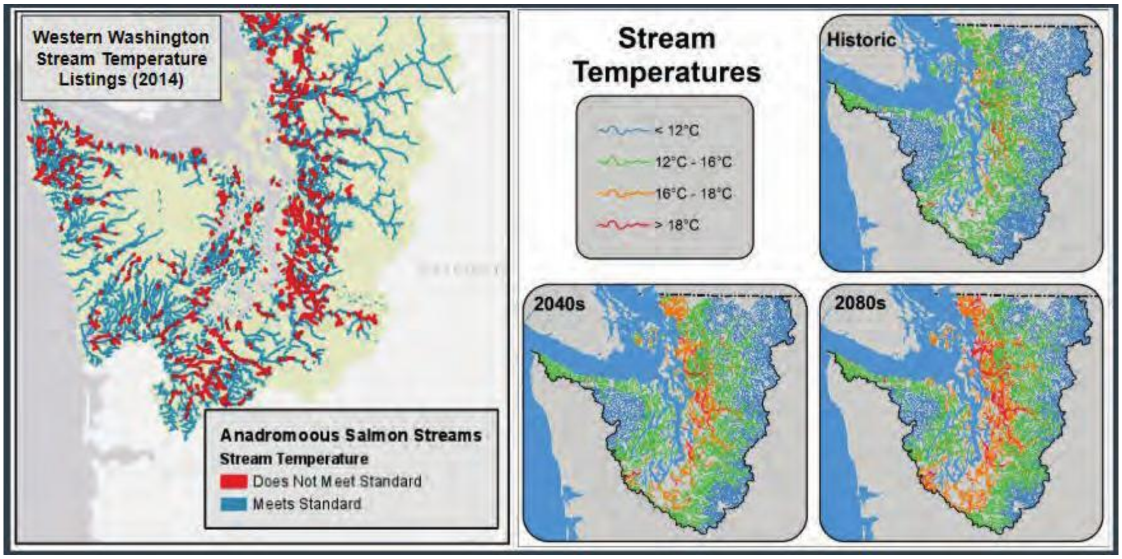
In fall 2019, Ecology held meetings with stakeholders and tribal government representatives to create a new "strategy" to "revitalize regional efforts to reduce water temperatures." Unfortunately, Ecology staff were prevented from discussing or addressing any regulatory solutions - they were given authorization only to discuss voluntary measures despite the clear intent from the Leadership Council resolution. The document produced by Ecology in December 2019 purportedly replaced the 2008 Lower Skagit Water Quality Improvement Plan, but in doing so it maintained sole reliance on voluntary measures, and provided no timeline for achieving the 100% goal of riparian plantings or water quality standards. The new voluntary plan also ignored the worsening impacts to stream temperatures predicted from climate models and recommended no actions to address increasing temperatures and longer, drier, warmer summers as a result of climate change.[6] The Swinomish Tribe strongly objected to the plan.

Gov. Inslee's Centennial Accord Commitment to Climate Resilient Salmon Streams

Gov. Jay Inslee exercised his strong leadership at the 2019 Centennial Accord in both acknowledging the importance of healthy riparian habitats for salmon and clean water and directing all state agencies to work with the tribes on a proposal that will engage current science and chart a new path toward achieving climate resilient salmon streams. Swinomish is hopeful that by working together, the state and tribal communities can take the important, urgent action needed to protect and recover salmon.

The difficult truth of the matter is that the tribes are running out of fish, and we are running out of time to take the action needed to recover the degraded habitat and water quality our fish need to thrive. Swinomish has watched its salmon harvest decline by over 80% in the past decades – no industry has suffered similar losses. Climate change is worsening the impacts to salmon, so it is equitable, timely and just to develop and implement regulatory measures to rapidly recover and protect our streams and salmon resources.

We can make up for lost time and the harm caused to Swinomish, other treaty tribes and the salmon that are our cultural lifeblood, but only if we prioritize action and move expeditiously to implement science-based solutions.



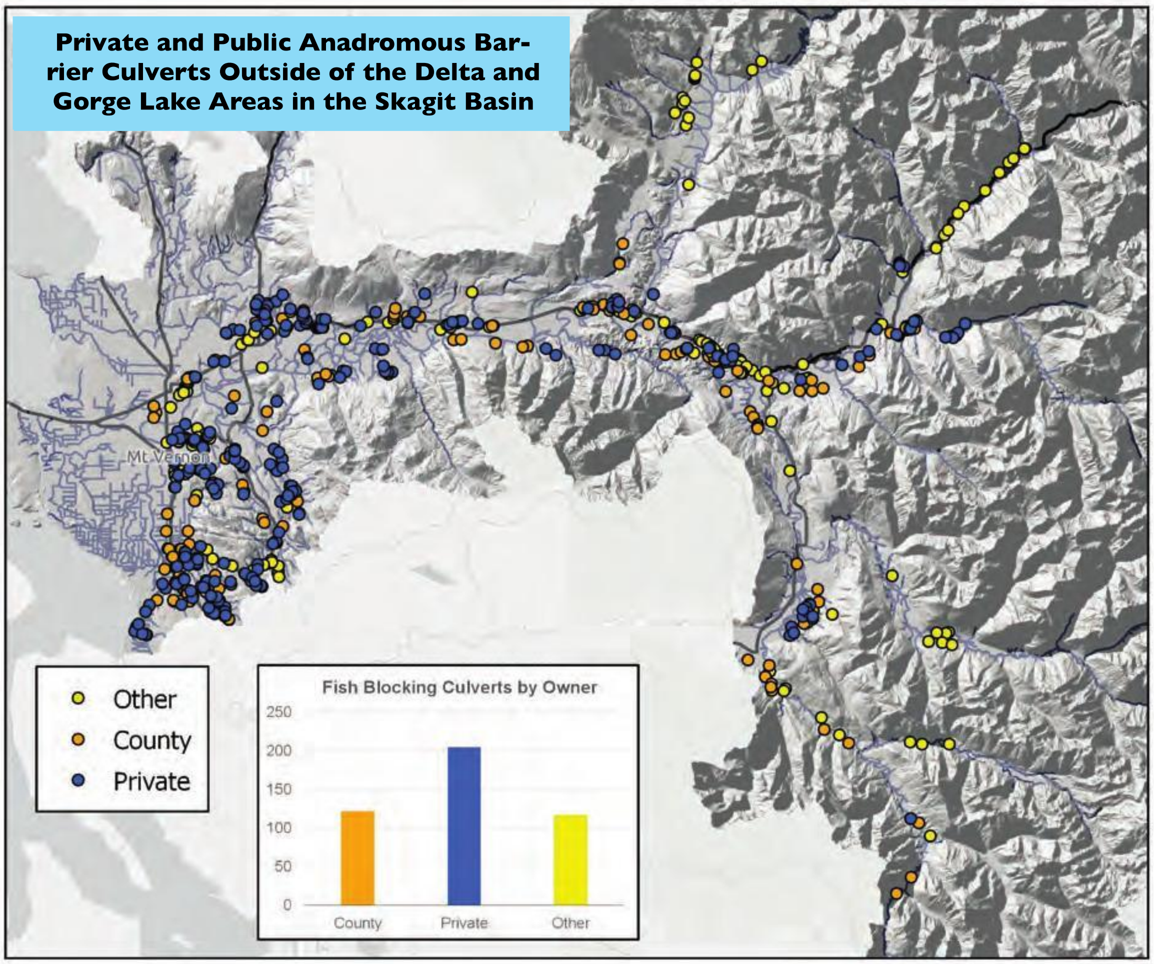
Nearly 1,800 miles of anadromous salmon streams are not meeting stream temperature standards in western Washington. Stream temperatures in Puget Sound are projected to increase dramatically if climate change continues on its current trajectory.

Map Data Sources: ESRI 2020,[12] SWIFD 2014,[13] WAECY 2016,[14] Mauger, et.al. 2015[15]

SWINOMISH INDIAN TRIBAL COMMUNITY

Public and Private Culverts in the Skagit River Watershed Continue to Block Anadromous Salmon Habitat

A recent, comprehensive survey of culvert barriers to anadromous fish passage in the Skagit watershed documented 443 culverts on anadromous fish-bearing streams. Of these, 352 culverts are fish-passage blockages and 91 culverts are unknown but may be fish-passage blockages. Over 74% of the blocking and unknown culverts are either privately owned (204 culverts, 46%) or county-owned (122 culverts, 28%). The remaining 117 culverts (26%) are spread across other public ownerships.[1]



Culverts make up more than 70% of known fish-passage barriers in the Skagit River watershed.[2] This survey, which included participation from the Skagit River System Cooperative (SRSC), the Upper Skagit Indian Tribe (USIT), Skagit County (SKCO), and the Skagit Fish Enhancement Group (SFEG) is the first comprehensive update of these barriers in 20 years. This survey is focused on anadromous fish-bearing streams within a selected survey area, and excludes the Samish River watershed, the Skagit estuary, Fidalgo Island and the portion of the Skagit Watershed upstream of the Gorge Dam at Newhalem due to complicating factors in those areas.[3]

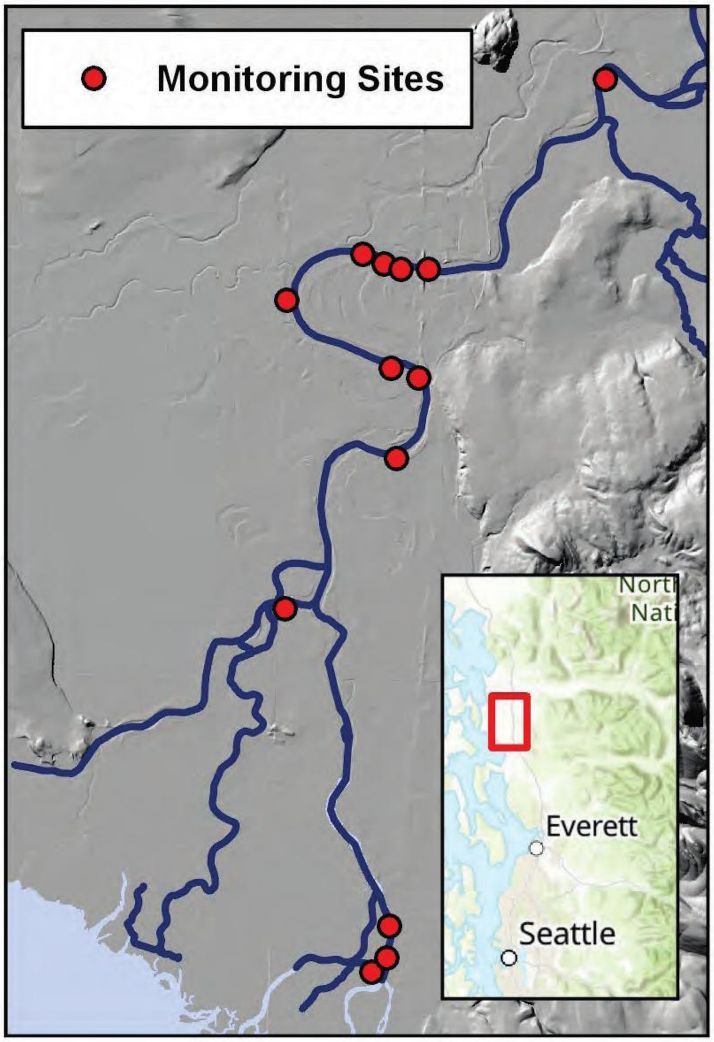
The barrier survey identified 443 culverts, known barriers and unknown but potential barriers within the study area. These barriers are to be considered as a group from which land managers and restoration planners in the Skagit River watershed can strategically locate projects to open up barriers to fish passage. This survey also identified barrier "clusters" to inform land managers and restoration planners where upstream and downstream are barriers located on the same stream system. This allows for strategic planning of multi-culvert removal in locations where up and/or downstream culverts are also blocking anadromous salmon habitat.[4]

The Skagit Watershed Chinook Recovery Plan recommends that each governmental entity identify each culvert on their lands or under their jurisdiction that have man-made barriers to chinook salmon.[5] With the tool now available from this barrier survey, it is even more possible for the culvert barrier owner, regardless of jurisdiction, to take responsibility for fixing their blockage to fish passage, as is required through current Washington state statute.

Map Data Sources: WDFW 2019,[6] SWIFD 2019,[7] WADNR 2014c,[8] SSHIAP 2004,[9] ESRI 2020[10]

Habitat Mitigation Is Partially Offsetting the Negative Impact of Riprap Repair to Riverine Edge Habitat

As part of the 2011 Environmental Assessment the U.S. Army Corps of Engineers was required to complete habitat mitigation for the batched 2007 and 2011 repairs at 60 sites along the lower Skagit River mainstem.[1] Monitoring was conducted at 13 of the 60 sites, and when compared with baseline riprap conditions, the mitigation sites as a whole were found to have offset impacts to riparian vegetation, rearing habitat, refuge habitat and forage habitat for fish. Individual sites partially or not providing functions were most often the result of habitat features not being installed during levee repair.[2]

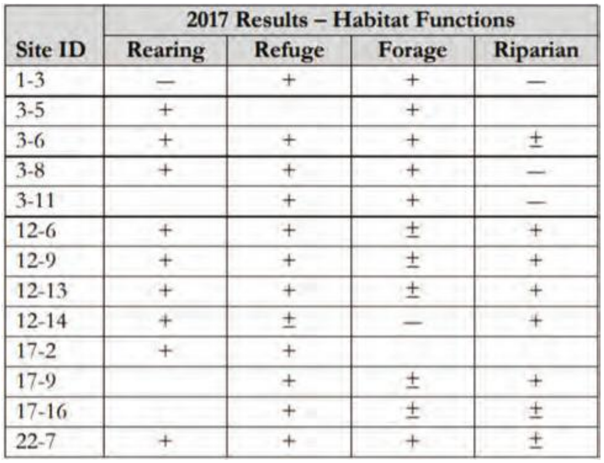


U.S. Army Corps of Engineers Mitigation Monitoring Sites Along the Lower Skagit River mainstem.

The Corps developed the 2011 Habitat Capacity Mitigation Tool (HCMT) in conjunction with the Environmental Assessment (EA) to have metrics for salmon habitat that could be used as a basis to measure the performance of compensatory mitigation. The habitat focus of the HCMT are rearing, foraging and refuge riverine edge habitat for juvenile chinook, as well as the riparian corridor. Monitoring for the 13 sites resulted in a performance status for each of these four focus areas reported as "functions met (+)", "functions unmet (-)", or "functions partially met (+/-)".[3]

The majority of functions were met, at least partially, for the 13 sites. Functions were not met for rearing and riparian at one site, not for foraging at another site, nor for riparian at two other sites.[4] As a whole, the negative impacts of Corps riprap repair appear to have been mitigated for through the HCMT. This should not be interpreted as restoration or recovery of habitat; this mitigation only means that the riprap repair actions taken by the Corps that negatively impacted riverine edge habitat and riparian habitat in the lower Skagit River were at least partially offset by habitat mitigation. The legacy habitat impacts of extensive riprap along the lower Skagit River mainstem continue mostly unmitigated.

Performance Results for 13 Monitoring Sites[8]



	2017 Results – Habitat Functions			
Site ID	Rearing	Refuge	Forage	Riparian
1-3	—	+	+	—
3-5	+		+	
3-6	+	+	+	±
3-8	+	+	+	—
3-11		+	+	—
12-6	+	+	±	+
12-9	+	+	±	+
12-13	+	+	±	+
12-14	+	±	—	+
17-2	+	+		
17-9		+	±	+
17-16		+	±	±
22-7	+	+	+	±

Map Data Sources: WAECY 2018,[5] USACE 2017,[6] SSHIAP 2004[7]

SWINOMISH INDIAN TRIBAL COMMUNITY

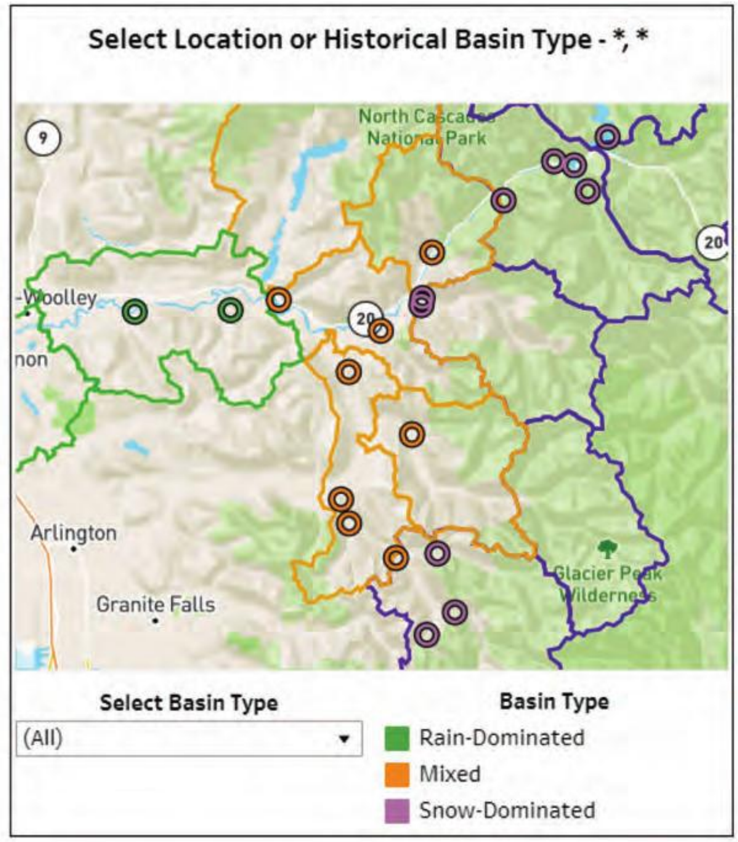
Climate Change Impacts to Streamflow Will Threaten Steelhead Recovery in the Skagit

Results from climate change modeling for a collection of sites throughout the Skagit River system show increasing winter peak flow and decreasing summer low flow as more future annual precipitation is expected to fall as rain than snow. By 2099, results from an ensemble of models forecast that the 2-year high flow event will increase from its historic average by 22% under a low emission scenario, and by 33% under a high emission scenario. The same ensemble of climate models forecast that by 2099, the lowest 7-day 2-year low flow event will decrease from its historic average by 33% under a low emission scenario and by 45% under a high emission scenario.[1]

Skagit River steelhead are more susceptible to streamflow changes driven by climate change than some other anadromous species in the basin because they are in freshwater for a longer period of time (over a year in some cases). The changes in summer base flow and in peak winter flow are likely to impact adult steelhead river entry, pre-spawn mortality, spawning, egg incubation and juvenile steelhead rearing.[2] That means Skagit steelhead will potentially be stressed at nearly every point in their freshwater life cycle in the near future.

In light of the relatively high impact climate change will have on Skagit steelhead in the freshwater environment, even more needs to be done to increase habitat resilience so that they have time to adapt. Adaptation measures should include all of the following:

- Protecting instream flows and improving flows in the Skagit River by enforcing regulations,
- Restricting permit-exempt wells in areas that are hydraulically linked to waterways with low summer flows,
- Supporting incentive programs for water banking or water rights lease or purchase,
- Protecting and restoring groundwater recharge areas and riparian buffer habitat and
- Improving other hydrological characteristics like floodplains to provide lower energy habitat during peak flows and wetted habitat during summer low flows.[3]



Select Location or Historical Basin Type - *, *

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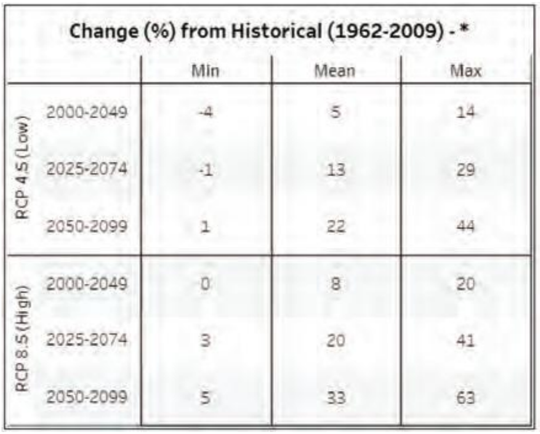
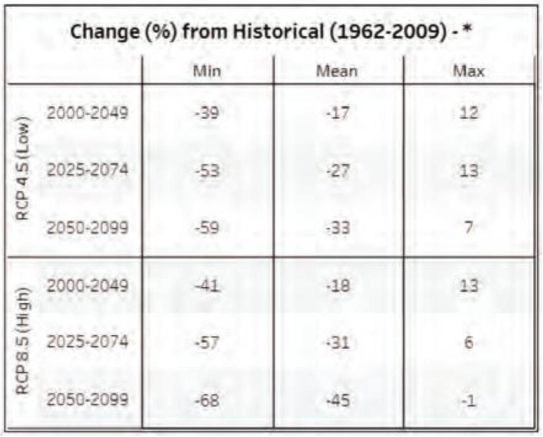
2-Year Peak Flow Events (Q2)



	Change (%) from Historical (1962-2009) - *			
		Min	Mean	Max
RCP 4.5 (Low)	2000-2049	-4	5	14
	2025-2074	-1	13	29
	2050-2099	1	22	44
RCP 8.5 (High)	2000-2049	0	8	20
	2025-2074	3	20	41
	2050-2099	5	33	63

Lowest 7-Day 2-Year Flow (7DQ2)



	Change (%) from Historical (1962-2009) - *			
		Min	Mean	Max
RCP 4.5 (Low)	2000-2049	-39	-17	12
	2025-2074	-53	-27	13
	2050-2099	-59	-33	7
RCP 8.5 (High)	2000-2049	-41	-18	13
	2025-2074	-57	-31	6
	2050-2099	-68	-45	-1

The Skagit Climate Science Consortium (SC2) worked with the UW's Climate Impacts Group to create an interactive web-based tool that anyone can use to look at the hydrologic impacts of forecast climate changes under different global emission scenarios. Captured here is Mean Monthly Flow averaged for all sites in the Skagit River watershed for water years 2038 through 2067 under low global emission and high global emission climate change scenarios.[4]

Map Data Sources: WAECY 2018,[5] USACE 2017,[6] SSHIAP 2004[7]

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2020 State of Our Watersheds Report
Snohomish River Basin

> *Salmon was always the only livelihood of our people. That's all the tribes ever lived on. Tribes have been protecting the salmon and shellfish for thousands of years. That's all we want to do – continue to protect and enhance our natural resources. That's how all of the tribes feel, and we're doing our share to bring these resources back. We just have to keep working at it and get everybody to protect the salmon.*
>
> **– Stan Jones**
> **Tulalip Tribes**

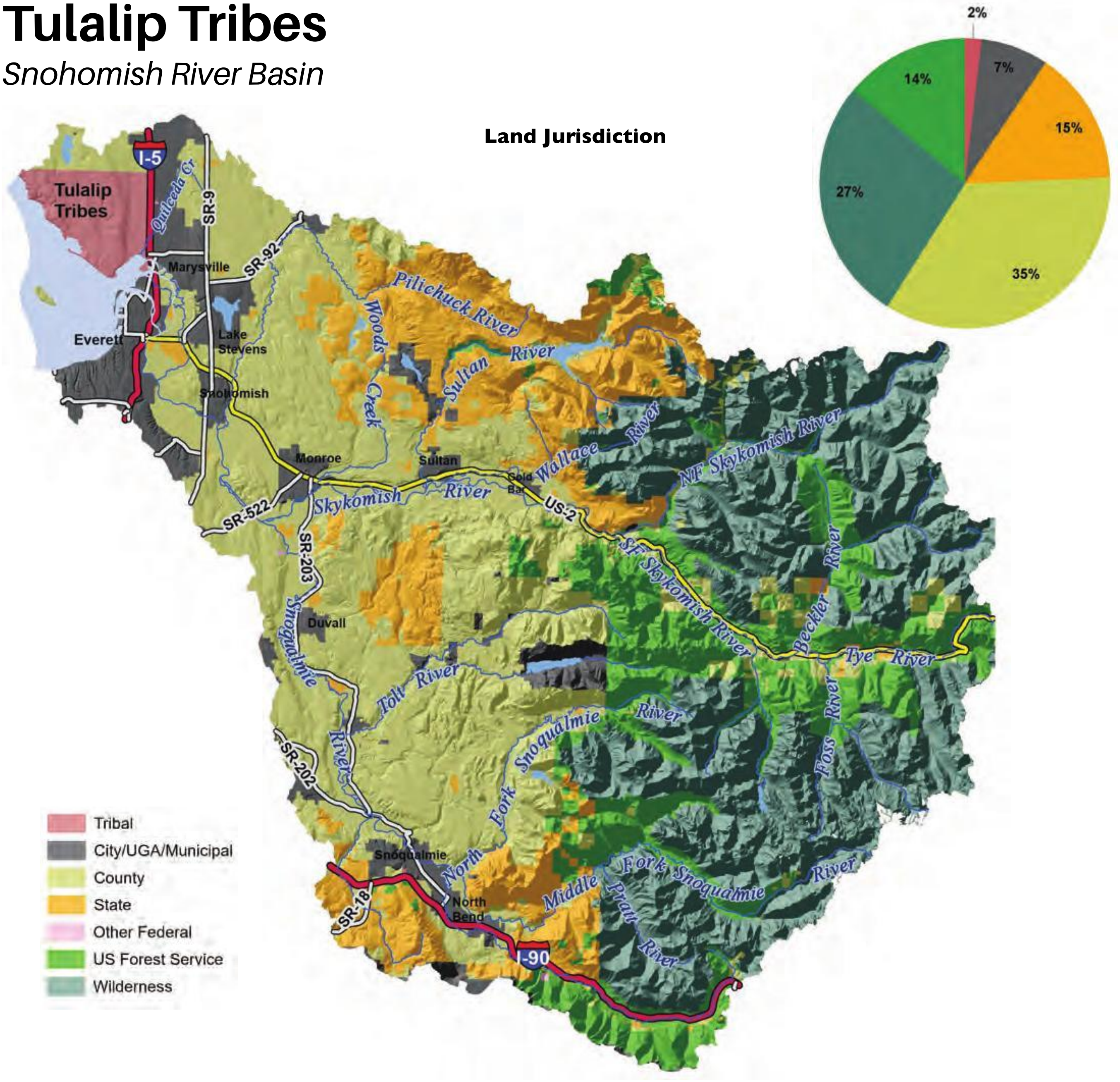
Area of Interest

Tulalip Tribes

The Tulalip Tribes are successors in interest to the Snohomish, Snoqualmie, Skykomish, and other bands of Indians. The Tulalip Reservation is at the mouth of the Snohomish River north of Everett, but historically, these tribes inhabited the drainages of the rivers that now bear their names, as well as parts of Whidbey and Camano islands and the mainland shore from north of Seattle to the mouth of the Stillaguamish River. At the time of European settlement, members of these tribes traveled throughout Puget Sound and north to the Fraser River and beyond to pursue fishing and trading opportunities. The 1855 Treaty of Point Elliott preserved tribes' right to fish, hunt and gather in their traditional areas. The federal government is obligated to protect those treaty-reserved resources. Today the adjudicated Usual and Accustomed fishing area of the Tulalip Tribes extends 120 miles from the Canadian border south to the north end of Vashon Island. This report will focus on the Snohomish River basin and surrounding marine waters, which is only a portion of the area the Tulalip Tribes work in and manage.

Tulalip Tribes

Snohomish River Basin



At 1,856 square miles, the Snohomish River has the second largest drainage basin in Puget Sound. It is the convergence of two major rivers: the Skykomish River and the Snoqualmie River. These rivers flow steeply from their headwaters in the North Cascades before descending on to the flat low-elevation Puget Sound trough.[1]

The Snohomish River basin is within the ancestral home of a number of tribes and bands that later formed the Tulalip Tribes. The present-day reservation lands of the Tulalip Tribes are located along the nearshore of the basin just north of Everett, WA.

Historically and presently, land use has been dominated by physical geography. The foothills and mountains are mainly used for wood products and outdoor recreation. The lowlands are primarily used for agriculture and rural residential development. Most of the urban and industrial land use is concentrated around the delta of the Snohomish River in the cities of Everett and Marysville. The Snohomish River system supports anadromous stocks of coho, chinook, chum and pink salmon, and steelhead, cutthroat and bull trout.[2] The basin is also a major source of municipal water for the cities of Everett and Seattle, along with surrounding areas.[3]

Since 1990 human population is estimated to have grown from ~230,000 to over 390,000.[4] Population is expected to grow at a 59% rate over the next 30 years.[5] The last 150 years of human expansion has left the natural ecology of the Snohomish watershed in a stressed and depleted state. The future protection, conservation and restoration of the watershed will require a better understanding of the current state of the watershed's natural resources and physical processes and a greater commitment to actively restoring, as well as conserving and protecting resources into the future.

Map Data Sources: USFWS 2018,[6] WAECY 2018a,[7] WAECY 2018b,[8] WAECY 1994,[9] WADNR 2014a,[10] WADNR 2014b,[11] WADOT 2013,[12] SSHIAP 2004[13]

Chapter Summary

The Tulalip Tribes have fished, hunted and gathered in their watersheds in western Washington since time immemorial and are leaders in the region's salmon recovery effort. No other people know these watersheds as well as the tribes and none has a greater stake in their future. The tribes believe that if salmon are to survive, real gains in habitat protection and restoration must be achieved.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribes' Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org*.

For this report, the Tulalip Tribes have focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation, including those nearshore areas and local marine waters in proximity to the mouth of the Snohomish River. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Armoring Nearshore Habitat Continues to Negatively Impact Forage Fish and Pacific Salmon

Nearshore beaches are critical to surf smelt (*Hypomesus pretiosus)* and Pacific sand lance (*Ammodytes hexapterus*) spawning. Both of these species are essential forage for Pacific salmon rearing in nearshore environments throughout Puget Sound. A recent survey has found over 54 miles of preferred forage fish spawning habitat in Whidbey basin to be armored. This is a 6% increase from the 51 miles reported in the 2016 State of Our Watersheds Report, putting forage fish and nearshore Pacific salmon habitat on a declining trend.

Restoration is Improving Estuary Habitat Critical to Chinook Salmon

The Snohomish River estuary has had 80-85% of its historic wetland habitat cleared and drained, resulting in the potential chinook losses of between one and 1.6 million per year. Significant restoration progress is beginning to restore critical estuary habitat. By the end of 2019, an estimated 1,100 acres of tidal marsh has been restored, this represents 89% of the Snohomish River basin 10-year salmon habitat restoration goal and is 26% of historic tidal marsh totals.

Riparian Forest Cover Continues to Decrease

Between 2005 and 2017, there has been a net loss of 25 acres of riparian forest cover. Since 2005, 445 acres of riparian restoration occurred but this has not been enough to keep up with the roughly 470 acres of natural and managed riparian vegetation loss over roughly that same time period (2006 to 2017).

Culvert Barriers to Fish Passage Continue to Increase

Since 2016, the number of inventoried structures, the number of blocking or impeding structures, and the miles of blocked anadromous habitat have all increased.

Groundwater Wells Continue to Be Developed in Closed Tributary Watersheds

Since 2015, nearly 30% of all groundwater well development in the Snohomish River watershed has occurred in tributary basins that have been closed to permitted water withdrawal since the 1950s.

Forest Cover in the Lowlands is in Poor Condition and Not Improving

In 2016, the percent of forest cover in the lowland area of the Snohomish River watershed (WRIA 07) was 45% and in a poor condition with respect to watershed health. From 2011 to 2016, the percent of forest cover condition remained unchanged.

Forestland Conversion in the Snohomish River Basin has Drastically Decreased since 2009

From 2000 through 2009 approximately 3,999 acres of land was converted from forest practices to nonforest practices, an average of 399 acres of land converted per year. Since 2010, around 1,024 acres of land was converted from forest practices to nonforest practices, an average of 102 acres of land converted per year. That is a nearly 75% decrease in average annual acres converted out of forestland between the two decades.

Impervious Surface Continues to Spread Around Cities and Towns

From 2011 to 2016, the percent of impervious surface continued to increase in the watersheds including or adjacent to Monroe, Sultan, Snohomish, Duvall, Snoqualmie and North Bend Urban Growth Areas (UGA), from just over 12% impervious to just under 13% impervious.

Nearshore Habitat Restoration Exceeding the 10-year Target of the Snohomish River Basin Conservation Plan

In 2016, only .22 miles of restoration had been completed. By 2020, they are exceeding the 10-year restoration target for Snohomish nearshore habitat has been met at 1 mile and exceeded by 0.42 miles.

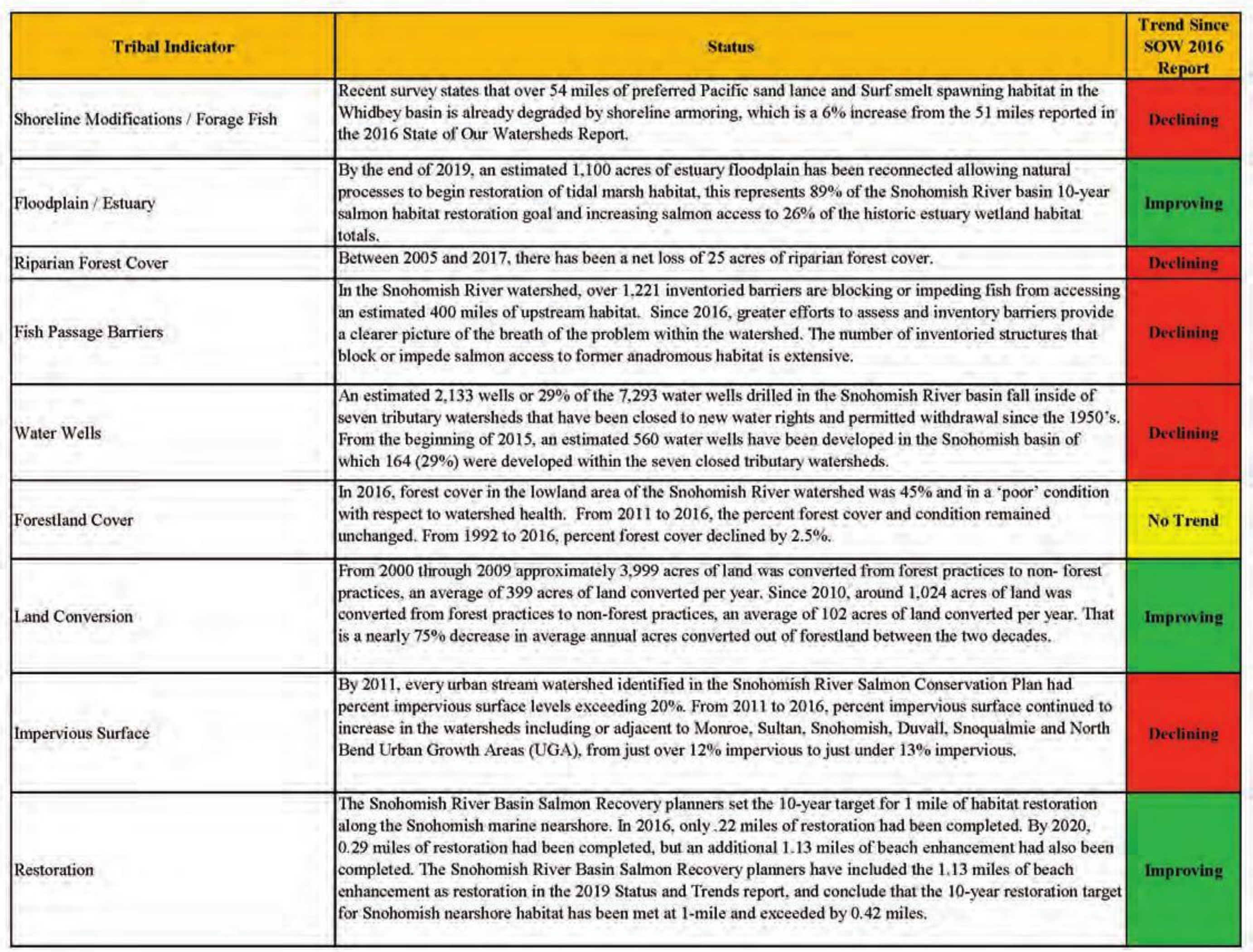
Conclusion

There have been a number of successes in Snohomish River basin restoration since the 2016 State of the Watershed Report. Estuary habitat has been restored and both riparian restoration and nearshore restoration have exceeded 10-year targets. At the same time, the incremental decline in habitat conditions across the watershed has continued. Too much nearshore habitat remains armored, lowland forest cover remains in a poor condition, impervious surfaces continue to expand from cities and towns into outlying areas and fish passage barriers continue to increase. Restoration is not enough to keep up with the impacts of a growing population and their land use in the watershed. People have to be held accountable to protecting, conserving and improving fish habitat in their land-use decisions, and federal, state and local governments all have a role in that. Land-use regulations and water laws that are in place and meant to protect critical areas and fish habitat need to be implemented. Implementation includes education and voluntary action, but it also needs to include enforcement when those laws are broken. The future of tribal treaty rights in the Snohomish River basin depends on it.

Recovery Efforts Show Signs of Improvement But Still Lagging in Key Indicators

At the 15-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Snohomish basin shows an improvement in the rate of land conversion and restoration efforts, but degradation in water quantity, impervious surface, fish passage barriers, forest cover loss, and marine shoreline habitat conditions. In general, there is a shortage of staff and funding at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat, and to monitor and enforce compliance of existing regulations. In addition, the longer time frames to implement large-scale projects and the lag time in ecological system recovery contribute to the slow pace of progress.

Review of the trend for these key environmental indicators since the 2016 State of Our Watersheds Report shows improvement for some indicators and a steady loss for others in habitat status:



Tribal Indicator	Status	Trend Since SOW 2016 Report
Shoreline Modifications / Forage Fish	Recent survey states that over 54 miles of preferred Pacific sand lance and Surf smelt spawning habitat in the Whidbey basin is already degraded by shoreline armoring, which is a 6% increase from the 51 miles reported in the 2016 State of Our Watersheds Report.	Declining
Floodplain / Estuary	By the end of 2019, an estimated 1,100 acres of estuary floodplain has been reconnected allowing natural processes to begin restoration of tidal marsh habitat, this represents 89% of the Snohomish River basin 10-year salmon habitat restoration goal and increasing salmon access to 26% of the historic estuary wetland habitat totals.	Improving
Riparian Forest Cover	Between 2005 and 2017, there has been a net loss of 25 acres of riparian forest cover.	Declining
Fish Passage Barriers	In the Snohomish River watershed, over 1,221 inventoried barriers are blocking or impeding fish from accessing an estimated 400 miles of upstream habitat. Since 2016, greater efforts to assess and inventory barriers provide a clearer picture of the breath of the problem within the watershed. The number of inventoried structures that block or impede salmon access to former anadromous habitat is extensive.	Declining
Water Wells	An estimated 2,133 wells or 29% of the 7,293 water wells drilled in the Snohomish River basin fall inside of seven tributary watersheds that have been closed to new water rights and permitted withdrawal since the 1950's. From the beginning of 2015, an estimated 560 water wells have been developed in the Snohomish basin of which 164 (29%) were developed within the seven closed tributary watersheds.	Declining
Forestland Cover	In 2016, forest cover in the lowland area of the Snohomish River watershed was 45% and in a 'poor' condition with respect to watershed health. From 2011 to 2016, the percent forest cover and condition remained unchanged. From 1992 to 2016, percent forest cover declined by 2.5%.	No Trend
Land Conversion	From 2000 through 2009 approximately 3,999 acres of land was converted from forest practices to non- forest practices, an average of 399 acres of land converted per year. Since 2010, around 1,024 acres of land was converted from forest practices to non-forest practices, an average of 102 acres of land converted per year. That is a nearly 75% decrease in average annual acres converted out of forestland between the two decades.	Improving
Impervious Surface	By 2011, every urban stream watershed identified in the Snohomish River Salmon Conservation Plan had percent impervious surface levels exceeding 20%. From 2011 to 2016, percent impervious surface continued to increase in the watersheds including or adjacent to Monroe, Sultan, Snohomish, Duvall, Snoqualmie and North Bend Urban Growth Areas (UGA), from just over 12% impervious to just under 13% impervious.	Declining
Restoration	The Snohomish River Basin Salmon Recovery planners set the 10-year target for 1 mile of habitat restoration along the Snohomish marine nearshore. In 2016, only .22 miles of restoration had been completed. By 2020, 0.29 miles of restoration had been completed, but an additional 1.13 miles of beach enhancement had also been completed. The Snohomish River Basin Salmon Recovery planners have included the 1.13 miles of beach enhancement as restoration in the 2019 Status and Trends report, and conclude that the 10-year restoration target for Snohomish nearshore habitat has been met at 1-mile and exceeded by 0.42 miles.	Improving

The Tribes continue to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

For over a decade since chinook salmon were listed in Puget Sound, harvest and hatchery impacts on Snohomish River chinook salmon have been greatly reduced, at great cost to the Tulalip Tribes. Meanwhile, significant public funds and volunteer hours have been spent restoring lost habitat according to a comprehensive recovery plan developed cooperatively by many watershed partners throughout the basin, and significant strides have been made.

Beach nourishment projects are scheduled between Mukilteo and Everett to provide much-needed sediment that historically came from the adjacent feeder bluffs now impounded by the railroad.[12] The estuary is on track to have restored over 1,000 acres of the Salmon Recovery Plan's 10-year goal of 1,237 acres of tidally influenced habitat.[13] Assessments and planning efforts are underway within the basin to develop an acquisition strategy to further develop floodplain restoration, fully inventory culverts to address the impacts of permit-exempt wells. As well, riparian forest restoration continues to move forward toward the 10-year goals of the Salmon Recovery Plan.

Yet with these much-needed gains through restoration, recent trends and this document demonstrate that net loss and degradation of key habitats continues. Unless appropriate habitat protection measures are taken immediately such that we start to see a net gain in habitat, our salmon recovery goals will never be reached, and all other recovery actions will have been in vain.

Despite the degradation it has suffered, the Snohomish watershed retains the potential to once again be a strong salmon producer that will provide the Tulalip people with the benefits they retained when they gave up so much else in the Treaty of Point Elliott. It is the Tribes' position that the reduction in habitat loss and the restoration of degraded and disconnected habitat are the greatest need and are the principal actions that need to be taken to recover salmon in the Snohomish basin. The Tulalip Tribes remain ready and willing to work with all watershed partners to turn us toward the goal of recovered salmon once again being the icon of the Pacific Northwest. But this will not happen without a meaningful commitment to protection of the habitats necessary to sustain them.

The Tulalip Tribes have a reputation in the Snohomish basin as a leading force, committed to full ecosystem recovery through collaboration with watershed partners.

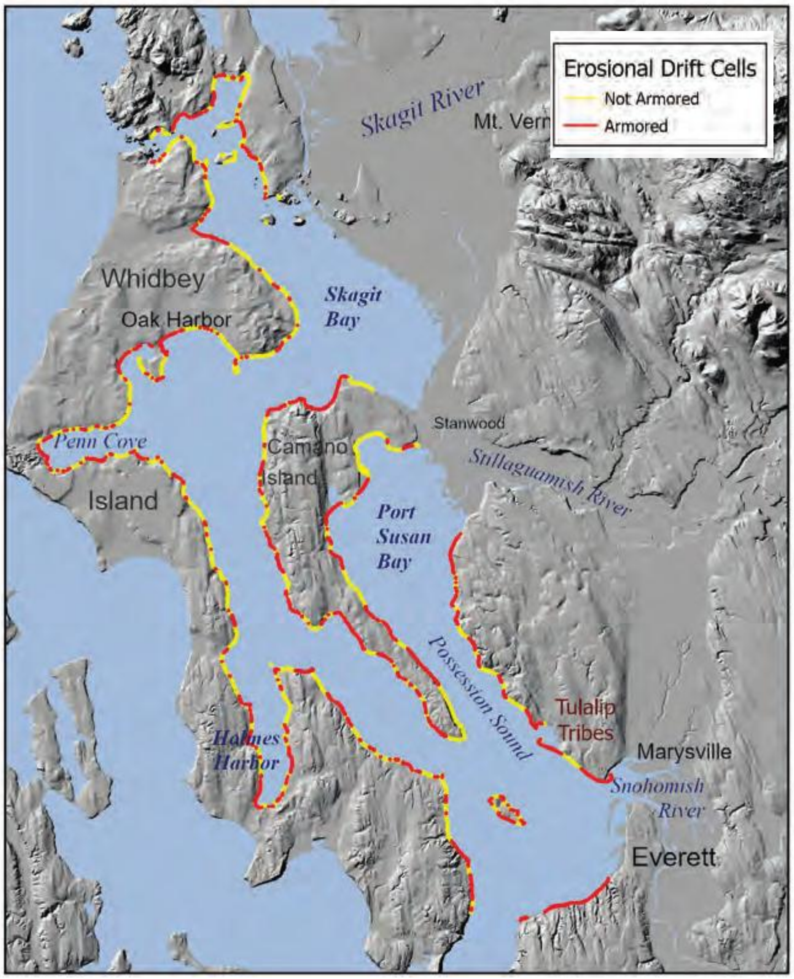
The Tribes will continue to push for solutions as we are a permanent fixture in the basin. We believe that the Snohomish system is imminently recoverable. Though there has been significant alteration, much of the change is reversible.

An excellent example is the completed Qwuloolt restoration project, which revitalized about 354 acres of estuary that was diked and thought to be lost, and improved salmon accessibility to 16 miles of stream habitat; and the removal of a dam on the Pilchuck that no longer served its purpose that will improve access to 37 miles of river and stream habitat. The last 150 years of human expansion has left the natural ecology of the Snohomish watershed in a stressed and depleted state, but we believe strongly in the resilience of the watershed. If areas are reopened and the watershed processes remain largely intact, treaty reserved salmon resources are recoverable.

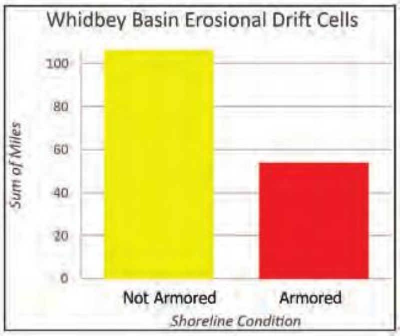
TULALIP TRIBES

Land use, Predation and Sea Level Rise Among Factors Impacting Forage Fish in the Whidbey Basin

A recent survey states that over 54 miles of preferred Pacific sand lance and Surf smelt spawning habitat in the Whidbey basin is already degraded by shoreline armoring, which is a 6% increase from the 51 miles reported in the 2016 State of Our Watersheds Report.[1] In addition, Whidbey basin herring stocks are declining in Holmes Harbor (72% lower than the 25-year mean), critical in Possession Sound (89% lower than the 25-year mean), and depressed in Skagit Bay (74% lower than the 25-year mean).[2]



The sediments of erosional drift cell habitats create the preferred spawning areas for forage fish. There is 160 miles of erosional drift cell habitat in the Whidbey basin and 54 miles of that habitat is already armored.[9,10] Armoring and sea level rise are combining to further threaten these limited habitats.



Pacific sand lance and surf smelt are an important food source for Puget Sound chinook. They are beach spawners and especially sensitive to the impacts of shoreline armoring. Whidbey basin has been partially surveyed for forage fish spawning habitat. Of the 110 miles that have been surveyed, over 104 miles (94%) are found along erosional drift cell habitats, like feeder bluffs, transitional zones and accretion shore forms.[3] There are only 160 miles of this preferred forage fish spawning habitat along 327 miles of Whidbey basin shoreline.[4] The estimated 54 miles of armoring is a 6% increase from the estimated 51 miles of shoreline armoring reported in the 2016 State of Our Watersheds Report.[5] The spawning impacts from shoreline armoring are compounded by current and continued sea level rise, which results in narrower beaches (coastal squeeze) and less available spawning habitat area for forage fish to access.[6]

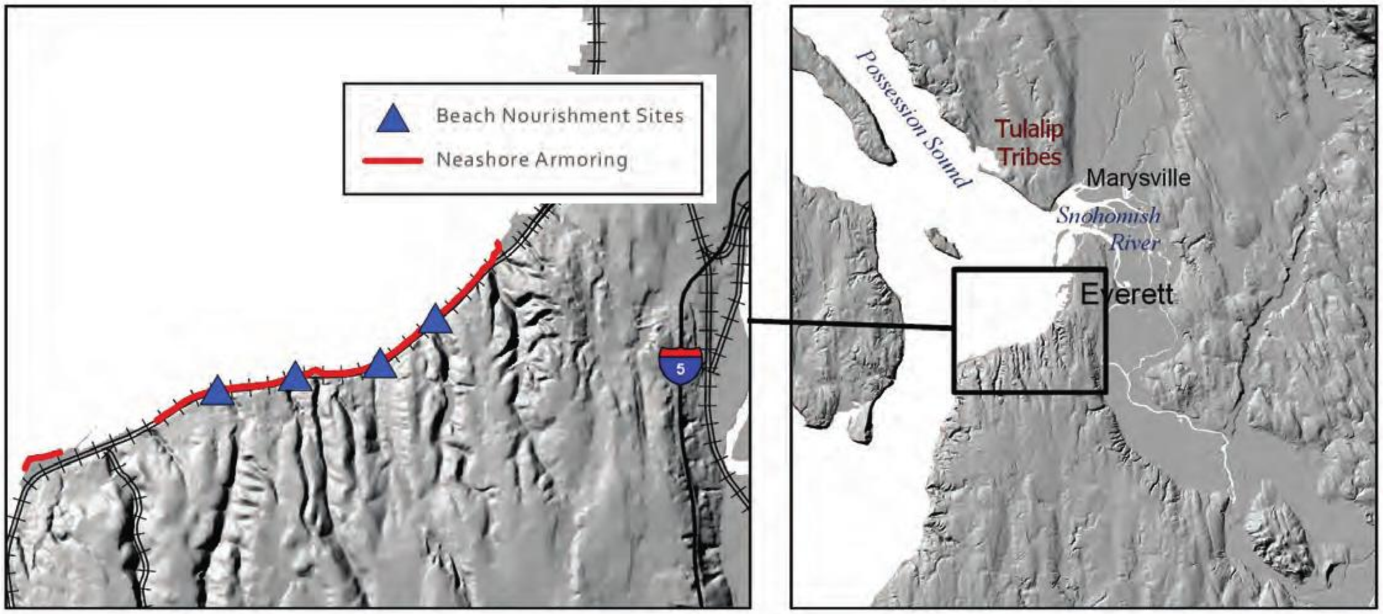
The importance of Pacific sand lance and surf smelt as forage fish for Snohomish River chinook stocks is magnified by the status of Whidbey basin herring stocks. WDFW biologist, Phillip Dionne points to a suite of factors leading to the decline of herring stocks.[7] These include, but are not limited to, shoreline armoring, loss of submerged vegetation, poor water quality and increased predation from marine mammals. Dionne further argues that to recover herring stocks in the southern Salish Sea, larger land use and development issues will have to be addressed.[8]

Snohomish County Marine Resources Committee

Map Data Sources: WDFW 2017,[9] CGS 2017[10]

Salmon Recovery is Meeting its 10-year Target for the Snohomish Nearshore

The Snohomish River Basin Salmon Recovery planners set the 10-year target for 1 mile of habitat restoration along the Snohomish marine nearshore. In 2016, only .22 miles of restoration had been completed. By 2020, 0.29 miles of restoration had been completed, but an additional 1.13 miles of beach enhancement had also been completed. The Snohomish River Basin Salmon Recovery planners have included the 1.13 miles of beach enhancement as restoration in the 2019 Status and Trends report, and conclude that the 10-year restoration target for Snohomish nearshore habitat has been met at 1-mile and exceeded by 0.42 miles.[1]



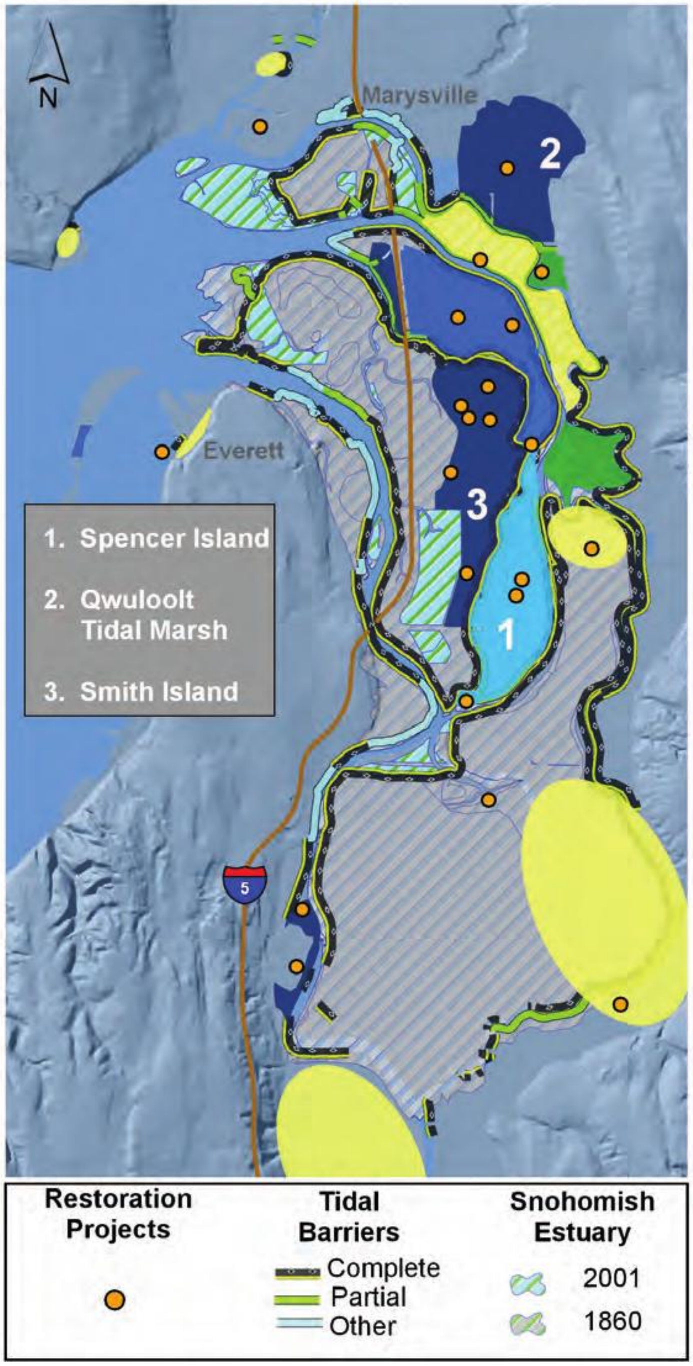
Beach nourishment has been completed at four locations along a 4.5-mile stretch of the railroad-impounded shoreline between Mukilteo and Everett. Dredge material from the Snohomish River was placed at these key nourishment sites allowing the drift cell to naturally distribute sediment along the shoreline.[4]

At the center of the planned restoration effort are a series of beach nourishment projects and a beach restoration project along the impounded stretch of shoreline from Everett to Mukilteo.[2] The proposed sediment nourishment restoration projects do not restore coastal bluffs as the sediment source for the beaches; instead dredged material from the Snohomish delta is used to fill the sediment-starved beach sites in need of nourishment. While beach nourishment is an enhancement to the nearshore, it is not restoration, as ongoing long-term maintenance will be required to ensure proper sediment placement continues.[3]

Restored shoreline at Howarth Park in the city of Everett is one of the four locations of beach nourishment along the impounded shoreline between Mukilteo and Everett.[5]

Snohomish is Meeting its 10-year Estuary Recovery Goal

By the end of 2019, an estimated 1,100 acres of estuary floodplain has been reconnected, allowing natural processes to begin restoration of tidal marsh habitat. This represents 89% of the Snohomish River basin 10-year salmon habitat restoration goal and increasing salmon access to 26% of the historic estuary wetland habitat totals.[1]



Wetlands of the Snohomish estuary in 1860 were 80-85% more extensive than in 2001.[5] Restoration efforts are slowly bringing some of that lost wetland habitat back and large projects like Spencer Island, Qwuloolt Estuary and Smith Island have the estuary close to meeting its 10-year restoration target.[6]

Map Data Sources: HAAS, A. and B. Collins, 2001,[5] HWS 2019[6]

Salish Sea Wiki

Through the efforts of the Tulalip Tribes in partnership with many agencies, the first tidal flood of the Qwuloolt Estuary was restored the afternoon of August 28, 2015.[7]

From 1860 to 1950, the clearing and draining of the Snohomish estuary resulted in 80-89% loss of historic estuarine wetland habitat.[2] The loss in habitat area has resulted in a potential loss of 1 million to 1.6 million chinook smolts annually, leaving the estuary a frequent bottleneck to chinook production.[3] While reaching the 10-year goal for estuary restoration will increase current estuary habitat to 26% of historic totals, it is still far from the 80% habitat restoration desired by the Tulalip Tribes. New research on fish use in the estuary is pointing to a need for connected habitat in the upper tidal forested estuary zones and the estuary habitat component of salmon recovery will need to include these areas as well.[4]

Tulalip Tribes

Early morning on the Snohomish Estuary.

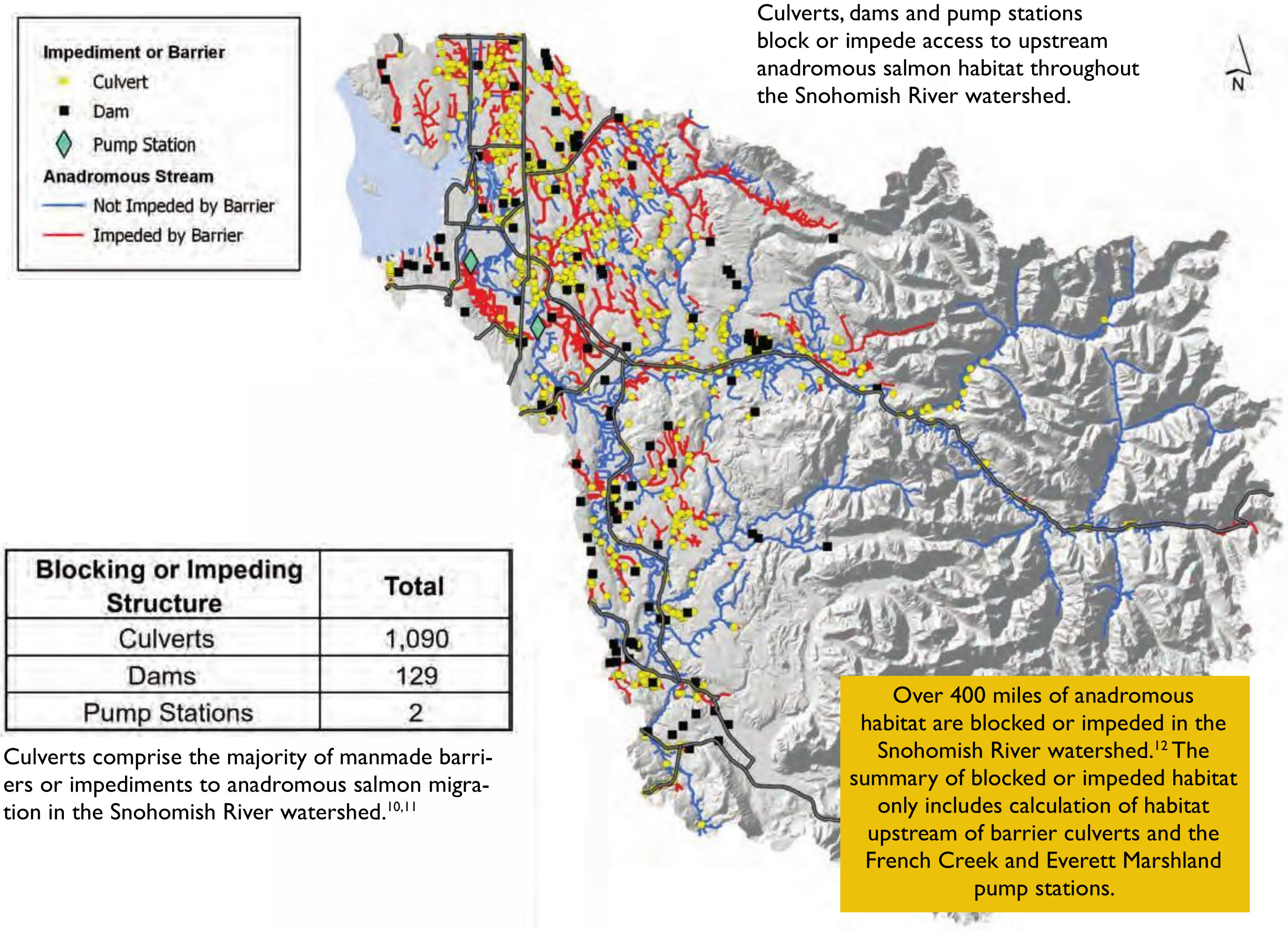
Fish Passage Barriers Continue to Block Anadromous Salmon from Upstream Habitat in the Snohomish Watershed

In the Snohomish River watershed, over 1,221 inventoried barriers are blocking or impeding fish from accessing an estimated 400 miles of upstream habitat.[1] Since 2016, greater efforts to assess and inventory barriers provide a clearer picture of the breadth of the problem within the watershed. The number of inventoried structures that block or impede salmon access to former anadromous habitat is extensive.

Based on survey records through the end of 2019, approximately 2,025 culverts are known to exist in the basin.[2] More than 500 culverts have been verified through surveys since 2016. With continued culvert inventory in the watershed, more barrier impacts to salmon and steelhead passage are being discovered. The total impact of culverts on anadromous fish will not be known until culvert inventories are complete, but as can be seen the width and breath of the problem within the basin is extensive. Addressing this problem needs to be a priority of all jurisdictions and within the watershed.

While culverts are the primary physical barrier impeding habitat in the Snohomish River watershed, pump stations at Everett Marshland and French Creek are blocking stream and wetland habitat. The removal of the French Creek pump station would open access to more than 50 miles and upwards of 115 miles of floodplain side-channel and tributary habitat and potential access to floodplain wetlands for anadromous fish.[3,4,5] Additionally, removal of the Marshland watershed pump station with accompanied restoration could provide anadromous fish access to between 400 and 500 acres of floodplain wetland habitat.[6]

Additionally, approximately 180 small and medium-size dam structures built by individuals are impacting anadromous salmon habitat throughout the watershed. These dams are partial or complete blockages to upstream salmon migration or affect stream processes and ecological conditions downstream of the structure.



Culverts, dams and pump stations block or impede access to upstream anadromous salmon habitat throughout the Snohomish River watershed.

Blocking or Impeding Structure	Total
Culverts	1,090
Dams	129
Pump Stations	2

Culverts comprise the majority of manmade barriers or impediments to anadromous salmon migration in the Snohomish River watershed.[10,11]

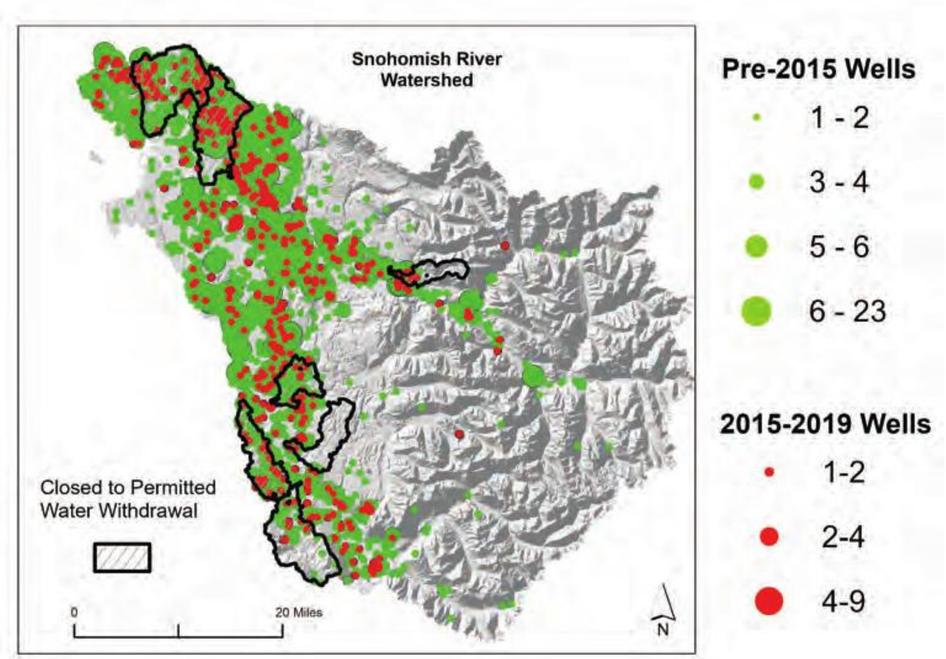
Over 400 miles of anadromous habitat are blocked or impeded in the Snohomish River watershed.[12] The summary of blocked or impeded habitat only includes calculation of habitat upstream of barrier culverts and the French Creek and Everett Marshland pump stations.

Map Data Sources: WDFW. 2019,[7] SWIFD 2019,[8] WAECY 2017[9]

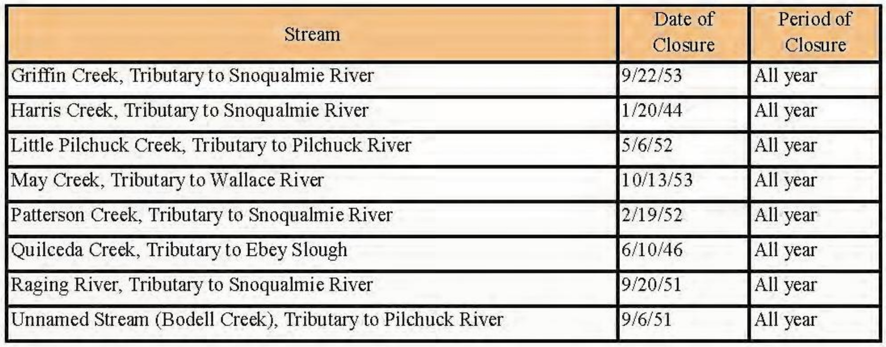
Wells Are an Accumulating Problem

An estimated 2,133 wells or 29% of the 7,293 water wells drilled in the Snohomish River basin fall inside of seven tributary watersheds that have been closed to new water rights and permitted withdrawal since the 1950s. From the beginning of 2015, an estimated 560 water wells have been developed in the Snohomish basin, of which 164 (29%) were developed within the seven closed tributary watersheds.[1,2]

On October 6, 2016, the Hirst decision of the Washington State Supreme Court established that counties had to make their own decisions about whether there was enough water, both physically and legally, to approve any building permit that would rely on a well.[3] In response, the Washington State Legislature passed the Streamflow Restoration Act in January of 2018. The law directs local planning groups to develop watershed plans that offset impacts and achieve a net ecological benefit from new domestic permit-exempt wells.[4] In the two years since the new law passed, an estimated 238 wells have been drilled in the Snohomish River basin, and 71 (30%) of those wells were drilled in the seven tributaries watersheds that were previously closed.[5,6]



Water wells developed prior to 2015, water wells developed between 2015 and 2020, and the location of the seven closed watersheds in the Snohomish River basin.[7,8]



Stream	Date of Closure	Period of Closure
Griffin Creek, Tributary to Snoqualmie River	9/22/53	All year
Harris Creek, Tributary to Snoqualmie River	1/20/44	All year
Little Pilchuck Creek, Tributary to Pilchuck River	5/6/52	All year
May Creek, Tributary to Wallace River	10/13/53	All year
Patterson Creek, Tributary to Snoqualmie River	2/19/52	All year
Quilceda Creek, Tributary to Ebey Slough	6/10/46	All year
Raging River, Tributary to Snoqualmie River	9/20/51	All year
Unnamed Stream (Bodell Creek), Tributary to Pilchuck River	9/6/51	All year

There are a total of eight closed basins in the Snohomish River watershed. The location of Bodell Creek, a tributary to the Pilchuck River, is not well documented, so this assessment only summarizes exempt well impacts for seven of the closed watersheds in the Snohomish River watershed.

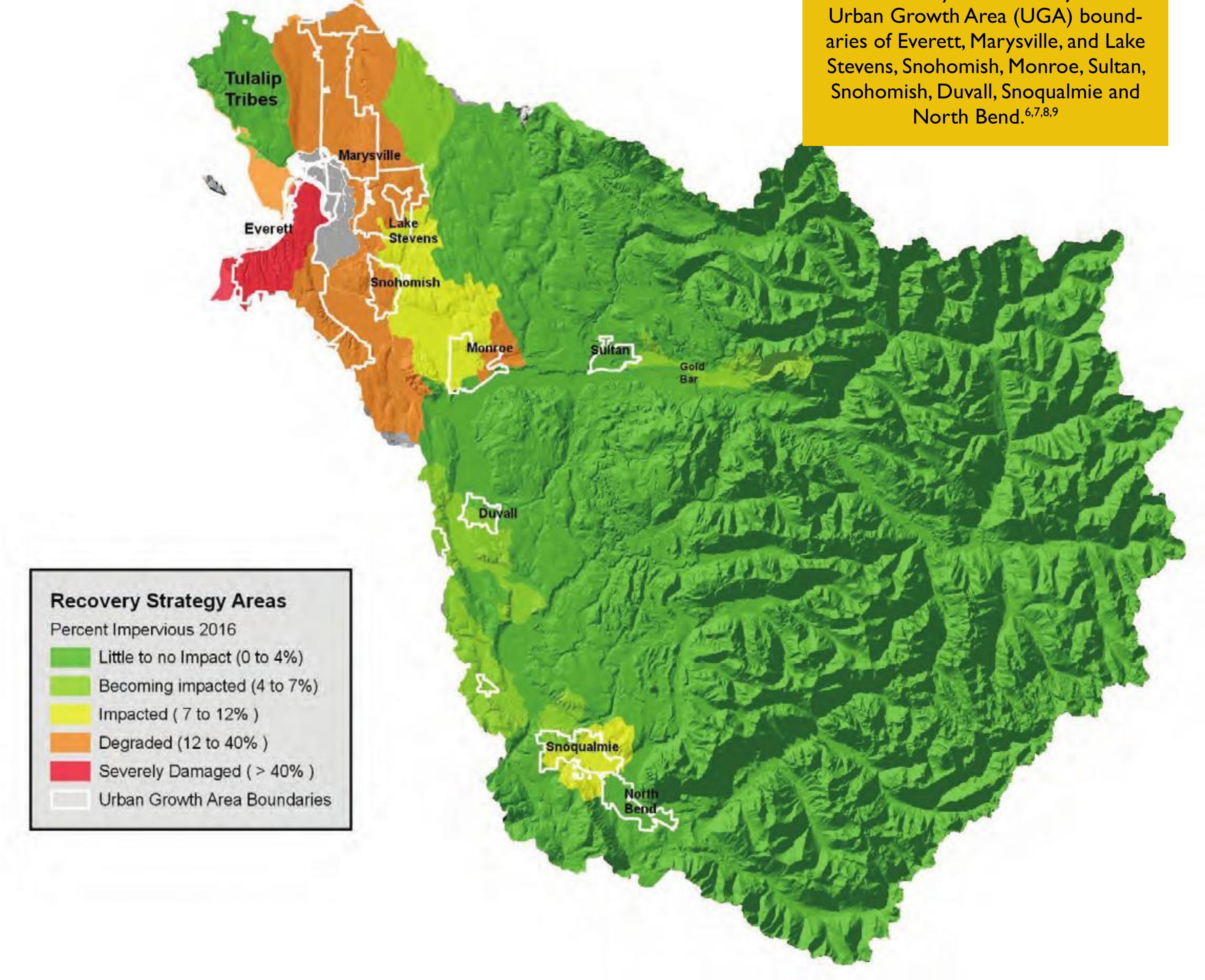
Note: In the previous State of Our Watersheds Report we reported that 11,613 water wells had been developed in the Snohomish River basin. Since the last report, Washington Department of Ecology has improved the well log dataset, which allows us to perform a more refined query of the data. Many of the wells previously identified as water wells for consumptive use are wells dug for other purposes. For this report, we have better identified and removed "nonconsumptive" water wells from the analysis. As the data continues to improve, our methods and analysis will continue to be refined.

Map Data Sources: WAECY 2019,[7] *WAC 173-507-3-(2)*[8]

Impervious Surfaces Continuing to Degrade Water Quality in the Lower Snohomish River Watersheds

By 2011, every urban stream watershed identified in the Snohomish River Salmon Conservation Plan had percent impervious surface levels exceeding 20%.[1,2] Between 2011 and 2016, percent impervious surface continued to increase in the watersheds including or adjacent to Monroe, Sultan, Snohomish, Duvall, Snoqualmie and North Bend Urban Growth Areas (UGA), from just over 12% impervious to just under 13% impervious.[3]

Between 2011 and 2016, development and impervious surfaces continued to increase in watersheds that are mostly within or adjacent the Urban Growth Area (UGA) boundaries of Everett, Marysville, and Lake Stevens, Snohomish, Monroe, Sultan, Snohomish, Duvall, Snoqualmie and North Bend.[6,7,8,9]



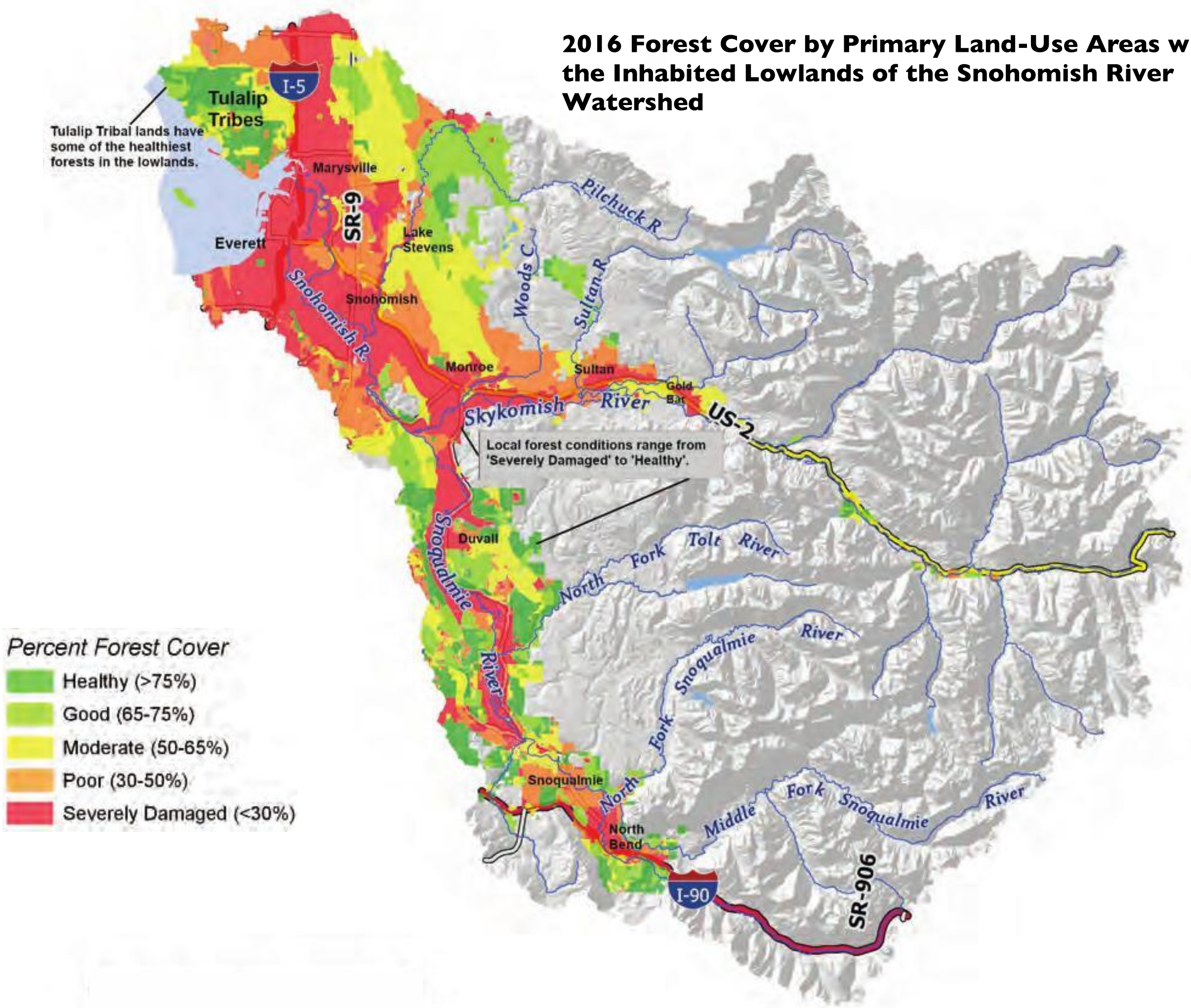
The Snohomish River Basin Salmon Conservation plan suggests impervious surface will have minor geomorphic, hydrologic, and biological impacts on streams if they are covering under 7% of the landscape at the sub-basin scale, but warns that watershed degradation is likely occurring at 12% impervious surface cover at the sub-basin scale.[4] The urban, mainstem and rural watersheds of the lower Snohomish River system are continuing to move away from conservation plan targets toward a worsening watershed condition. The intensification of impervious surface in urban watersheds, and the spread of impervious surface into adjacent mainstem and rural watersheds like the Pilchuck River, Patterson Creek and the Skykomish River are a concern and are continuations of a trend identified in the 2012 and 2016 State of the Watershed Reports.[5]

Map Data Sources: WAECY 2018a,[6] NLCD 2016,[7] Snohomish County 2005,[8] SSHIAP 2004.[9]

TULALIP TRIBES

Forest Cover Loss Continues in the Lowlands of the Snohomish River Basin

From 2011 to 2016, the percent forest cover and condition in the lowlands of the Snohomish River basin remained unchanged. However, from 1992 to 2016, percent forest cover in this area declined by 2.5%.[1,2,3,4]



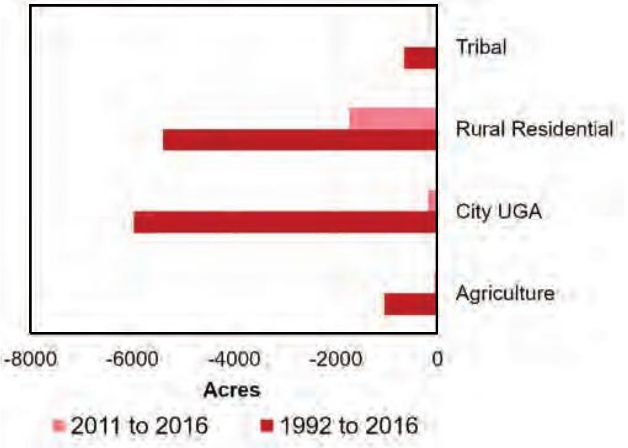
2016 Forest Cover by Primary Land-Use Areas within the Inhabited Lowlands of the Snohomish River Watershed

The desired forest cover in the Snohomish River watershed is mature canopy of conifer and deciduous trees that covered at least 65% of non-urban sub-basins in the watershed.[5] Forest cover at this level provides a healthy environment for water and biota. As forest cover drops below 50% in a sub-basin because of forest clearing and development, water quality is more likely to decrease and biota is more likely to show negative impacts.[6,7] Between 1992 and 2016, land development associated with a growing population resulted in forest cover loss in the inhabited lowlands of the Snohomish River basin.

The majority of lowland forest cover loss between 1992 and 2016 was in rural residential areas and the second largest amount of forest cover loss was in the city UGA areas. While there has been very little continued forest cover loss on agricultural lands since 1992, forest cover on agricultural lands was well under 50% in 1992, at less than 18% forest cover, and that condition persists in 2016.[8,9,10,11]

Map Data Sources: WAECY 1992-2016,[12] Snohomish Cty 2020,[13] SSHIAP 2019,[14] King Cty 2020,[15] SSHIAP 2004[16]

Acres of forest cover loss by land use in the inhabited lowlands of the Snohomish River watershed: 1992 to 2016 and 2011 to 2016[17,18,19,20]



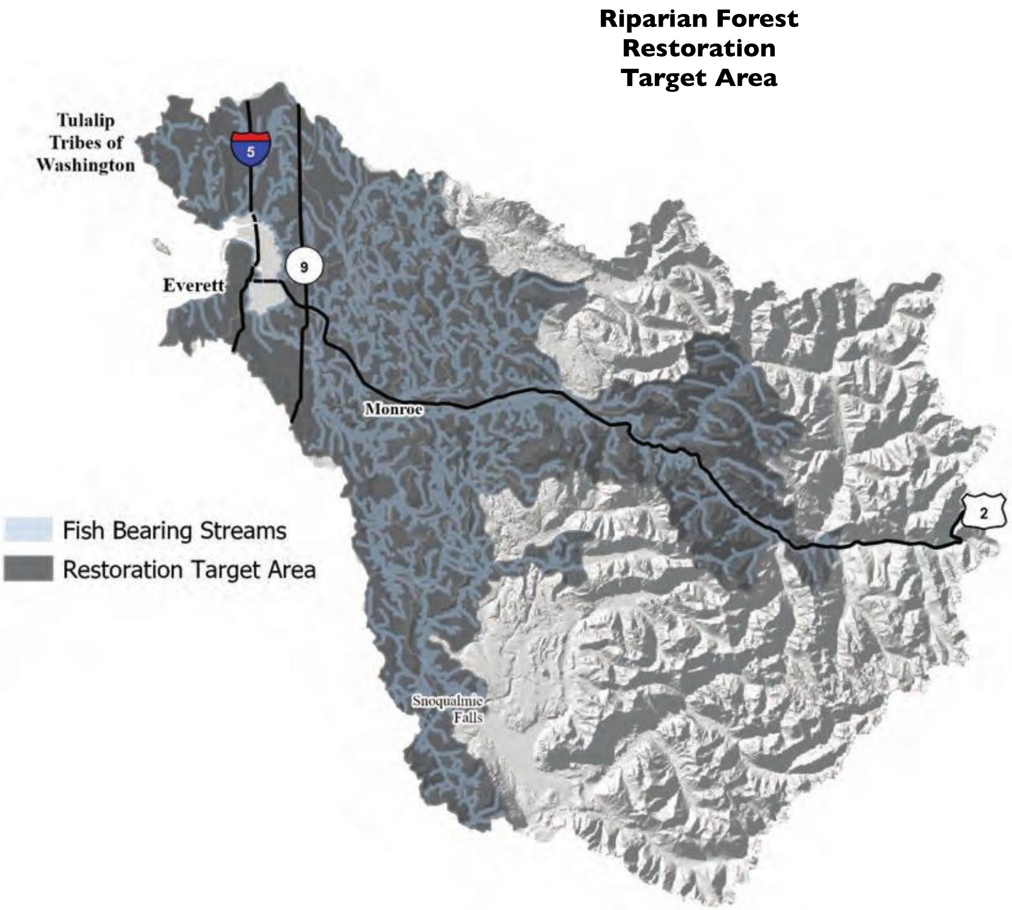
Riparian Forest Cover Continues to Decrease

Between 2005 and 2017, there has been a net loss of 25 acres of riparian forest cover.

Riparian forests and trees near rivers and streams are vital to salmon habitat. They provide shade, organic material, nutrient inputs and habitat forming large woody debris.[1]

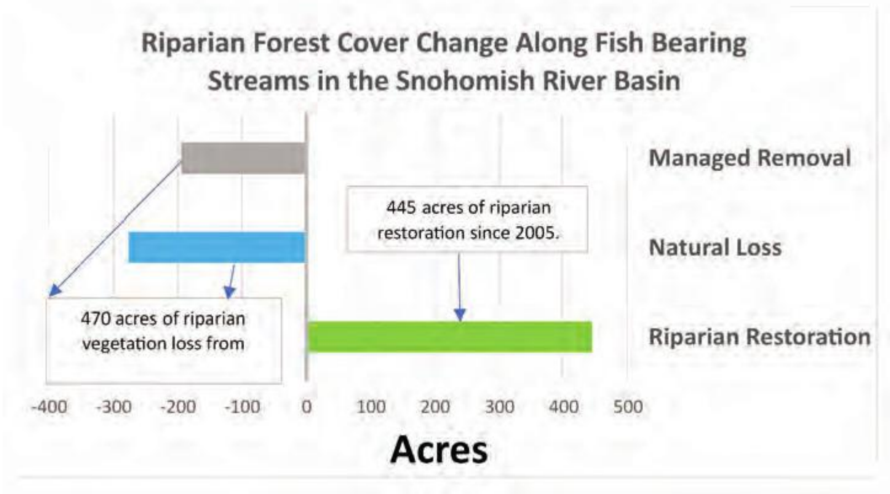
The 2019 Snohomish River Basin Salmon Conservation Status and Trends Report documents that riparian restoration has occurred across 445 acres, which exceeds the 350 acres planned for restoration by 2017.[2] However, this assessment did not factor estimated loss of forest cover over that same time frame. To estimate forest cover loss, we looked at the WDFW High Resolution Change Detection (HRCD) data for 2006 through 2017 and found 470 acres of riparian acreage removed over that time frame, 194 acres through a managed removal for human land uses, and 275 acres removed through stream movement and other natural causes.[3]

As the Snohomish River basin continues working toward its 50-year riparian restoration target with a goal of 6,468 acres, adjusting for riparian forest loss to man-made and natural causes is needed to truly reach the objectives of the conservation plan.[4]



Fish-bearing Streams within Snohomish River Basin Salmon Conservation Plan's Riparian Restoration Target Area.

Riparian forest cover loss and riparian forest restoration within 150 feet of fish-bearing streams in the Snohomish River Basin Salmon Conservation Plan Riparian Restoration Strategy Target Area.[5,6,7]



Map Data Sources: SSHIAP 2004,[8] Snohomish Co. 2005,[9] WADNR 2019[10]

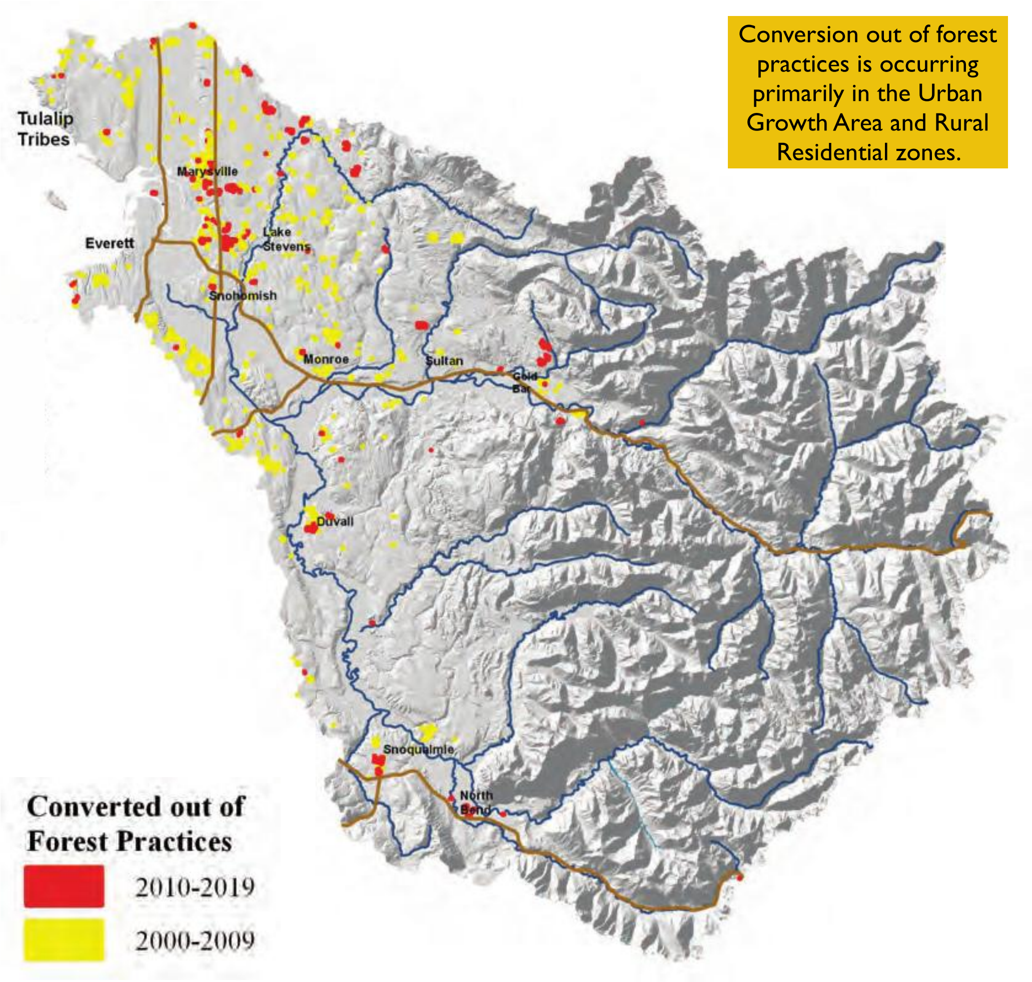
TULALIP TRIBES

Forestland Conversion in the Snohomish River Basin has Drastically Decreased since 2009

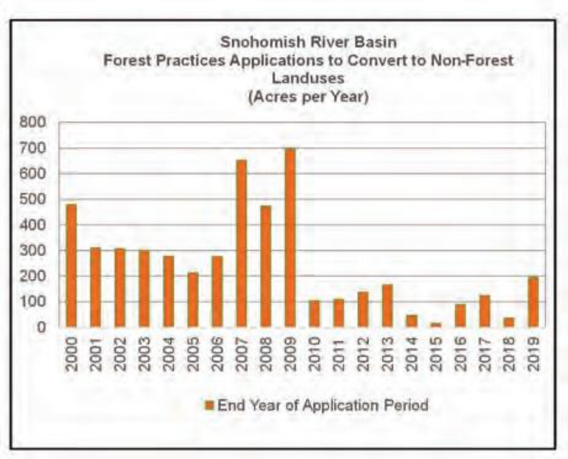
From 2000 through 2009 approximately 3,999 acres of land were converted from forest practices to nonforest practices, an average of 399 acres of land converted per year. Since 2010, around 1,024 acres of land was converted from forest practices to nonforest practices, an average of 102 acres of land converted per year. That is a nearly 75% decrease in average annual acres converted out of forestland between the two decades.[1]

Since 1995, nearly 6,400 acres of forestland has been converted out of forest practices in the Snohomish River watershed.[2] Evidence suggests the primary motivation for conversion out of forest practices is residential development. Over 2,100 acres or 1/3 of forestland conversion since 1995 occurred between 2007 and 2009, coinciding with the region's housing boom. After 2009, forestland conversion rates decreased by an average of 75% per year in the Snohomish River basin. This reset in forestland conversion to a much lower per year rate coincides with the regional and global housing recession of the mid-2000s.

Land in working forests is protected by the Washington State Forests and Fish Rules, a law designed to comply with the Endangered Species Act (ESA) and the Clean Water Act (CWA) to protect native fish and assure clean water compliance.[3] Only 58% of private forestland in the Snohomish basin is signed up for the "Designated Forestland Program" meant to incentivize nonconversion of forestland. The 42% of private forestland that is not signed up is considered to be at risk for permanent conversion to residential land uses.[4] Once land is converted out of working forests, not only do the trees disappear, but so do the fish protection and clean water guarantees of the Forests and Fish law. In their place is a residential landscape with greater pollution and less protection.



Conversion out of forest practices is occurring primarily in the Urban Growth Area and Rural Residential zones.



In the Snohomish River basin, over 81% of forestland that was converted to nonforest uses in the last 20 years occurred by 2009. Since then, forestland conversion has been occurring at a much lower annual rate.[10]

Map Data Sources: UW 2012,[5] WADNR 2019,[6] SSHIAP 2004,[7] WAECY 2018b,[8] WADOT 2018a,[9]

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2020 State of Our Watersheds Report
Skagit River Basin

> *The mighty Skagit River is named after its salmon people who resided in cedar longhouses in villages along its banks since time immemorial. The Skagit in pre-contact times provided for its people with its year-round historically abundant salmon runs of all of the five species of Pacific salmon, which helped the Upper Skagit to flourish and prosper relatively untouched or changed by the outside world. The Upper Skagit would make salmon nets, traps, and spears out of cedar, ironwood and other available materials to catch salmon in ancestral fishing sites that have been used for thousands of years. These survival skills and deep connectivity to the culture was passed down from generation to generation, by elders sharing the act of fishing and hunting. The tribe after reserving the right to continue to fish on the Skagit and its tributaries by signing the 1855 Treaty of Point Elliott in exchange for ceding most of its ancestral lands has now seen the great salmon runs of the Skagit disappear. Today, after 150 years of continual habitat loss and degradation due to floodplain development, untenable land-use practices and hydropower, the tribe's treaty-reserved rights have been diminished to fishing just 4-6 days annually on mostly hatchery-derived runs.*
>
> **– Scott Schuyler**
> **Natural Resources Director &**
> **Policy Coordinator**

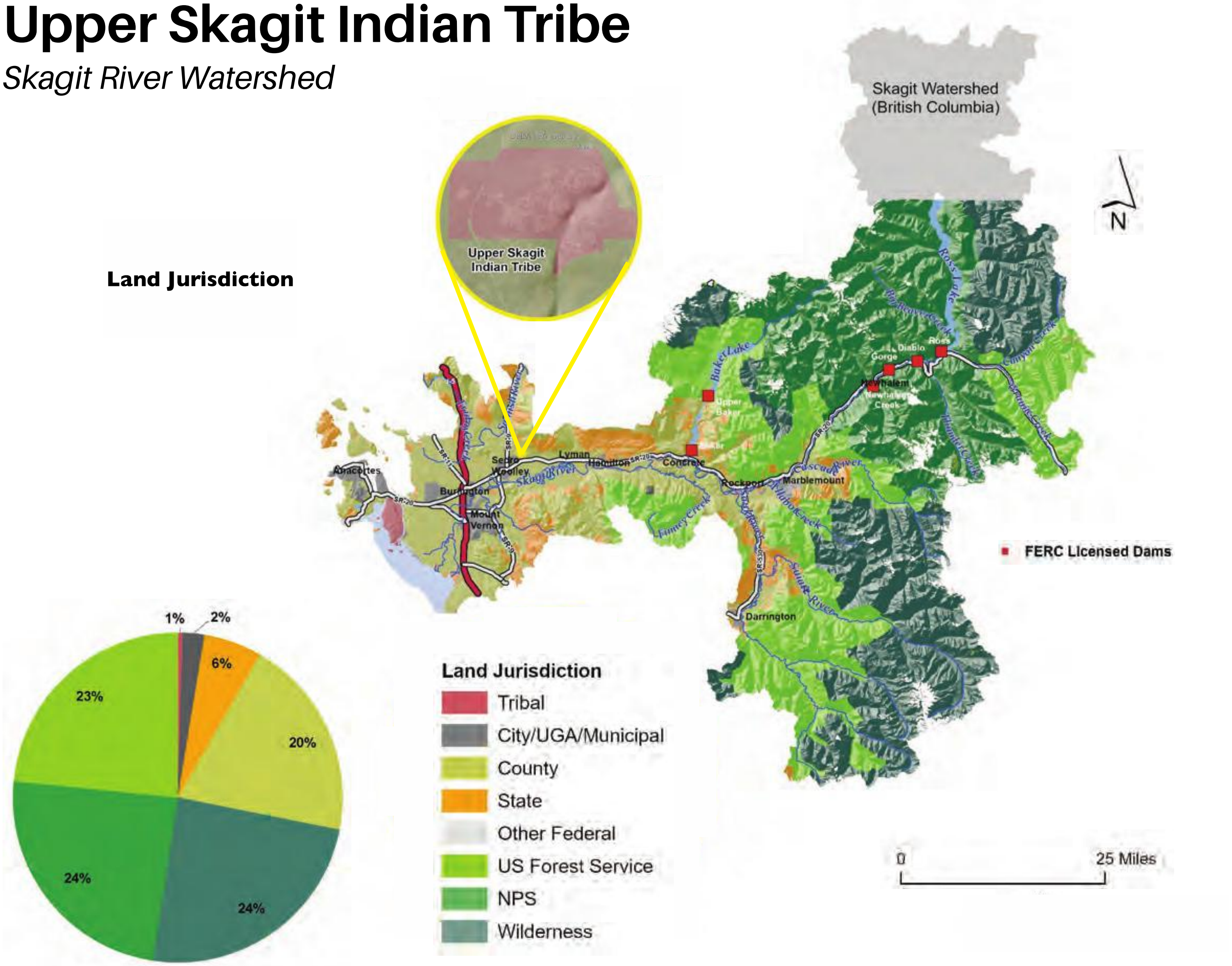
Area of Interest

Upper Skagit Indian Tribe

Upper Skagit was not granted a reservation at treaty time like some tribes and many Upper Skagit tribal members refused to relocate to these newly formed reservations. This act of defiance, along with their continued resistance to encroachment after treaty signing, forever preserved Upper Skagit identity and culture. Upper Skagit was also one of the original tribes to participate in the treaty fishing case after decades of Upper Skagit fishers being harassed, arrested and jailed for fishing the Skagit as their ancestors did.

Upper Skagit Indian Tribe

Skagit River Watershed



The Skagit river flows from a 3,100-square-mile watershed that originates in British Columbia and flows south into Washington state before continuing westward through Skagit County and into Puget Sound. It has the largest watershed in Puget Sound, and provides 30% of the sound's freshwater input.[1] There are an estimated 396 glaciers in the watershed, making up one of the largest areas of glacial cover in the United States outside of Alaska.[2] The Baker River, Sauk River and the Cascade River all flow from glaciers within the Skagit River watershed.

The Skagit River watershed has been home to the Upper Skagit Indian Tribe, the Sauk-Suiattle Indian Tribe and the Swinomish Indian Tribe since time immemorial. All three tribes have their reservations in the watershed and all have entered into a treaty with the United States guaranteeing them the right to fish at their usual and accustomed places forever. These U&A areas include some or all of the Skagit River watershed, depending on the tribe.

Since European settlement, land use in the watershed has been dominated by natural resources extraction. The foothills and mountains have been mainly used for wood products, mining and outdoor recreation. The river valleys, the delta and the coastal areas have been used for agriculture, industry, commerce and residential development. As of 2019, the U.S. Census Bureau estimates 129,205 residents in Skagit County, a 25% increase in population since the year 2000.[3,4]

The upper watershed is primarily within the National Forest and the North Cascades National Park. The lower watershed mainly comprises state forest, private forest, agriculture, rural residential, and urban residential/commercial/industrial lands.

There are five Federal Energy Regulatory Commission (FERC) licensed hig head dams in the Skagit River watershed: the lower and upper Baker River dams, and the Gorge, Diablo and Ross Lake dams.

The Skagit River is home to all five species of Pacific salmon, as well as steelhead trout. It has the healthiest and largest runs of wild chinook and pink salmon in the Puget Sound.[5] Even so, the last 150 years of human population growth and associated land use has resulted in declines in chinook, a near collapse of chum, and declines in other salmonid productivity. The Skagit Chinook Recovery Plan (2005) provides a strategy for both protection and targeted restoration. It will take federal, tribal, state and local leadership to provide a consistent yet adaptive plan to control the future impacts of land use in the watershed.

Map Data Sources: USFWS 2018,6 WAECY 2018a,7 WAECY 2018b,8 WAECY 1994,9 WADNR 2014c,10 WADNR 2014d,11 WADOT 2013,12 SSHIAP 200413

Chapter Summary

Upper Skagit was one of the original tribes to participate in the treaty fishing case, as many Upper Skagit were continually arrested in the 1960s and '70s and thrown in jail for fishing. Since the days of the treaty fishing case, the Upper Skagit tribal members have continued to fish the Skagit River on or near their historical villages from present day Mount Vernon to Newhalem. In recent years, however, the fish have not been returning to the Skagit in numbers that can sustain Upper Skagit tribal harvest, and the tribe has been forced to fish less and less to protect the fish that remain while the fish populations recover. This is at a great cost to the Upper Skagit culture as a younger generation is not being allowed on the river to learn the lessons of their elders.

Recovery of the fish populations isn't happening fast enough, because while harvest is being restricted, the habitat of the fish continues to be managed in a degraded state. Since European settlement began in the middle of the 19th century, the landscape of the watershed has been prioritized to support cities, residences and agriculture, and not to support the natural estuaries, large floodplains and riparian-lined tributaries needed for healthy populations of salmon. That pattern continues today, and with a growing population of people, the degrading impact it has on salmon habitat has intensified.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *www.treatyrightsatrisk.org*.

For this report, the Upper Skagit Tribe has focused on portions of the watershed that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Upper Skagit Tribe Remains Committed to Salmon Recovery

Tribal leaders have taken on the difficult task of asking their communities for continued restraint and sacrifice to their economic and cultural way of life, by limiting their fishing of stocks of concern. The Upper Skagit fisheries on natural origin chum have been non-existent since 2007, pink and coho have been greatly reduced, and since 1983 the tribe has had 2.2 days fishing natural origin chinook.

Samish Bay Conditionally Closed to Shellfish Harvest Even After 10 Years of the Clean Samish Initiative

Since 2015, additional testing has led to an increase of "approved" commercial growing areas to the north of Samish Bay (526 acres) and Padilla Bay (151 acres). Since 2011, there has been no change in the "conditionally approved" status of over 4,000 acres of commercial growing area in Samish Bay. That area continues to be periodically closed for harvest due to pollution.

Marine Nearshore Survey Reveals More Nearshore Armoring Since 2008

Continued survey of the shoreline in the Skagit and Samish marine nearshore areas have found an additional 5 miles of nearshore armoring. This additional armoring is assumed to be due to improved data. Current estimates are that 118 miles of this area are either armored or modified. The best opportunity we have for improving the shoreline is through voluntary restoration activities that result in complete removal of shoreline armoring and a return to natural shoreline conditions. There is another opportunity for improving the shoreline and that is during the "repair/replacement" permitting process. Permitting agencies have an opportunity to prioritize "soft armoring" replacement and/or partial armoring removal wherever feasible.

Tidal Estuary Marsh Habitat Restoration Has to Increase to Meet Desired Future Conditions by 2030

Habitat restoration resulted in the overall net gain of 83 hectares (13.6 hectares/year) of Skagit River tidal delta habitat between 2003 and 2013. To reach the desired future condition for tidal marsh by 2030 (mid-point of a 50-year recovery plan), the pace of restoration needs to increase, and there must be explicit consideration of sea level rise, storm surge and sediment routing in an update to the current tidal habitat restoration plan.

Lower Skagit Watersheds Are Not Meeting the Recommendations of the 2008 Stream Temperature TMDL

In March 2020, Washington Department of Ecology published guidance on a renewed effort to revitalize action on the TMDL. The renewed effort continues to emphasize voluntary actions and relies on financial incentives to achieve riparian planting on private properties. The reliance on voluntary measures has resulted in only 51% of stream length forested or planted, and the continuation of this approach, without significantly increased financial support, means stream temperature will not be in compliance by 2080.

Increasing Traffic Density in the Skagit Watershed Puts Coho at Higher Risk of Pre-Spawn Mortality

Even in the more rural Skagit River watershed, predicted modeling of coho pre-spawn mortality shows increased risk in and around towns, and along interstate and state highway corridors. At-risk watersheds need to be identified based on existing conditions and spatially explicit projections of future population growth. Where bioswales or rain gardens are needed to mitigate the impacts of toxic runoff, they should be required. The region's effort should also be coordinated across local and state transportation departments for consistency throughout the watershed.

Floodplain Habitat Critical to Chinook Salmon Resilience in a Changing Climate

As precipitation and temperature patterns change in the Skagit River basin winter (October to January) flow variability also changes. Chinook salmon productivity is showing a strong negative sensitivity to winter flow variability. Reconnection of floodplain channel networks to provide more storage and off-channel habitats, and restoration of lateral connectivity of floodplain aquifers will buffer against increasing winter streamflow variability.

Floodplain Restoration is Occurring, but Needs to Occur Faster and to a Greater Extent

The tribes, all levels of government, nongovernmental organizations and private citizens are all working to restore the Middle Skagit River floodplain wherever opportunity presents itself. This has resulted in 5,023 acres of protected lands and 604 acres of riparian plantings, and the floodplain rearing range for chinook salmon has improved slightly from 37% to 35% impaired. On the other hand, the majority of the Middle Skagit River floodplain, 10,896 acres, remains in unprotected private lands that are being maintained and cleared for infrastructure, agriculture and other forms of human development.

Skagit Watershed Hydropower Operations: Understanding Cumulative Impacts to Fishery Resources

Lack of regulatory alignment with salmon recovery goals is often cited as a major impediment to salmon recovery and treaty rights protection. The Federal Energy Regulatory Commission's (FERC) relicense process is a prime example of the regulatory challenges salmon recovery faces. FERC's relicense process for environmental assessment of project impacts establishes as a baseline the "current operating conditions," limiting the review and assessment of the original project infrastructure. Seattle City Light's Skagit Hydropower Project was started in 1915, well before the known impacts to salmon could be tied to regulatory frameworks.

Conclusion

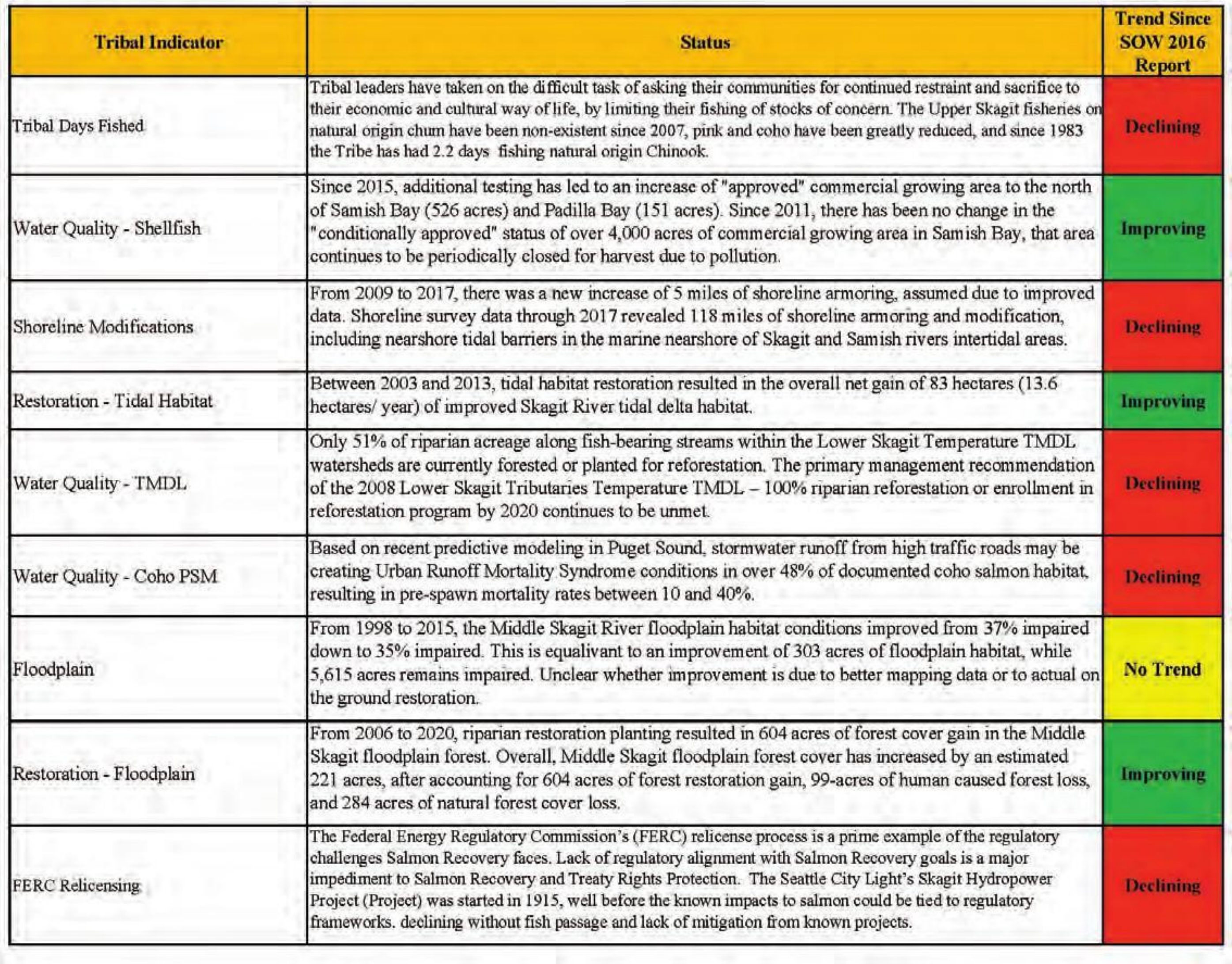
The needs of salmon have been understood by the tribes since time immemorial. For more than two decades, local planners have recognized these needs as well. Salmon habitat research, planning, restoration, monitoring and adaptive management have all been occurring for over 20 years, and still the habitat remains critically degraded in many instances. More riparian vegetation is needed, more water quality protections are needed, more water is needed, more wetted floodplain habitat is needed and more tidally influenced estuary habitat is needed.

All of the education, cooperation, volunteering and all of the work that is done to protect and restore salmon is very important to salmon recovery and needs to be acknowledged, but the treaty rights of the tribe and the legal habitat protections of the salmon need to be enforced according to the regulatory framework already in place. Without that, the salmon won't be able to recover and the tribe won't be able to fish.

Recovery Efforts Show Signs of Improvement But Still Lagging in Key Indicators

At the 15-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Skagit basin area shows an improvement in restoration efforts and water quality in the shellfish growing areas but degradation of freshwater quality and marine and freshwater shoreline habitat conditions. In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. Due to funding shortfalls for large-scale projects contributing to the slow pace of progress. There is need for well-funded, incentive-based programs to get more private landowners involved in salmonid recovery.

Review of the trend for these key environmental indicators since the 2016 State of Our Watersheds Report shows improvement for some indicators and a steady loss for others in habitat status:



Tribal Indicator	Status	Trend Since SOW 2016 Report
Tribal Days Fished	Tribal leaders have taken on the difficult task of asking their communities for continued restraint and sacrifice to their economic and cultural way of life, by limiting their fishing of stocks of concern. The Upper Skagit fisheries on natural origin chum have been non-existent since 2007, pink and coho have been greatly reduced, and since 1983 the Tribe has had 2.2 days fishing natural origin Chinook.	Declining
Water Quality - Shellfish	Since 2015, additional testing has led to an increase of "approved" commercial growing area to the north of Samish Bay (526 acres) and Padilla Bay (151 acres). Since 2011, there has been no change in the "conditionally approved" status of over 4,000 acres of commercial growing area in Samish Bay, that area continues to be periodically closed for harvest due to pollution.	Improving
Shoreline Modifications	From 2009 to 2017, there was a new increase of 5 miles of shoreline armoring, assumed due to improved data. Shoreline survey data through 2017 revealed 118 miles of shoreline armoring and modification, including nearshore tidal barriers in the marine nearshore of Skagit and Samish rivers intertidal areas.	Declining
Restoration - Tidal Habitat	Between 2003 and 2013, tidal habitat restoration resulted in the overall net gain of 83 hectares (13.6 hectares/ year) of improved Skagit River tidal delta habitat.	Improving
Water Quality - TMDL	Only 51% of riparian acreage along fish-bearing streams within the Lower Skagit Temperature TMDL watersheds are currently forested or planted for reforestation. The primary management recommendation of the 2008 Lower Skagit Tributaries Temperature TMDL – 100% riparian reforestation or enrollment in reforestation program by 2020 continues to be unmet.	Declining
Water Quality - Coho PSM	Based on recent predictive modeling in Puget Sound, stormwater runoff from high traffic roads may be creating Urban Runoff Mortality Syndrome conditions in over 48% of documented coho salmon habitat, resulting in pre-spawn mortality rates between 10 and 40%.	Declining
Floodplain	From 1998 to 2015, the Middle Skagit River floodplain habitat conditions improved from 37% impaired down to 35% impaired. This is equalivant to an improvement of 303 acres of floodplain habitat, while 5,615 acres remains impaired. Unclear whether improvement is due to better mapping data or to actual on the ground restoration.	No Trend
Restoration - Floodplain	From 2006 to 2020, riparian restoration planting resulted in 604 acres of forest cover gain in the Middle Skagit floodplain forest. Overall, Middle Skagit floodplain forest cover has increased by an estimated 221 acres, after accounting for 604 acres of forest restoration gain, 99-acres of human caused forest loss, and 284 acres of natural forest cover loss.	Improving
FERC Relicensing	The Federal Energy Regulatory Commission's (FERC) relicense process is a prime example of the regulatory challenges Salmon Recovery faces. Lack of regulatory alignment with Salmon Recovery goals is a major impediment to Salmon Recovery and Treaty Rights Protection. The Seattle City Light's Skagit Hydropower Project (Project) was started in 1915, well before the known impacts to salmon could be tied to regulatory frameworks. declining without fish passage and lack of mitigation from known projects.	Declining

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

Tribal communities in the Skagit basin have sustained their cultural richness with salmon for centuries, and fragments of that habitat still support enough salmon to sustain their cultural identity. But that identity and habitat is under a constant threat due to population growth, climate change, a mismatch of regulatory frameworks, and lack of political and social will of reversing the losses from large-scale habitat destruction from the previous century.

New alliances are forming to protect what is left and restore some sections of what was lost. Current trends indicate that land-use regulation reform is required and expanding funding of habitat restoration activities is necessary in order to achieve the agreed-upon recovery goals. A successful program must include local coordinating bodies that provide a forum for tribal leadership across all the H's of salmon recovery: Habitat, Hydropower, Hatcheries and Harvest. New partnerships must form to expand financial support for salmon recovery, while also improving the political and social will for salmon recovery, such as sport fishing organizations and tribal fishing communities working together, business leaders and developers supporting smart growth, and climate-resilient infrastructure projects that clearly support salmon recovery.

Over the next few years, the tribe will be focusing on several recovery, restoration and management areas. Puget Sound Ecosystem Recovery includes clean beaches for harvesting shellfish and stabilizing the resident orca population that requires reduced pollutants and increased prey base. The tribe's priority management objective for Seattle City Light's FERC relicense will focus on aligning ecosystem recovery with the upcoming Skagit Hydropower Regulatory Processes.

The Tribes' Natural Resources Department will support habitat restoration and protection actions with projects that increase natural floodplain processes targeting habitat productivity for all salmonids. The tribe is gearing up for supporting the implementation of the culvert injunction, with an expanded workplan of assessing all known barriers on local and private lands. One project still under development is a partnership with Skagit County and Dike District 21 to develop a management plan for the East Fork Nookachamps watershed. This important watershed suffers from high water temperatures, low summer streamflows, low functioning fluvial processes, and isolated or degraded aquatic habitats. Severe annual flooding impacts fishery resources in the basin. The project's goals include the restoration of natural sediment and hydrogeologic processes; reconnection of stream and floodplain habitats supporting anadromous spawning, rearing and migration; alleviation of recurring flood impacts to public and private property; and supporting progress of the Lower Skagit Tributaries Temperature Implementation Strategy (Washington Department of Ecology, March 2020).

The tribe is interested in planning for long-term summer low flow/groundwater recharge and forest practices reform upslope of important watersheds. The need for groundwater recharge to supply summer streamflows has never been more evident and the causes for the lack of recharge are becoming increasingly better understood as are methods to sustain flows in spite of drought and climate change. Some initial planning and scoping of an engineered solution known as Managed Aquifer Recharge (MAR) has been conducted and shows potential along the Skagit River corridor and some tributaries like the Nookachamps.

In support of these habitat and hydropower projects, the tribe will also maintain effective management strategies for harvest and hatcheries that support both treaty rights and salmon recovery. USIT's terminal harvest strategies do not compete with the need for expanding the prey base for orca recovery, and can be managed effectively around weak stocks of concern. Hatcheries will be operated with the newest scientific principles ensuring Skagit hatchery programs address genetic and ecological interactions of native fish and inform conservation goals. Surplus fish can be used to provide needed nutrients to human communities and watersheds that have been isolated from this significant nutrient supply.

Upper Skagit Indian Tribe

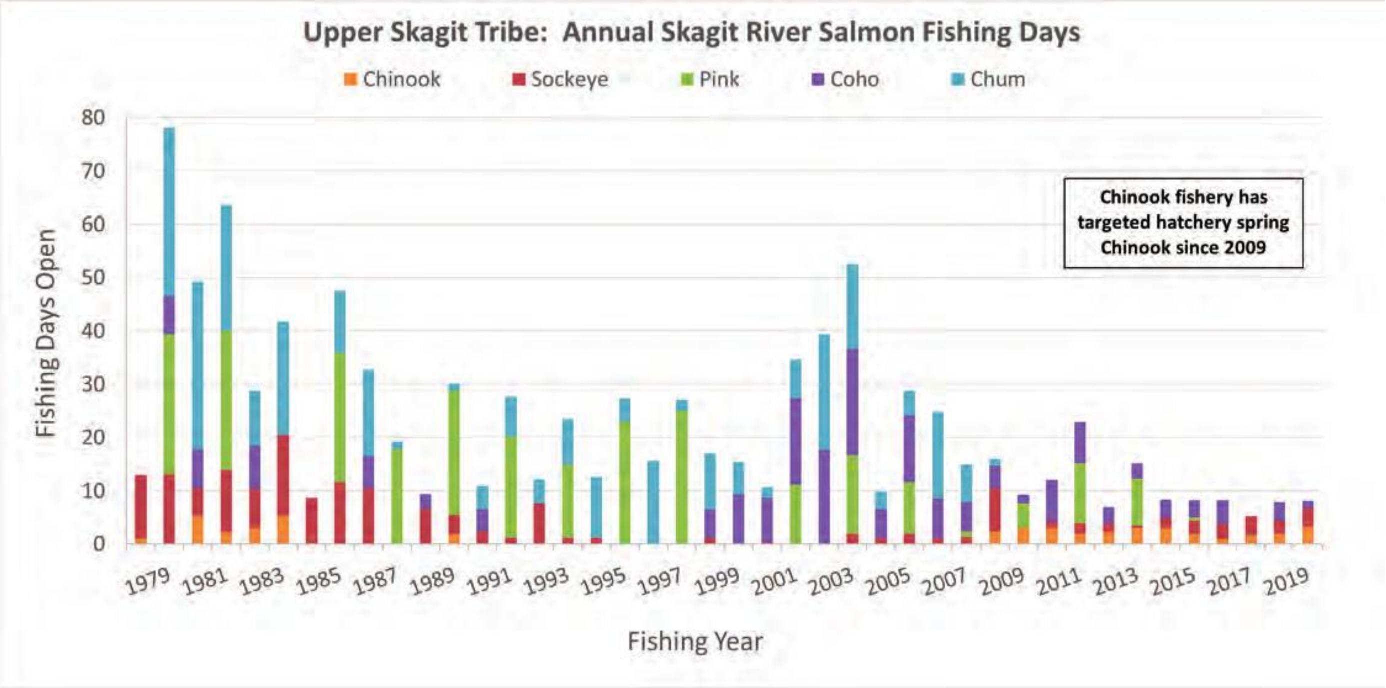
Upper Skagit Tribe Remains Committed to Salmon Recovery

Conversations around salmon recovery often start with a need for habitat protection and restoration and end with attacks on overutilization with a particular focus on treaty terminal harvest practices. Historic overutilization has no doubt played a role in the salmon's struggle, but recent efforts have changed the damaging practices of the past. Tribal leaders have taken on the difficult task of asking their communities for continued restraint and sacrifice to their economic and cultural way of life, by limiting their fishing of stocks of concern. Those actions speak to their commitment to restore salmon to sustainable harvest levels.

The tribe, through treaties, has been given the right to continue to take fish from their usual and accustomed fishing grounds, but the tribe is struggling to advance the regulatory framework needed to protect the habitat supporting their treaty fishing rights. Supreme Court Justice Gorsuch's comment during oral arguments in the culvert injunction notes the situation, "I don't see anything in the treaty – maybe you can point it to me, maybe I'm missing it textually – anything in the treaty that says: 'Ah and your rights to those usual and customary grounds and stations is limited by, and may be completely eliminated, if necessary, to meet the other domestic interests that municipality might have.' " (138 S.Ct. 1832 2018). To provide transparency and elucidate the sacrifices we all must make to bring salmon back, the Upper Skagit Indian Tribe will be tracking the number of days fished each year as a new indicator for watershed health. The indicator will focus on the Skagit River terminal area, and track the number of days the tribe fishes for both hatchery and wild stocks.

Before any fishing plans are approved by the federal government, tribal and state agency staff must prepare joint forecasts and fishing plans to ensure an accurate estimate of abundance. The other key action in the process includes an allocation assessment, and any take of listed species does not jeopardize the rebuilding plans for recovery. This entire process takes 4-6 months annually and ends with a negotiated settlement for fishing opportunities. Once the harvest begins, tribes have strict reporting periods for their catch and must comply with agreed-to sampling plans. Not all fisheries are held to such strict reporting obligations. To the tribe, all the work of protecting and restoring fisheries is driven by the primary objective of exercising treaty rights.

Habitat impacts also take and kill fish, but this mortality is difficult to measure or regulate in the way that harvest is regulated. Habitat impacts on salmon productivity impact generations of fish until the threat is removed, in essence killing more salmon over time. When trying to recover salmon, we must look at the total mortality they face along their journey, and not unjustly attack those with the right to harvest for economic, cultural and subsistence values. Now that we have the means to stabilize escapement through reduced and heavily regulated fisheries, we must address the habitat-related mortality to recover these culturally iconic species.



Upper Skagit fisheries target primarily hatchery-produced fish, with the most stable fisheries occurring on Skagit hatchery spring chinook and Baker sockeye with assisted natural production and hatchery-origin reproduction. Fisheries on natural-origin chum have been non-existent since 2007, pink and coho have been greatly reduced, and since 1983 the tribe has had 2.2 days fishing on natural-origin chinook.

Samish Bay Remains Conditionally Closed to Commercial Shellfish Harvest

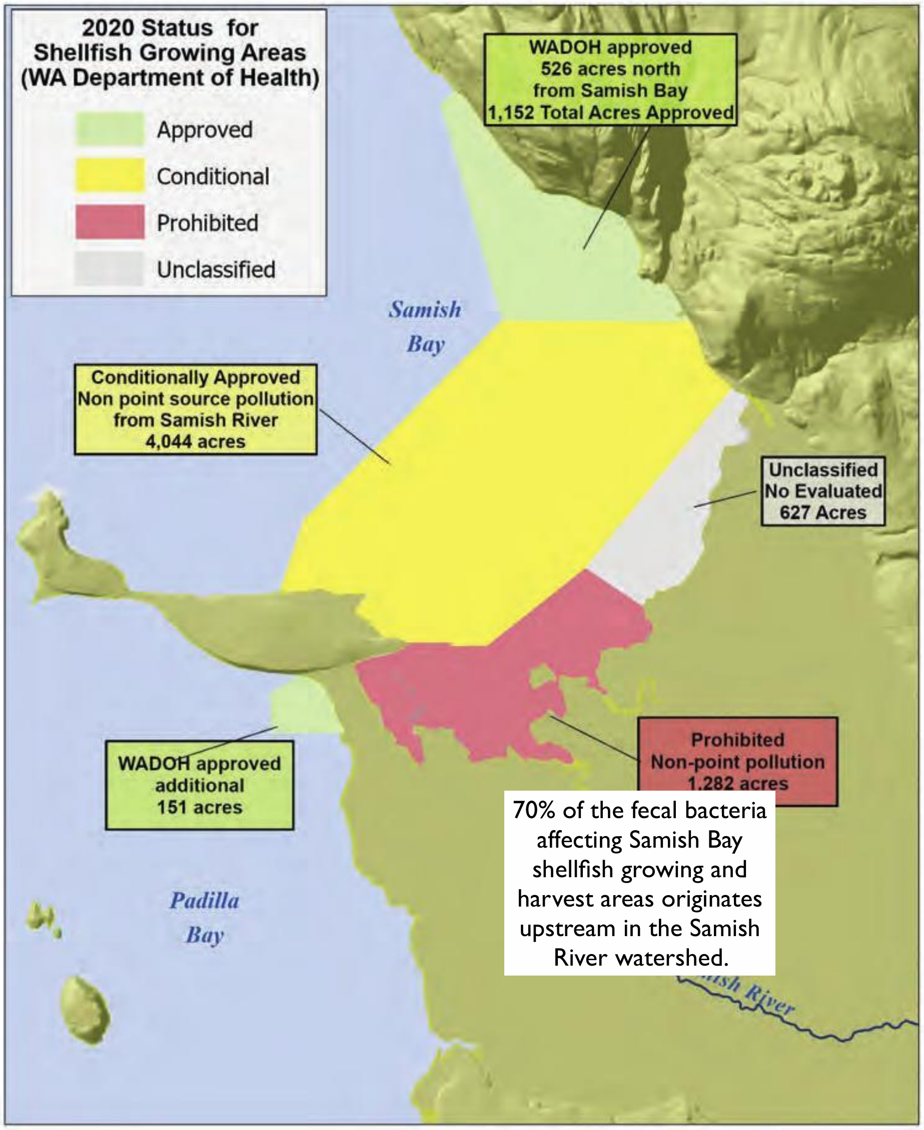
Since 2011, there has been no change in the conditionally approved status of over 4,000 acres of commercial growing areas in Samish Bay. That area continues to be periodically closed for harvest due to pollution.[1] Since 2015, additional testing has led to an increase of approved commercial growing areas to the north of Samish Bay (526 acres) and Padilla Bay (151 acres).[2]

Samish Bay is important for shellfish resources, both economically and ecologically. User groups include shellfish growers, recreationists and members of five different tribes who have reserved rights to collect fish and shellfish from the bay. The ability to exercise this right has been put into jeopardy by fecal pollution runoff through the entire Samish watershed.

In 2010 the Clean Samish Initiative partners implemented a Pollution Identification and Correction (PIC) program, and have been working with farmers and residents in the watershed to find and fix sources of fecal bacteria pollution. The team has used everything from windshield surveys and water quality sampling to sewage sniffing dogs and DNA tracing to identify where the problem is coming from and fix it. While the Clean Samish Initiative has been well-coordinated and that has resulted in some success, it has not been cleaning up Samish Bay quickly enough, and a majority of shellfish harvesting area remains periodically closed.

Additional approved acreage in 526 acres in Samish Bay and 151 acres in Padilla Bay is a positive development for tribal shellfish harvesting opportunities, however the continued periodic closures in over 4,000 acres, combined with the unchanged status of unclassified and prohibited areas in the bay all impede the tribe's ability to exercise its treaty right to provide resources to tribal members. Future economic development plans to establish a shellfish aquaculture business are still uncertain due to lack of tangible success in addressing point and nonpoint pollution in this watershed.

Current Status of Commercial Shellfish Growing Areas in Samish Bay and Padilla Bay.



70% of the fecal bacteria affecting Samish Bay shellfish growing and harvest areas originates upstream in the Samish River watershed.

NWIFC

Map Data Sources: WADOH 2020,[3] SSHIAP 2004,[4] USGS 2018[5]

UPPER SKAGIT INDIAN TRIBE

Marine Nearshore Armoring Increased in the Skagit Bay and Samish Bay Intertidal Area

Shoreline survey data through 2017 revealed 118 miles of shoreline armoring and modification including nearshore tidal barriers in the marine nearshore of Skagit and Samish rivers intertidal areas. In 2008, published data for that same region showed 113 miles of shoreline armoring and modification including nearshore tidal barriers.[1,2] It is assumed that the majority of the 5-mile increase is due to improved data, including for areas not previously surveyed.

Juvenile Puget Sound salmon depend on the quantity and quality of nearshore habitats for their population viability.[3] Armored shorelines impact juvenile salmon's nearshore migration, food availability, safety from predators and overall survivability.[4]

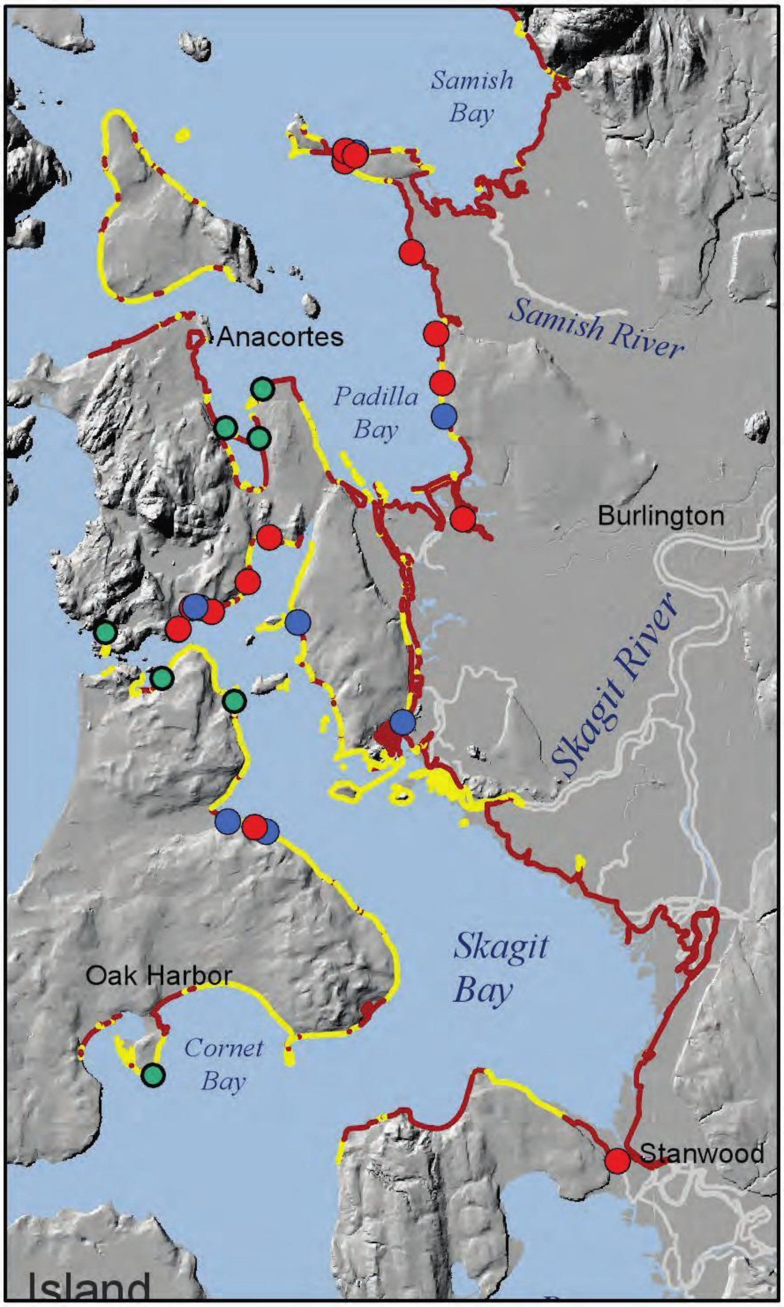
Voluntary restoration: Since 2015, there have been four nearshore restoration projects resulting in the removal of 4,295 feet of shoreline armoring.[5] This is the best opportunity for improving the shoreline, because activities are focused on complete removal of shoreline armoring and a return to natural shoreline conditions.

Voluntary restoration will require continued coordination among all parties to find and fund nearshore restoration that includes armoring removal.

Regulatory protection and mitigation: Since 2015, WDFW has issued marine shoreline armoring permits for 22 Hydraulic Permit Applications (HPA) within the intertidal area frequented by Skagit chinook. Of those permits, 4 were for new armoring and 18 were for repair or replacement of existing armoring. More ecologically suitable or soft armoring was included in 40% (9 of the 22 projects), and removed in 1 of the 22 projects.[6]

Repair/replacement permits are providing another opportunity for shoreline improvement. However, these activities do nothing to improve the shoreline for chinook habitat if they don't exchange traditional hard armoring for either soft armoring or no armoring. For this opportunity to be fully realized, federal, state and local permitting agencies need to increase inclusion of soft armoring during replacement and repair activities.

Skagit and Samish Bay Marine Nearshore Projects 2014-2019: WDFW-Permitted Projects and PSEMP Monitored Restoration Projects



● Restoration Sites

Permitted Construction

● Hard Armoring

● Soft Armoring

Shoreline Armoring 2017

— No Armoring

— Armoring

Map Data Sources: CGS 2017,[7] PSEMP 2020,[8] WDFW 2020,[9] SSHIAP 2004[10]

Tidal Habitat Restoration Needs to Accelerate to Reach Desired Future Conditions in a Changing Climate

Tidal habitat restoration resulted in the overall net gain of 83 hectares (13.6 hectares/ year) of Skagit River tidal delta habitat between 2003 and 2013.[1]

Skagit River Delta Tidal Habitat Restoration Sites from 2005 to 2016.[7,8]

Skagit River Tidal Delta Habitat Restoration 2005 to 2016.[9]

Restoration	Year Completed	Hectares Gained
South Fork Dike Setback	2007	8.37
Smokehouse	2008	26.9
Swinomish Channel	2008	3.37
Wiley Slough	2009	64.62
Fisher Slough	2011	18.66
Fir Island Farms	2016	52

Map Data Sources: GSRO 2019,[7] ESRI 2020[8]

Tidal habitat restoration in the Skagit River delta is being successfully implemented. From 2004 to 2013, the tidal habitat footprint in the Skagit River delta increased from 3,184.65 hectares to 3,467.68 hectares, from 80% to 81.9% of the desired future condition (DFC) of the Skagit River Chinook Recovery Plan.[2] A point of concern, the pace of habitat restoration has slowed considerably since 2009. From 2005 to 2009, 103.3 hectares of tidal delta extent were restored, an average of 25.8 hectares per year. Since 2009, another 71.2 hectares has been restored, an average of 10.2 hectares per year.[3] The higher pace, between 2005 to 2009, was due largely to restoration of publicly owned land, but these opportunities have been nearly exhausted. Future restoration will need to occur on private land which presents more of a challenge.

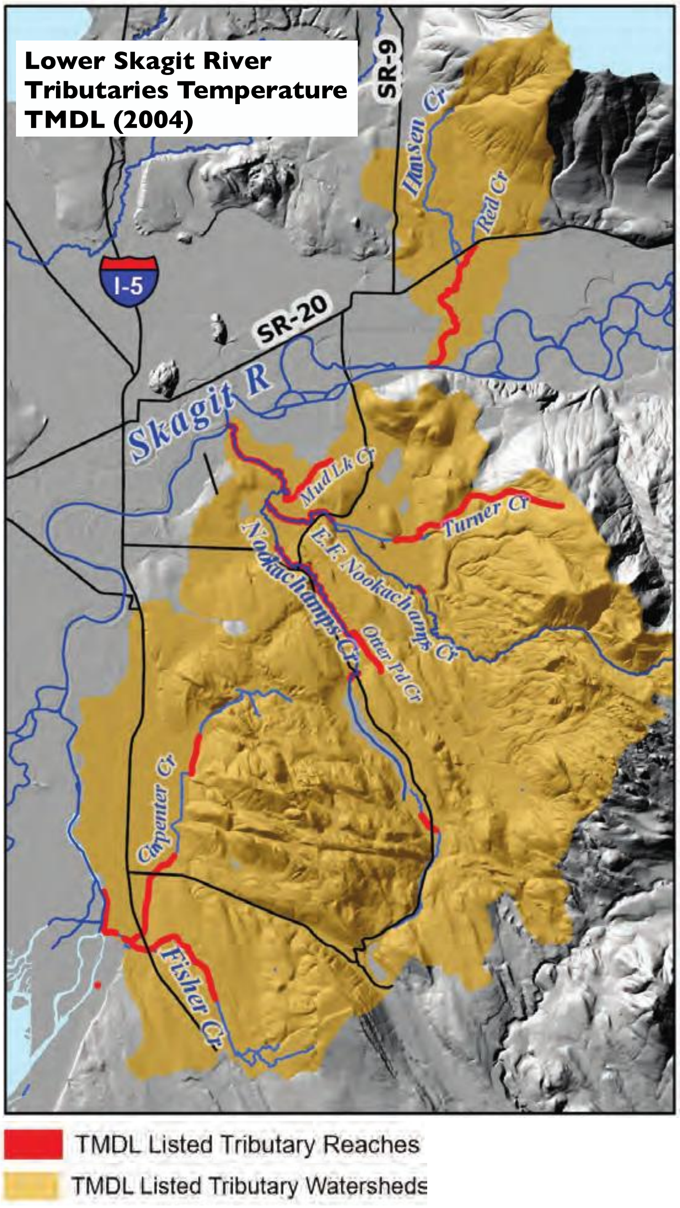
While the pace of tidal habitat restoration is slowing, sea level rise and associated wave energy are resulting in the natural loss of tidal delta extent, primarily along the Skagit Bay front. In addition, levees within the delta are likely inhibiting habitat formation by creating areas that are sheltered from sediment supply but not from sea level rise or storm surge.[4,5]

Compounding these sediment routing issues, two hydropower projects interrupt the transport of fine sediment to the delta, reducing the amount of available chinook habitat. The city of Seattle's dams, which cut off 37% of the Skagit basin by area, are undergoing a federal relicensing process. This provides an important opportunity to restore sediment delivery to the delta.

To reach DFC for tidal marsh by 2030 (mid-point of a 50-year recovery plan), the pace of restoration needs to increase, and there must be explicit consideration of sea level rise, storm surge and sediment routing in an update to the current tidal habitat restoration plan.[6]

Lower Skagit Watersheds Are Not Meeting the Recommendations of the 2004 Stream Temperature TMDL

The primary management recommendation of the 2004 Lower Skagit Tributaries Temperature TMDL – 100% riparian reforestation or enrollment in reforestation program by 2020 – continues to be unmet. Only 51% of riparian acreage along fish-bearing streams within the Lower Skagit Temperature TMDL watersheds are currently forested or planted for reforestation.

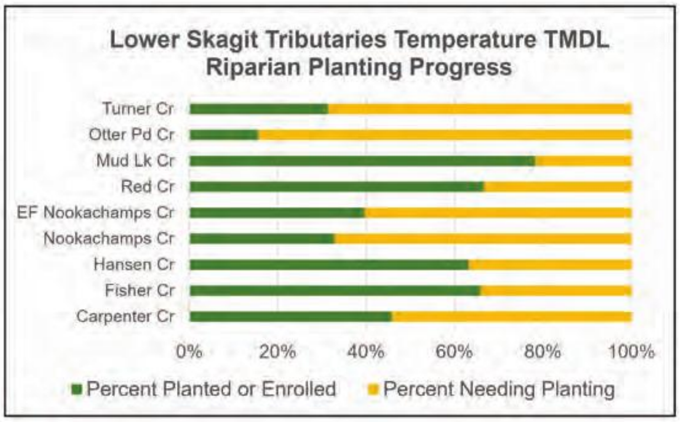


Nine tributaries in the Lower Skagit River Temperature TMDL watersheds continue to exceed state standards for stream temperature. These streams are important to ESA-listed species. Nookachamps Steelhead are an independent Puget Sound ESA-listed steelhead population.

In 2001, Washington Department of Ecology measured high water temperatures in late summer at nine different tributaries in the lower Skagit River watershed. The measurements exceed the state water quality standards for temperature (Chapter 173-201A Washington Administrative Code) and put at risk cold-water fish and invertebrates that normally live in these creeks.[5]

In 2004 Washington State Department of Ecology established total maximum daily load (TMDL) limits for nine tributaries in the Lower Skagit Tributaries Temperature TMDL. That report established a goal of "100 percent of all stream miles of these creeks to be protected by riparian shade or enrolled as part of larger creek restoration and improvement projects by 2020."[6]

Despite a recent attempt to reinvigorate efforts for reducing stream temperature, the state's TMDL implementation strategy continues to emphasize voluntary actions and relies on financial incentives to achieve riparian planting on private properties.[7] Yet, lack of established funding is a major constraint for successful implementation of this strategy. The TMDL stated that streams will be in temperature compliance by 2080.[8] The reliance on voluntary measures has resulted in only 51% of stream length forested or planted, and the continuation of this approach, without significantly increased financial support, means stream temperature will not be in compliance by 2080.



Riparian planting progress in the Lower Skagit River Temperature TMDL watersheds.[13]

Map Data Sources: WADNR 2014c,[9] WAECY 2018,[10] WAECY 2014b,[11] SSHIAP 2004[12]

UPPER SKAGIT INDIAN TRIBE

Regenerating Conifer Forests May Reduce Summertime Low Flows in Important Fish Streams Due to Increased Transpiration

Many critical salmon-bearing tributaries to the Skagit River may experience summertime flow deficits due to increased transpiration (water use by trees) by dense, second-growth conifer forests relative to their more diverse old-growth predecessors. Lower flows may reduce habitat area and exacerbate high stream temperature hazards for some salmon species, which rely on cold water even during the summer. The level of impact differs between tributary basins as shown by a screening tool that accounts for forest age structure. However, large uncertainties remain and are the subject of ongoing research.[1]

It has long been recognized that flow volumes in forested watersheds may be elevated within the first decade or two after timber harvest due to reduced evapotranspiration. More recently, researchers have demonstrated that intermediate-aged Douglas fir stands (10-50+ years) may reduce summertime flow volumes by as much as 50% in experimental basins of uniform age in the Oregon Cascades (Fig. 1).[2] To apply the Oregon results to Skagit River tributaries with a complex harvest history, we modeled stand ages in 58 basins and used the modeled stand age structure to make predictions of flow change due to past forestry practices. Preliminary results suggest that all analyzed tributaries have estimated summertime flow reductions of 1% to 58%, with the greatest deficits in basins where virtually all stands are 10-50 years old (Fig. 2).[3]

However, challenging questions remain: how translatable are the Oregon results to other watersheds with other types of bedrock geology, soils, geomorphology, climate, and forest composition? Do riparian buffers reduce the effect of stand regeneration on low flow hydrology? What is the effect of seasonal snowpack? What forest age or management practices result in flows returning to old-growth levels? These and other issues will need to be resolved before we can confidently and accurately predict summer flow deficits caused by regenerating forests.

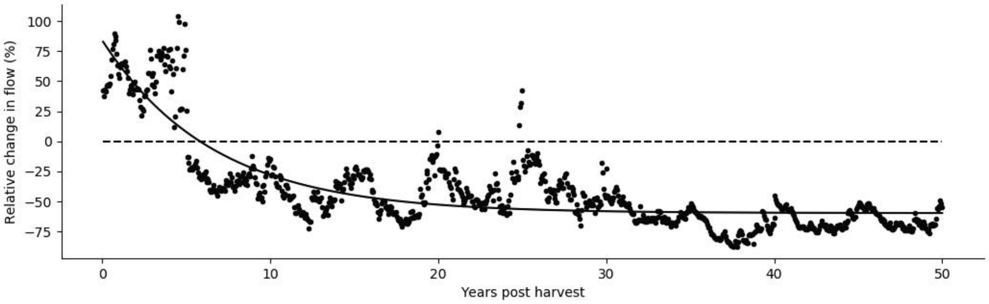


Figure 1. Relative change in flow between a 100% clear-cut basin and an old-growth reference basin in the Oregon Cascades. The solid black line is the exponential model used to extrapolate the Oregon results to the Skagit River tributary basins analyzed here. The dashed line demarcates 0% change.

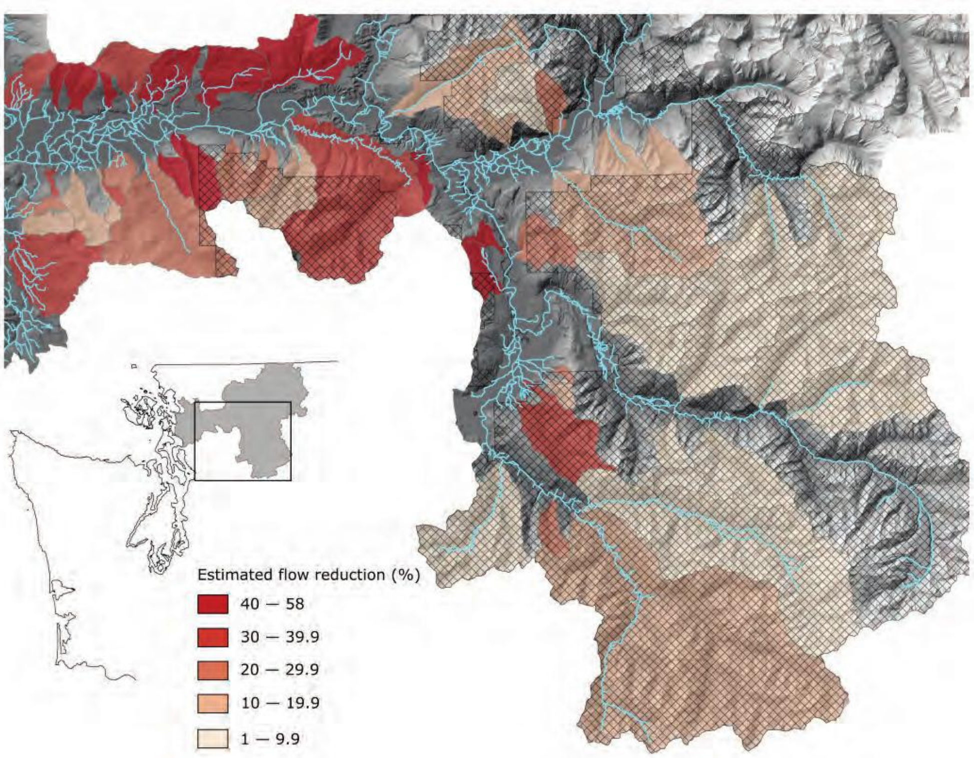


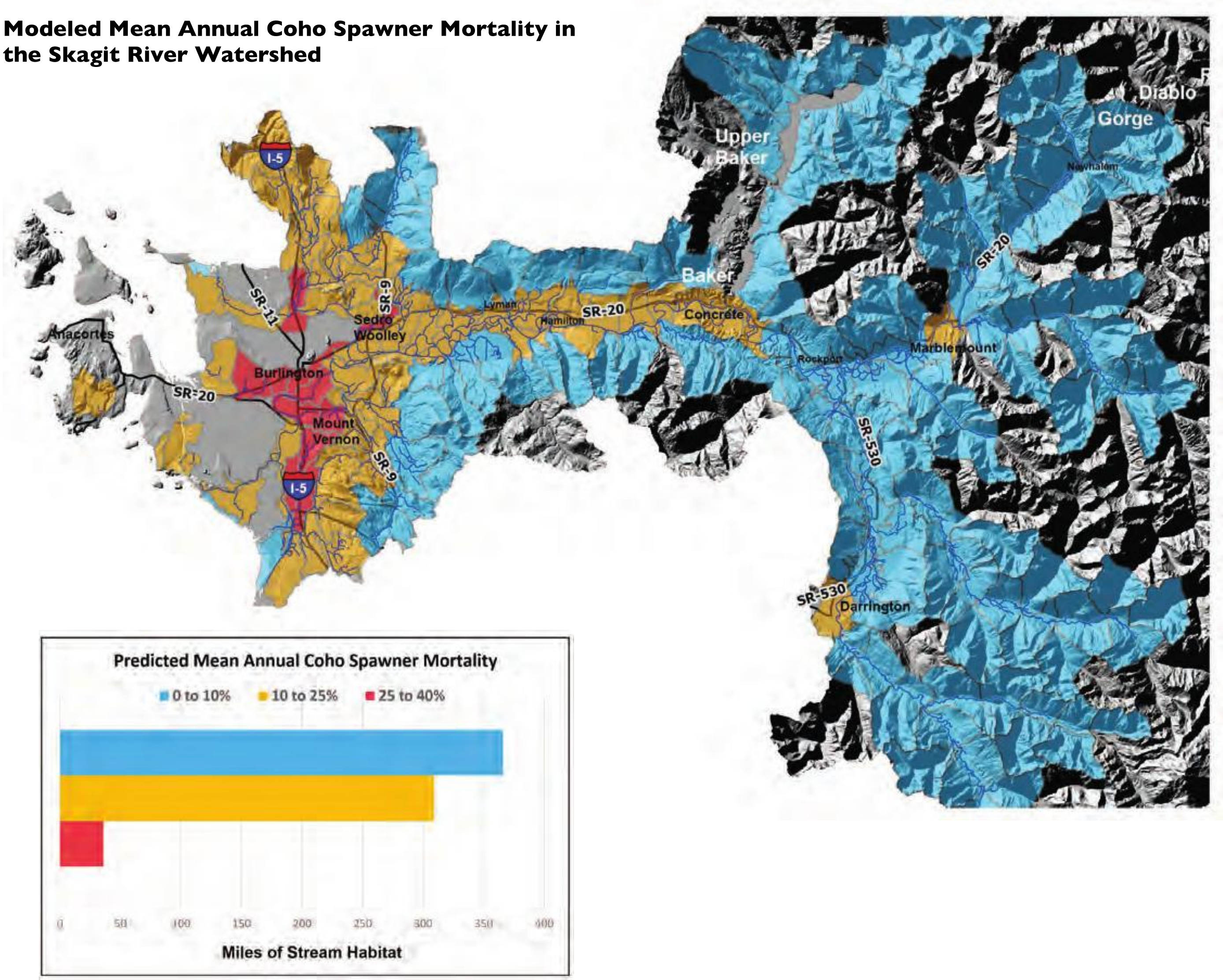
Figure 2. Preliminary results for Skagit River tributaries analyzed for low flow deficits caused by conversion of diverse old-growth forests to uniform, dense conifer forests. Colors represent the estimated percent change in summertime flow (July-September) that can be attributed to denser forests if the Oregon results are valid in these basins. Cross-hatch pattern represents National Forest lands, some of which have experienced partial timber harvest and some of which have had no harvest. Anadromous fish streams are shown in blue.

UPPER SKAGIT INDIAN TRIBE

Skagit River Coho Salmon Face Increasing Risk of Coho Urban Runoff Syndrome

Based on recent modeling in Puget Sound, stormwater runoff from high traffic roads may be creating Urban Runoff Mortality Syndrome conditions in over 48% of documented coho salmon habitat, resulting in pre-spawn mortality rates between 10 and 40%.[1,2]

Modeled Mean Annual Coho Spawner Mortality in the Skagit River Watershed



Coho Urban Runoff Mortality Syndrome is causing coho salmon to die in large numbers when they return to increasingly urbanized watersheds throughout Puget Sound. Untreated stormwater runoff from roads, parking lots and other surfaces with high volumes of car traffic kills coho before they can spawn. If the Urban Runoff Mortality Syndrome continues to increase with a growing human population, increasing development and increasing traffic, it likely will be unsustainable for wild stocks of coho salmon.[3]

Even in the more rural Skagit River watershed, modeling of coho pre-spawn mortality shows increased risk in and around towns, and along interstate and state highway corridors. Over 48% of stream length with documented coho use occurs in these areas and the coho in these areas may be at elevated risk of mortality already.[4,5]

Full consideration of the Coho Urban Runoff Mortality Syndrome needs to be taken in all future transportation planning, regardless of jurisdiction. Scientific research has proven the capacity for properly engineered rain gardens and bioswales to clean or treat stormwater runoff to a point that it can enter streams and tributaries without killing coho salmon before they have spawned.[6]

At-risk watersheds should be identified based on existing conditions and spatially explicit projections of future population growth Where bioswales or rain gardens are needed to mitigate the impacts of toxic runoff, they need to be required. This effort should be coordinated across local and state transportation departments.

Map Data Sources: Feist et al. 2017,[7] SWIFD 2019,[8] SSHIAP 2004[9]

UPPER SKAGIT INDIAN TRIBE

Floodplain Restoration Is Critical to Counter the Increased Variability in Winter Flows' Impacts on Chinook Productivity

In a recent study, half of 60 rivers researched in the Pacific Northwest have experienced increased variability in October – January (winter) streamflows since 1950.[1] The same study found that increased variability in winter freshwater flows had a more negative effect on chinook productivity than any of the other climate signals researched within the study.[2,3]

A multi-channeled section of the Skagit River floodplain provides the space necessary to carry increasingly variable winter flows without disrupting incubating chinook salmon, giving them a better chance to survive.[10]

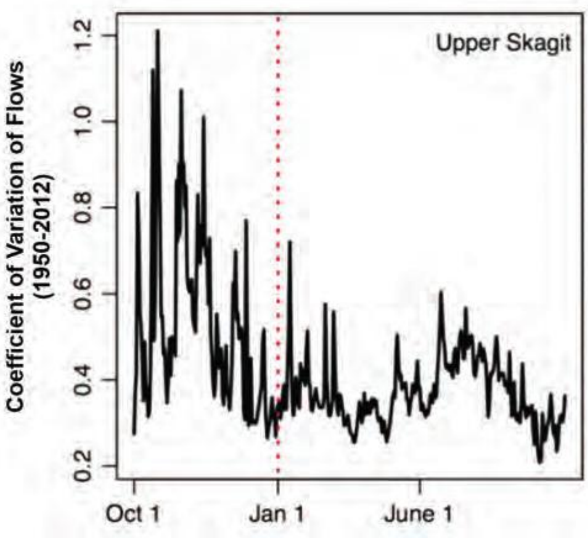
By the 2080s, the Skagit River is projected to have only one rain-driven peak flow season in the winter months, as opposed to its current two-peak flow seasons – rain-driven in the winter and snow melt-driven in the summer.[4] The large increase in winter flows coupled with the decrease in summer flows creates a larger variation in freshwater flows between October and September (water year). A study of historical stream gauge records for multiple rivers in the Pacific Northwest, including stream gauge records from the Skagit River system, has also shown a greater variability in winter stream flows since 1950.[5]

Increasing variability of winter streamflows may be having a more negative impact on chinook salmon because the winter season coincides with their incubation period, and chinook are vulnerable to mortality during the freshwater incubation period.[6,7] Climate change is expected to increase winter streamflow variability. If the effects of this are left unmitigated, chinook recovery may be in jeopardy.

It is unlikely that management actions to slow climate change will decrease the variability of winter freshwater flows in the Skagit River system. A more effective approach will be to focus on protection and restoration actions that buffer chinook salmon from increasing flow variability.[8]

Floodplain restoration is critical to this approach. Reconnection of floodplain channel networks to provide more storage and off-channel habitats, and restoration of lateral connectivity of floodplain aquifers will buffer against increasing winter streamflow variability.[9]

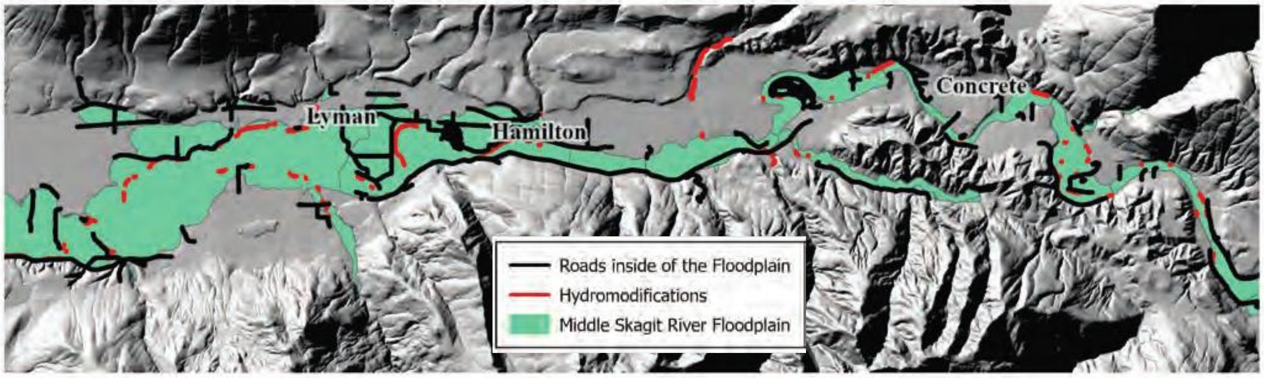
A recently hatched chinook salmon.[11]



Coefficient of variation (CV) for each day of the water year calculated across years 1951-2012. This shows the high variability of freshwater flows in the Upper Skagit River during the winter months (October-January).[12]

Slow Pace of Floodplain Reconnection Imperils Salmon Recovery Efforts

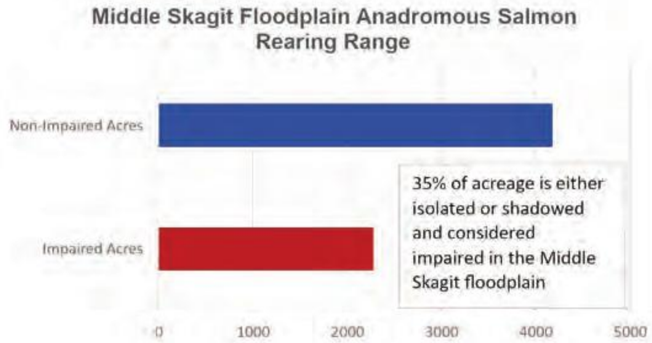
From 1998 to 2015, floodplain rearing range for anadromous salmon improved slightly from 37% impaired to 35% impaired.[1,2]



Skagit River floodplain restoration is a habitat target for chinook in the Recovery Plan. Floodplain habitat is not only critical for juvenile chinook for freshwater rearing. Floodplain habitat is also important for freshwater rearing of anadromous salmon because the availability of complex mainstem edge habitat, backwaters and off-channel habitat is essential for the foraging and refugia of all freshwater life history phases.[3] These floodplain habitats can be degraded or eliminated by hydromodifications (e.g., bank armor, levees), roads, houses, fills and any other structures that limit lateral channel migration and the formation of backwaters and off-channel habitat. For this reason, restoring natural floodplain processes by removing or relocating floodplain modifications, and/or reconnecting historic floodplain channels is critical to salmon recovery.[4]

Continued floodplain habitat impairment is one reason the Middle Skagit remains a juvenile rearing bottleneck to chinook population production.[5] In the Middle Skagit River floodplain, improving from 37% impaired to 35% impaired means 303 acres of floodplain habitat have been improved, and 5,621 acres of floodplain remains impaired.[6]

The pace of floodplain restoration and recovery in the Middle Skagit floodplain is constrained by public and private infrastructure, residential property and agricultural land use. State roads, county roads, public utilities and other public infrastructure are present throughout the Middle Skagit floodplain and protected from the floodplain channel migration needed to improve floodplain salmon-rearing habitat. While public infrastructure, and residential and agricultural land use remain inside of the floodplain and are prioritized over salmon habitat, restoration opportunities will remain limited and progress toward recovery will be slow.



Impaired rearing range within the Middle Skagit River floodplain includes both isolated areas and shadowed areas. These are areas where roads or dikes completely cut off river interaction with its floodplain or roads, and hardened streambanks shadow the floodplain from riverine processes.[11,12]

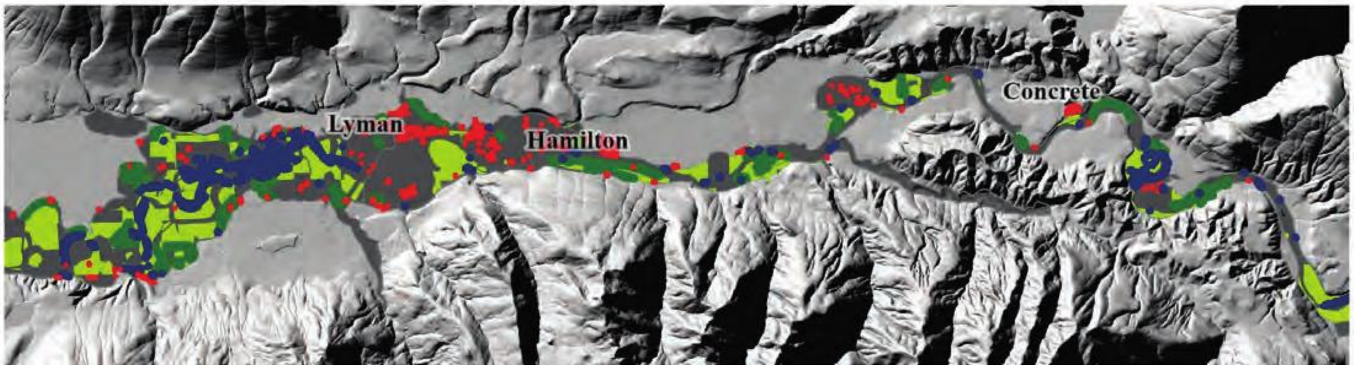
State Route 20 and a rural developed land parcel constrain the Skagit River within the Skagit River floodplain.[10]

Map Data Sources: USIT 2015,[7] Smith et al. 2011,[8] WADNR 2014[9]

Protecting and Restoring the Skagit River Floodplain Is Critical to Chinook Salmon Recovery

There are 5,023 acres in the Middle Skagit River floodplain, and since 2006 riparian restoration has resulted in 604 acres of newly planted floodplain trees. An estimated 221 acres, after accounting for 604 acres of forest restoration gain, 99 acres of human-caused forest loss, 284 acres of natural forest cover loss, forest cover in the Middle Skagit floodplain forest has increased by an estimated 221 acres..[1,2,3]

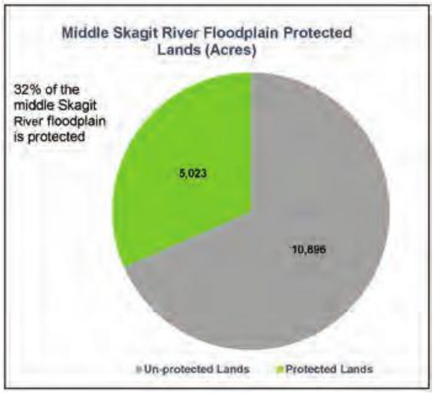
Protected Lands, Riparian Restoration and Forest Cover Loss in the Middle Skagit River Floodplain



- ⬛ Middle Skagit River Floodplain
- 🟩 Riparian Restoration Plantings
- 🟩 Protected Lands
- 🟥 Human Caused Forest Cover Loss
- 🟦 Natural Forest Cover Loss

The unbroken floodplain forest of Skiyou Island was slated for the pulp mill until the Skagit Land Trust negotiated its transfer and protection to the United States Forest Service.

Skagit Land Trust



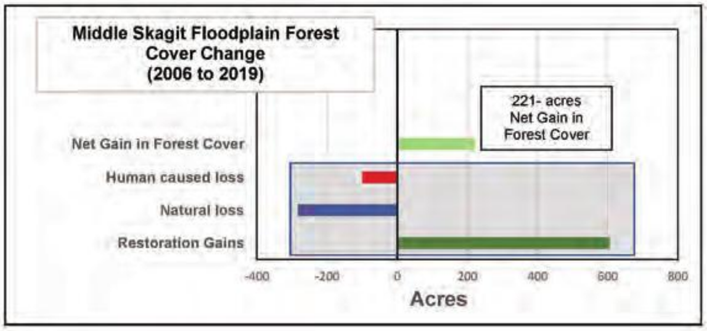
Protected lands, riparian restoration and forest cover loss in the Middle Skagit River floodplain.[9]

The tribes, all levels of government, nongovernmental organizations, and private citizens are all working to restore the Skagit River floodplain wherever opportunity presents itself. This has resulted in 5,023 acres of protected lands and 604 acres of riparian plantings.[4] Protected lands provide the necessary space for the Skagit River to migrate and create new off-channel habitats, and the riparian plantings will provide naturally recruited large woody debris and shade for mainstem edge, floodplain tributary and off-channel anadromous salmon-rearing habitats.

The majority of the Middle Skagit River floodplain, 10,896 acres,[5] remains in unprotected private lands that are being maintained and cleared for infrastructure, agriculture and other forms of human development. Additionally, 55% of the floodplain's land area is cleared of native forest.

Riparian restoration and negotiation of floodplain lands into protected status has to increase in pace. We currently have protected lands left unrestored and are missing opportunities to put lands into protected status due to inadequate funding. Looking for opportunities to move infrastructure and development out of the floodplain entirely needs to be considered in long-term strategic planning and requires dedicated funding sources for implementation.

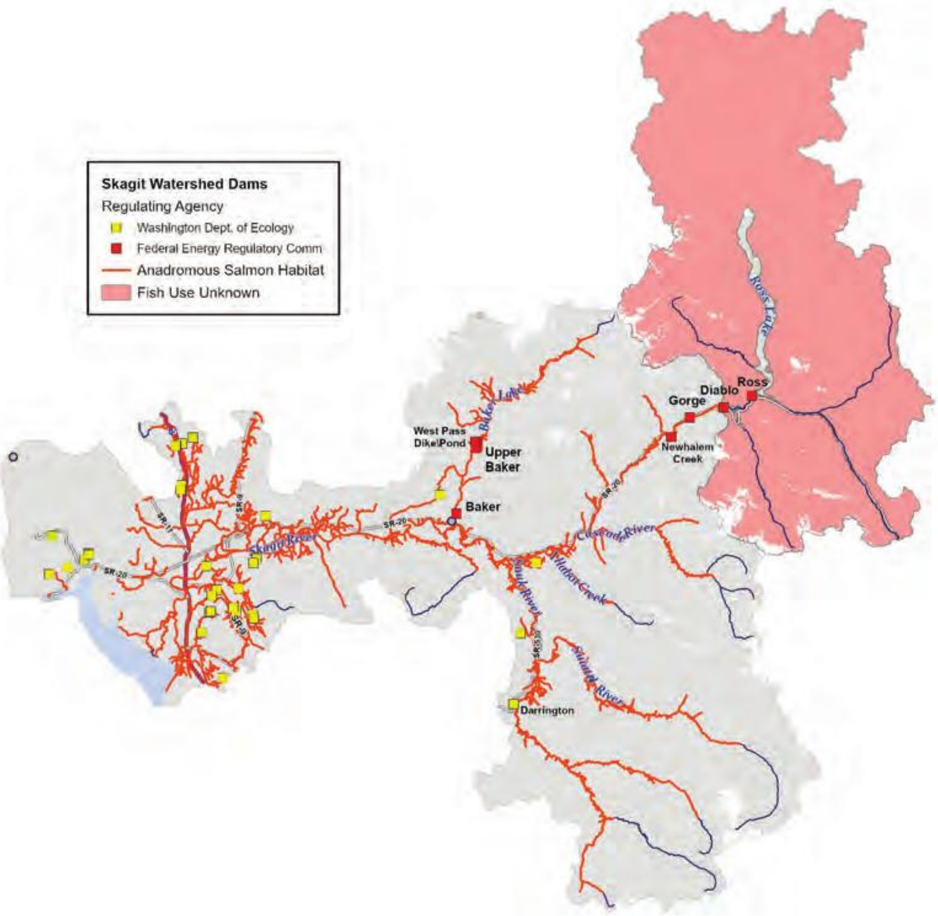
Map Data Sources: SRSC 2005,[6] SWC 2019,[7] SWC 2019a[8]



Forest cover loss to the natural process of a migrating stream is a sign of a healthy floodplain. Human tree removal needs to be restricted from the floodplain wherever possible. Riparian restoration provides the floodplain with needed trees on its road to recovery.[10,11,12] It will take decades, and ultimately centuries, before these trees attain a size capable of providing historic levels of habitat function.

UPPER SKAGIT INDIAN TRIBE

Skagit Watershed Hydropower Operations: Understanding Cumulative Impacts to Fishery Resources



Lack of regulatory alignment with salmon recovery goals is often cited as a major impediment to salmon recovery and treaty rights protection. The Federal Energy Regulatory Commission's (FERC) relicense process is a prime example of the regulatory challenges salmon recovery faces. FERC's relicense process for environmental assessment of project impacts establishes as a baseline the "current operating conditions," limiting the review and assessment of the original project infrastructure. Seattle City Light's Skagit Hydropower Project was started in 1915, well before the known impacts to salmon could be tied to regulatory frameworks.

The Upper Skagit Indian Tribe, federal and state resource agencies, local governments and non-governmental organizations have recently formed a coalition to collaboratively assess the impacts of ongoing operations on watershed natural processes and salmon recovery goals and objectives. The goal is to scientifically assess the project's cumulative impacts, while applying the FERC regulatory framework to address salmon recovery and treaty rights protection. The two large FERC-regulated hydropower projects in the Skagit watershed cut off 47% of the watershed and control flows of the entire Skagit River all the way to Puget Sound.

Almost half of the Skagit basin is isolated above large hydropower projects and the entire Skagit River is impacted by flow regulation. The degree of degradation from smaller dams is unknown. The FERC dams have inundated vast quantities of habitat, and since the Skagit project lacks fish passage it currently blocks miles of upstream habitat, as well as limits genetic, life history and productivity exchanges between reservoirs and downstream fish populations. In addition to the loss of upstream habitat, there are several major downstream implications caused by managing the flows and sequestering important resources such as sediment and wood that provide and help create critical habitat for downstream fishery resources. The relative lack of large logjams in low gradient reaches of the managed Skagit compared to unmanaged tributaries is stark. In addition to wood, the dams interrupt large amounts of sediment, which would normally be delivered to downstream reaches and play an important role in the formation of channel and floodplain habitats. Managed flows downstream of the dams exacerbate these impacts by reducing the capacity of the Skagit River to transport tributary-derived sediment and wood. This is visible on aerial photos where sediment accumulations

(Continued next page)

Map Data Sources: USGS 2018,[3] SWIFD 2019,[4] Maloney 2020,[5] WAECY 2017,[6] WAECY 2018,[7] WADOT 2013[8]

UPPER SKAGIT INDIAN TRIBE

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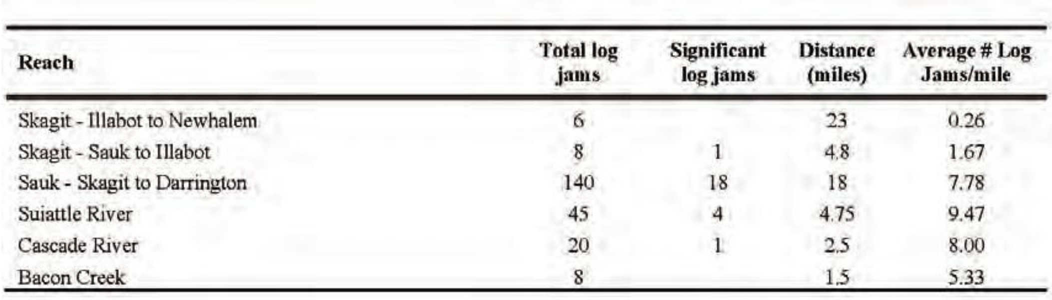
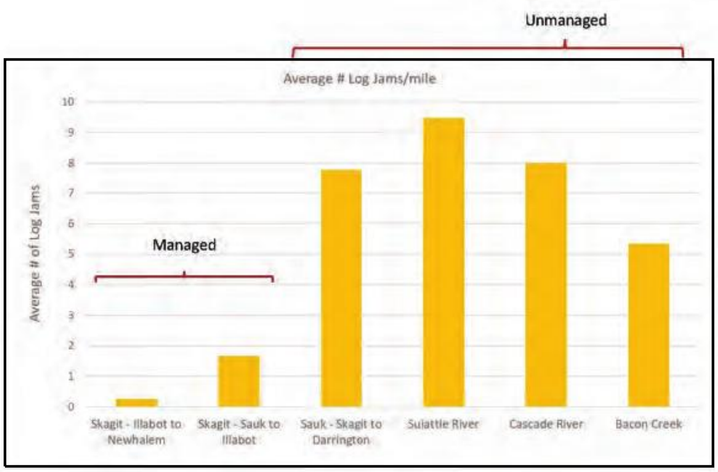


Reach	Total log jams	Significant log jams	Distance (miles)	Average # Log Jams/mile
Skagit - Illabot to Newhalem	6		23	0.26
Skagit - Sauk to Illabot	8	1	4.8	1.67
Sauk - Skagit to Darrington	140	18	18	7.78
Suiattle River	45	4	4.75	9.47
Cascade River	20	1	2.5	8.00
Bacon Creek	8		1.5	5.33

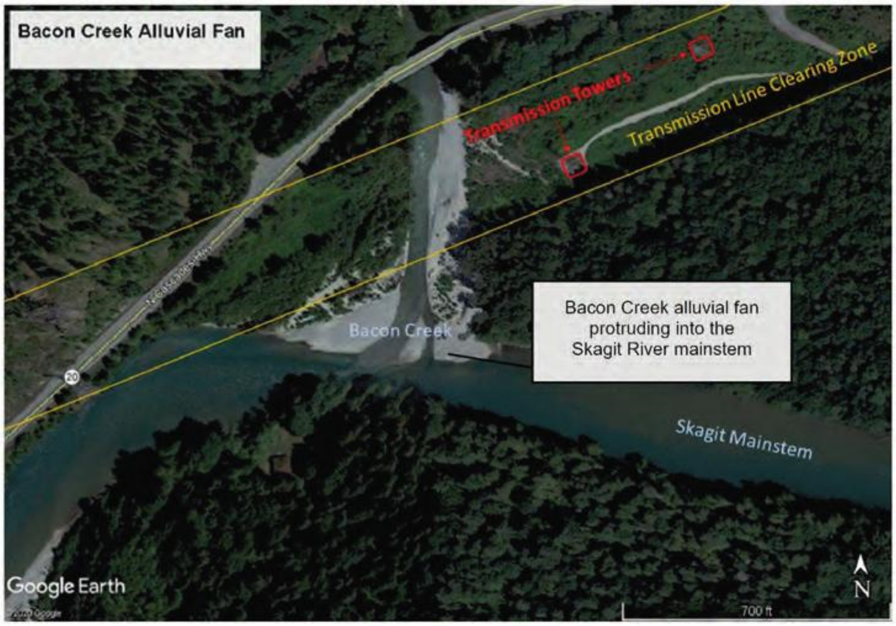
Logjam statistics from Skagit Yearling Phase I data in 2005 comparing the upper reaches of the managed Skagit River above the Sauk River to unmanaged major tributaries.

at tributary junctions, where the Skagit is restricted and forced to the opposite bank [Bacon Creek Map]. Due to the combined effects of managed flow, and sediment and wood sequestration behind the dams, downstream reaches have apparently become sediment starved and locked in place, resulting in simplified habitat features and channel incisions that disconnects the river from the floodplain. Furthermore, flood control has decreased the 1% annual chance exceedance flood by 24%.[1] Although this protects economic development in the floodplain it also increases the extent and intensity of development, thereby degrading important floodplain habitats, including those designated as critical under the federal Endangered Species Act.[2]

To more fully assess impacts from the Skagit project, tribal governments and agencies will be studying the aquatic and riparian habitats along the transmission line corridors. Hydropower operators clear these areas of native vegetation, place significant infrastructure in channel migration and riparian zones, and maintain access roads that may impact fish passage and other floodplain processes. The tribe will be assessing these impacts to inform protection, enhancement, and mitigation solutions in the future.



Existing logjams counted in 2005 as reported in Skagit Yearling Phase I. Compares the number of logjams per mile of river in the managed Skagit River above the Sauk River confluence and the unmanaged major tributaries.



Bacon Creek alluvial fan reaching far across the Skagit River. The buildup is impacted by insufficient mainstem flows and may seasonally impact fish access into the tributary. The transmission line corridor passes directly over the alluvial fan, requiring vegetation clearing and tower protection.

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Thanks & Acknowledgments:

We would like to thank and acknowledge the participants who took time out of their regular schedules to meet with the SSHIAP staff and to review drafts to complete this report. Their tireless work and devotion to the Northwest Tribes and to this report shows in the final product. The following individuals are especially recognized (Commissioners in blue, project leads in red):

Hoh Tribe
(Rosetta Hernandez, Wendy Largent, Joel Green, Julie Ann Koehlinger, Bernard Afterbuffalo)

Jamestown S'Klallam Tribe
(Ron Allen, Hansi Hals, Robert Knapp, Randy Johnson, Neil Harrington, Aaron Brooks)

Lower Elwha Klallam Tribe
(Frances Charles, Matt Beirne, Mike McHenry, Randall McCoy)

Lummi Nation
(Steve Solomon, Barbara Fisher, Kara Kuhlman, Hannah Winter, Andy Ross, Gregg Dunphy, Kelley Turner)

Makah Tribe
(John "Buster" Ides, Stephanie Martin, Ray Colby, Adrianne Akmajian, Angela McMurphy, Katie Wrubel, Riley Smith)

Muckleshoot Indian Tribe
(Leo LeClair Jr., Isabel Tinoco, Glen St. Amant)

Nisqually Indian Tribe
(Georgiana Kautz, David Troutt, Chris Ellings, Jennifer Cutler, George Walters)

Nooksack Indian Tribe
(Roswell "Ross" Cline Sr., Treva Coe, Mike Maudlin, Ned Currence, Oliver Grah, Jezra Beaulieu, Eric Stover, Lindsie Fratus-Thomas)

Port Gamble S'Klallam Tribe
(Chris Tom, Paul McCollum, Abigail Welch, Emily Bishop, Hans Daubenberger, Sam Phillips, Roma Call)

Puyallup Tribe of Indians
(Sylvia Miller, Russ Ladley, Eric Marks, Paul Arnold, Char Naylor)

Quileute Tribe
(Marty Penn, Frank Geyer, Mike Rossotto, Garrett Rasmussen, Nicole Rasmussen, Jennifer Hagen, Sarah Riutzel, Dwayne Pecosky, Chris Wagemann)

Quinault Indian Nation
(Ed Johnstone Jr., Dave Bingaman, Lauren Macfarland, Larry Workman, Mark Mobbs, Daniel Ravenel, Tony Hartrich, Janice Martin, Justine James, Elyse Wulfkuhle, Greg Eide)

Sauk-Suiattle Indian Tribe
(Jason L. Joseph, Scott Morris)

Skokomish Tribe
(David Herrera, Joseph Pavel, Alex Gouley, Seth Book, Dana Sarff, Julian Sammons)

Squaxin Island Tribe
(Andrew Whitener, Brian McTeague, Rana Brown, Erica Marbet, Joseph Peters, Joe Puhn, Eric Sparkman, Scott Steltzner, Sarah Zaniewski)

Stillaguamish Tribe
(Shawn Yanity, Pat Stevenson, Franchesca Perez, Jody Brown, Scott Rockwell, Jason Griffith)

Suquamish Tribe
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Swinomish Indian Tribal Community/Skagit River System Cooperative
(Lorraine Loomis, Amy Trainer, Devin Smith, Kate Ramsden, Tim Hyatt, Curt Veldhuisen, Gus Seixas, Mike Olis, Eric Beamer, Greg Hood)

Tulalip Tribes
(Terry Williams, Morgan Ruff, Kurt Nelson, Colin Wahl, Derek Marks, Ryan Miller)

Upper Skagit Indian Tribe
(Scott Schuyler, Jon-Paul Shannahan, Rick Hartson, Curtis Clement)

Point No Point Treaty Council
(Randy Harder, Cynthia Rossi, Jhanek Szypulski)

Northwest Indian Fisheries Commission
(Lorraine Loomis, Bruce Jones, Tyson Waldo, Marilu Koschak, Osa Odum, Ron McFarlane, Katrina Keleher, Fran Wilshusen, Tiffany Royal, Kari Neumeyer, Tony Meyer, Eliza Ghitis, Tommy Moore, John Hagen, Randy Lumper, John Hollowed, Jim Peters, Cecilia Gobin, Ash Roorbach)

We would also like to thank the U.S. Bureau of Indian Affairs, which helped fund this project. The contents of this document do not necessarily reflect the views and policies of the Bureau of Indian Affairs, nor does mention of trade names or commercial products constitute endorsement or recommendations for use.

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