Native/ non-Native Watershed Management in an Era of Climate Change:

Freshwater Storage in the Snohomish Basin

by

Nahal Ghoghaie

A Thesis: Essay of Distinction
Submitted in partial fulfillment
of the requirements for the degree
Master of Environmental Study
The Evergreen State College
September 2011

This Thesis for the Master of Environmental Studies Degree

by

Nahal Ghoghaie

has been approved for

The Evergreen State College

by

_____

Zoltan Grossman, Ph.D.
Member of the Faculty

_____

Date

ABSTRACT

Native/ non-Native Watershed Management in an Era of Climate Change:
Freshwater Storage in the Snohomish Basin

Nahal Ghoghaie

Climate change impacts are mounting in the Pacific Northwest, including reduced snowmelt flow quantities and altered runoff timing. Rapidly shifting natural cycles strain Washington river basin resources and communities, causing water managers to seek previously overlooked solutions to resource challenges. An increasingly utilized method for climate change adaptation builds on collaborative watershed management efforts implemented across the state since the 1980s. These management structures pool input from diverse interests, with the shared objective of salmon recovery. Native American tribes have contributed to, and led, a number of Washington watershed collaborations. Tribal input is increasingly vital in an era of climate change, as tribal knowledge contributes place-based and time-tested understandings of natural cycles that significantly enhance problem-solving capability. While there is a relative abundance of work addressing collaborative watershed management, there have been few attempts to explore the central role of tribes. Using case study methodology, this study addresses the gap in the research by investigating three cases of Native/ non-Native watershed collaboration: the Nisqually watershed in South Puget Sound, the Snohomish watershed in mid-Puget Sound, and the Skagit watershed in the upper Puget Sound. Relevant criteria are assessed to determine factors that encourage or discourage prospects for successful collaboration between Native and non-Native watershed residents. Derived from the research are the following interrelated factors: levels of community and agency involvement, shared and disparate values of watershed residents to aquatic resources, legal standing of tribes, and tribal capacity to develop and implement watershed programs. While each case experienced unique outcomes, the Nisqually Tribe has led the most successful watershed project in the region. Consideration of factors assessed in this study yields a proposal for a tribally-led water storage project in the Snohomish Basin, along with further recommendations for communities, agencies, and tribes to work toward successful partnerships in collaborative watershed management.

Table of Contents

List of Figures

Acknowledgements

This thesis would not have been possible without the guidance and support of many individuals and organizations. Eternal thanks to Zoltan Grossman for offering his glowing encouragement and many years of expertise in Native/ non-Native power sharing. Thank you also to Martha Henderson, Craig Partridge, and Ralph Murphy – three very committed faculty members who nurtured my interest in the cultural, political, and scientific aspects of water resource management. I owe very special thanks to Terry Williams for being there from the beginning, advising me and sharing his decades of experience in Washington Native resource management issues. Dave Batker, Jennifer Harrison-Cox, and Rowan Schmidt deserve special thanks for inviting me to be part of their team and for believing in me. Kate Berry from the University of Nevada, Reno and Gregory Knapp from the University of Texas, Austin offered me their time and invaluable insights to this field of study. My mom, dad, and my sister, Hadis, provided me with love, warmth and much needed confidence. My parents also helped me with substantial financial support through my graduate career. Additionally, the loving support of Eric Sarai enabled me to persevere in my most stressed moments. Furthermore, I would like to thank Abby Hook for providing me with information from her research in the Snohomish Basin, Kurt Nelson for guiding me on an enlightening tour of wetland restoration projects on the Tulalip Reservation, and to Frieda Williams for kindly assisting me with my Tulalip visits and correspondences. Also, immense thanks to the Native tribes highlighted in this thesis, whose inspiring work led me to pursue research in this area: the Tulalip Tribes, the Swinomish Tribe, and the Nisqually Tribe.

Thanks to my friends and housemates in Olympia and beyond for making the process more enjoyable, in particular Sara Haston, Graziamaria Grillo, Courtney Bell, Sheila Shapouri, Miguel Hinojosa, Adam Beadel, Diane Grundy, Jordan Milliman, Fared Shafinury, Dimitri Lebid, Benjamin Groves, Leslie Simonds, Luke Noble, Carlos Gemora, Elizabeth Antonio, Kira Nelson, Marlo Winter, Justin Crawford, Alexis Wolf, and Austen Walsworth.

I am endlessly grateful for Sophie and John Bilezikian who financially supported me through the Sara Anne Bilezikian Fellowship, which they founded in loving memory of their daughter. Sara's legacy will remain with me in my endeavors towards environmental justice.

CHAPTER I. Introduction

In response to the growing concern over climate change, governments around the world are seeking the best technologies and practices for sustainable development (Mihelcic et al. 2007). In the quest for building sustainable capacities, enhanced knowledge of ecosystem cycles and efficient resource use are the primary goals. Integrating the, "… best and most appropriate knowledge, methodologies, techniques, principles, and practices from developed and developing worlds" can provide natural resource managers with unique insight to the human relationship to the dynamic environment (Mihelcic et al. 2007).

Sustainability planners around the globe are turning to Indigenous nations to enhance understandings of environmental change, as these groups' long histories of practical innovation and application of knowledge are increasingly recognized as useful tools for adaptive resource management techniques. Fikret Berkes defines these knowledge systems, or Traditional Ecological Knowledge (TEK), as "... a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations through cultural transmission, about the relationship of living beings (including humans) with one another and with their environment (Berkes 2008). These specific systems of knowledge and cultural practice are developed and accumulated over generations and are unique to that natural region.

The Pacific Northwest is distinguished by its moist climate, yet with increasing pressures from population growth, changes in snowpack, stream flow variation, and inter-annual variation in the water budget, water scarcity has

increasingly become a concern in the region (Luce and Holden 2009). A rise in the rate of drought occurrence places incremental stress on water distribution infrastructure while causing detrimental impacts to typically moist Northwest ecosystems (Luce and Holden 2009). Recent analyses indicate that glacial runoff quantities are declining and timings are shifting to earlier in the year than mid-20th century averages (Marr 2010). Such declines in water flow will worsen with population growth and continuing climate change effects (Marr 2010). Knowledge of these changes is critically significant to future water management strategies.

The onslaught of climate change (and the rapidly deteriorating state of the environment) has led academics and scientific researchers to pursue an in-depth exploration of ecological knowledge shared by Indigenous peoples. More experts are adopting the belief that TEK is essential to sustain future communities (Berkes et al. 2000). Indigenous people around the world have spent generations observing and understanding the land and local resources. Based off these advanced understandings of local ecosystems, Indigenous nations formed their laws and customs to fairly manage and allocate resources. Their extensive history of co-inhabiting the land with the animals and plants has provided them with a keen awareness of ecosystem functions.

While maintaining traditional lifestyles has been exceedingly difficult, as industrial and urban landscapes have dominated development in the state of Washington for the past 150 years, some members of Indigenous groups have retained a connection to their traditions, and traditional interactions with the land. Tribal elders, along with tribal experts on environmental change hold a

degree of knowledge that can rarely be matched by scientific data. Therefore, many environmental authorities agree that it is crucial to incorporate this information into adaptive resource management strategies (Berkes 2008).

Some natural resource policies around the world require the integration of Indigenous and Western decision-making (Gagnon 2009). The sharing of resource management powers is referred to as *co-management*, defined as "… any one of a variety of institutional arrangements in which groups of resource users – individuals, communities, or companies – share with government the property rights, and thus the responsibility for managing a natural resource" (Armitage et al. 2007). A widely referenced example of this type of management structure comes from Washington State, regarding the government-tribal collaborative agreement to share management responsibility of salmon fisheries. Co-management regimes usually emerge in response to a crisis facing a common pool resource (CPR) in the commons (Yandle 2006). The commons "is a vast realm that lies outside of both the economic market and the institutional state, and that all of us typically use without toll or price" (Rowe 2011). The atmosphere, oceans, watersheds, land, and forests are all considered commons in traditional societies (Barlow 2009). Despite the tragic narrative on the commons described by Garrett Hardin, equitable sharing of the commons is emerging within co-management systems and outside of the market systems that led to the rapid depletion of these resources (Hardin 1968; Barlow 2009).

Watershed disputes involve social, ecological and cultural issues and have traditionally been settled using litigation. However, the Pacific Northwest (and Washington State in particular) has gradually restructured its dispute

settlement process. "The collaborative conservation model has emerged as an alternative to deadlocked negotiations and protracted court battles over natural resource management decisions" (Cronin 2005). A focus for these collaborative management groups in the Puget Sound is on watersheds, which are by no means exempt from the scarcity crisis occurring around the globe. Native Americans' contribution to the success of these adaptive water management regimes is not fully understood. Therefore, tribal input and leadership is underutilized in watershed management negotiations. Yet, it is crucial to utilize the role of Native American tribes, their TEK, commitment to Native lands, and legal standing as sovereign nations to enhance the effectiveness of these collaborative watershed-wide resource management strategies.

Theory & Background

A collection of theoretical concepts, derived from academic researchers and Indigenous communities, helped guide the research presented in this paper. Models of relationships between human beings and the waterways on which they live have assisted public understandings of water management conflicts and potential resolutions throughout the world. With the application of such models and a close reading of historical accounts from settlers' as well as Indigenous peoples' experiences, an examination not only guides public understandings of the consequences of past and present water-human relationships, it also reveals the persistence of Native tribes during and after colonial settlement (Smith and Wobst 2005). Environmental issues regarding natural resource management conflicts can be examined through a variety of approaches. The theoretical lenses I have chosen to apply to the subjects of this

study include Traditional Ecological Knowledge (TEK), collective action and common pool resources, collaborative watershed planning, environmental justice, participatory democracy, Indigenous sovereignty, and affinity politics.

Collaborative and participatory forms of water management are relatively new governance structures in Washington. Prior to the growing appreciation for community-based management, decision-making on water resources was left to individuals who possessed water rights, regulated only by state and federal agencies. The move away from this structure began to take place in 1908 with the Winter's Doctrine, which recognized prior use of water by tribes. A significant shift in Washington State took place with the honoring of Native American treaty rights to natural resources through the 1974 Boldt Decision (Wilkinson 2000, p. 56). The Nisqually, and other treaty tribes of Washington, have been initiating co-management agreements with the state of Washington regarding fisheries, timber, and wildlife since 1989. With the experience gained from working on collaborative salmon habitat recovery, tribes are in a uniquely advantageous position as scientists begin urging collaborative resource management structures in response to the threat of climate change.

The 1974 decision of Federal Judge George Boldt, which re-affirmed tribal treaty-reserved rights to access to resources in Usual and Accustomed (U. & A.) places, has increased in significance with the growing concern around climate change. Climate change realities have encouraged a renewed awareness of a concept central to many societies throughout history, "the Commons" (Barlow 2009). In numerous traditional societies around the world (both rural and urban) community members had equal access to common resources and

contributed equally towards management decisions. Barlow explains that in such societies, it was inconceivable to deny people their rights to common resources such as air, land, and water (Barlow 2009). Such structures were deeply ingrained in these communities, and permeated spiritual beliefs, social behavior, and other aspects of their culture. Yet, in contemporary societies where respect for common pool resources is not central to cultural or economic structures, CPR management injustices are prolific.

From inadequate management structures to conflicts over access to the resources, users of these resources are encountering growing problems as they face rapid depletion and suffer from environmental degradation (Adams et al. 2002). As modern societies have become exponentially more complex over the years, a CPR that once may have supported a community of fewer than a thousand people is now expected to support millions. Groups that depend on the resource have also diversified significantly, which has resulted in more divergent perceptions of the appropriate use of said resource.

Water policy in the American West is inefficient, outdated, and moreover it does not treat water as a CPR. In his publication *Crossing the Next Meridian*, Charles F. Wilkinson explains that, "… developers have been allowed to tap into any western stream without charge and extract as much water as desired, so long as the water is put to beneficial use… Diverters of water under this system obtain vested property rights that cannot be taken away unless the government pays full compensation" (Wilkinson 1992, p. 21). This appropriation doctrine was developed in the mid-1800s. Since the 1908 Supreme Court ruling of the Winters Doctrine, which reserved a sufficient quantity of water rights to meet

the economic needs of Indian reservations, water right reforms have been almost non-existent. One of the leading reasons behind this problem involves the major players who have been controlling the economy of the West. Major industries such as railroads, timber companies, agribusiness, and mining companies were amongst the leading drivers of resource-management policies (Wilkinson 1992, p. 22).

While these industries drove local economies, their resource management practices primarily served their own interests and paid little to no regard to others. A specific group of communities who have suffered from resource injustice since the first European-Americans settled the West are Native American nations. Native Americans have a long history of harsh competition over resources with settlers and economic interests. In particular regions of the country in the late 20th century, "tribes fighting for their treaty rights dealt with local white farmers, ranchers, commercial fishers, or sportfishers as the main obstacle to securing treaty guaranteed access to fish, game, and water" (Grossman 2005). Even after treaties were signed between tribal nations and the federal government in order to recognize tribal sovereignty and protection of their distinctive identities, tribal members were regularly regarded as obstacles to control of the land and the resources. Although some tribes had their own territories and were considered by the federal government as sovereign nations, they were often subject "geographies of exclusion." This concept describes the control of social spaces, including barriers to equal resource allocation. It defined indigenous peoples as the "outsider" who did not deserve equal treatment as the "insider" settler group, especially involving

access to natural resources (Grossman 2005).

In the 1980s, Washington natural resource managers and governments were introduced to new ways of addressing declining natural resources that upheld treaty negotiations. Phase II of the Boldt litigation, filed starting in 1977, emphasized environmental protection and habitat restoration for salmon fishing. The environmental stewardship described in Phase II suggests collaborations between Native and non-Native stakeholders. Therefore, the water laws and extractive behaviors that established the West were reaching a point of obsolescence. Water management professionals and decision-makers in the state are increasingly recognizing the merits of adopting the concept of water as a commons and are allowing room for Indigenous involvement, and Native tribes are often taking the lead role in these efforts (Grossman 2005).

Native communities have been affected by a variety of adverse conditions including colonization, disease, industrialization, urbanization, as well as several past climate shifts (Klosterman and Ballew 2006). They have thereby learned to adapt to various climate and resource crises and have developed thorough understandings of local natural system functions. Until recently, tribes were excluded from natural resource decisions. During the last two decades the value of locally developed TEK has been increasingly recognized as important in effectively addressing resource management (Berkes 2008). Indigenous peoples provide wisdom on how we may reverse the shortcomings of industrial development and contemporary resource management (Menzies 2006). Yet, incorporating TEK as a complementary component to resource management decisions often leaves tribes in a discordant position, unless they have a seat at

the table and share the power of making decisions. Indigenous peoples' opinions of their recent involvement in the watershed planning process vary; while some believe in active participation in the dissemination of TEK, others are reluctant cooperate with the same institutions that have spent the majority of historical interactions with Natives ignoring their warnings of ecological collapse (Inglis 1993). The former perspective participates in collaborative management processes for a variety of reasons, which include close dependence on the land and the integrity of the ecosystems that ensure their cultural survival, an understanding that they share a common goal of sustainable resource use with fellow watershed citizens, they believe resource bases surpass political, social, and cultural boundaries, as well as the perk of distributing capacities to make such arrangements cost-effective (Berkes et al. 2000).

According to CPR literature, there are a variety of ways to manage resources. Collaborative management models are becoming more widely utilized, as they are able to evolve and adapt with each application. While there are still cases in which tribal members are unwilling to share TEK due to experiences with territorial exclusion, commercial exploitation, cultural appropriation, and the conversion of TEK into a tool of Western science (Menzies 2006). There exist other situations where tribes are committed to sharing the specialized data and insights on adaptive planning strategies to help the greater community address natural resource problems (Bushnell 2006). In some cases, collaborative water management methods attempt to incorporate systems used by non-human species. For instance, the presence of beavers provided important functions to the resiliency of the pre-colonial landscape.

While learning science from the beaver might seem odd to some, the concept of bio-mimicry, or "learning from and then emulating natural forms, processes, and ecosystems to create more sustainable and healthier human technologies and designs," is gaining credibility amongst researchers, planners, and decisionmakers (Biomimicry Institute 2011). An understanding can be gained from all communities of a landscape, and beaver water storage science is a model that several successful stream restoration projects mimic (Pollock et al. 2004). Chapter three includes an in-depth exploration of the beaver's role in water storage.

Native American values are distinctive from the values clearly revealed through the formerly described American West water rights doctrine. Indigenous cultures tend to focus on extended family and not as much on the individual or the nuclear family (Papiez 2009). Instead of giving unlimited common pool resource use rights to an individual user, most Native American communities have a history of encouraging group loyalty above individual interests. Therefore, many tribal governments have well-established cooperative resource management and group decision-making structures that could offer lessons to other levels of government in shaping resource management models. Communities and governments from Canada to South America are learning lessons in commons management by incorporating local knowledge from tribal members (Berkes 2008). Collaborative environmental management platforms that resemble those of traditional communities are emerging around specific watersheds, and thus are democratizing water and riparian ecosystem management amongst previously disparate groups of

individuals and species (Warner 2007). As multi-stakeholder platforms effectively address issues of resource conflict and efficiency they are, "…increasingly recommended and applied to the management of common-pool resources" (Warner 2007).

The Boldt Decision process served as a springboard for Washington Indigenous Nations to assert their self-determination and in turn led them to take on leadership roles in restoration and natural resource issues. The Western, scientific form of management is not the only structure undergoing adaptation and change in order to incorporate new information and technology. Indigenous communities are dynamic and their styles of governance and function have also evolved. In my experience working with Washington tribes, I encountered numerous non-Native natural resources staff, which revealed that Western knowledge has expanded the scope of Tribal Nations' management tools and their ability to adapt to changing environments. Employing non-Native specialists with Western skills is a means for tribes to adapt to environmental and societal pressures while also helping to train Native staff to acquire these skills. At the same time, tribal natural resource agencies are unique by incorporating traditional forms of adaptive management to help empower everyone on the land, not just themselves.

The dichotomy between Native and non-Native communities is becoming less of an issue where the public realizes sustainability is a matter of being in a place together (Johnson 2011). The definition of TEK often includes the accumulated knowledge of many different communities, which have developed a detailed understanding of the environment around them over the centuries

(Menzies 2006). Thus, the concern is no longer about tribes "taking power" away from the State and putting it back into their own hands, because the power is being shared and expressed in the form of "Affinity Politics." The Canadian sociologist Richard Day explains; "… it is necessary to find more ways to link actually existing groups through a shared commitment to groundless solidarity driven by infinite responsibility to the extent that this commitment drives concrete action, to the extent that it brings about changes in daily practices, obstacles based on traditional divisions can be overcome. This is, of course, an endless process, but is essential to creating and maintaining the affinity-based relationships that compose the coming communities" (Day 2005). Collaborative resource management is one example of how humans and other beings can "co-belong" in heterogeneous networks that are infinitely interconnected (Day 2005).

Methodology

I use case study methodology by collecting data from a variety of sources including original documents and artifacts used by scientists, engineers, and tribal resource managers. Data is also drawn from interviews with project managers and staff people of appropriate agencies, as well as direct observation from site visits and Tribal/ agency meetings. The analyses of these data vary depending on their contribution to this study of Native/ non-Native collaborative watershed groups. Using findings from a review of case studies of co-management water resource projects from the Puget Sound, I borrow a system of evaluation, which allows me to determine the varying levels of success experienced by each study group. I assess these factors to determine the overall benefits and barriers

to the collaborative management case studies and develop a case for whether or not the benefits have outweighed the barriers or visa versa. Another set of data is collected first-hand from observations and interviews regarding a project on the Tulalip Tribes' reservation. I conduct a comparative evaluation and analysis of the three case study projects to understand the potential challenges and benefits to these specific projects. Based off of my findings, I develop best practices guidelines and recommendations for a future water storage project outside the Tulalip Reservation boundaries.

This thesis is comprised of eight chapters that are organized into three sections distinguished by geographic scale. Section I is a thorough literature review of work relating to the large-scale projected effects of climate change on water resources, and broad adaptive measures being developed in response. Section II is a continuation of the literature, which narrows in on watershed-based collaboration in Washington State and Indigenous tribes' roles in collaborative watershed management. Section II concludes with an assessment and comparative analysis of varying levels of tribal participation in three Washington collaborative watershed management case studies. Section III focuses specifically on the Tulalip Tribes' history and relationships to other Snohomish River Basin communities. Finally, using discourse from the fields of collaborative watershed planning, environmental justice, participatory democracy, indigenous sovereignty, and affinity politics, this study concludes by exploring the feasibility of a water storage project led by the Tulalip Tribes, and implemented as a watershed-wide collaborative project in the Snohomish Basin. This study aims to contribute to the field of natural resource management

addressing adaptation issues connected to climate change. An overview and analysis of the measures necessary to implement a successful collaborative resource management project is intended to aid resource specialists, policy-makers, and community members in making sound decisions on adapting to an increasingly unpredictable freshwater supply.

CHAPTER 2. Climate Change & Freshwater Resources

Global Climate Change

Climate change is significantly impacting ecosystems, economies, and cultures around the world. Anthropogenic activities have caused concentrations of various heat trapping, or greenhouse, gases (GHGs) to increase at a more rapid rate than scientific records show from Earth's past. The three dominant greenhouse gases, carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2), are reaching extreme highs that have not existed in at least the past 650,000 years – shown in figure 1 (IPCC 2007 WG1 Ch.6). This trend is causing radiative forces to increase, and is warming temperatures and the climate at an alarming rate.

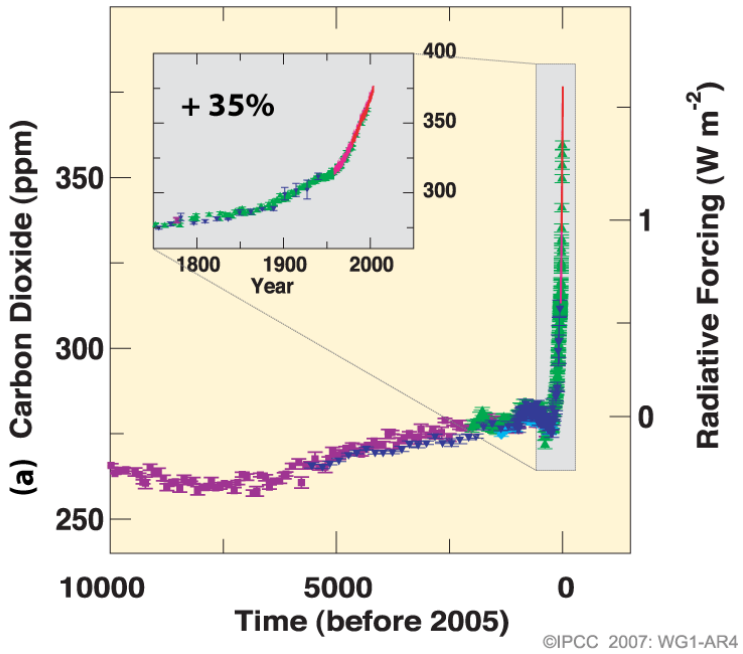


Figure 1 Atmospheric Carbon Dioxide levels over time

The United Nations and the World Meteorological Organization (WMO) recognized the necessity to provide global decisionmakers with a scientifically

sound outlook of the changes occurring to the world's climate. The Intergovernmental Panel on Climate Change (IPCC) was created in 1988 to address this need, with output objectives such as reviewing the social and economic impacts of climate change, possible adaptation and mitigation strategies, and assessing all related information to understand human causes of climate change and potential risks to the health of society (IPCC 2011). The significance of IPCC's findings were indisputably crucial to future decision making, which led to the 1994 creation of the UN Framework Convention on Climate Change, an international treaty to reduce human contributions to climate change. IPCC's assessment reports have since guided scientists and decision-makers worldwide on scientific data, methodologies, and perspectives on various related topics of interest.

On a global scale, climate change is threatening human health, agriculture and food supply, forests, ecosystems and biodiversity, coastal zones, water resources, energy production and use, public lands, and recreation (Samenow 2011). Scientific evidence reveals the accelerating rate at which climate disasters are occurring and if we do not plan to adapt, our natural resources and our societies are likely to face devastation. Changes are occurring more rapidly than trends from past eras have shown, and scientists are beginning to share insights regarding even more abrupt changes that will result in higher human and ecosystem casualties. The IPCC projects average temperature increases to be between 2° and 5°C over the next century, which will increase intensity of storms, hurricanes, floods, droughts and various other troubling events (IPCC 2007).

Sea-level rise already is and will continue to be one of the most notable effects of climate change. Ocean levels are expected to rise anywhere from 1 to 6 feet along coastal regions. Water scarcity is also affecting regions around the world, including places that are traditionally considered water abundant. In conjunction with increasing demand for freshwater resources due to population growth, climate change is placing pressures on water systems. Changes in precipitation over the seasons will affect water availability while decreasing aquifer and reservoir recharge rates. Snowcover, glaciers, and permafrost are thawing and decreasing which is leading to earlier spring peak flows in river basins, and in some cases leads to major flooding (IPCC 2007). Stream dynamic disruptions are causing vegetation changes, reduced infiltration, and increased erosion of streambeds. Sediment loads being transported downstream scour streams and diminish already vulnerable aquatic habitats.

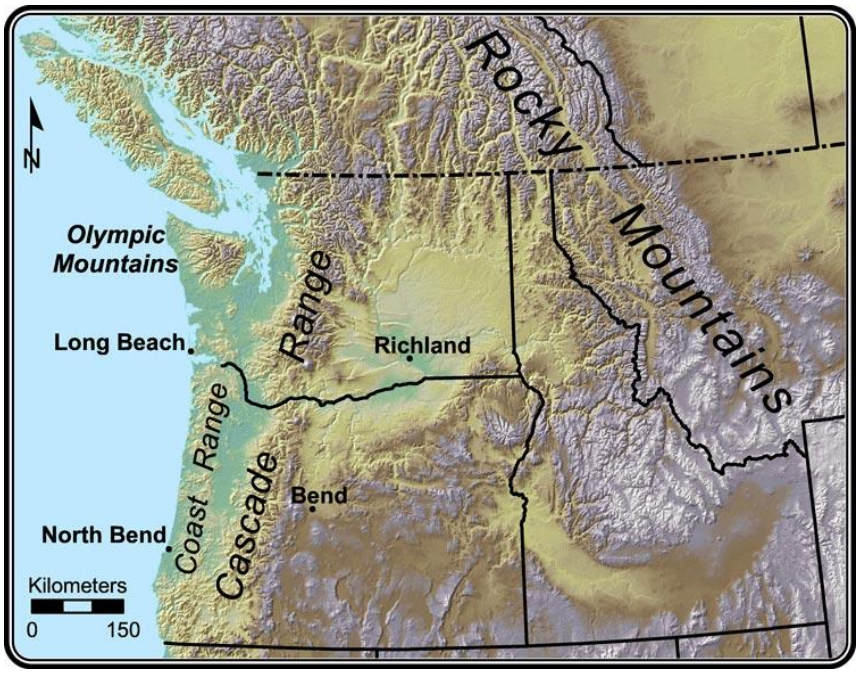


Figure 2 Pacific Northwest regional map

Effects in the Pacific Northwest

Melting glaciers and related impacts on fish populations are major concerns in the Pacific Northwest region, where economies, cultures, and ecosystems are heavily dependent on these aquatic species (CIG 2008). The Pacific Northwest is already experiencing these effects, along with many others.

In an article written for the *Climate Change and Pacific Rim Indigenous Nations* report, "Impacts on Indigenous Peoples", Terry Williams and Preston Hardison list the impacts observed and studied by the team of scientists at the Tulalip Tribes' headquarters in Marysville, Washington. One of the most substantial impacts thus far is ecohydrologic alterations and the resulting reduced infiltration of sediments and pollutants. This infiltration is destroying streamside vegetation and near-shore transitional salmon habitats. Temperature alterations, which are leading to reduced base flows, increased stream temperatures, and eventually to dried streams, are another cause of concern amongst tribes in the Pacific Northwest. Aquatic invertebrate numbers are dropping steadily, while salmon populations are enduring higher rates of disease. Williams and Hardison connect higher temperatures to increased rates of disease, pests, and invasive species infestations, which are already attacking forest health and may soon begin to impact human health. Other issues described in this report include invasive species, species range shifts, sea-level rise, island erosion, and ocean acidification (Williams and Hardison 2006).

The 2006 Department of Ecology report, "Impacts of Climate Change on Washington's Economy: A Preliminary Assessment of Risks and Opportunities," provides a scientific assessment of climate change evidence in the region:

- **Glaciers**: Up to 75 percent of North Cascade glaciers are at risk of disappearance.
- **Snowpack**: North Cascades snowpack has declined at least 73 percent.
- **Peak flows**: Stream flows in the Columbia basin and most watersheds in the state are reaching their peaks much earlier in the year.
- **Wildfires**: State wildfires have increased from about 6 per year to almost 20 per day.
- **Rising sea levels**: Puget Sound shoreline is expected to experience 1 to 5 inches of sea level-rise per decade (Brodie 2006).

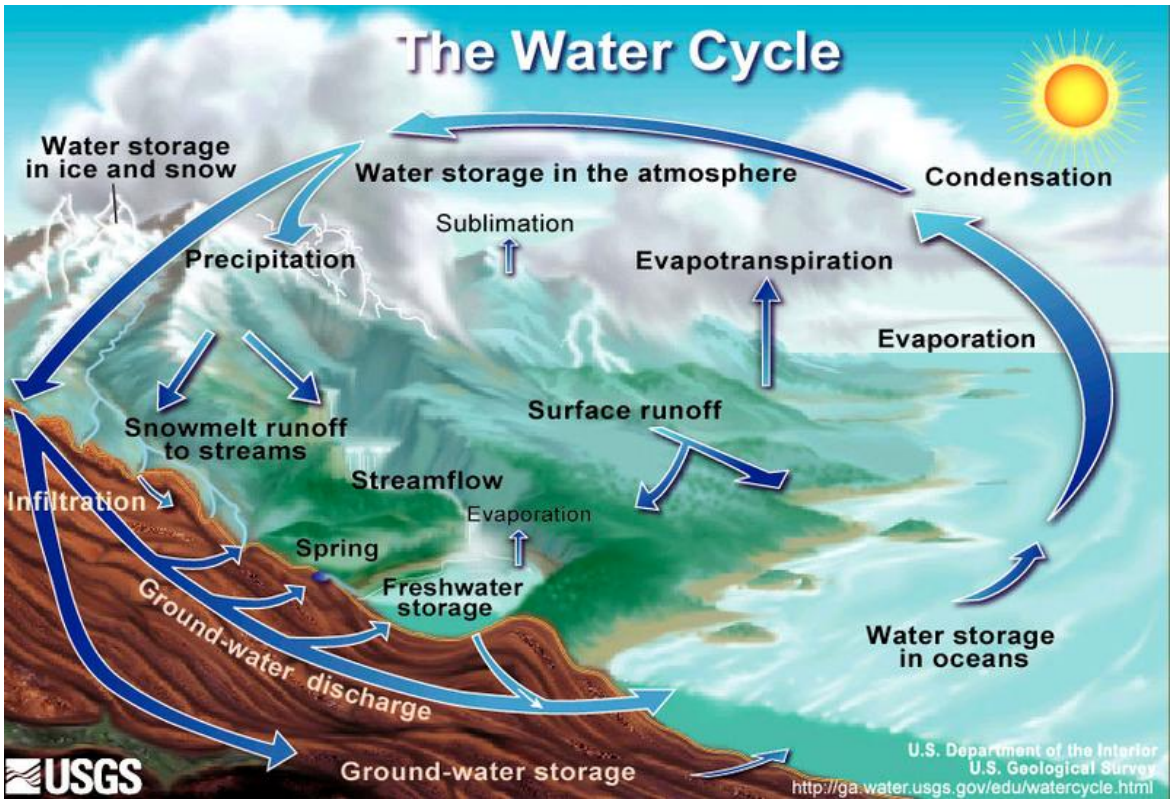


Figure 3 The hydrologic cycle

Impacts to Water Resources

Water quantity issues are amongst the most troubling climate change-related concerns at a global, national, and regional scale. Although precipitation

rates are expected to increase, this trend does not translate into more water availability for human beings and the rest of nature. Higher amounts of precipitation are expected to fall in the form of large storms, which will be too rapid for soils to absorb, thus leading to increased flooding and faster runoff into marine waters. Models developed by the Tulalip Tribes and Battelle Pacific Northwest show that one-third of the freshwater that was recharging groundwater storage is now being lost to the ocean (Batker 2010, p. 50). Loss of freshwater supply is likely to increase conflicts among competing water users. Municipal water supplies, instream flows for salmon, agricultural irrigation, hydropower, navigation, and recreation will all endure the effects of water stress in the region (CIG 2008).

Precipitation that traditionally fell as snow accumulated in the mountains is now quickly releasing as large volumes of meltwater, and is significantly contributing to the water storage loss. Over extended periods of time, such changes can become permanent, which means lost aquifer storage capacity and collapse of various natural water storage structures (Williams and Hardison 2006). Quality and quantity of freshwater will also experience intense reductions due to salt-water intrusion into freshwater supplies from rising sea levels and increased flooding (IPCC 2007). Snowpack, stream flow, and sea level rise impacts in the Pacific Northwest are amongst the highest observed in the nation (Mote et al. 2008, as cited in Marr 2010). In another study across North America, the largest decreases of snowmelt flows from April to July were observed in Pacific Northwest basins (Stewart et al. 2005, as cited in Marr 2010).

Profound impacts to Washington water resources due to climate change are abundant. Tribal natural resource managers emphasize that many of these problems would continue to exist, even if climate change never happened. Regardless, tribal and state water managers are facing increasing challenges as development trends continue to affect rivers, streams, lakes, and groundwater basins. Climate change is intensifying these problems, which will make it increasingly difficult to meet the needs of people, the environment, and related species. It is thus important for water resource managers to understand watershed characteristics and effects from changing water resource regimes. Each watershed should be assessed from several perspectives in order to understand how hydrologic cycle variability will influence natural and social systems connected to that watershed. This is why each basin has been designated with a Water Resource Inventory Areas (WRIA) code to streamline watershed activities and allow for shared planning strategies across watersheds in Washington (CIG 2008). Water managers may therefore understand the full scope of impacts to Washington's hydrology in order to prepare for implementing adaptive strategies. It is important to enact such strategies immediately to ensure the improvement of water quality and supplies, protection of ecosystems, and enhancement of flood management. These measures will thus assist society in adapting to and in some cases, averting climate change impacts to water resources.

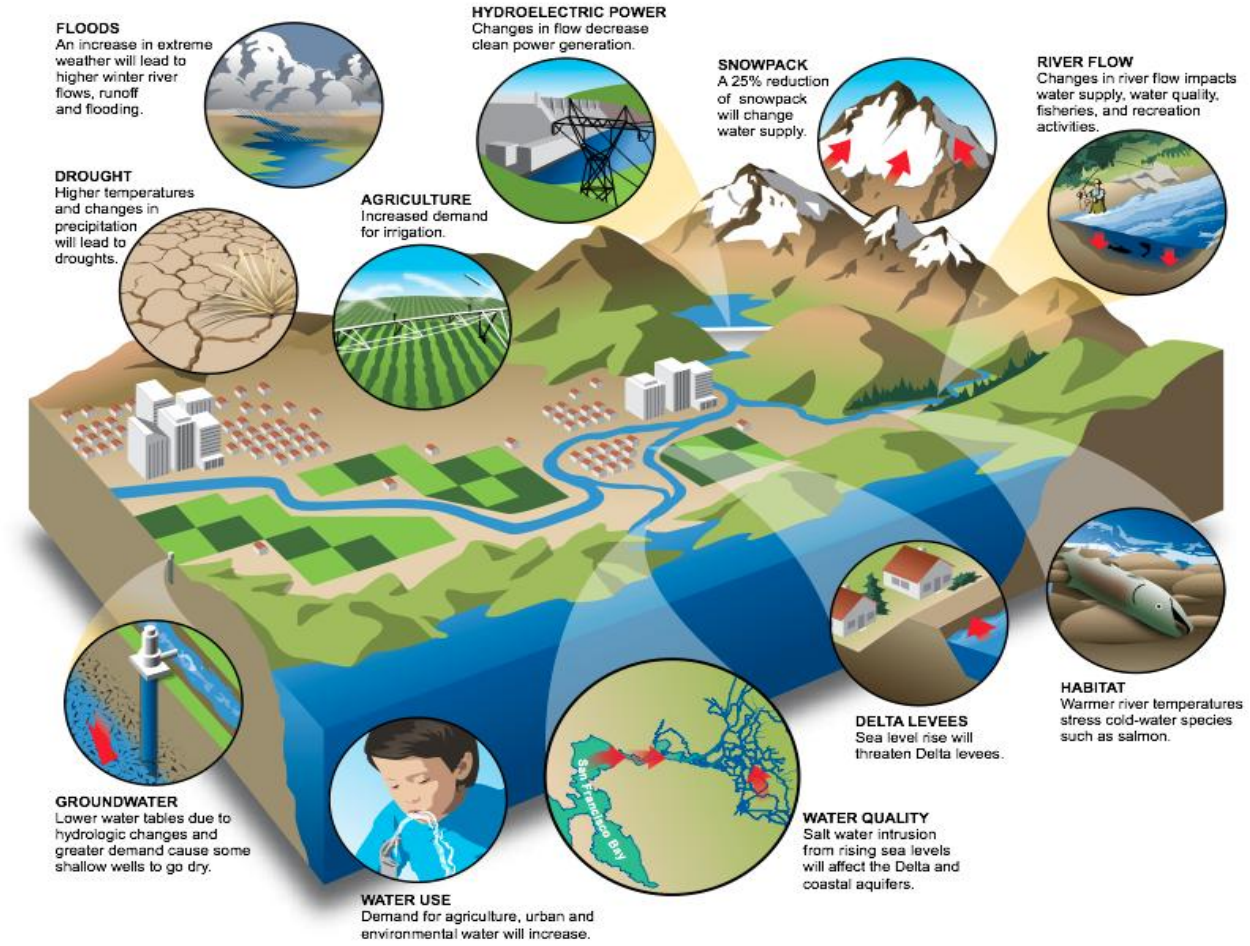


Figure 4 Climate change impacts to watersheds

Chapter 3. Adapting to Protect Watersheds

> Water covered the Earth in the beginning. Beaver lived in this water. They dived and brought up the mud. The Great Spirit Manitou created the dry land from this mud.
>
> *Creation myth of the Amikonas ("People of the Beaver")*

> Never had the rains been so torrential in the forests of the lush Cascade Range. The plants, foliage, ferns, moss, and lichen became inconceivably vibrant. The roads in the upper portion of the mountains were deserted and the trails below were treacherous with mudslides and were virtually impassable. The people of the villages and town sat grumbling in their homes with their hearths ablaze waiting for the long, dark winter to pass and become the unimaginable perfection of summer. It was also a hard time for the animals of the region. Many of the small ones were unable to stave off the rains from destroying their intermittent shelters. There were only a few creatures accustomed with dealing with these unusually harsh conditions. Amongst such creatures was the steadfast and resilient beaver of the marsh, pond, and river.
>
> *Lessons from a River Beaver, Eric Sarai, 2011*

> Repeated encounters with uncertain water dynamics led beaver's evolution to consist of a compromise of life on land and life in the water. Today, beaver is a superb semi-aquatic animal, living in wetland lodges that are built to adjust to varying water levels. Throughout the ages, naturalists and engineers have considered the beaver's structures as remarkable examples of adaptation and they strive for beaver's evolved understanding.
>
> *Dietland Muller-Schwarze and Lixing Sun, 2003*

Historical data suggests that beavers' microdams assisted in water flow through hydrologic systems in the precolonial era, hydrating the systems with ponds and wetlands, and allowing surface water to recharge aquifers. The positive contributions of beaver dams were lost as non-Native settlements and industrial agriculture spread throughout the region and wiped out beaver habitat. According to these reports, "the landscape began to dry out in many places during this same period" (Buckley 2010). Beavers were almost

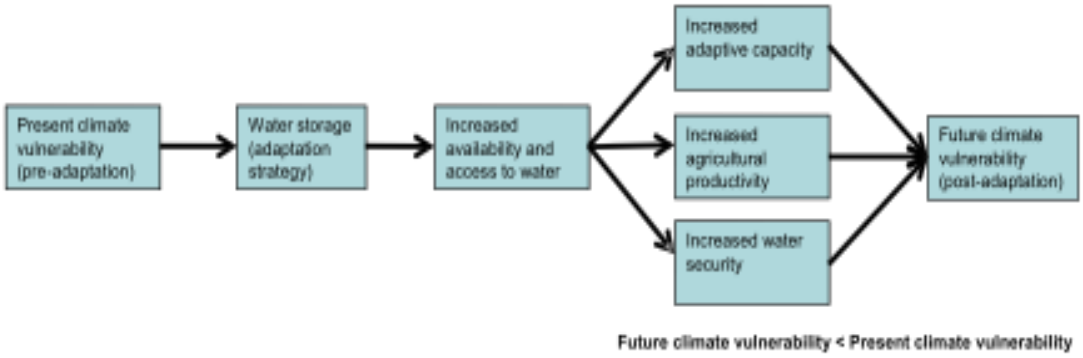
completely eradicated from the Western U.S. by the early 1800s, as their fur had become a colonial trade item in high demand. Recently, the beaver has become more important for its role in wetland restoration and other water storage projects. Watershed enhancement projects have become a priority for communities concerned about changing water dynamics brought about by climate change. While some wetland managers might look down on the beaver's wetland practices, as their ponds have often flooded existing wetlands and associated restoration projects, others are beginning to realize that the untiring beaver (along with other knowledgeable members of watershed communities) can be an important ally in rehydrating the landscape. Beavers are providing a model for adaptive management techniques for scientists, natural resource managers, and concerned citizens to prepare for water scarcity and interannual variation of stream flow. This relationship between beavers, wetlands, and human beings serves as an example of how learning from nature and collaborating with one another can serve as a successful approach to adaptive watershed management.

Current State of Freshwater Resources

Although projected changes in the 21st century are not completely clear, IPCC scientists have assessed several possible future scenarios. Based on 20 models that measure GHG levels, projections show near 2° C increase in global temperatures by mid-century. We are beyond the tipping point, and have no choice but to confront the challenges that are already appearing as a result of climate change (IPCC 2011). As we are better able to understand these challenges, scientists and decision makers are beginning to agree that water will

be the primary indicator of climate change stress on societies. Climate has not been the only impact on the state of water systems over the past several decades. Non-climatic influences have also posed significant damage in the form of water pollution, river damming, drainage of wetlands, and irrigation that has greatly lowered the groundwater table (IPCC 2007). It is almost certain that climate change will increase rainfall variability, which will cause additional stress to agriculture and to the general population. Water security and agricultural productivity are already in vulnerable states in many regions of the world, and vulnerability will increase as the climate becomes less predictable. The ability to make informed decisions about protection and allocation of this increasingly scarce resource requires an understanding of latest adaptation planning measures.

Figure 5 Water Storage as an adaptation strategy to reduce climate variability



Beyond Dams

In the past century, it was common for water managers to address water uncertainty by constructing large dams, which would often double as sources for hydroelectric power. These large structures have assisted in water resource predictability, yet they have also been major sources of habitat alteration and health detriments to fish and other aquatic species. Dams are barriers to the migration and movement patterns of salmon and steelhead. They alter habitat by creating stagnant reservoirs and increasing temperatures in rivers that provide productive spawning habitat for salmon. Dams in the Columbia-Snake River Basin permanently block over 55 percent of the historic salmon and steelhead habitat (NPCC 2011). Dams also alter downstream ecology through changes in sediment transport. Irrigation dams can contribute to salinity levels, which impacts agriculture in the river basin.

Other forms of water storage include natural wetlands, groundwater aquifers, and ponds (McCartney and Smakhtin 2010). Each individual storage type, including large dams, may outperform the alternative option, depending on the geography of the region and the purposes for which they are required. Additionally, the allocation and accessibility of the resources retained in each storage mechanism can vary. While some are only accessible by users with the proper technology, others are open to all human and animal populations. Some situations will allow for the viability of certain water storage options where other options will prove ineffective or even detrimental.

Wetlands and beaver ponds have provided water to society and ecosystems for millennia. Mimicking these natural storage options is relatively

inexpensive, as they do not require costly infrastructure, and are implementable by individual farmers and local communities (McCartney and Smakhtin 2010). Another common technique utilized by water managers is using groundwater and aquifers as storage banks, which can capture high peak flows, provide cold water release for fish, protect water quality, and offset lost snowpack storage (Snow 2008). "Under the right circumstances, small-scale water storage interventions can contribute to both food security and increased economic prosperity at a local level" (McCartney and Smakhtin 2010). While subterranean storage options also include such benefits as reduced evaporation and decreased susceptibility to climate variability impacts, a few significant setbacks also exist. Costly detailed geologic information is required in order to locate prime sites for wells, and many aquifers in the U.S. are contaminated with toxic substances, which require remediation before proving useful to water managers (Snow 2008). Regardless of the potential obstacles, groundwater recharge is becoming a widely used avenue of water storage. It involves either pumping surface waters directly into an aquifer, assisting the infiltration process by increasing permeability of surfaces and substrate, or by diverting channels and streams in directions that will flow back into a local aquifer (McCartney and Smakhtin 2010).

An understanding of physical and socioeconomic characteristics of the region is required in order to best determine current and future needs of the area, and thus to choose the most suitable type of storage (McCartney and Smakhtin 2010). Research is currently under way to enhance water resource managers' understandings of what type of storage is most suitable (cost-

effective, socially apt, resilient, and reliable) to a site (McCartney and Smakhtin 2010). This is a difficult task, as all storage types have strengths and weaknesses, and the scientific information needed for robust planning is often insufficient. These barriers to reliable planning are leading managers to pursue 'storage systems' comprised of different storage types that complement one another and have proven to be the most effective technique in several cases (McCartney and Smakhtin 2010). While each type of storage option contributes to water security at different levels, they all remain potentially vulnerable to climate change impacts.

Water is the CPR that governments, scientists, and industries around the globe agree warrants most attention. Freshwater provides a metric to gauge societal stress felt from climate change. It is without a doubt that climate change will increase the severity of rainfall, droughts, and floods, which will cause significant health risks to communities. Wisely planned water storage can offset climate change impacts by providing a buffer, which will enhance water security, aquatic organism and habitat health, and agricultural productivity (McCartney and Smakhtin 2010).

Figure 6 Wetland filtration diagram

Water Management

As with water storage methods, management regimes can vary greatly. Management decisions can lie with farmers, private industry, government agencies, and in some cases with the entire community surrounding the resource. Regardless of the designated storage technique, water managers increasingly agree that ubiquitous improvements are required to enhance the hydrologic cycle within watersheds and between regions. As climate change impacts are uncertain, planning must be adaptive and flexible to allow for dynamic conditions within individual watershed regions. Management strategies that are organized across regions result in better flood management,

reliability of water systems, and improved responses to uncertain supply and use (Snow 2008).

Water storage and allocation regimes must be managed concurrently to ensure efficient and effective plans to meet the needs of citizens, industries, and the environment. It is important to utilize updated mitigation and adaptation measures in the water sector. Mitigation includes actions taken to minimize anthropogenic influences on climate change, such as regulating emissions and enhancing carbon sinks. Adaptation, on the other hand, refers to adjusting systems in order to either anticipate or prevent climatic effects that may be harmful, such as constructing new reservoirs, or improving conservation strategies (Parry et al. 2007, as cited in UNDP 2010).

Although mitigation efforts should continue, impacts to the environment from human activities have already occurred, and scientists argue that even if all emissions stopped, residual GHGs would remain in the atmosphere for decades to come. Thus, governments and environmental management institutions should place greater emphasis on adaptation projects. Innovative, water-efficient technologies, water recycling, and using more water efficient agricultural techniques are adaptive means of protecting communities from climate change-related water quantity impacts. Adaptation also involves educating society to equip the public with an understanding of alterations they can make to their lifestyles, not only to prepare for changing conditions, but also to empower them in their lives and within their communities (UNDP 2010).

In order to create resilient societies that are able to survive future changes to their environment, a range of actions must be utilized concurrently to

more effectively reduce projected climate change impacts. An assessment of the needs, effectiveness, and suitability of the different water storage and management options must be done for each system in order to properly determine the most complementary system (McCartney and Smakhtin 2010). While a specific water storage option might be advantageous for a certain place and time, grouping water storage systems that mimic nature (by acting as an interconnected organism) is likely a more effective strategy (McCartney and Smakhtin 2010).

Yet developing and implementing holistic water resource regimes that are planned and managed as complex units in an even more complex system will require a fundamental shift in the way many managers implement water management decisions. It will require taking a wider range of social, economic, and environmental factors into consideration than in past planning programs (McCartney and Smakhtin 2010). Planning that involves the coordination of other regional efforts, increased community input, and enhanced government interest and responsibility is required to ensure well-planned water storage that can result in water security and increased public and ecosystem well-being. Growing awareness of this issue is leading to an emergence of collaborative management platforms in Washington State. Communities are implementing such projects around the shared vision of protecting their local watersheds and enhancing connected ecosystems' functions. In many cases, Indigenous nations are initiating and leading these collaborative watershed-planning projects.

Chapter 4. Engagement with Tribal Nations

Tribal members use their own methodologies of gathering and interpreting information about the natural world. These methodologies have emerged from deeply embedded values and time-tested understandings of natural cycles and management strategies, which can help set priorities for strategic planning and adaptation. Cultural stories and historical documents are just as useful in Indigenous resource management as taking pH and other types of data measurements. Using a scientific approach alone inadequately addresses cultural and socio-economic factors that need to be taken into account for adaptive water management planning. Scientific knowledge of ecosystems such as wetlands, for example, can be limited and is sometimes inaccurate as far as gauging the functions of the wetland for a human community. Cultural assessments and uses of wetlands can greatly enhance an overall understanding of wetland functional valuation, which will better protect and preserve the wetland ecosystem. Yet, the distinct cultural differences between tribes and majority communities might discourage the level of involvement and communication required to effectively unite the two communities into one refined system (Cronin 2005).

Tribal nations are tied to their homelands in a unique relationship that includes their place-based identities and legal standing as sovereign entities. They offer alternative perspectives on resource use that are based on locally developed practices (Berkes et al. 2000). Their identities are deeply rooted to their lands, which are believed to be the places from which they emerged, where their ancestors still dwell, about which their stories and languages refer, and to

which they have continuing spiritual and collective obligations (Williams and Hardison 2006).

Conservation scientists are increasingly seeking sources of TEK, which are often shared through rituals and everyday cultural practices, as they believe it can contribute to the fields of ecological conservation, ethnobotany, anthropology, and to pharmaceutical research (Berkes et al. 2000). "The analysis of many Traditional Ecological Knowledge systems shows that there is a component of local observational knowledge of species and other environmental phenomena, a component of practice in the way people carry out their resource use activities, and further, a component of belief regarding how people fit into or relate to ecosystems" (Berkes et al. 2000). TEK has proven to be more adaptive than Western science, and is perceived by some Western scientists to be complementary to scientific ecology. This trend has developed to the point that some Indigenous peoples are objecting to the exploitation of their knowledge for commercial profit, particularly by the pharmaceutical industry.

There has been a recent growing demand for insights gained from exploring local practices of resource use, as steps towards the next phase of natural resource and environmental planning are becoming more urgent with climate change (Berkes et al. 2000). Traditional knowledge is also beneficial because it can help highlight research priorities by contributing a local, established community's perspective (Riedlinger 2000, as cited in Bushnell 2006). Locally evolved ecosystem management practices are helping resource managers and scientists in general to monitor, interpret, and respond to increasing environmental changes.

TEK & Climate Change

Native tribes federally recognized treaty rights apply to their reservations and "usual and accustomed" places for fishing and harvesting. Therefore, moving away from these lands to adapt to large-scale environmental decline would cut them off from their origins, from the places of their collective memory, and from their right to self-determination. Their long-standing connection to the places they inhabit provides an intimate understanding of past climatic trends, which is why it is important to listen to their concerns regarding climate change. (Papiez 2009). "From villages in Alaska suffering from unstable ground associated with melting permafrost and ice, to Pacific Islanders becoming the first climate change refugees due to sea-level rise inundating small island nations; Native people are experiencing the first major effects of global climate change" (Papiez 2009). Since first European-American contact and through earlier climate shifts, tribal people's persistent connection to their traditional homelands has remained strong. Evidence reveals millennia of successful occupation, and is proof of their enhanced adaptive capacities (Hunn et al. 2005). This long-standing perspective is crucial to the success of adaptive resource management. Such efforts tend to be multi-phased and span the course of ten or even twenty years, and therefore require strongly committed stakeholders (Cronin 2005). Inherited Tribal wisdom and place-connected identity as a people reveals a strong personal stake in solving environmental problems, which justifies broader utilization of these time-tested resource management strategies.

TEK Challenges

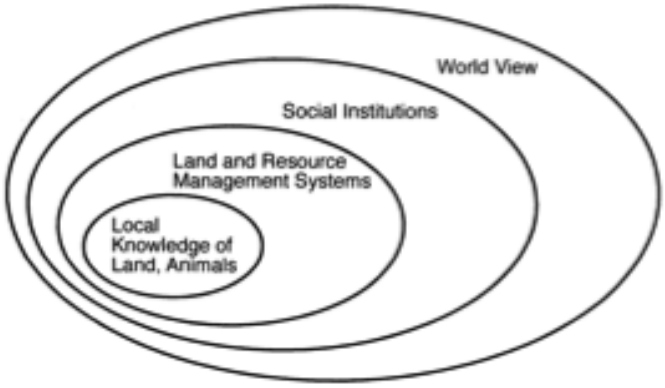
Developing research and practices that apply TEK has proven successful in many cases, yet it also involves some significant challenges. In a study on the Alaskan Fisheries Monitoring Program, which was designed to involve TEK, these specific challenges are explored in detail (Wheeler and Craver 2005). As this program has clear structural guidelines, researchers were able to highlight some of the issues involved in applying TEK to a government run program. They present two key issues, which include: 1) methods for documenting TEK; and 2) approaches for summarizing, analyzing and presenting TEK (Wheeler and Craver 2005). Beyond those described in the Alaskan fisheries case, there are myriad of challenges associated with incorporating TEK into resource management and conservation.

Although tribal sovereignty has supported their environmental management capacities, integration and communication barriers are prolific amongst tribal and non-tribal managers. Tribal representatives have distinct beliefs and knowledge bases from managers who use Western science. Some tribes have their own natural resources departments with staff who are often non-tribal (and who are trained in Western academic institutions) while others might lack an environmental department altogether (Cronin 2005). Perspectives on the significance of scientific fact also vary greatly, and can present a greater rift between Native and non-Native decisionmakers. "The challenge ahead is not just more science but rather how to understand the interactions between science and ideology- facts and values- and most importantly how to integrate them systematically in a more comprehensive

analysis" (Fischer 2000).

Beyond these challenging factors, the trust relationship between tribes and the federal government has also been problematic. Over the past century and a half, treaty tribes have allegedly been considered sovereign nations by the federal government. Yet, they are often treated as second-class citizens, and in the case of resource management, as mere "stakeholders," equivalent to local governments or non-governmental organizations. This designation does not do tribes justice. To give an entire nation the consideration and level of input as any other citizen is invalid and represents the injustices tribes have continued to endure. This lack of recognition has resulted in the refusal of many tribes to accept requests from scientists and managers exploring TEK and tribal participation. Overall, lack of tribal resources, inability to communicate in scientific jargon, and lack of existing trust relationships with managers and other stakeholders contributes significantly to the exclusion of Native Americans (Foster 2002).

Figure 7. Levels of analysis in traditional knowledge and management systems



Treaty & Non-Treaty Tribes

The 1974 Boldt Decision is the primary reason why Washington tribes have a stronger bargaining position vis-à-vis the State than other tribes in the rest of the United States. Federal Court Justice George Boldt, recognized the treaty rights of tribes who were party to the 1855 Stevens Treaties and mandated a co-management relationship between Tribes and the state of Washington to manage fisheries. Although treaties were a result of coercion to cede territories and acquiesce to a Western governance model, Tribal Nations with treaty rights have reserved a priority status in natural resource issues. The Boldt Decision served as a springboard for Tribal sovereignty, while it also highlighted the need to learn to work together, as there existed a significant lack of candor between the State and the tribes.

In the Pacific Northwest, each jurisdiction must manage natural resources within its jurisdictional boundaries and to cooperatively create a comprehensive plan to management with neighboring jurisdictions. "Although treaties are legally binding, specific tenets of many treaties were routinely broken following signature" (Cronin 2005). Through the Stevens Treaties, tribes ceded title to thousands of acres of land to allow for the peaceful settlement of the Washington Territory by non-Indian settlers and to provide for tribal survival by guaranteeing tribal access to off-reservation resources. In return, the tribes were to receive reservation homelands for their exclusive use and were promised assistance from the United States. The treaties also retained the rights of tribes to continue to hunt and gather resources at their "usual and accustomed" places in order to ensure they could maintain their lifestyles and

economies. At the time of the treaties, the tribes had a strong reliance on their surrounding natural resources. Fish was a staple food of the communities and fishing constituted the principal economic activity (IPCC 2007).

The United States Constitution describes all treaties as considered the supreme law of the land: "… and all Treaties made, or which shall be made, under authority of the United States, shall be the supreme Law of the Land; and the Judges in every State shall be bound thereby, anything in the Constitution or Laws of any State to the contrary notwithstanding" (U.S. Const. art. VI, § 2). Although both treaty and non-treaty tribes' involvement in management is driving efforts to prevent and resolve resource conflicts, tribes with most power and legal standing off-reservation are those with treaty rights.

Judge Boldt established a legal pronouncement that strengthened treaty tribes' rights in the 1974 case, United States v. Washington. This case followed a turbulent period in the Northwest during the 1950s-1970s, popularly known as the Fish Wars (Cronin 2005). The Boldt Decision mandated a co-management relationship between the tribes and the state of Washington, which meant that the tribes are entitled to half of salmon and steelhead annual harvest (Wilkinson 2000, p.52). While the Boldt Decision benefitted tribes by increasing active management of ancestral lands and waters, it also spurred substantial public opposition against the tribes. Tribal and non-tribal communities continue to face numerous conflicts, yet the public is gradually recognizing treaty tribes' rights to control their resources, both on tribal land and within ceded territories that cross jurisdictional boundaries (Cronin 2005).

Non-treaty tribes in the Pacific Northwest region, on the other hand, have

not experienced the same degree of success in their tribal/ non-tribal relationships as those tribes that signed the treaties. Although non-treaty tribes desire cooperation with local and regional partners to draw upon their Traditional Ecological Knowledge in efforts to protect and manage their culturally significant resources, they have encountered immense difficulties in securing opportunities (Cronin 2005). A major reason for this is their lack of administrative capacity and trained personnel. This issue exists in both treaty and non-treaty tribes, yet is more common amongst those without treaties. Tribes must hire non-tribal contractors in order to pursue environmental planning projects, which proves to be more costly than contracting with a tribal member. Sending contractors to regular meetings is often unrealistic, as it consumes significant time and monetary resources (Cronin 2005). Legal standing, along with the financial capacity of the tribes, is key in establishing their status as equally respected co-managers of the resource (Cronin 2005).

Treaty tribes with reservation lands within a given WRIA (Water Resource Inventory Areas), which the Department of Ecology developed and manage as administrative and planning boundaries for watershed-wide resources, must be invited to join the "initiating governments" (DOE 1998). The initiating governments choose a lead agency, establish a planning process and the "planning unit," and choose whether to consider additional components other than water quantity. "Affected tribes" are those tribes with federal fisheries-resource rights in the WRIA, tribes with federally reserved water-rights claims on WRIA resources, and tribes that have federally approved water-quality standards in the WRIA or are affected by the waters of the WRIA. These affected

tribes must be consulted by the initiating governments in setting up the planning process (DOE 1998). The law requires that all tribal governments that may have a "fiscal impact, a redeployment of resources or a change of existing policy" be allowed a seat in the planning committee. Tribes with fisheries-resource rights must be involved in the watershed plan to address the requirements analysis regarding federally reserved rights. Watershed plans are prohibited from containing provisions that conflict with existing tribal treaty rights (DOE 1998). Tribes without treaty rights must make a great effort to achieve involved roles. Additionally, they must volunteer their time and effort to attend meetings. A further analysis of the barriers non-treaty tribes regularly confront is required, as they are prolific, yet are beyond the scope of this research.

Historical, Spiritual & Cultural Connections

Regardless of treaty status, tribal peoples' cultural connection to local resources is sacred, thus they have struggled with notions of ownership since early interactions with European-American settlers. While families often owned resources, individual resource ownership is foreign to Indigenous ways and has diminished quality of tribes' cultural connection to these resources (Cronin 2005). The Western concept of resource ownership, which is intensified with climate change stress, has often dissuaded tribes from collaborating with non-tribal communities on resource management issues. The current situation does not promote collaboration, as Native peoples, who have contributed very little to climate changes, have few options, but to stay in place and attempt to survive and sustain their cultures. Climate change has the potential of scattering the

resources on which Native cultures are based (Williams and Hardison 2006). Indigenous peoples face the risk of seeing their homelands washed over by waves of climate change, and see species guaranteed in the treaties shift out of their territories. Herein lies the paradox of the relationship between Indian tribes and non-tribal natural resource managers; on one hand, tribes should not need to invest their resources in solving climate change problems and on the other hand, tribes are ideally positioned to take leadership roles in resource management projects. This is a principal reason why resource protection works best with tribes in the lead; they have nowhere else to go, so they have a substantial incentive to enforce the most effective, resilient, and reliable resource management strategies.

As evidenced by rituals, stories and art, certain natural areas and organisms have superior value to Indigenous people, especially from a spiritual perspective (Batker et al. 2010, p. 52). Although non-Native people often feel emotional and spiritual connections to landscapes, the spiritual values Native peoples associate with these places and resources is a significant component to their history. "Spiritual and religious values are very difficult to assess monetarily, as there is no real way to measure their quantity or importance across individuals" (Batker et al. 2010, p. 52). The Pacific Northwest is home to many tribes who see water and marine species as spiritual and cultural relatives. "While each tribe is distinct, one commonality is an intrinsic connection to land that permeates their modern way of life" (Cronin 2005).

A report on ecosystem services found in Washington's Snohomish Basin provides a local example of tribal peoples' connection to the resources that are

core to their economic and spiritual ways of existence. This case study explains the central role of salmon harvests in the Tulalip Tribes' way of life. Salmon ceremonies have always been a part of Tribal culture and religion, yet the disappearance of salmon and other fish species has prevented the Tulalip from recently holding these ceremonies (Batker et al. 2010, p. 52). The Tribes have since taken active roles participating in and leading collaborative projects with the community on restoring salmon runs. The Tulalip sacrificed a significant amount of their harvest levels to bring fish populations back with hopes of lowering their risk of extinction (Batker et al. 2010, p. 53). Along with the majority of U.S. Indian tribes, the Tulalip do not exclusively possess the resources to save their ancestors and sacred sites from extinction and destruction. Regardless of their lack of finances, many Washington tribes are prioritizing fundraising to support efforts, as the disappearance of these resources will undoubtedly result in the loss of their entire culture.

Tribal Community

Fundamental to Indigenous systems is community involvement. Everybody in the tribe is responsible for upholding the principles of sustainable resource management and for participating in the work it takes to maintain the ecosystem and community health (Broderick 2005). It was understood that ecosystems provide important services to society, including necessary resources, nutrient cycling, and a sense of place and well-being. Today, with over half of the world's population (including Native Americans) living in cities, there is a severe disconnect between people and the environments and resources that sustain them. By looking to indigenous systems and associated

values, we can gain knowledge and inspiration for creating the models that will sustain us in the 21st century and beyond (Brower 2006).

Chapter 5. Collaborative Watershed Management

Most scientists are aware that we are past the point of preventing the effects of climate change, and their attention is moving towards adaptive strategies for communities to best cope with the inevitable changes ahead. Human beings have adapted ways of living to extreme environmental conditions throughout our existence (Aerts and Droogers 2004). Adaptation is generally defined as "responses to climate change that may be used to reduce vulnerability" (McCarthy 2001). When examining varying stream flows, for instance, scientists studying the ecosystem must ascertain the resilience of the communities of human beings, flora, and fauna. In order to be equipped with the adaptive tools for climate change's impacts, decisionmakers need to work closely with watershed communities and resource managers to pool as much relevant knowledge as possible to maintain the integrity of sensitive watersheds and streams.

In order to completely understand the significance of collaborative environmental management, it is important to review the political and social structures that have defined watershed management throughout U.S. history. The historical eras of watershed management have been concisely outlined in Melissa Newell Paulson's 2007 MES Thesis entitled "Collaborative environmental management: Stakeholder participation and watershed partnership success" (Paulson 2007). Paulson cites Sabatier et al.'s text, "Swimming Upstream: Collaborative Approaches to Watershed Management," and begins with the era of "Manifest Destiny," from the 1860s to the 1890s. As the name implies, there was no concern for management of watersheds in terms

of preservation during this era. The primary focus was on economic growth and development, and resources such as water were seen for their role in transportation, power generation, waste disposal, and other trade-related functions (Sabatier et al. 2005, as cited in Paulson 2007).

"The Progressive Era" followed in the 1890s to the 1930s, which included Franklin D. Roosevelt's New Deal. This era aimed to emphasize correcting environmental damage caused during the era of "Manifest Destiny." Although this era initiated concern for environmental issues in the U.S., government priorities were placed mostly on recreation rather than subsistence. This emphasis led to increased conflicts between the states and tribes, as states limited treaty harvesting in the name of conservation. While relatively progressive projects were developed and implemented during this time, conservation policies tended to deny access to resources for the tribes, and thus this era is not recalled by tribal historians as progressive. Nevertheless, accomplishments that paved the way for current collaborative management techniques include the establishment of forest reserves that were delineated according to watershed boundaries, increased government regulations on resource use, as well as a growing awareness of the need for multi-use, environmental and economic, watershed management (Sabatier et al. 2005, as cited in Paulson 2007).

Natural resource paradigms gradually shifted along a conservation-focused trajectory in following eras. The "New Deal" era, from 1924 to 1964, was dominated by federal oversight and regulations. This led to the emergence of Soil Conservation Districts, which resembled the forest reserves model by

highlighting watershed issues and (as stated by Sabatier et al. 2005) was a precursor to today's watershed councils.

The decades from the 1950s to the 1970s, a time referred to as the "Environmental" era, marked a significant advance in citizen involvement. Societal values shifted because of numerous environmental disasters that were poorly handled by government agencies, which also led to a lack of confidence in government regulatory power. U.S. citizens gradually began taking environmental issues into their own hands, which finally gave way to the era in which we have found ourselves since the 1980s, the "Collaboration" era. This research focuses on collaborative resource management within watershed regions. Amanda Elizabeth Cronin defines collaborative watershed management groups as "The voluntary association of stakeholders, which may include local community leaders; state and federal agency employees; elected officials; tribal environmental, and industry representatives; and community members" (Cronin 2005).

Although tribes across the nation have traditionally believed broad citizen participation in decisionmaking and environmental stewardship is essential to successful sustainable resource use, non-tribal environmental managers more recently adopted it to solve the problem of expensive court cases that resulted in gridlock (Cronin 2005). During the 1980s, environmental issues escalated to the point of aggressive polarization among environmentalists, farmers, timber workers, ranchers, and agency representatives (Brick et al. 2001). Environmental managers grew frustrated at

the fact that "no one was winning" and they needed to find a new platform for negotiations (Cronin 2005).

Communities can effectively participate in resource management and thereby improve their overall understanding of environmental processes, which can change individuals' behavior and support resource reliability (Broderick 2005). Through collaborative resource management, communities can generate knowledge and tools to help watershed districts initiate adaptive strategies to respond to climate change. As cited by Warner, Steins and Edwards' definition for these types of platform is, "A decision-making body comprising different stake-holders who perceive the same resource management problem, realize their interdependence for solving it, and come together to agree on action strategies for solving the problem" (Warner 2007). Such collaborative decision making models have become a popular way of solving multifaceted CPR-related problems amongst groups such as Indigenous nations, agricultural producers, county governments, habitat restoration groups, water quality groups, ecological researchers, fishing and hunting groups, nature and wildlife groups, as well as individual landowners (Cronin 2005). Collaborations amongst these groups serve as proactive techniques to aid the success of communities during crises.

Watershed Partnerships

An increasing application of collaborative resource management platforms has occurred in watershed basins, which commonly take the form of watershed or river councils. Water governance is a top priority for climate change researchers and decision-makers. While there are a multitude of

challenges associated with collective decision-making processes, they are generally proving successful when applied in watershed regions. One reason watershed collaborations are proving to be more effective than collaborations taking place in mountain ranges or deserts, for instance, has to do with the fact that water is equated to life across cultures, and is a key lifeblood of economic development. "Water represents an integral link in a world view where water is sacred and extremely important in preserving precious balance. Water is the origin of and essential for the survival of all life" (Umatilla 2004, as cited in Cronin 2005). Many tribal cultural areas correspond to watersheds, but hydrology rather than territorial administrative or cultural boundaries is beginning to dictate management implemented at the state and regional scale (Warner 2007). "Government authorities are working together across boundaries and treat water bodies as part of ecosystems. Involving stakeholders in decision-making, with the accountability and transparency that it brings, these developments necessitate a new phase in an already changing deal between the public, private, and civil society sectors…"(Warner 2007).

Watershed Collaboration in Washington

New communities of concerned and proactive citizens are emerging and democratizing water management as well as the management of the ecosystems in Washington State. Watershed management in Washington State relatively recently became an agenda item with Governor Christine Gregoire's implementation of an advisory panel called the Puget Sound Partnership (Paulson 2007). The partnership of 22 stakeholder agencies, including all levels of government, tribes, businesses and citizen groups, began collaborating in

2007 to create a Sound Health strategic plan. The Puget Sound Partnership serves, "… in a coordination capacity, taking a collaborative, holistic approach to the recovery of the Puget Sound ecosystem" (Paulson 2007). Although this agency was formed as the result of Washington State policy decisions, the management and organizational structure has been utilized for many years amongst citizen activist groups and for centuries amongst tribes. Often, the state-created structure incorporates regionalization to maximize costs and services, which is not always beneficial or ideal for tribes. Until the 1980s, the state of Washington resembled the rest of the United States in how it addressed watershed-related issues. Currently, Washington leads the national movement towards a new co-management paradigm of water resources, which is largely attributed to the leading role of the tribes.

Washington watershed councils helped establish the foundations of collaborative resource management strategy in the United States. A collaborative, holistic approach strives to serve as an alternative to the litigation-based environmental policy format by inviting, "… all stakeholders to participate in place-based watershed management on more or less equal footing" (Sabatier et al. 2005, as cited in Paulson 2007). This resource management and leadership approach can be difficult to implement, as it is both time-consuming and slightly 'elusive' due to its lack of clear definitions and laws that would normally set precedents, nevertheless it has proven to be the preferred choice for the majority of watershed communities in Washington state.

Collaborative Management Success

Georgiana Kautz, Natural Resources Director for the Nisqually Tribe, summed up tribal perspectives on watershed collaborations in her statement, "Everyone needs a healthy watershed. It's not just the Nisqually who need salmon, clean water, flood protection it's everyone" (Earth Economics 2009). In order to ensure the success of collaborative watershed management projects, decisionmakers who recognize this technique as the established code for many tribes are pursuing more tribal involvement and leadership. In addition to tribal participation and the participation of the stakeholders listed in Cronin's definition, resource managers, economists, and tribal leaders have tailored assessment guidelines to determine the potential successes of watershed collaborations.

This research builds upon a model developed by Craig Partridge, the Washington Department of Natural Resources Policy and Government Relations Director. Partridge's model of collaborative problem solving and assessment criteria "essentially calls for an assessment of evidence for some specified encouraging and discouraging factors, leading to an overall evaluation, with rationale, of the reasonable prospects for successful collaboration and development of a collaborative objective, along with critical limiting factors that present a risk of failure and need to be addressed, perhaps in advance of attempting a collaborative process (Partridge 2011). The model allows resource managers and decisionmakers to address potential methods and the likelihood of successful outcomes for each method. This assessment also provides justification for choosing non-collaborative action. Process method

considerations range from whether they will be more science-centered or value-centered, centralized or decentralized, short- or long-time range of the project activities and goals, as well as deliberative or consensus-oriented decisionmaking (Partridge 2011). Several of the listed factors can be paired to allow a more focused analysis.

Partridge's assessment criteria are divided into four categories: issue, context, involved parties, and process. Through Partridge's application of this method to years of resource management cases, he has been able to conclude with a list of criteria that lead to higher chances of success. Some of which include:

- The issue is timely and well-framed.
- A sense of urgency among the parties involved.
- No disagreement about the relevant facts.
- "Official trust" is high due to perceived competence of leadership.
- A reasonable balance of power among interests.
- One or more interests has a strong economic or personal stake in a solution.
- Fair representation, collaborative capacity (skills) of interests, effective facilitation, and sufficient time for data gathering.

The preceding methodology is helpful in structuring a collaborative management group with high potential for success. In the cases included in this research, several of the criteria Partridge highlights are known. Therefore, it is possible to conduct a further analysis of how Tribal involvement contributes to project success rates. A relative abundance of work is aimed at addressing collaboration and resource management focuses on managers, bureaucrats and local stakeholders, but does not explore tribes' involvement in collaboration efforts (Cronin 2005). This research aims to address the gap in the literature by

examining the specific role of tribes in collaborative watershed management. The case studies provided in the next chapter include and surpass the list provided by Partridge and share specific criteria, which allow for a more in-depth analysis of factors contributing to or hindering project success. These criteria are borrowed from a list developed by Cronin, which include:

- There is one or more established collaborative group in each watershed.
- All three watersheds include tribal land ownership.
- Issues of water quality and water quantity exist and are topics of discussion in all cases (Cronin 2005).

Tribes & Collaboration

The democratization of water management, and increased tribal participation, is a step forward in watershed management practices, yet social structures must also advance in order to keep up and to ensure the effectiveness of new resource management practices. The new paradigm of collaboration has led researchers to see "the unequal representation and influence that underlie conventional decision making processes" (Fischer 2000). Although many watershed collaborations that involve tribes have proven successful, several issues associated with tribal involvement exist. Three authors provide a brief explanation of these issues in a report prepared for a tribal collaboration workshop (Azelzadeh et al. 2003, as cited in Cronin 2005). Their paper addresses and explains the topics of tribal sovereignty, trustee responsibility, consultation with tribes, sacred sites, environmental justice, tribal politics, limited resources of tribes, tribal customs, existing public land paradigms, separation of church and state, traditional ecological knowledge, and science and communication (Azelzadeh et al. 2003, as cited in Cronin 2005).

Rollins and Warren also present the fact that recognizing Indian tribes as a common stakeholder is not in line with the sovereign nation status of tribes (Rollins and Warren 2004). Beyond their status serving as support for tribal involvement, it also places them in an ideal situation to take leadership roles. With regard to other work specific to tribes and natural resource collaboration, Donoghue and Thompson presented a paper at the Community-Based Collaborative Research Consortium's 2003 conference entitled "Characterizing Tribal-Federal Collaborative Resource Management," in which the authors subdivide tribal-federal relationships into five categories (comanagement, contractual, cooperative, working relationships, and conservation easement). The authors do note that cultural values were not only recognized in each case, yet they played a key role in the process. For example, a case from Oregon is referenced where a "shared ideology between Nez Perce Tribe and local landowners and local government was the secret to success of the Wallowa County/Nez Perce Salmon recovery Plan (Waage 2001, as cited in Cronin 2005).

Climate change adds a sense of urgency to these collaborative resource management projects. Building relationships with neighbors who share common interests in protecting CPRs is an indispensible strategy to prevent conflicts before they begin. Agreements can be made amongst members of these collaborations to work together to protect CPRs for future human and wide-ranging species use. The actions of these collaborators can also often lead to the support of local resource extractors, and build public support of government representatives and agencies that have contributed. The primary goal of collaborative management is the efficient and successful management of CPRs,

but the additional benefit of cross-cultural and cross-sectoral learning emerges from such structures, making them less temporary and easier to set up for the next challenge. Native/non-Native environmental alliances do not as much "cross" social boundaries but rather reconfigure those boundaries in the face of an outside threat (Grossman 2005). Groups that might have formerly been in conflict with one another can now learn from one another through cooperation, which leads to joint gains (Warner 2007). According to Warner, any consensus-seeking council comprised of members in conflict with one another should include good facilitation to assist members in bringing their issues out into the open in order for compromises and mutual learning to take place.

Chapter 6. Case Studies

The research presents a comparative analysis of three Western Washington case studies. By investigating three cases of Native/non-Native watershed collaboration located in Washington State, this study addresses a gap in the literature, while also providing a solid foundation from which to propose further collaborative projects in the region. A comparison of relevant criteria listed in the previous chapter on collaborative watershed management helps to assess factors that encourage and discourage prospects for successful collaboration between Native and non-Native watershed residents. Derived from the research are the following interrelated factors that influence success rates of watershed collaborations with tribal involvement: levels of community and agency involvement, shared and disparate values of watershed members, tribes' cultural connections to aquatic resources, legal standing of tribes, and the capacity of tribes to develop and implement watershed programs. The cases are taken from the Nisqually watershed in South Puget Sound (Nisqually Tribe), the Skagit watershed in the upper Puget Sound (Swinomish Tribe), and from the mid-Puget Sound Snohomish watershed (Tulalip Tribes).

Active participation in fishery and water resource management by Washington tribes is secured by several state and national orders, which began with the 1850s treaties. The legal standing of Pacific Northwest tribes was strengthened when they acquired major federal backing in the 1974 Boldt Decision. Political clout of Washington tribes was further strengthened with the

passage of Phase II of the Boldt Decision, starting in 1977, which dealt with the environmental rights reserved by treaty tribes and further clarified the sufficient protection of fish habitat (Cronin 2005). It was Boldt II that enforced habitat protection and has obliged state and federal agencies, farmers, and industries to work with Coast Salish tribes.

Case Study Background

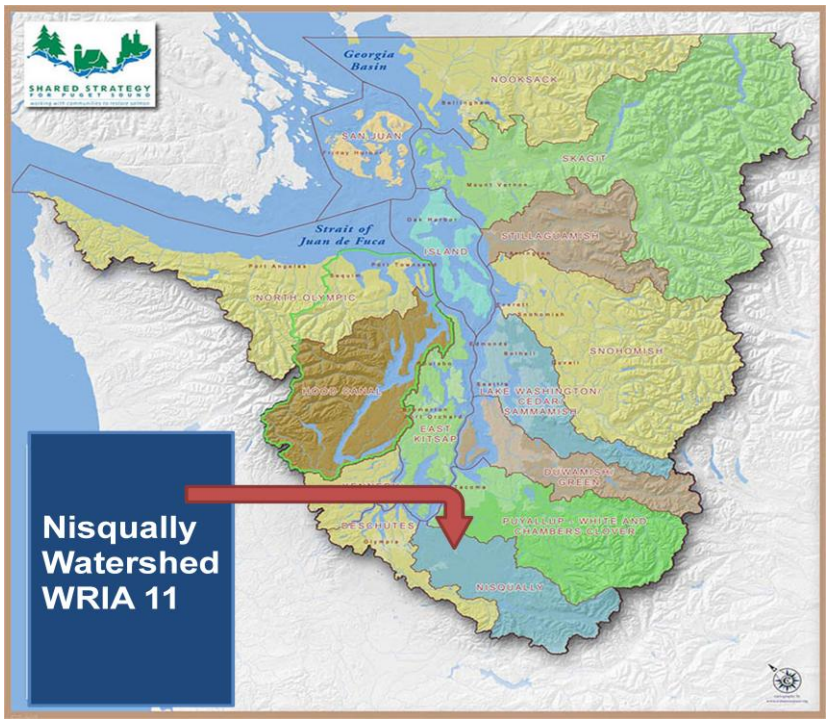


Figure 8. Nisqually Watershed

Nisqually Watershed

One shining example of Pacific Northwest co-management of ancestral lands and waters is the Nisqually River Basin and delta restoration project. The Nisqually is an entire watershed protected by legal mandates. This is the only watershed in the country that has headwaters in a National Park and mouth in a National Wildlife Refuge. The Nisqually River's source is in Mt. Rainier National Park, where streams form from glacial runoff, snowmelt, and rainfall. The

Nisqually watershed encompasses parts of Thurston, Pierce, and Lewis Counties, tribal and federal lands, Joint Base Lewis-McCord, and several protected areas – Gifford Pinchot National Forest, Tacoma Public Utilities, Nisqually Indian Reservation, and the Nisqually Land Trust (Batker et al. 2009, p. 19). The Nisqually National Wildlife Refuge also protects Nisqually Delta habitat, water quality, and various species of fish and wildlife. Although much of the watershed is minimally impacted by human activity, relative to the other two case study watersheds, increasing development and climate change impacts are making it more critical for the watershed community to implement stringent watershed protection, restoration, and management efforts (Batker et al. 2009, p. 21).

Land use includes farming, forestry, hydroelectric dams, rural residential development, and towns with rapidly growing populations. The expected increase in population will place significant pressure on the watershed and its resources. The watershed has also been the site of several restoration projects. The Nisqually Tribe and watershed community members have implemented several initiatives in the region to ensure the health of the Sound and have been working to protect and restore the Nisqually River since the 1980s. The Nisqually Delta Restoration Project is one of the most effective in this effort to recover Puget Sound wildlife populations and represents one of the most significant advances to date towards the recovery of the Sound.

Nisqually Tribe

"Archeological evidence estimates that people have inhabited the Olympic Peninsula for at least 12,000 years- not long after the glaciers receded" (Warren 1982, as cited in Cronin 2005). Marine resources are the primary

source of food and other essential materials used by Native people in the Puget Sound. Nisqually elder Willy Frank declared that, "when the tide goes out the table is set" (Wilkinson 2000, p. 22). By the mid-1800s, conflicts between white settlers and Native inhabitants escalated and threatened Nisqually land. Chief Leschi fought hard to ensure the Nisqually Tribe had access to the river and prairies for sustenance. Regardless of Leschi's refusal to sign, the first Indian treaty signing in Washington, the Medicine Creek Treaty of 1854 occurred in the Nisqually River Basin. The treaty recognized Nisqually rights to fish on the river in their canoes, to hunt and gather their food, and it established the foundations of the present relationship between the U.S. and the Nisqually Tribe. It also set aside a small plot of land (1,280 acres), which was on a rocky plain and did not have direct river access (Grossman 2005). This new reservation was scarcely a fraction of the Nisqually's original homeland, which was ceded with the signing of the Medicine Creek Treaty.

Treaties initiated an era of extreme lifestyle changes for tribal members. The Allotment Act of 1888 further divided reservation land into smaller plots and, attempting to "civilize" Native people, it forced tribal members to leave their roles as hunters and fishermen to become farmers. Tribal people, who were not trained farmers, often struggled with the new livelihoods into which they were forced. The U.S. government viewed the Nisqually people's failure to establish productive farms as justification for reclaiming allotments, which further decreased land left for the Tribe's reservation. In the late-1800s to the early-1900s, deprivation was made worse with the removal of Nisqually children to what were referred to as "boarding schools". Native children were

tortured more than they were taught at these institutions. They were punished for speaking their own language and for having tribal names, which psychologically affected the Nisqually people (Georgiana Kautz, personal communication, April 10, 2011). Boarding schools were a further attempt to assimilate Indian people, where traditional ways could be erased and replaced by those approved by the government and churches. Nisqually life continued this way for at least a century and a half before the Boldt Decision reinterpreted and reestablished Indian rights that were written in the treaties.

Collaborative Management in the Nisqually Basin:
Nisqually Delta Restoration

In spite of an extended history of discord with settler communities, the Nisqually have successfully established a leadership role as stewards of the watershed. Management of the Nisqually watershed is comprised of a partnership, characterized by a collaborative approach led by the Nisqually Tribe. The Nisqually River Council has provided a dependable template for other Puget Sound watershed collaborations to follow. "The Nisqually River Task Force, consisting of federal, state and local governments, business representatives, the Nisqually Indian Tribe, and interested citizen activists, created the Nisqually River Management Plan in 1985" (Nisqually River Council 2011). As a result of over a decade of efforts, the Nisqually River Council produced one of the largest restoration projects in Washington State, and the largest tidal marsh restoration project in the Pacific Northwest, the Nisqually Delta Restoration Project.

On November 11, 2009, the Nisqually Indian Tribe restored 57 hectares of wetlands to assist in recovery of Puget Sound salmon and wildlife

populations. The Nisqually Tribe and partners including Ducks Unlimited, U.S. Fish and Wildlife Service, U.S. Geological Survey, along with a list of over 20 other partners, "… have restored more than 35 km of the historic tidal slough systems and re-connected historic floodplains to Puget Sound, increasing potential salt marsh habitat in the southern reach of Puget Sound by 50%" (Nisqually Delta 2011).

Prior to the formation of the council, activities affecting the watershed's ecosystems were inefficiently delegated across independent institutions, as jurisdictional boundaries were more recognized than watershed boundaries. Council agencies realized that if such activities were better coordinated, related efforts could prove less costly and more effective. Additionally, it was beneficial to the project's success that the designated location was on territory that had been collaboratively protected from industrial projects including a port development proposal, a landfill proposal, and several other proposals made by commercial interests. They thus created Nisqually River Management Plan, which was adopted in 1987. By 2003, the council came to a consensus that water management issues not only transcended municipalities and counties, yet went beyond riparian zones as well. Thus, they developed a new stewardship plan that emphasized watershed-wide goals (Batker et al. 2009, p. 19).

The Nisqually Watershed has been the site of several examples of collaborative management through restoration projects, including salmon recovery, land use planning, and storm water management. The Nisqually Delta Restoration Project is amongst the most recent as well as most successful in the region (Nisqually Delta 2011). What makes this project truly unique is that the

Nisqually Tribe is recognized by state and federal governments as the leading government coordinating the management plan process.

The natural ecosystems of the Nisqually Watershed provide many goods and services to its residents. The Nisqually Tribe has valued nature's gifts throughout history, and descendants of American settlers have recently joined in their efforts. The watershed is a unique and exceptional place and the delta restoration project proves that full community participation is an effective leadership and management model, as it, "… increases procedural legitimacy, builds problem-solving capacity, and increases likelihood of overall success, leads to more complete understanding of environmental problems, increased likelihood of project implementation, and successful completion of planning projects" (Paulson 2007).

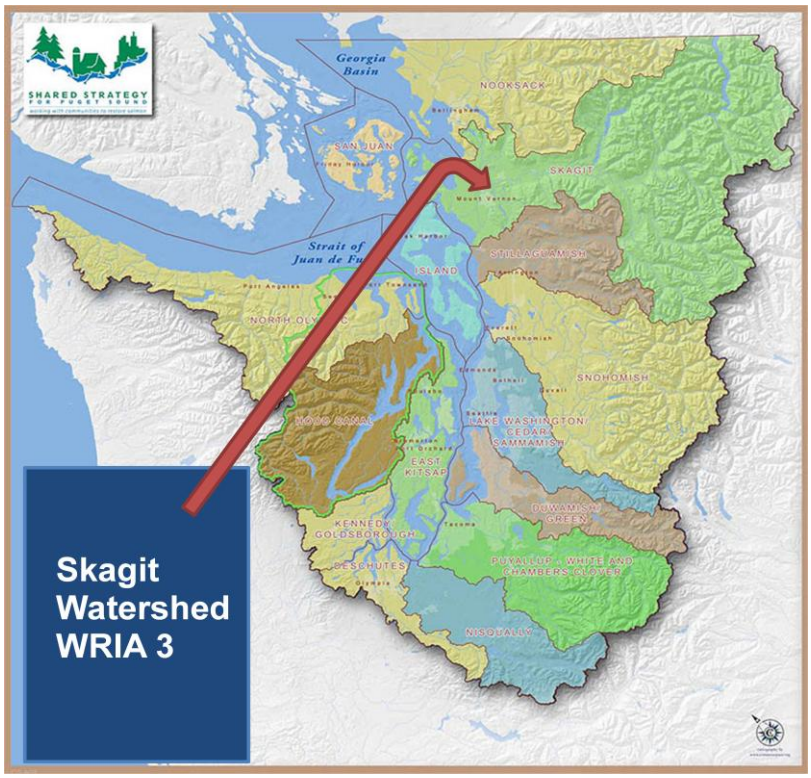


Figure 9. Skagit Watershed

Skagit Watershed

The Skagit River is the third largest river on the West Coast of the U.S. and the largest watershed in the Puget Sound region. The river originates at Allison Pass in the Cascades of British Columbia. At approximately 158 miles long, the Skagit flows southward into Washington State. As it receives numerous tributaries it passes through the towns of Sedro-Woolley and Mount Vernon. At Skagit City, the river forks to both the north and to the south, both forks empty into Skagit Bay in the upper Puget Sound. The Skagit provides habitat for all five native Washington salmon species, trout, bald eagles, snow geese, and various other wildlife (Skagit Watershed Council 2006). The delta hosts some of the most productive farmland in the area, yielding berries, potatoes, organic vegetables, and is well known for its fields of daffodils and tulips (Shared Salmon Strategy 2011). Three major dams were constructed in the 1920s and 1930s on the upper river, and provide power to Seattle and local communities (Kunzler 2005). Today, the Skagit is a major whitewater rafting and fly-fishing destination. "Fifty percent of the Skagit system is in private ownership, 44 percent is National Forest System land, and 6 percent is owned by the State and other agencies" (Shared Salmon Strategy 2011).

Washington State, Tribal governments, and the Skagit Watershed Council have identified the Skagit Basin as a major restoration and recovery region, as they have measured high rates of habitat loss near agricultural centers. Agricultural practices, such as diking and draining, have reduced tidal wetlands by over 90 percent (Shared Salmon Strategy 2011). The prevalence of private property in the basin has led to jurisdictional disputes between tribal and local

governments. But recently, some farmers and tribal representatives from the Swinomish and Sauk-Suiattle tribes began to join forces with goals of finding solutions that work for both the farms and fish. As a region with one of the highest population growth rates in the state, farmers, tribal representatives, and environmental activists are beginning to work to prevent these lands from being developed for residential or other uses (Shared Salmon Strategy 2011). The Swinomish are familiar with the issue of rapid development, which has been a source of conflict between the Swinomish Tribe and the local governments throughout their history, particularly in such a rich agricultural and recreational region.

Swinomish Tribe

Native people have lived, hunted, fished, and gathered along the Skagit for at least 8,000 years. Located on the small peninsula of Fidalgo Island in the upper Puget Sound, the Swinomish Indian Reservation is almost completely surrounded by water. The Swinomish Tribe is a confederation of several tribes and bands of Coast Salish communities, including Samish, Kikiallus, and Lower Skagit. They lived in villages during the winter and in encampments during the summer to gather resources from the river, sea, and forests. With the growing American settlements of the 19th century, the allied bands of the Swinomish, Lower Skagit, Kikiallus and Samish tribes reluctantly signed the Point Elliot Treaty of 1855. The treaty was written in order to set land aside for the Swinomish Reservation, which is now approximately 7,000 acres of tribally owned land, partially held in trust. The treaty included a provision to harvest fish at "usual and accustomed" sites, as the Swinomish are a fishing people

(Kincade 1990).

Similar to the rest of the Puget Sound treaty tribes, major changes affected Native lifestyles after the treaty signing. In the 1850s, spirit dancing and other Indigenous religious practices were prohibited and instead, the Swinomish were pressured to follow the Roman Catholic tradition. The churches were determined to "save" U.S. Indian communities. Swinomish people were subject to boarding schools, the allotments of the late 1880s, and many tribal assimilation initiatives. The Swinomish Tribe has since constituted a governing body and has petitioned to regain reservation lands promised to them in the Point Elliott Treaty, but carved off from the original land base. One location of interest to the Tribe, the March Point enclave, is ironically now the site of an oil refinery. So far, their attempts have not been successful, but they have begun repurchasing their reservation lands (Swinomish 2009).

Collaborative Management in the Skagit Basin: Swinomish Climate Change Initiative

In recent years, the Swinomish Tribe has taken the lead in cooperative resource use planning projects. Its Cooperative Land Use Program provides a forum for resolving issues that might arise amongst landowners of the "checkerboarded" plots of land in the Swinomish reservation. The Swinomish Indian Tribal Community (SITC) established the program with Skagit County to reduce permitting and regulation uncertainties with which they had been regularly confronted since the early 1980s. "The resulting confusion over jurisdiction and allowable land use engendered anti-Indian and anti-non-Indian sentiments, a litigious atmosphere and serious difficulty in attracting investment" (Swinomish 2009). Both governments admitted that they were not

entitled to make resource and land use decisions without consulting the other, and gradually started working together towards mutual agreements on comprehensive land use planning. This 1987 Memorandum of Understanding (MOU) led to the creation of a Planning Advisory Board, which is made up of four tribal appointees, four County appointees and a neutral facilitator (Swinomish Tribe 1999). The Draft Land Use Plan was the first planning effort between a tribe and a county. The SITC and the County's commitment to cooperative land use enhanced cross-cultural understanding and improved overall relations between the SITC and the County.

Over the past few decades, the Swinomish Tribe has learned lessons in cooperation as a means of strengthening self-determination (O'Haracohara 2000). It has since pursued funding for further environmental projects. For instance, in 2002, the SITC was awarded a $1.2 million research grant by the EPA to investigate shellfish contamination. Later, in 2008, the Swinomish asked the Department of Ecology to investigate and correct what the Tribe perceived to be illegal irrigation practices by farmers in the Skagit Delta. The Tribe explained to Ecology that illegal water uses were taking stream flows away from salmon. Yet, after repeatedly being ignored, the Swinomish began to look into environmental issues independently. The State of Washington eventually identified the Lower Skagit as at high risk for sea-level rise, which increased local awareness of climate change issues. A 2006 storm surge and flooding on the reservation also provided a catalyst for developing the Tribe's next research project. In order to determine appropriate responses to climate change for both the reservation and to assist the broader Skagit watershed community, the Tribe

secured funding through the U.S. Department of Health and Human Services for a $400,000 Climate Change Initiative (Swinomish 2009).

The Swinomish Climate Change Initiative provides the Skagit watershed community an action plan for implementing strategic climate change planning policies and actions (Swinomish 2009). The two-year project, begun in 2008, addressed the possible effects of climate change, and how the Tribe could adapt to these changes. Although initiated by the Swinomish Tribe, the project required the participation of neighboring jurisdictions including Skagit County, Town of LaConner, and Shelter Bay Community, as well as public and private entities, and scientific researchers such as Skagit River System Cooperative, Center for Science in the Earth System University of Washington / Climate Impacts Group, and Administration for Native Americans (SITC 2010). The action plan includes a wide range of strategies for adaptation to and mitigation of potential impacts, relying upon expert scientific advisors to assist with analyzing data and seeking coordination with local jurisdictions where common interests exist with the Swinomish Tribe.

The success of the Swinomish Climate Change Initiative has put the Tribe at the forefront of planning for climate change on a national level, which has led it to adopt more leadership roles in the region. This collaborative project has given the SITC a place to educate non-Indian partners about the cultural importance of the land and how it can serve as a venue for community development (Swinomish 2009). The Swinomish Tribe continues to prove that Tribal leadership is essential to natural resource management, especially in an era of climate change.

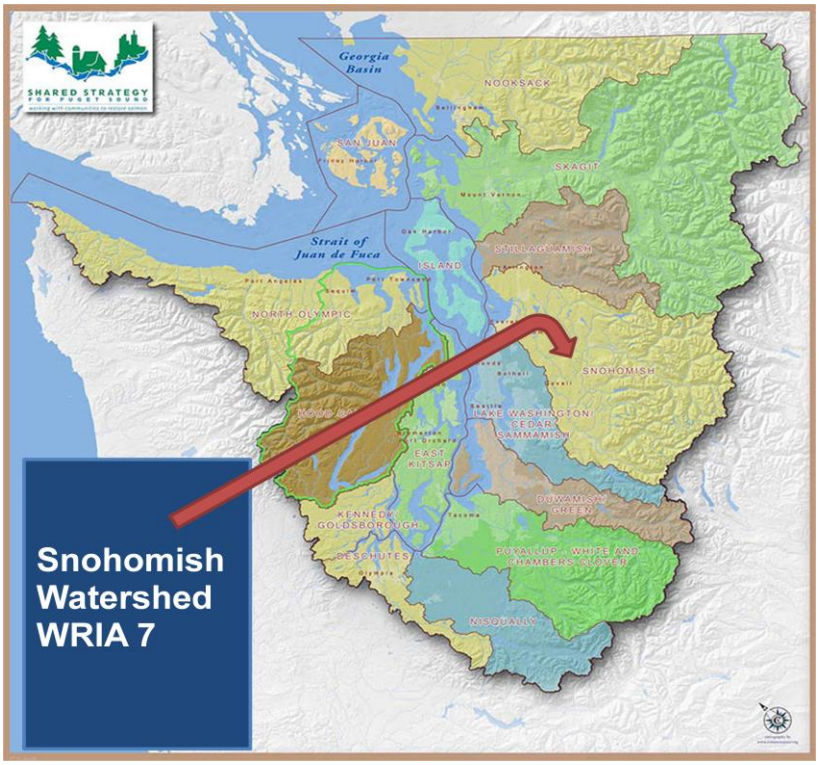


Figure 10. Snohomish Watershed

Snohomish Watershed

Located in the east-central Puget Sound Region, the Snohomish River Basin is 1,856 square miles, which makes it the region's second largest basin. It includes the Skykomish, Snoqualmie and Snohomish Rivers, the counties of Snohomish and King, and the Tulalip and the Snoqualmie tribes. The Snohomish Basin is one of the most rapidly growing areas in Puget Sound. The Snohomish River empties into Puget Sound north of Everett, the region's third largest city, which includes the Port of Everett (Shared Salmon Strategy 2011). Nutrient-rich river water comes into contact with saltwater in the Snohomish River estuary. Located at Possession Sound, the estuary provides habitat for blue heron, eagles, osprey, salmon, seals, otter, and varieties of other birds, mammals, and plants. It also provides a service to Snohomish Basin people by acting as a natural filter

that cleans water before it passes into the Sound and also slows floodwaters (Puget Sound Strategy 2010).

The primary economic sectors of the Basin include manufacturing, forestry, recreation, tourism, agriculture, and retail. The economies of Snohomish Basin counties and municipalities represent some of the most populated counties in the state and are increasingly becoming areas of urban growth and development. Home to some of the best farmlands remaining in Western Washington, the Snohomish River Basin provides attractive quality of life, high land values, extensive timber resources, diverse outdoor recreation, vast areas of public land, and abundant natural resources. The very aspect that makes the basin so distinctive is also contributing to its ruin. Population growth and development are leading to a steady decline of the basin's natural systems and biological health. Although the Tribes have long been aware of the fact that the health of their people and cultures are closely tied to the health of natural systems, the broader Snohomish Basin community has recently begun to adhere to this perspective, resulting in an increase in habitat restoration efforts (Batker et al. 2010, p. 52).

Tulalip Tribes

Since the arrival of European-American settlement and new sawmills, the tribes and the land suffered greatly. Since their 1792 encounter with Captain George Vancouver, the Tulalip Tribes have lost the vast majority of their ancestral lands and resources. By 1842, the U.S. government encouraged white settlers to begin inhabiting the Puget Sound region by selling homesteads to

lands which they did not own titles, for minute fractions of their real value (Tulalip 2011).

In 1855, the Snohomish, Snoqualmie, Skagit, Suiattle, Samish and Stillaguamish tribes and allied bands living in the region somewhat reluctantly joined Territorial Governor Isaac Stevens to sign the Treaty of Point Elliott. Not only did this treaty establish a permanent home for this group of Coast Salish tribes, it also granted rights for tribes to access their ceded territories in order to exercise fishing, hunting, and gathering rights. At the time of the treaties, fish and other culturally significant resources were abundant, yet continuous development and settlement by European-American settlers made it more difficult for tribes to fish, hunt, and gather. While State and Federal government agencies and other non-Native residents quickly forgot about the Stevens Treaties, this was not true for the treaty tribes. The Tulalip resemble the two preceding case study tribes in their movement to regain the rights they were promised in the Stevens Treaties.

Collaborative Management in the Snohomish Basin:
Tulalip Biogas Partnership

Over the past few decades, State and Tribal natural resource managers in the Snohomish Basin have worked to resolve issues resulting from increasing population density and climate change. The quality of water resources have undergone rapid decline, which has led to increased political conflicts and lawsuits involving environmentalists, tribes, farmers, developers, and concerned citizens. Conflicts such as these have taken place between the Tulalip Tribes and agricultural producers when one or both groups are faced with economic or cultural pressure (Careless 2009). Clashes have historically taken place in

Tualco Valley in Snohomish County between the Tulalip Tribes and dairy farmers. The growth of dairy herds, coupled with inefficient manure management practices, has endangered the Snohomish River's water quality, which poses a threat to the survival of culturally important fish species. According to a 2001 report by the Washington Department of Ecology (DOE) to assess the basin's compliance of the Federal Clean Water Act, tributaries to the Snohomish River were exceeding regulation limits of fecal coliform (Wright et al. 2001). The presence of fecal coliform posed a substantial threat to salmon listed under the Endangered Species Act, which presented a common challenge to the Tulalip Tribes and Snohomish County agricultural producers. Faced with violation fines from the DOE punishing their unsustainable manure management practices, dairy farmers were struggling financially. At the same time, the Tulalip Tribes' treaty rights were being violated and their access to a culturally significant fish was severely diminished. The pressure led the two groups to turn to each other and find a common ground to transcend the constant lawsuits and animosity, and come up with a joint restoration plan (Williams 2011).

The community's efforts to protect water quality and habitat have recently paid off with the establishment of the cooperatively run non-profit group, Qualco Energy (Qualco Energy 2010). Comprised of Snohomish County dairy farmers, the Tulalip Tribes and representatives from local conservation groups, Qualco Energy is a self-governed answer to CPR issues such as inefficient manure management, water quality and species habitat degradation, which also helps the community in exploring a new industry, renewable energy production. On December 18, 2008, The Snohomish/ Skykomish Agricultural Alliance, the

Tulalip Energy Corporation and Northwest Chinook Recovery opened their cooperatively managed bio-gas facility, "… to make dairies more economically viable and help protect water quality for fish" (Williams 2011). The Tulalip Tribes shared their autonomous status with Qualco Energy Corporation partners in order to ensure the integrity and success of their restoration project (Qualco Energy 2010).

The Bio-Gas facility is a sewage treatment system for cow manure, with a methane collector and power generator attached. Cow manure releases methane gas, which can be burned to create electricity or compressed and sold as compressed or liquefied natural gas. Methane is a relatively clean burning fuel and its emissions are less damaging to the ozone layer than the methane gas itself. The treated bio-solids collected during the process are free of harmful bacteria and can be used for creating high quality compost or fertilizer for the local market. The liquid effluent can be re-used for flushing the manure out of barns and for irrigating the farms fields (Qualco Energy 2010). The only waste at the end of the process is the exhaust emissions from the generator.

If this property in the Snohomish watershed is properly managed and restored, it can also support agricultural uses while aiding with salmon recovery. The parties to this agreement voluntarily work together to protect water quality, restore salmon habitat, support agriculture in Snohomish County, to develop support for the Snohomish Basin Bio-Gas Partnership among all levels of government, to seek participation of other individuals and organization in the Partnership, and to obtain funds to support the objectives of the Snohomish Basin Bio-Gas Partnership (Qualco Energy 2010).

Case Studies Comparison

These three cases illustrate how tribes have been able to incorporate cultural values into resource management by communicating with the entities that share watershed resources. "Applying and communicating information in western terms is a function of how well the tribes have been able to build the capacity to gather that information" (Cronin 2005). All three tribes interpret and implement solutions to natural resource issues with managers and scientists trained in both Western science and who can utilize shared tribal knowledge of place-based TEK. Nobel Prize winning economist Elinor Ostrom's theories on the self-governance of CPRs serve as useful lenses to analyze and fully understand the complex dynamics of these collaborative partnerships. While each watershed example does not involve all of Partridge's required criteria for the successful formation of a collaborative association, it does meet several.

In all the case studies, climate change has added a sense of urgency for local residents and involved agencies, strengthening their collaborative resource management projects. While building relationships with neighbors who share common interests in protecting CPRs is a wise and indispensible strategy to prevent conflicts before they begin, it is also important for groups with disparate beliefs to communicate effectively. In the Nisqually case, as well as the Tulalip case, agreements on relevant facts were more easily reached than in the Swinomish case. The Swinomish Tribe had to invest more of their own resources into researching and compiling relevant data to support their requests for further investigations and adaptive planning projects. The crux of the

conflict in the Swinomish case is from the Skagit Delta's higher proportion of highly valued and lucrative agricultural land that is in private ownership. Current property owners fear tribal measures may diminish the high value of the land, and therefore have strongly resisted tribal involvement.

Levels of official trust also varied amongst the three case studies. The Nisqually Tribe have had more success in gaining support from local resource extractors, general public, and government agencies due to a variety of factors. Such factors include perceived competence of the tribes to provide clear facilitation based on success of similar past projects. This aspect also contributes a general sense of confidence in tribal capacity to take on leadership roles. The Tulalip Tribes have established a similar reputation in the Snohomish region, while the Swinomish have only recently made strides in this area.

Another aspect of Partridge's framework that assisted in the comparative analysis of these case studies involves the balance of power among interests. Although the three collaborations varied in their power balances, it did not appear that any of them exhibited a pure 50-50 balance. Instead, in the Swinomish case, the tribe has struggled to have an influence in their region, which reveals its ranking in the local power hierarchy is relatively low. The Tulalip Tribes have also been unable to establish a leadership position comparable to the Nisqually Tribe. This success is due to the Nisqually's multiple positive past collaborations with their watershed community, as well as the fact that a greater proportion of the land is in public or government ownership. The Nisqually have a less complex list of stakeholders with which they must cooperate than the other two case studies included in this research. In

other words, Nisqually watershed's current management employs agencies and residents with significant shared interests, as well as strong economic and/or personal stakes in a solution.

Factors that contribute to watershed collaboration project success referenced from Cronin's methodology: 1. There is one or more established collaborative group in each watershed, 2. Watersheds include tribal land ownership, 3. Issues of water quality and water quantity exist and are topics of discussion in all cases exist in each of the case studies (Cronin 2005). All three cases are from the same region in Western Washington, which minimizes the possible range of diversity that can be observed. Nevertheless, this analysis suggests important conclusions for the role of tribes in resource management in regions throughout the U.S. Building a political environment that promotes productive discussion rather than litigation fosters collaboration between tribes and other land managers (Cronin 2005). Furthermore, building tribal capacity, specifically for tribes with treaty rights, is key to collaborative success of these case studies. Watershed community members in all cases came together to make urgent decisions regarding their threatened shared resource, and through their success, may now serve as an inspiring model of collaborative resource management.

Although collaborative partnership does not eliminate conflicts, the Nisqually Delta restoration project shows that relatively balanced participation of each collaborating agency, along with Tribal leadership, entails more benefits than setbacks. "Collaborative watershed management is also viewed as the only way to achieve the protection of complex ecosystems while meeting the needs of

both natural systems and human populations" (Paulson 2007). Collaborations allow many watershed stakeholders to come to a common table, which often results in reduced conflict, increased collaboration, secured sustainability and improved efficiency for participants (Batker et al. 2010, p. 10). Improved coordination saves watershed stakeholders millions of dollars and ensures the more effective allocation of ecosystem goods and services (Batker et al. 2010, p. 10).

Chapter 7. Tulalip Water Storage Project

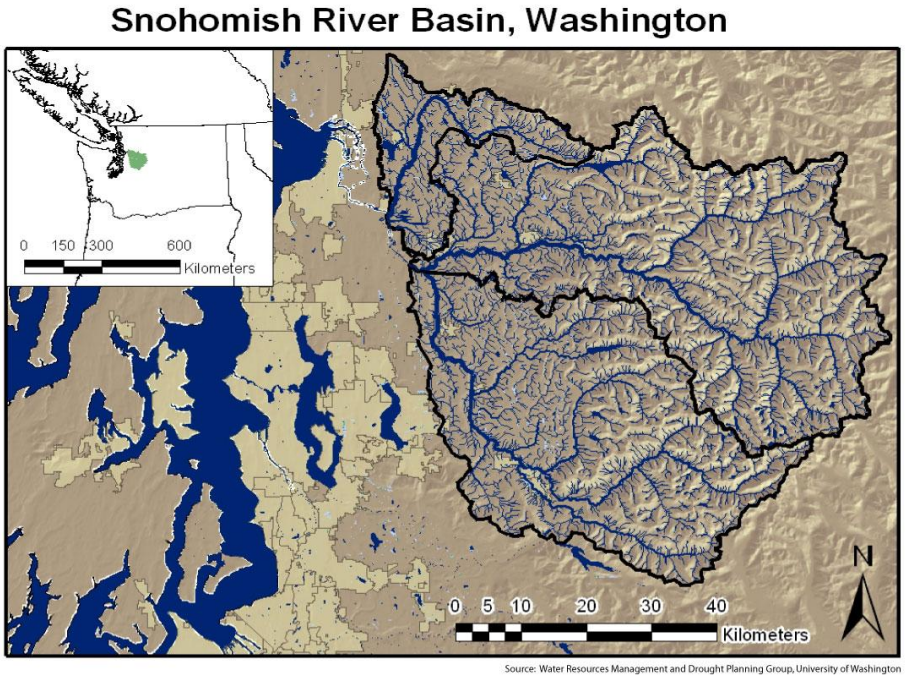


Figure 11. Snohomish River Basin tributaries map

Tulalip Tribes History

Descendants of the Tulalip Tribes have resided in the upper Puget Sound of the Salish Sea region for 10,000-12,000 years. Over one hundred and fifty years ago, the Snohomish, Snoqualmie, Skagit, Suiattle, Samish and Stillaguamish tribes (and allied bands living in the region) formed the present-day Tulalip Tribes, a confederation of tribes from the northern Puget Sound region. Evidence suggests that as recent as one thousand years ago, the Tulalip Tribes had a functioning and integrated economy that was well in balance with the natural systems of the region. Until the 19th century, local peoples lived in longhouses, and during warmer seasons, they slept in temporary homes made of cattail or tule mats (Tulalip Tribes 2011). Hand-built canoes made of cedar provided the primary means of transportation and were used for long fishing and trading journeys. Though many Coast Salish languages were spoken during

early times, *Lushootseed* is amongst approximately twenty surviving Native languages in the region stretching from Oregon to British Columbia, and some members of the Tulalip Tribes still speak it today. Other aspects of Tulalip culture were almost lost when their children were forced to attend government-run boarding schools, yet are gradually making their way back into daily life on the Tulalip Reservation, include basketweaving, beading, carving, story-telling, gathering of medicinal plants and herbs, and several other essential practices.

Marine and river resources have been key to Native people in the Northwest since their origins. Salmon harvesting methods were limited to ensure that healthy populations would return to the region the following year. The cultural survival of Coast Salish tribes heavily depends on healthy freshwater resources, so innovative stewardship of watersheds has been central to local tribes' culture throughout their history. Nine salmonid species use the Snohomish Basin's waters: Chinook, coho, chum, pink, and sockeye salmon, steelhead and rainbow trout, cutthroat trout, bull trout and mountain whitefish. Skykomish and Snoqualmie Chinook salmon are two threatened populations; both are below 10% of their estimated historic population levels. Today the basin produces between 25-50% of coho salmon in Puget Sound (Batker et al. 2010, p. 54).

Since their 1792 encounter with Captain George Vancouver, the Tulalip Tribes have lost the vast majority of their ancestral lands and resources. With the arrival of European settlement, their canneries in the 1800s, and their later sawmills, the tribes and the land suffered greatly. By 1842, the U.S. government encouraged settlers to begin inhabiting the Puget Sound region by selling

homesteads to lands which they did not own titles, for minute fractions of their real value (Tulalip Tribes 2011). Conflicts regarding the lack of treaty recognition and implementation were abundant and reached a pivotal point in the late 1950s - early 1970s, resulting in the 1974 Boldt Decision. This federal court ruling upheld tribes' rights to fish up to half of Washington's fisheries. Now, the 1855 treaty, signed by the Tulalip, is being utilized to address broader related environmental issues, involving crucial ecosystem habitats upon which healthy fish and game populations depend.

Cooperative Management:
Tulalip & Snohomish Watershed Stakeholders

The descendants of the Tulalip, Snohomish, Snoqualmie, Skykomish, and other Native peoples who signed the Treaty of Point Elliott, have lived alongside each other on the Tulalip Reservation for over 150 years. Although each tribe had separate villages prior to the treaties, they were urged to form a single government in accordance with the Indian Reorganization Act of 1934 (Tulalip Tribes 2011). Since before their establishment, the Tulalip Tribes have taken repeated measures to acquiesce to the requests of the U.S. Government in order to avoid conflicts and maintain harmony in the region. They have honored agreements made with the federal government, and have continued to pursue collaboration with Snohomish Basin neighbors.

In their efforts to reestablish a sustainable economy and address vulnerable cultural and natural resources, the Tulalip have joined a growing number of Pacific Northwest tribes in placing a strong focus on restoring their fisheries. In pursuit of this mission, the Tulalip Tribes quickly realized that the formation of strong regional and national partnerships would be essential. The

Snohomish Basin Salmon Recovery Forum was established in 1998 primarily to provide a setting for collaborative projects aiming to protect fish within the watershed. The Forum is a 41-member group of citizens, businesses, tribal representatives, farmers and elected officials who guide conservation efforts to protect and restore the ecological health of the watershed (Snohomish County 2011). It encourages cooperative efforts for implementing fish recovery projects and has led decision-making members to initiate their own local monitoring and outreach programs. The Forum's mission includes hydrology and water quality in its scope, as these variables contribute to productivity and diversity of fish stocks.

Although this Snohomish watershed group was founded with a focus on salmon recovery, it has gradually been broadening its roles in response to increasing knowledge on climate change issues. The members have sought funding to support their recent conservation plan, which encourages planning towards regional conservation and adaptation, on issues ranging from engaging with Puget Sound Partnership to strategies for effective policy guidance. The Tulalip Tribes Natural Resources Program is leading in efforts to work with partners to outreach and improve coordination with regional interests. The Tribes' harvest management strategies have informed concerned Snohomish Basin landowners and individuals, as well as tribal and state managers throughout Washington. Therefore, they are quickly building capacity to continue this stewardship and education leadership effort.

A recent example of the Tulalip Tribes' creative and collaborative solutions to regional natural resource issues is described earlier in the Qualco

Energy partnership case study. The successful creation of this facility serves as a guide for future tribally led watershed-related projects. The Tulalip Tribes developed an effective solution to degraded water quality with an aim to avoid the need for lawsuits and further conflicts with local dairy producers. The desire to find common ground has proven to be an effective means of working to improve water quality and enhance salmon runs. Thus, the Tribes are looking to future conversations with agricultural landowners and habitat conservation initiatives on methods for improving water quality and other water projects upstream from the Tulalip reservation (Qualco Energy 2010).

Further Collaborations

Due to experience gained from their many successful environmental projects, the Tulalip Tribes are expanding their capacity, as well as their influence on environmental problem-solving beyond the Snohomish River Basin salmon recovery activities. Terry Williams, the Commissioner of Fish and Wildlife for the Tulalip Tribes, is heavily involved in national and international initiatives to address biodiversity and climate change issues. Williams is leading an effort to examine the effects of climate change on the Snohomish watershed from the perspective of treating it as a complex organism, starting from its source in the Cascade Mountains to its mouth in Puget Sound. Williams' climate change research team is analyzing soil quality and forest cover to measuring river flows and the level of carbon in each piece of this intricate system. The Tulalip-led research team is diligently working to document other climate change implications to the region.

The Tribes are working with the University of Washington's Climate Impacts Group, faculty from the University of Colorado, and the Tacoma-based non-profit group Earth Economics to map out the carbon budget of the Puget Sound system with a focus on the near-shore environment to understand how increased levels of carbon are affecting pH levels in the ocean (Batker et al. 2010, p. 59). Terry Williams' team is administering a near-shore plant carbon sequestration project (with eelgrass and kelp) to help remove some carbon from the environment. This project is part of a broader campaign for the Tribes to demonstrate the value of adaptation projects in stabilizing the effects of climate change versus the more often utilized, yet less effective avenue of mitigation (McCloud 2011).

On a global scale, the Tulalip Tribes have been recognized as leaders since 1997 when the Secretary for Policy and International Affairs Office of the U.S. Department of the Interior appointed Williams to represent U.S. Indigenous peoples on the U.S. delegation to the United Nations Conference on Biodiversity (Parker et al. 2006). Williams and other global indigenous representatives have worked hard to propose negotiations to effectively combat climate change, as Indigenous peoples are some of the most vulnerable to climate change impacts and realize that their local failing ecosystems are indeed connected to one another. Williams is a lead U.S. representative at annual global gatherings, where he teaches and strategizes on adaptation goals to address climate change concerns amongst various related issues.

Indigenous nation representatives along the Pacific Rim also began discussing a treaty in 2002 that would serve as an alliance on common goals to

secure their influence and political leverage on a global scale (Parker et al. 2006). What is now known as the "United League of Indigenous Nations" works collectively towards the following goals: protecting cultural properties, sacred items and traditional knowledge, developing a method for trade amongst Indigenous nations easing transit across international boundaries, and creating a unified political body that would protect Indigenous nations' rights to fully participate in agreements and conventions regarding global climate change (Parker et al. 2006). Indigenous nation representatives from the U.S., Canada, Australia and New Zealand signed the Treaty in the Lummi Nation in 2007.

Climate Change Impacts to the Snohomish Basin

The Snohomish Basin, like other Pacific Northwest river basins, is already experiencing warmer temperatures, which is leading to more precipitation in the region's mountains in the form of rain, reducing snowpack, earlier and more rapid peak spring runoff results in higher peak flows, lower and warmer summer stream flows, and increased channel erosion (Parker et al. 2006). Further projected increases in temperatures, reduced precipitation, and increased evaporation will not only lead to higher rates of water stress, but will cause a significant impact to salmon populations. High spring flows can lead to more erosion and sedimentation, which decreases the quality of riparian filtering functions in runoff, and inhibits important stream nutrients from reaching forest riparian zones (Parker et al. 2006). Increased streambed scouring poses major risks to salmon eggs and disturbs juvenile migration cycles (CIG 2011).

Pacific Northwest winters have shortened by several weeks, while spring

flows occur earlier than regional records show. Reduced snowpack and intermittent high volumes of water flows reduce infiltration and lead to higher rates of erosion, which degrades in-stream habitats (Williams and Hardison 2006). Water flow amounts and timing are important to ecosystem stability on various levels, including cool water provision for salmon migration, drinking water for humans and other animals, irrigation water for agriculture and riparian ecosystems, as well as their contribution to properly functioning hydroelectric dams (Batker et al. 2010, p. 42).

The Snohomish Basin is flood prone and would suffer greatly from a drastic increase in flood events. USGS's flood history 2009 data includes "Recurrence intervals equal to or greater than 100 years were most numerous in the Puyallup, Chehalis and Snoqualmie-Snohomish Basins" (USGS 2009). In 2007, Western Washington rivers, including the Skagit and Snohomish, set new record highs (USGS 2009). Typical hazards to local communities include large trees and other debris being flushed down the river, damaged crops and livestock, and destroyed homes. Flooding events most commonly occur between the months of November and February during periods of heavy rain or rapid snowmelt (SCSWM 2011).

In November 2006, Snohomish County experienced a Phase 4 flood that will long be remembered as one of the most dramatic flood events in the valley "Normally the Skykomish River at Gold Bar flows at a rate of 700 to 1,000 cubic feet per second (CFS). At the peak of the flood event on November 6, 2006 the mighty Skykomish was raging at over 100,000 CFS. Translation: that is a freight train comin' your way son" (Sky Valley 2008). A 2009 report put out by the

Snohomish Times, titled "Record Flooding is Being Predicted!" warned of the dire state of Snohomish rivers. The region is seeing regular record crest levels on the Snohomish River, which poses extreme risks of landslides (Snohomish Times 2009). Several areas were cut off from the surrounding communities in 2006, 2008, and again in 2009, due to the rapidly rising high floodwaters.

Figure 12. Snohomish homes built on stilts for flood disaster adaptation. Photo by Zoltan Grossman.

Flood managers, key decision makers, and residents of the Snohomish Basin are facing more complex resource management issues and have been pursuing various avenues to offset the effects of climate change in their region. As with most parts of the country, conditions of the natural environment are suffering and it is crucial that decisionmakers develop more effective tools to address the issues of deteriorating resources and climate change. A recent approach to flood protection at the confluence of the Tolt and Snoqualmie Rivers involved setting a levee back 800 feet to reconnect the river with the floodplain and allowed more habitat for salmon and trout (Batker et al. 2010, p. 42).

Further management strategies that recognize the significance of adapting to rapidly changing water flow dynamics must be developed and implemented in the region to establish resilient natural systems (Batker et al. 2010).

Snohomish Basin Water Storage
Background

The Snohomish Basin is the second largest in the Puget Sound, at 1,856 square miles. It includes the Skykomish, Snoqualmie and Snohomish Rivers. The Snohomish Basin is classified as Water Resource Inventory Area (WRIA) 7 and is home to the Tulalip Tribes and the Snoqualmie Tribe. Coast Salish peoples' teachings refer to a glacier that retreated 13,000 years ago, providing further evidence of the extent of their ancestral connection to the land. The Snohomish Basin counties and municipalities today represent some of the most populated counties in the state and are increasingly becoming areas of urban growth and development.

Snohomish County residents receive the majority of their drinking water from snowpack. Current reservoirs in the Puget Sound depend on snowpack to supplement water storage, so snowpack can be viewed as a large system of natural reservoirs (Batker et al. 2010). Losing snowpack creates a need for development of replacement artificial reservoirs, which will be substantially more costly. The Tulalip Tribes have been monitoring climate change's potential impacts to water resources in the Snohomish Basin, and are leading actions required to assist residents of the basin in offsetting future water problems. Such efforts involve documenting current initiatives in the Snohomish Basin, identifying representational climate change impacts, assessing the carbon cycle

budget to provide income for the Tribe, assisting in statewide efforts, and targeting potential funders for adaptation projects (Batker et al. 2010).

Tulalip Water Assessment Project

A crucial project towards which the Tulalip Tribes are currently working involves freshwater storage. Relocating is not an option for the Tribes, as their culture is so intimately tied with the lands and resources of their current reservation and specific treaty fishing areas. Preventative measures are required to ensure future generations of the Tulalip peoples will have the ability to reside on their ancestral lands. A water storage project that could meet increasing provision demands involves storing glacial and snowpack runoff in the spring, for use in the drier summer months, rather than continuing to allow it all to flow to the sea and damage gravel-bed salmon spawning areas in intensifying spring flood events.

The Tulalip Tribes, in partnership with hydrology experts at the Surface Water Management Division of Snohomish County, are using watershed characterization methods to determine the ideal volume of water to be stored, channel maintenance flows, normative flows, the speed at which water moves through the system, and the best techniques for redistributing this volume of water over the landscape in order to protect and help habitat building processes that are happening upstream (A. Hook, personal communication, 9/15/2011). The project team will develop a multi-phased plan to control, accommodate and discharge storm and glacial melt runoff. The ideal plan will also recharge groundwater, control sediment, stabilize erosion, establish monitoring capability, and rehabilitate stream and drainage corridors for hydraulics,

aesthetics, and fisheries benefits (Bylin 2011). In this proposed management plan, an emphasis is placed on diverting snowmelt runoff into upland water catchments and storing it underground in gravel formations, aquifers, forested wetlands and in areas with forested cover to be released during low-flow periods. This adaptation strategy would substantially reduce climate change impacts on stream flow, as it involves filling storage reservoirs and pre-existing aquifers with a freshwater supply to be released when natural flows decline.

Currently, the Tribes do not have full the authority to implement water storage projects upstream and outside of their reservations. Yet they do have treaty interests in their ceded territories (including the entire basin) and should have input on how projects are administered upstream. The only way for them to extend proactive water management up the mountain slopes is in collaboration with local, state and federal agencies, similar to tribal strategies in the Nisqually Basin.

Terry Williams has initiated a partnership with Debbie Terwilleger, the Director of Surface Water Management Division at Snohomish County. The Division awarded a Centennial Clean Water Fund Grant from the Department of Ecology in 2001 to protect groundwater resources in Snohomish County. It now attends regular meetings on watershed-scale climate change adaptation strategies, and at the top of the list of future projects is a comprehensive ground water management program. A Ground Water Management Plan (GWMP) was created in 1999 for Snohomish County and is led and administered by Terwilleger's team at the SWMD. The program involves compiling groundwater data and providing public access to the database, preparing a study to evaluate

groundwater issues and recommend solutions, protecting groundwater quality for residential consumption, identifying standards and policies that would protect and assist recharge and prevent contamination, and coordinating with county, state, and federal departments on actions for achieving goals set forth in Snohomish County's GWMP (Bylin 2011).

Progress with this program has been slow, as administrative and technical details have yet to be fully understood. Implementation currently cannot extend beyond the boundaries of Snohomish County, and the Snohomish Basin includes parts of King County, which is why watershed-wide issues and related projects should be addressed at a watershed-wide scale. (Point Elliott itself is also included in the basin, although the effects of this treaty span multiple counties.) King County has devoted efforts towards similar projects and has data regarding aquifer health and critical recharge areas. Snohomish County, on the other hand, has made less progress with this program and would greatly benefit from the Tribes' assistance, as they have demonstrated groundwater management success in the past. Terwilleger's team has been coordinating with Williams' department to create a GIS map designating priority aquifer recharge areas in the Snohomish Basin. According to Abby Hook, Tulalip Tribes GIS Specialist, this is one of many current projects at a conceptual stage, and is far from being implemented (A. Hook, personal communication, 8/31/2011). Hook shared her expertise on this project; "The idea in our office is to combine the Puget Sound Watershed Characterization project results from Department of Ecology with the historical wetland data that Batelle did for Snohomish County. Watershed characterization will point out areas that storage

is of high importance and is degraded. The historical wetland information from the County should point out within those subbasins where the most appropriate sites for wetland or storage restoration areas are located" (A. Hook, personal communication, 8/31/2011). Hook is in the process of collecting GIS layers from both Snohomish county and Ecology. Hook and her team will overlay historical wetland information from Battelle's "wetness indicator studies" over the current watershed characterization maps, which include the following criteria: importance of delivery, restoration and protection for delivery, surface storage importance, surface storage degradation, and discharge rates (A. Hook, personal communication, 9/15/2011). Figure 13 is a map from Ecology's Puget Sound Watershed Characterization Project geodatabase, and provides an example of how surface storage importance attributes can be shown with GIS.

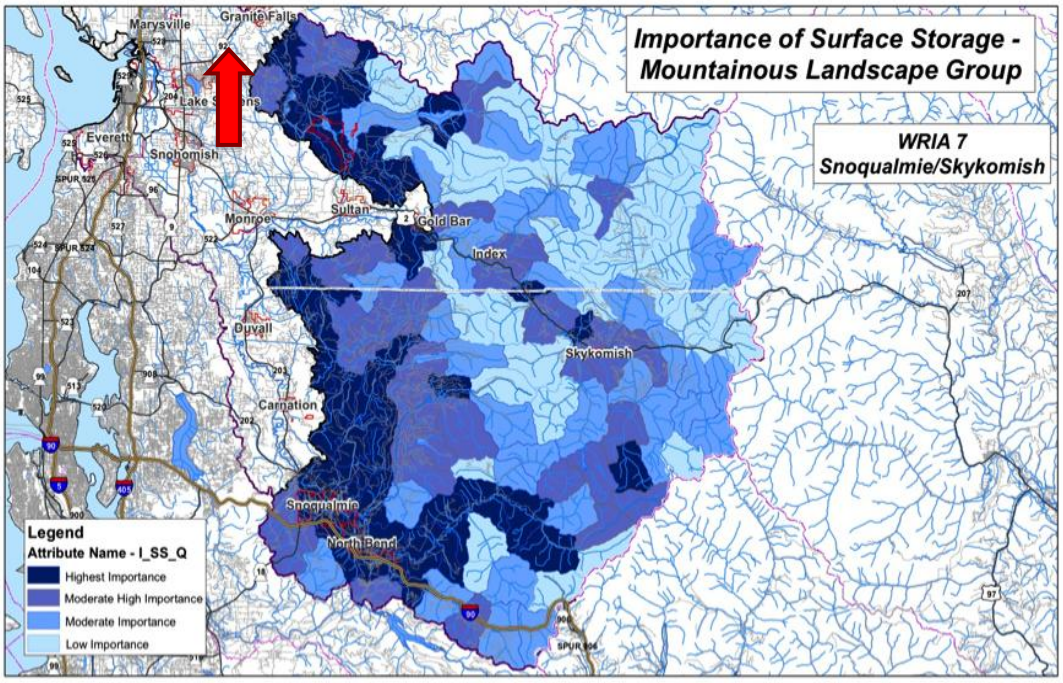


Figure 13. Priority surface storage map (arrow pointing to Pilchuck River Basin)

So far, Hook and the team at Tulalip have developed sub-basin rankings for the Pilchuck River Basin. They are utilizing the methods from the characterization shown above, where shades of blue display importance of storage. According to Ecology, the upper watershed is still intact and the projected impacts from climate change are not depicted at higher elevations. In order to avoid this weakness in their sub-basin maps, Hook and the Tulalip team are creating a more detailed map that will provide restoration and protection rankings, so when they overlay the two maps they would have a better idea of future project sites. As these maps are not yet complete, Abby was unable to release the documents for my research.

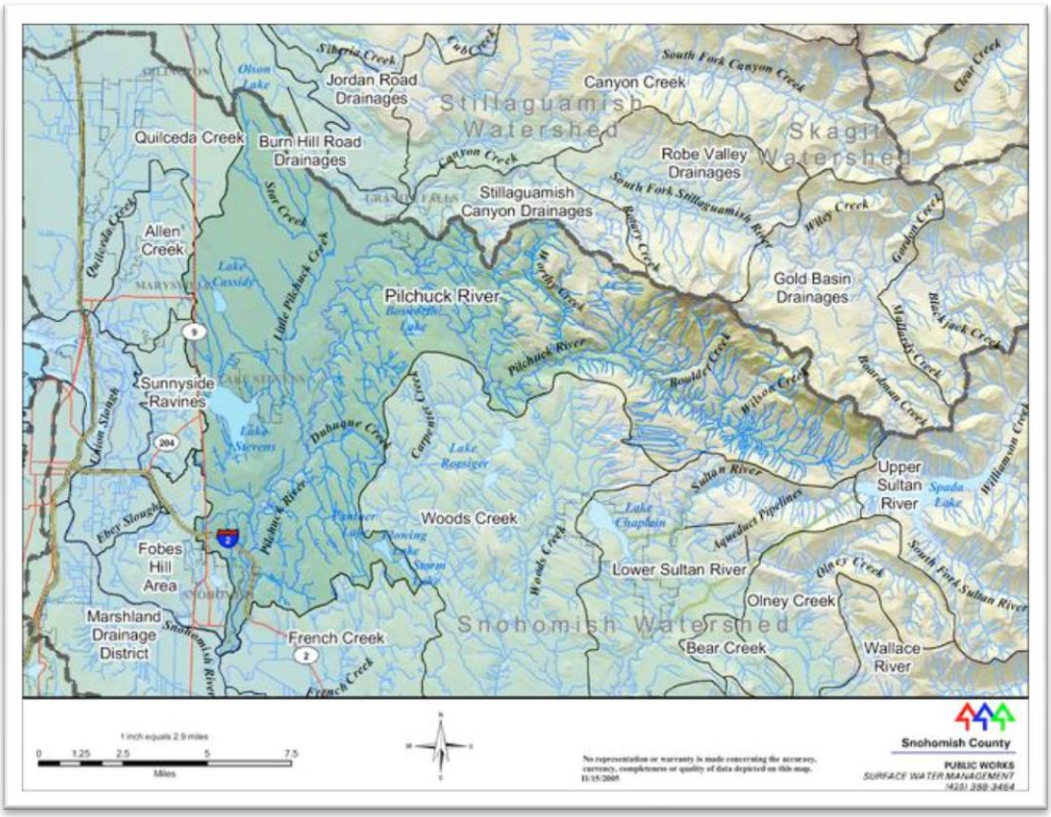


Figure 14. Pilchuck River Basin map: Current focus sub-basin for Tulalip Tribes' water flow assessment study

The Snohomish water assessment team is currently focusing on the Pilchuck River Subbasin as a potential pilot project. The team anticipates designating priority water storage sites in forested wetland regions. A variety of factors led the team to pursue a forested water storage pilot project, including the fact that forestland preservation incentives are underdeveloped in Washington, therefore the Legislature is encouraging watershed ecosystem service transactions that involve private forestlands. The Department of Natural Resources, in association with the Nisqually Tribe, the Tulalip Tribes, Snohomish County, and several other related decisionmakers, is in the process of developing a program where downstream landowners who are benefitting from ecosystem services such as storm water management pay a fee to the land owners upstream who are providing or enhancing such services (C. Partridge, personal communication, 9/15/2011). Beyond this, latest research shows that second- or third-growth timber stands, which are homogeneous, can be knocked down to add structure to the forest floor and reestablish habitat for species that were removed by clear-cutting. Such forestry practices would also replace associated storage features, including those involving beaver dams (A. Hook, personal communication, 9/15/2011). Forest soil water storage hydrates the surrounding ground and creates spring lines in downhill regions. "Once in the soil, water takes weeks, months, and even years to travel distances that would only takes days if flowing over the land. Plus, this water is fully protected from the sun's rays and evaporative forces" (Buckley 2010). Additionally, forest ecosystems can reduce sedimentation and land degradation, while also serving as effective water filtration and temporary buffering systems. The Snohomish

team has thus already begun approaching landowners in the region to volunteer a portion of their forested wetlands as test sites for measuring the functionality of such ecosystem services (ecosystem health) and water storage values. While individual landowners are beginning to take interest, others such as Weyerhauser, Hancock Timber, and Westcott Gravel, are proving to be more difficult to persuade.

This study serves as support for a Snohomish Basin-wide water storage assessment and implementation project that would be led by the Tulalip Tribes, and would involve work with partners such as the Surface Water Management Division at Snohomish County, the Ecological Economics Analysts at Earth Economics, NOAA, Department of Ecology, and regional interests. The Tulalip Tribes Natural Resources Division has exceeded in its capacity building to carry out a preliminary water storage assessment. It has already begun to highlight the optimal sites for water storage projects farther upstream in higher elevations. It makes more sense to harvest snowmelt glacial runoff upslope than further downstream in the Snohomish River Delta, because the slope can enable filtration into aquifers and water catchments, and because higher elevations ensure less contaminant from agricultural and urban activities.

Chapter 8. Conclusion & Recommendations

Water management partnerships have been increasingly adopted in Washington State as a way to optimize outcomes for all interests involved. While all citizens of a watershed should have equal claim to a seat at the table, there are several reasons why tribes play an especially crucial role in the collaborative decision-making process. Among the top of the list is the requirement for quality water for tribes to exercise their spiritual, cultural, political and economic rights to this resource. Indigenous nations' rights to resources in their "usual and accustomed" places have been recognized for over 150 years in Washington State, and have governed the relations between tribes and the U.S. government, since the 1974 Boldt Decision.

As a result of climate change, these natural resources face worsening degradation, which poses a major threat to local tribal communities and other watershed citizens. Most resource managers are aware that collaborative efforts take much work to implement and thus have not readily resorted to this method of management. Yet, in response to the mounting conflict of climate change (and various other pressing factors) resource managers have turned to collaborative watershed management as a long-term solution to local water resource conflicts.

The Boldt Decision represented a major step towards the self-determination Indigenous nations in Washington. It allowed Indigenous peoples to reclaim their treaty rights to the land and its resources, reassert their governing authority, and reconnect with traditions and place-based practices that date back many centuries. Indigenous forms of ecological knowledge have contributions to make to the mounting challenge of sustainable water use.

Indigenous leadership, or a high degree of Native participation in collaborative water management institutions, will bring benefits to the entire watershed via cross-cultural problem solving. A unique result of collaborative efforts that might not be found in other types of management regimes is the development of social capital, and the breaking down of barriers between tribes and surrounding communities that have historically been at odds.

This research identified the factors that encourage or discourage tribal participation in collaborative watershed management. I also addressed the role of Western and Native science (and associated power sharing dynamics) between the State and the tribes of Washington in collaborative watershed management. The general research objective was to highlight the dynamics of tribal involvement in collaborative management, and to provide support for enhancing watershed management practices. While the goals of this research are broad and require long-term commitment and continuing research, the discussions in which I was able to participate revealed that this research is significant. The topic is an agenda item for the Washington Department of Natural Resources, several tribes, Department of Ecology, city and county governments, and scientific researchers. And while participatory watershed partnership success is still not unanimously viewed as the answer to water resource degradation in an era of climate change, one variable that contributes to the success rate of such institutions is the leadership of Indigenous nations, particularly those with treaty rights. Indigenous peoples' interest in protecting water resources is key to their cultural survival and future ability to remain in their homelands, and thus, collaborative watershed protection is most successful

when led by Native American nations based in the watershed.

Emerging from this research is a series of recommendations for tribes, local communities, and agencies seeking to work collaboratively. The Nisqually watershed serves as a prime example of a successful tribally led collaborative habitat restoration project that is now referenced throughout the U.S. The Nisqually Delta restoration serves as a model of how varying spatial and temporal scales of knowledge are important to understand when developing adaptive resource management strategies. Observations made throughout the generations serve as the bases of traditional ecological knowledge, as a scientific understanding of local natural history, which has only recently been recognized by Western scientists as a valuable source of information for natural resource decision-making.

A one-sided approach to resource and ecosystem management exhibits the type of behavior that led to unequal power relationships on the land. Although partnerships are strengthening relationships among watershed residents, competing priorities remain to be a major challenge to Native/non-Native watershed collaborations. Until recently, the Skagit watershed collaboration management initiative has not seen as much success in its restoration efforts, which is a direct result of a historical lack of Swinomish tribal input. Tribal leadership of such collaborations alone might not ensure the type of success attained by the Nisqually Tribe.

As revealed in the case of the Tulalip Tribes and the Qualco Energy project, a common interest must be present, and it is helpful if the local tribe steps forward to initiate discussions to develop an optimal compromise and solution

to the issue. Through the Qualco Energy project, the Tulalip Tribes have developed partnerships that build social capital with communities in the Snohomish Basin. The success of the Qualco Energy project has led to the gradual establishment of regional confidence in Tulalip leadership for future collaborative resource management projects.

The Tulalip Natural Resources department employs a mix of Native and Western science practices. It has incorporated gravel corporations, dairy farms, and has even reintroduced beavers as helpers in hydrologic system restoration, in efforts to utilize commonly overlooked contributions to collaborative resource management. The Tulalip have been successful in these creative efforts and seek to expand to the broader region. Bridging scales and knowledge types will maximize the benefits of collaborative watershed projects. If designed with tribal input, overall knowledge will be greatly enhanced and understandings will advance more quickly than with tribes or scientists alone, acting separately in isolation from each other.

The Tulalip Tribes look at salmon as an indicator that also holds tribal cultural significance. All natural resources have cultural terms and values, which the Tulalip Tribes have strived to incorporate into their environmental efforts. After the Tulalip completed their climate impacts study, they were able to realize that changes in forest habitat (loss of trees, animals, soil, etc.) have been a major causal factor for negative effects on local vegetation, hydrology, wetlands, aquifers and the ecosystem's overall systematic hydrology. The Tribes have seen trends in river flows coming 2-3 months earlier than usual, causing the river flow to be out of sync with fish reproduction cycles. Damage from

springtime floods and summertime low flows counteract the Tribes' salmon recovery goals. They thus have been looking at their watershed's hydrology and designing scientifically, politically, and economically sound projects that will regulate the flow of the river over time. By storing water, watershed collaborators can prevent harmful spring flooding and release water for salmon to survive dry summers. Projects that rehydrate the landscape mimic the essential role that beaver performed for several centuries.

Although current landowners have begun to join the Tribes in their efforts, they have tended to deal with only small pieces of the problem at a time. In order to be truly effective, restoration efforts need to be implemented on a larger scale, which requires larger grants, more corporate partners with larger land holdings, and legal allowance to exercise the Tribes' treaty-based authority and extend projects into upland zones, regardless of county boundaries. This research reveals that the Tulalips' past successes, knowledge of the local ecosystems, vested interest in the health of the watershed, understanding of the urgency related to climate change, legal power through treaties, and inspiring leadership in a myriad of natural resource issues, make them ideally positioned to fill the role of recognized leaders of successful water management in the Snohomish River Basin.

Works Cited

Adams, Bill, Dan Brockington, Jane Dyson, and Bhaskar Vira. (2002). *Common Pool Resource Policy Paper*. Department of Geography. Cambridge, U.K.: University of Cambridge.

Aerts, Jeroen. C. J. H., and Peter Droogers. (2004). *Climate Change in Contrasting River Basins: Adaptation Strategies for Water, Food, and Environment*. Cambridge, Mass.: CABI Publishing.

Armitage, Derek R., Fikret Berkes, and Nancy Doubleday. (2007). *Adaptive Co-management: Collaboration, Learning and Multi-level Governance*. Vancouver, B.C.: University of British Columbia Press.

Azelzadeh, Mary, Todd Bryan, and Steven Yaffee. (2003). *Tribal Issues and Considerations Related to Collaborative Natural Resource Management.* Ann Arbor, Mich.: Ecosystem Management Initiative, School of Natural Resources and Environment.

Barlow, Maude. (2009). *Our Water Commons: Toward a New Freshwater Narrative*. The Council of Canadians. Retrieved on 9 Feb 2011, from <http://www.canadians.org/water/publications/water%20commons/.

Batker, David, et al. (2009). *The Natural Economy of the Nisqually Watershed.* Tacoma, Wash.: Earth Economics.

Batker, David. (2010). *Snohomish Carbonfinity Workshop*. Unpublished scope, Earth Economics, Tulalip Tribes, Wash.

Batker, David. et al. (2010). *The Whole Economy of the Snohomish Basin: The Essential Economics of Ecosystem Services*. Earth Economics, Snohomish County, Everett, Wash.

Berkes, Fikret. (2008). *Sacred Ecology*. 2nd. New York: Routledge.

Berkes, Fikret, Johan Colding, and Carl Folke. (2000). Rediscovery of Traditional Ecological Knowledge as Adaptive Management. *Ecological Applications.* 10 (5): 1251-1262.

Biomimicry Institute. (2011). "About Us." Retrieved on 14 August 2011, from http://www.biomimicryinstitute.org/about-us/

Brick, Phillip, Donald Snow, and Sarah Van De Wetering. (2001). *Across the Great Divide: Explorations in Collaborative Conservation and the American West*. Washington, D.C.: Island Press.

Broderick, Kathleen. (2005). Communities in Catchments: Implications for Natural Resource Management. *Geographical Research, 43* (3), 286-296.

Brodie, Nelsa, and Seth Preston. (2006). *Impacts of Climate Change on Washington's Economy*. Washington State Department of Ecology, Olympia, Wash.: Department of Ecology.

Brower, Andrea. (2006). Keep it Local Ahupua'a Management: Lessons for Today*. The Garden Island.* Retrieved on 22 Feb 2009, from http://thegardenisland.com/business/local/article_4abba0d6-1b58-5ccf-8fce-656873493cc1.html

Buckley, Adrian. (2010, April 30). "Water Harvesting and Storage." Retrieved on 27 July 2011, from http://www.bigskypermaculture.ca/node/64.

Bushnell, Jill. (2006). *Local Indigenous Responses*. In *Climate Change and Pacific Rim Indigenous Nations* (pp. 63-70). Olympia, Wash.: Northwest Indian Applied Research Institute (NIARI).

Bylin, Ann. (2011). The Groundwater Management Program. Retrieved on 19 July 2011, from http://www1.co.snohomish.wa.us/Departments/Public_Works/Divisions/SWM/Work_Areas/Water_Quality/Groundwater/.

Careless, James. (2009, September). Finding Common Ground. *Manure Manager.* Retrieved on 10 May 2011, from http://www.manuremanager.com/content/view/2558/38/.

Climate Impacts Group. (2008, March). Retrieved on 24 June 2011, from http://cses.washington.edu/cig/pnwc/cc.shtml.

Climate Impacts Group. (2011). *Modeling Climate Change and Land Use Impacts on Salmon Recovery in the Snohomish River Basin*. Retrieved on 3 August 2011, from http://cses.washington.edu/cig/res/ae/snohomish.shtml.

"Constitution of the United States," Article 6, Section 2.

Cronin, Amanda E. (2005). *Tribal Participation in Collaborative Watershed Management: A Comparison Between the Desert Southwest and the Pacific Northwest*. MS Thesis. Flagstaff, Ariz.: Northern Arizona University.

Day, Richard J. F. (2005). *Gramsci is Dead: Anarchist Currents in the Newest Social Movements*. Toronto: Pluto Press.

Donoghue, Ellen M., and Sara Thompson. (2003). Characterizing Tribal - Federal Collaborative Resource Management*. Community-Based Collaborative Research Consortium.* Charlottesville, Va.

Earth Economics. (2009). *Tribal Rights and the Natural Economy of the Nisqually Watershed*. Retrieved on 12 September 2011, from http://www.eartheconomics.org/Page123.aspx

Fischer, Frank. (2000). *Citizens, Experts, and the Environment: the Politics of Local Knowledge*. Durham, N.C.: Duke University Press.

Foster, Sheila. (2002). Environmental Justice in an Era of Devolved Collaboration. *Harvard Environmental Law Review.* (26).

Gagnon, Alain-Gustave. (2009). *Contemporary Canadian Federalism: Foundations, Traditions, Institutions*. Toronto: University of Toronto Press.

Grossman, Zoltan. (2005). Unlikely Alliances: Treaty Conflicts and Environmental Cooperation Between Native American and Rural White Communities. *American Indian Culture and Research Journal*. 29 (4): 21-43.

Hardin, Garrett. (1968, Dec 13). The Tragedy of the Commons. *Science Magazine,* 162 (3859): 1243-1248.

Hunn, Eugene S. et al. (2005). *Huna Tlingit Gull Egg Harvests in Glacier Bay National Park*. In J. Sepez and H. Lazrus (Eds.), *Traditional Environmental Knowledge in Federal Resource Management Agencies*. Oklahoma City, Okla.: Practicing Anthropology: pp. 6-10.

Inglis, Julian T. (1993). *Traditional Ecological Knowledge: Concepts and Cases*. Ottawa, Canada: International Development Research Centre.

Intergovernmental Panel on Climate Change. (2007). Retrieved on 16 May 2011, from http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html.

Jansen, Eystein, Jonathan Overpeck, Keith R. Briffa, Jean-Claude Duplessy, Fortunat Joos, et al. (2007). Palaeoclimate. In, *Climate Change 2007: The Physical Science Basis.* Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, U. K. and New York.

Johnson, Jay T. (2011, April 14). *Being-in-Place Together: Is there Room for the Settler in Anarcho-Indigenism?* Affinity and Geography Conference Presentation. Association of American Geographers Meeting. *Seattle, Wash.*

Kincade, Marvin D. (1990). *The Swinomish Tribe*. Retrieved on 22 May 2011, from http://www.fourdir.com/swinomish.htm

Klosterman, Renee, and Laural Ballew. (2006). *Potential Paths for Native Nations.* In, *Climate Change and Pacific Rim Indigenous Nations* (pp. 63-70). Olympia, Wash.: Northwest Indian Applied Research Institute (NIARI).

Kunzler, Larry. (2005). *History of Skagit River*. Retrieved on 2 September 2011, from http://www.skagitriverhistory.com/

Luce, Charles H., and Zachary A. Holden. (2009). Declining Annual Streamflow Distributions in the Pacific Northwest United States, 1948–2006. *Geophysical Research Letters*, *36* (10).

Marr, Andrew E. (2010). *Snowmelt Hydrology of Mt. Rainier Rivers: Implications for Future Water Resources Management*. MES Thesis. The Evergreen State College. Olympia, Wash.

McCarthy, James J. (2001). *Climate Change 2001: Impacts, Adaptation, and Vulnerability.* Contribution of Working Group II to the third Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, U.K. and New York.

McCartney, Matthew, and Vladimir Smakhtin. (2010). International Water Management Institute. *Water Storage in an Era of Climate Change: Addressing the Challenge of Increasing Rainfall Variability*. Battaramulla, Sri Lanka: IWMI.

McCloud, Sheila. (2011, Spring). Tulalip Looks Closer at Climate Change. Northwest Indian Fisheries Commission, *NWIFC News*. Olympia, Wash.

Menzies, Charles R. (2006). *Traditional Ecological Knowledge and Natural Resource Management*. Vancouver: University of British Columbia Press.

Mihelcic, James R., Julie B. Zimmerman, and Anu Ramaswani. (2007). Integrating Developed and Developing World Knowledge into Global Discussions and Strategies for Sustainability. *Environmental Science and Technology.* 41(10): 3415-3421.

Mote, Phillip W., Alan F. Hamlet, and Eric Salathe. (2008). Has Spring Snowpack Declined in the Washington Cascades? *Hydrologic and Earth Systems Science*. 12: 193-206.

Muller-Schwarze, Dietland and Lixing Sun. (2003). *The Beaver: Natural History of a Wetlands Engineer*. Ithaca, N.Y.: Comstock Publishing Associates.

Nisqually Delta Restoration. (2011). "About the Project." Retrieved on 8 January 2011, from http://nisquallydeltarestoration.org/.

Nisqually River Council. (2011). *Nisqually Watershed Stewardship Plan*. Retrieved on 10 January 2011, from http://nisquallyriver.org/who-we-are/the-nisqually-river-management-plan/

Northwest Power and Conservation Council. (2011). *Dams: Impacts on Salmon and Steelhead*. Retrieved on 18 September 2011, from http://www.nwcouncil.org/history/DamsImpacts.asp

O'Haracohara, Charles. (2000). Swinomish Cooperative Land Use Program. *The Harvard Project of American Indian Economic Development*, Cambridge, Mass.

Ostrom, Elinor. (2001). *Protecting the Commons: A Framework for Resource Management in the Americas*. Washington, D.C.: Island Press.

Papiez, Chelsie. (2009). *Climate Change Implications for the Quileute and Hoh Tribes of Washington: A Multidisciplinary Approach to Assessing Climatic Disruptions to Coastal Indigenous Communities*. MES Thesis. The Evergreen State College, Olympia, Wash.

Parker, Alan et al. (2006). *Climate Change and Pacific Rim Indigenous Nations* Olympia, Wash.: Northwest Indian Applied Research Institute (NIARI).

Parry, Martin et al. (2007). *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the third Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, U.K. and New York.

Partridge, Craig. (May 15, 2011). "Criteria for assessing collaborative potential in wicked policy problems." Environmental Policy Class Lecture. The Evergreen State College, Olympia, Wash. In Person.

Paulson, Melissa N. (2007). *Collaborative Watershed Management: Stakeholder Participation and Watershed Partnership Success*. MES Thesis. The Evergreen State College. Olympia, Wash.

Pollock, Michael M., George Press, Timothy J. Beechie, and David R. Montgomery. (2004). The Importance of Beaver Ponds to Coho Salmon Production in the Stillaguamish River Basin, Washington, USA. *North American Journal of Fisheries Management*, 24:749-760.

Qualco Energy Corporation. (2010). Qualco Energy. Retrieved on 5 April 2011, from http://www.qualcoenergy.com/qualcoenergy.htm.

Riedlinger, Dyanna. (2000). *Inuvialuit Knowledge of Climate Change*. In, *Pushing the Margins: Native and Northern Studies*, J. Oakes, *et al.*, eds. 346-355. Winnipeg: Native Studies Press, University of Manitoba.

Rollins, Dora M. and William A. Warren. (2004). *Indians, Non-Indians, and Collaboration: An Issue of Fairness and Status.* Posted on The Center for Community-Based Collaborative Research Consortium. Accessed by Cronin on May 03, 2004, at http://www.cbcrc.org/phpbin/news/showArticle.php.

Rowe, Jonathan. (2011, June 30). The Hidden Commons. *Yes!* Retrieved from 30 September 2011, from <http://www.yesmagazine.org/issues/reclaiming- the-commons/the-hidden-commons>.

Sabatier, Paul A., Will Focht, Mark Lubell, Zev Trachtenberb, Arnold Vedlitz and Marty Matlock, eds. (2005). *Swimming Upstream: Collaborative Approaches to Watershed Management*. Cambridge: MIT Press.

Samenow, Jason. (2011, April 22). *Climate Change Indicators in the United States*. Retrieved on 16 August 2011, from http://epa.gov/climatechange/indicators.html.

Shared Salmon Strategy. (2011). *Watershed Profile: Salmon and the Skagit Watershed*. Retrieved on 27 August 2011, from http://www.sharedsalmonstrategy.org/watersheds/watershed-skagit.htm.

Skagit Watershed Council. (2006). Skagit Basin Three-Year Workplan. Mount Vernon, Wash.

Sky Valley 101. (2008, October). Flood Information You Need to Know. *Sky Valley Chronicle*, Retrieved on 4 September 2011, from http://www.skyvalleychronicle.com/SKY- VALLEY-101/FLOOD-INFORMATION-YOU-NEED-TO-KNOW-488

Smith, Claire, and Hans M. Wobst. (2005). *Indigenous Archaeologies: Decolonizing Theory and Practice*. New York: Routledge.

Snohomish County. (2011). *Surface Water Management Division Snohomish River Salmon Recovery*. Retrieved on 11 September 2011, from http://www1.co.snohomish.wa.us/Departments/Public_Works/Division\s/SWM/Work_Areas/Habitat/Salmon/Snohomish/default.htm.

Snohomish County Surface Water Management. (2011). Surface Water Management Division. *The Four Flood Phases*. Retrieved on 10 September 2011, from http://www1.co.snohomish.wa.us/Departments/Public Works/Divisions/SWM/Services/River_Flooding/The_Four_Flood_Phases.htm

Snohomish Times. Record flooding is being predicted! (2009, January 6). *Snohomish Times*. Retrieved on 8 July 2011, from http://www.snohomishtimes.com/snohomishnews.cfm?inc=story&news

Snow, Lester A. (2008). California Resources Agency, Department of Water Resources. *Managing an Uncertain Future: Climate Change Adaptation Strategies for California's Water*. Sacramento, Calif.: California Department of Water Resources.

Stewart, Iris T., Daniel R. Cayan, and Michael D. Dettinger. (2005). Changes Toward Earlier Streamflow Timing Across Western North America. *J. Climate,* 18**,** 1136–1155.

Swinomish Climate Change Initiative. (2009). *Impact Assessment Technical Report*. Retrieved on 6 August 2011, from http://www.swinomish.nsn.gov/climate_change/project/project.html

Swinomish Indian Tribal Community (SITC). (1987). *Memorandum of Understanding for Establishing a Coordinated Tribal/County Regional Planning Program*. Retrieved on 17 August 2011, from http://modelpolicies.thepraxisproject.org/node/77.

Swinomish Indian Tribal Community (SITC). (2010). *Swinomish Climate Change Initiative Climate Adaptation Action Plan*. La Conner, Wash.: Swinomish Office of Planning and Community Development.

Tulalip Tribes. (2011). "Tulalip Tribes." Retrieved on 10 January 2011, from http://www.tulaliptribes-nsn.gov/

US Geological Survey. (2009, January 13). *Latest Summary of Flooding in Western Washington*. Retrieved on 3 August 2011, from http://wa.water.usgs.gov/news/flood/summary/

Waage, Sissel A. (2001). (Re)Claiming Space and Place Through Collaborative Planning in Rural Oregon. *Political Geography* (20).

Warner, Jeroen. (2007). *Multi-stakeholder Platforms for Integrated Water Management*, Hampshire, U.K.: Ashgate Publishing Co.

Warren, Henry C. (1982). *Olympic: The Story Behind the Scenery*. Wickenberg, Ariz.: KC Publications Inc.

Washington State Department of Ecology. (1998). Watershed Planning: Indian Tribes. *Role in Local Watershed Planning (ESHB 2514)*. Olympia, Wash.: Washington Department of Ecology. Retrieved on 19 April 2011, from http://www.ecy.wa.gov/watershed/misc/indian_tribes.htm.

Wheeler, Polly and Amy Craver. (2005). *Office of Subsistence Management and Issues and Challenges of Integrating TEK into Subsistence Fisheries Management.* In J. Sepez and H. Lazrus (Eds.), *Traditional Environmental Knowledge in Federal Resource Management Agencies.* Oklahoma City, Okla. *Practicing Anthropology.* (15-20).

Williams, Daryl. (2011, April 26). Qualco Energy Corporation. *Bio-Gas Cooperative Information*. Qualco Energy. Retrieved on 26 April 2011, from <http://www.qualcoenergy.com/>.

Williams, Terry, and Preston Hardison. (2006). *Impacts on Indigenous Peoples.* In, *Climate Change and Pacific Rim Indigenous Nations* (p. 19-28). Olympia, Wash.: Northwest Indian Applied Research Institute (NIARI).

Wilkinson, Charles F. (1992). *Crossing the Next Meridian: Land, Water, and the Future of the West*. Washington, D.C.: Island Press.

Wilkinson, Charles F. (2000). *Messages from Frank's Landing*. Seattle, Wash.: University of Washington Press.

Wright, Robert J., Randall Coots, and Robert F. Cusimano. (2001). *Snohomish River Tributaries Fecal Coliform Total Maximum Daily Load*. Washington State Department of Ecology. Olympia, Wash.

Yandle, Tracey. (2006). Sharing Natural Resource Management Responsibility: Examining the New Zealand Rock Lobster Co-management Experience. *Political Science*. 39:249-278.