



Climate Adaptation Plan for the Territories of the Yakama Nation

APRIL 2016



Climate Adaptation Plan for the Territories of the Yakama Nation Version 1

The Yakama Nation acknowledges and greatly appreciates support from the following partners in preparation of this Climate Adaptation Plan.

Cascadia Consulting Group

SAH Ecologia LLC

University of Washington Climate Impacts Group



Courtesy of Shyanne Pinkham

Dedication to our Children

Our Yakama People came after everything the Creator made, as we know it - the earth, water, foods, medicines, trees, and plants.

He made the animals and gave them their place here.

From that time on, we knew where these blessings came from and we gave thanks to the Creator for all of nature and the elements that took care of them - the rain, snow, sun, moon, stars, wind, and earth!

It is this belief, prayer, and following of our sacred ceremonies that have created a close relationship with these things, and they tell us when things are not right – not of this earth or the elements, but us as humans!

This Climate Adaptation Plan is dedicated to you - our children - and to your children, and to all generations of Yakama to follow. Our elders, leaders, and staff have gathered this information and present it here today. We hope this knowledge will help our people understand what it will mean to be subject to climate change.

Using this knowledge, we must begin preparations to maintain our community and our natural resources. We must carry forward our culture and traditions for our tribes' future and for your own families' well-being.

For many generations, you will be challenged with a changing climate. But always remember, since time immemorial, we have looked to our elders for their wisdom and guidance, and within our children we will always see hope.

“Shxmyah” a.k.a. Edwin “Arlen” Washines Yakama

Table of Contents

Tribal Chairman’s Proclamation	1
Executive Summary	2
Introduction and Background	3
Overview of Potential Climate Change Impacts	9
Community Resources	11
Health and Public Safety	13
Tribal Infrastructure	15
Lands and Agriculture	17
Environmental Resources	20
Forestry	20
Water and Wetlands	24
Fisheries	28
Shrub-Steppe and Rangelands	31
Wildlife and Vegetation	34
Toxics	38
Appendix 1: Key Terms	40
Appendix 2: References	42
Notes	44

Tribal Chairman's Proclamation



Courtesy of Yakama Nation staff

Our climate is changing. The effects of climate change are being noticed by our own people. These changes, coupled with the rapid growth of cities throughout our homelands; dams across our rivers; and unsustainable forestry, rangeland, and agricultural practices have drastically altered our traditional way of life, our foods, and many aspects of our heritage and culture. From the vast information now available concerning climate change, we understand that its impacts on our natural resources will continue and that our grandchildren will likely see profound and ever-increasing changes within their lifetimes.

The issues in front of us are not unique to just the Yakama Nation, but can be seen across all Indian nations. Although we find ourselves at a tipping point, it is not a time to decry our losses and bemoan our future. We will work with other tribes, and we will learn together. We must learn how to adapt, as we have done for many thousands of years on these lands which have always been our home.

We cannot know and anticipate at this time all changes to come—but we can start. Contained within these pages is the Yakama Nation Climate Adaptation Plan. This Plan provides a strong foundation for our next steps and sets them into motion. This Plan is more than just words and pictures. It describes much of our understanding of potential climate change impacts and establishes preliminary recommendations for our tribal programs to consider and evaluate and for our tribal leadership to act upon appropriately.

The Yakama Nation Tribal Council directs all of our community and natural resource programs to carefully assess the vulnerabilities and risks identified in this Climate Adaptation Plan over the next year. In many cases, these considerations will go beyond our reservation lands and necessitate an evaluation of resources throughout the territories of the Yakama Nation. We also direct our programs to prepare and present recommendations for addressing the vulnerabilities and risks—actions that will rebuild resilience and durability within these resources for generations to come. These assessments and recommendations are not intended to be comprehensive, but they represent a substantial beginning on a long path forward.

The Yakama Nation is strong, and our strength is growing. By continuing to blend our traditional knowledge with newer innovations, and by reshaping our long-established tribal community and natural resource programs, the Yakama Nation will continue to thrive amidst an ever-changing world.





Courtesy of Yakama Nation staff

Executive Summary

The Confederated Tribes and Bands of the Yakama Nation are a diverse people from many areas. We are the Kah-miltpah, Oche-Chotes, Palouse, Wenatchapam, Klickitat, Pesquose, See-ap-Cat, Yakama, Klinquit, Shyiks, SK'in-pah, Kow-was-say-ee, Li-ay-was, and Wish-ham. Our tribes are strong and resilient people. We have lived on these lands for countless generations, from time immemorial. We will continue to flourish on our homelands for countless generations to come.

This document is an acknowledgment that climate change is real and that it poses a threat to our grandchildren, our culture, and our way of living. This document represents the first collective effort by our many governmental departments and programs to identify (1) important resources and cultural components most likely to be impacted by climate change, (2) work we are currently undertaking that recognizes and will help to reduce climate change impacts, and (3) specific recommendations for deeper analyses of vulnerabilities and risks to our most important interests and adaptation actions that we should implement now.

This Plan has four sections:

1, the Introduction and Background, is a brief overview of our history. It provides a perspective on our relationship with the land and the diverse resources that the land has always provided to our people. It reaffirms that our territories—where we have hunted, fished, and gathered our foods and medicines—are essential to us and always will be. This section also summarizes the Yakama Nation climate adaptation planning process, which was used to obtain much of the technical information found within this document. Section 1 concludes by emphasizing that our work now, and for many generations, will never be complete – but will be a continuing cycle.

2, Summary of Climate Change Drivers and Potential Impacts, provides a technical backdrop of climate change and expected regional impacts. Most importantly, we expect that both summer and winter temperatures will continue to increase and snowpack in the mountains will diminish. We have observed that many of these changes are already being realized today.

3, Community Resources, focuses primarily within the reservation lands of the Yakama Nation, outlining specific concerns and potential impacts on four general areas: a) cultural heritage, b) human health and public safety, c) tribal infrastructure, and d) lands and agriculture. In particular, we describe many issues related to excessive heat in the summer and moderated temperatures through the winter months. Our planning must consider the need to add capacity to our emergency management, infrastructure, and health systems. We must also look towards new technologies and efficiencies in the management of our tribal water and lands, particularly in our agricultural sector.

4, Environmental Resources, provides a broad view of the landscape addressing issues and recommendations associated with forestry, rangelands, water, fisheries, wildlife and vegetation resources, and the toxic materials found throughout our ceded lands and our usual and accustomed places to hunt, fish, and gather our foods and medicines. Throughout each of these sectors we note many potential issues that cross multiple jurisdictional lines. Most of these issues will require increased and persistent local, state, federal, and tribal collaboration and coordination. All of these issues will call for innovation and increased resources.





Courtesy of Yakama Nation staff

1 Introduction and Background

Since time immemorial, the people of the Confederated Tribes and Bands of the Yakama Nation have lived on these lands and cared for the natural resources we share. Our

ancestors' spirits live on and guide us. They live through our traditions and our religion, which have been handed down from one generation to the next. Our traditional knowledge and cultural practices reflect the natural cycles of our earth and reaffirm what we have learned from long-past elders.

Climate change is real and, unfortunately, the effects appear to be in motion. We are witnessing changes in the seasons. Our roots and berries must be gathered sooner, and salmon returns are less predictable. Our people notice less snow in the mountains now, and there is less cool water during the summer when it was once abundant. The changes we see may not bode well for our future. Over the years to come, we may lose natural resources that are important to our culture and our heritage. Some of these losses may be irreversible.

The purpose of this document is to begin the conversation about climate change and planning for adaptation throughout all of the territories of the Yakama Nation.

It is derived from the experience of our people, our tribal programs, and findings from regional experts on these important topics. This document is one way we can educate ourselves about current vulnerabilities and future risks and share ideas about actions that we may need to take to build climate resilience. It is a living document that will be revisited and adjusted over time to reflect new information, new understandings, and new priorities.

"Climate change affects our everyday life, because we are connected to all of these natural resources. What affects them affects us."

Workshop Participant

This document is an important step for the Yakama Nation. It is a step in helping us prepare for an uncertain future where a rapidly changing climate will disrupt long-held traditional cycles. It represents the beginning of a continued and meaningful conversation between tribal leadership, tribal programs, and tribal members. Our people must consider these questions:

1. How is climate change affecting our lives and well-being?
2. How might climate change affect generations to come?
3. What can the Yakama Nation do now to prepare for and adapt to these changes?

With this document, we begin to think about, develop, and enact solutions to address climate change impacts on our communities and our homelands.



OVERARCHING GOALS

There is much to be done. Our work must be guided by clearly stated and achievable goals. Our goals, listed below, call on all tribal members and our leadership to educate themselves and to act. Our future is embedded within the lands and waters of our territories.

- Tribal members will be educated on the present and future effects of climate change on our homeland and will continue to be engaged in our progress to adapt to these new challenges.
- Tribal youth will be involved in cultural education, and learn how to help the Yakama Nation adapt to climate change impacts.
- The Yakama Nation will remain actively involved as a sovereign government in national and international climate change discussions and negotiations and continue to pressure national governments to reduce emissions.
- The Yakama Nation will continue to work with other indigenous nations to protect treaty rights in the context of a changing climate.
- The Yakama Nation will be prepared for impacts on culturally significant plant and animal species throughout the territories of the Yakama Nation.
- The Yakama Nation will protect, enhance, and secure sources of fresh water now to meet the future needs of our tribal communities and economies.
- The Yakama Nation will continue to develop and strengthen relationships with neighboring governments and communities regarding the protection and restoration of our resources. Collaborative actions may include long-term land use planning and continued improvements in emergency management for future extreme weather events.
- The Yakama Nation will develop and implement strategies to unite tribes and communities around long-term resource utilization, habitat protection, and resource restoration in order to increase climate resilience while maintaining a strong economic base.
- The Yakama Nation will protect, enhance, and secure a future source of culturally important foods and medicines as well as long-term production and storage capabilities for important climate-resilient crops.
- The Yakama Nation will continue to develop and strengthen alliances with local and regional governments to build renewable energy capacity and thereby contribute to climate change mitigation efforts.

The impacts of climate change are being noticed by our people today, and our grandchildren will likely see profound effects upon our communities and our way of life. We cannot know and anticipate all changes at this time, but we can prepare. Together we must look ahead and blend our traditional knowledge and cultural insights with newer innovations to create a future where the Yakama Nation will continue to thrive despite the changing climate.



*All this for future generations yet unborn
according to teachings by our elders*

OUR HISTORY

For generations before the rise of the modern world, the lands of the Yakama extended in all directions. We used the entire land base, from the lowlands around the Columbia River to the snow-peaked Cascade Mountains. We held our land as a trust given by the Creator for the use of the living and as a heritage to be held and protected for unborn generations.

The Yakama people spent the coldest months in winter villages generally located on the valley floor, a place with a relatively moderate climate. This area provided a reliable source of wood and water, and protection from cold winds. Villages were located on or near waterways, in places where a variety of resources could be obtained, including deer, elk, fish, and riparian and desert plants.

In the springtime, as soon as the first edible greens appeared above the ground, tribal people began moving across the countryside in search of fresh food resources. The people followed the melting snows upland and collected edible roots as they matured. Some tribal people would go to the rivers to fish. Others would remain in the mountains, following the maturing plants upslope, until the huckleberry harvest in the fall. At that time, foods would be either stored or transported back to the winter village from both the mountains and the rivers, and people would settle in, once more living on stored foods and occasional fresh meat until the following spring.

Today, the reservation lands of the Yakama Nation are located within the Yakima River basin. The territories of the Yakama Nation—which consist of lands ceded by the Yakama Nation and all of the usual and accustomed areas where we fish, hunt, and gather foods and our medicines—extend beyond the reservation boundaries. The territories are all interconnected by Nch’i-Wana, the Big River. Upriver, to the north, are the Methow, the Entiat, and the Wenatchee basins which drain the east slopes of the northern Cascade Mountains. Lower portions of Crab Creek and the Snake River come in from the east. The territories continue downstream to Rock Creek, the Klickitat River, and the White Salmon, Little White Salmon, and Wind Rivers and then extend to the Washougal, Lewis, and Cowlitz basins. Although much of the focus of this initial Climate Adaptation Plan is on the Yakima River basin and our reserved lands, the whole of the territories are contained within this document and within our long-term vision, as they are all important to the welfare of our people.

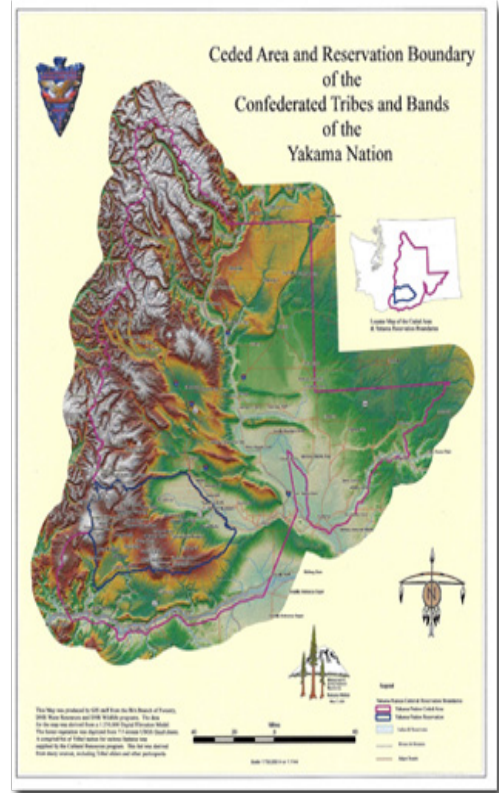


Figure 1. Ceded Area and Reservation Boundary



DESCRIPTION OF OUR ADAPTATION PLANNING PROCESS

We recognize that the efforts of the Yakama Nation alone—or any one entity alone—will not be enough to address the challenges of climate change. Ultimately, it will require a concerted, collaborative effort between tribal, local, state, and federal governments. Our planning approach rests upon this central idea.

We also recognize that many of our tribal programs have already begun considering aspects of climate change as part of program planning and implementation. Our planning process not only considered newly available research and data, but also consolidated and highlighted these existing efforts.

Perhaps most importantly, our approach emphasizes the engagement of tribal members and our tribal natural and community resource programs. Priorities and recommended actions come from all of these involved members and staff. The Yakama Nation leadership will use these inputs to consider and adopt both short-term actions and longer-term strategies and direct tribal programs to lead implementation. The diagram in Figure 2 below summarizes the management structure for our climate adaptation planning process and highlights the importance of engaging program staff from across a wide range of tribal departments.

In this first year, seven technical workshops and planning workshops were held between May and September of 2015, which program managers from all departments were encouraged to attend. A list of the seven workshop topics is provided in Table 1. The technical workshops provided the basis for understanding climate science, climate change projections, and some of the anticipated impacts on key resources and habitats in our region. The planning workshops enabled participants to brainstorm and discuss potential adaptation measures. Additional input was solicited through interviews, and departments also provided feedback on drafts of this plan.

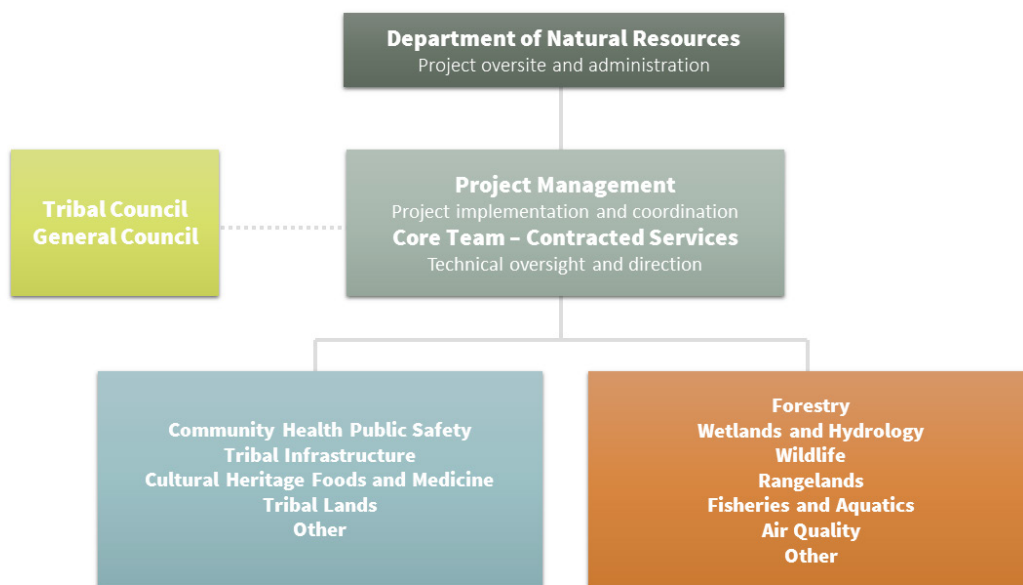


Figure 2. Management structure for the Yakama Nation climate adaptation planning process



Table 1. 2015 workshop topics

Technical workshop topics	Planning workshop topics
Climate Change Impacts on Vegetation Management, Forestry, and Fire Risk (June 16)	Tribal Leadership and Engagement: Planning for Adaptation (May 27)
Climate Change Impacts on Wildlife and Shrub Steppe (June 17)	Consequences and Building Resilience (July 22)
Wetlands, Water and Fish (July 8)	Adaptation Actions to be Considered (August 13)
	Screening potential adaptation strategies (September 24)

Finally, our approach takes a long-term view and follows a three-phase process. Together, the three phases aim to cultivate a comprehensive vision, directing the capacity and sustained coordination from within the Yakama Nation towards continued development and implementation of necessary actions to address climate change over the next seven generations. This initial Climate Adaptation Plan is the outcome of the first phase.

In 2016 and 2017, Yakama Nation staff will carry out the second phase, which will involve working with tribal, local, and regional experts to develop a more detailed assessment of vulnerabilities and risks for resources that are particularly important to the tribal community. The third phase will focus on implementing adaptation actions that are prioritized in Phases 1 and 2.

It is important for all to realize that the work we have identified in this first Climate Adaptation Plan is not complete. However, we have started this important process, which will now become a significant part of the Yakama Nation’s work over many generations to come. Every few years, we will revisit our progress, gather new information, and identify additional actions. Thus, over time, we will continue to strengthen our climate resilience and maintain a link between our cultural past and our tribe’s future.

All climate change scenarios show a continued decline in snowpack in the mountains. This could be in the range of a 29 percent decrease in snowpack in the Cascades by the 2020s and a 44 percent decrease by the 2040s, compared to what we experienced in the last century (using a medium greenhouse gas emissions scenario) [7].

Rising temperatures and changing precipitation patterns will also increase wildfire risk. The area likely to burn in the Columbia River Basin is projected to double by the 2020s, triple by the 2040s, and increase by a factor of five by the 2080s, compared to the median observed between 1916 and 2006 [8].



We know there are many existing pressures that are affecting the Yakama Nation's natural resources. Livestock, wild horses, and invasive plant species like cheatgrass, medusahead, and yellow starthistle are already having adverse impacts on the rangelands. The Hanford nuclear site and agribusiness runoff are affecting water quality in streams and rivers. Irrigation and lawn watering systems are putting heavy demand on available water. Fish passage has been hindered in places by dams and culverts. Climate change adds another stress on top of these current pressures.

The remainder of this report describes some of the expected impacts of these changes on the community and natural resources important to the Yakama Nation. Impacts include increased stress for salmon, affecting juvenile survival and migration to spawning grounds; changes in the area of suitable habitat available for a variety of wildlife and plant species; increased water scarcity; issues concerning air quality and community health; and the potential for service disruptions and damage to Tribal infrastructure. We also provide recommendations for future analysis and actions to help build our resilience in the face of these ongoing and emerging risks.



Courtesy of Yakama Nation staff

2 Overview of Potential Climate Change Impacts



Courtesy of Yakama Nation staff

The climate is changing in the Pacific Northwest. The average annual temperature increased by 1.3 °F between 1895 and 2011 [1]. We have seen changes in the mountains; over the last century, nearly all of the glaciers in Washington State have retreated. Agricultural conditions have changed as well. The number of frost-free days has increased by more than a month, on average, and the growing season has lengthened accordingly [1]. We are seeing changes in our rivers and streams. Peak streamflows are coming earlier in the year than they used to in many locations, and late summer streamflows are declining. These changes are consistent with what we expect to see based on regional projections of climate change, although natural variability also continues to play an important role in what we experience from year to year.

In 2015, the city of Yakima had the warmest June on record, and the Columbia River was the warmest it has been since 1950 [2]. Approximately one-quarter of a million salmon died, reportedly because of warm water and resulting diseases [3]. Wildfires brought “unhealthy” and “very unhealthy” air quality conditions to the communities of Toppenish, White Swan, and Yakima [4]. While the high temperatures and drought that we experienced in 2015 cannot be fully attributed to climate change, given the aforementioned role of natural variability and the influence of El Niño, recent experiences give us a picture of what we are likely to experience more often in the future as the climate continues to change.

FUTURE CHANGES

There are a number of scenarios that scientists use to project what might happen as a result of climate change. The scenarios make different assumptions about future greenhouse gas emissions. However, all of those scenarios project further warming in this century: between 4.3 to 5.8 degrees F warmer on average in Washington State by the 2050s compared to the 1950-1999 period. In the Yakima Basin, average summer temperatures are expected to be 83 to 90 degrees by mid-century, depending on what choices are made—locally, regionally, and globally—that affect the trend of greenhouse gas emissions [5]. Those would be the averages; our hottest summer days will likely be even hotter than what we are used to.



When it comes to rain and snow, precipitation projections are uncertain. Climate scientists currently anticipate only slight increases in average annual precipitation, with more of that precipitation coming in the winter and in heavier downpours. Meanwhile, the Yakima Basin is a temperature-sensitive system, so warmer temperatures will mean less snow and more rain. We expect to see increasing winter flows and decreasing summer flows in the rivers. We also expect to see peak streamflows occurring four to nine weeks earlier in the 2080s than what we are used to seeing today [1]. Snowmelt runoff already happens two to three weeks earlier than it did historically in many streams in the Pacific Northwest [6].

“We’ve seen the telltale signs of climate change for several years now. It will affect each and every living thing, including us. Everything depends on water for life – our foods, our salmon, our roots and berries. Many Tribes will be affected.”

Gerald Lewis, Tribal Council



Courtesy of Yakama Nation staff



5 Community Resources



Courtesy of Yakama Nation staff

CULTURAL HERITAGE

Introduction

Within the Yakama paradigm, five categories of resources are recognized: land, air, water, natural, and cultural resources. The Yakama Nation’s definition of cultural resources is very broad and inclusive. Tribal elders have defined significant cultural resource types including, but not limited to: Walts’ats’as (legends), Wawkstimit (monuments), Pakstimit (ceremonies), Temani pashwa (petroglyphs/pictographs), Yawatash (burial), ancestral use, and archaeological sites. These are defined in the unwritten laws of the Yakama people in Ichi Skin Sinwit (the words we speak). They have been passed down from generation to generation since the beginning of time.

The protection, preservation, and perpetuation of cultural resources cannot be complete without the utilization of Ichi Skin Sinwit. Therefore, to meet the goals and objectives of the Yakama Nation Cultural Resources Program, professionally-trained archaeologists are partnered with fluent, traditionally-raised Yakama tribal members. This ensures that the Yakama Nation’s scientific and cultural paradigms are reflected in the management of cultural resources. The program carries out four main activities within the reservation, including inventory, evaluation, monitoring, and restoration cultural resources. Some projects are small-scale, and others involve large-scale Cultural Resource Management Plans. The goal is to simplify the process of managing complex, sensitive resources with strong cultural significance.

Anticipated climate impacts and vulnerability

It is difficult to predict exactly how climate change may affect our cultural resources. We have reason to be concerned, however, about the potential increase in wildfire and the changes to our yearly water cycle. Unchecked wildfire can inhibit access to and the use of our culturally important sites. Increased high-velocity flooding could deteriorate the integrity of current and historic sites. Also, ceremonial and ancestral use of key areas may be significantly curtailed due to a lack of water during the summer and autumn months.



Potential actions and information needs

To protect our cultural resources in the face of climate change and support the continued development of the Climate Adaptation Plan throughout the territories of the Yakama Nation, the Tribal Council directs that the following actions be evaluated and that recommendations for future actions be provided. Additional items may be included during the Phase 2 analysis as new information becomes available.

MANAGEMENT AND IMPLEMENTATION

1. **Develop outreach and education materials** that will inform the tribal community about near-term and longer-term climate change threats and ways that we can prepare and build resilience to these changes.
2. **Protect and enhance priority wetlands, riparian areas, and other ecosystems** in order to conserve culturally important foods and medicines that could be adversely impacted by climate change.



Photos courtesy of Emily Washines

HEALTH AND PUBLIC SAFETY

Introduction

The well-being, health, and safety of the people of the Yakama Nation will be at greater risk due to climate change. Some of our tribal members may be more vulnerable than others; we share particular concern for the elders, the very young, the infirm, the economically disadvantaged, and those who must labor outdoors. Increased risks will come from many fronts, including longer and more intense periods of heat, decreased air and water quality, insect-borne disease and allergens, and increased flooding. Planning and responses in emergency management will need to be revisited from time to time to renew preparedness and coordination with local and regional partners. Our preparations must include response training for emerging and continuing threats and also consider initial and longer-term steps towards recovery from future adversities. Now is the time to consider, prepare, and act to address these new challenges.



Courtesy of Raynel Begay

Anticipated climate impacts and vulnerability

As we look forward and anticipate a changing climate, there are obvious risks that must be considered and contingencies to be identified.

Rising temperatures will bring an increase in the potential for heat-related illnesses like heat rash, heat exhaustion, and heat stroke. Because we have air conditioning in many of our homes and workplaces, we may be reasonably well-equipped to deal with some of these heat-related illnesses. However, our people spend a considerable time outdoors, where exposure is more of a concern. Additionally, we may see a worsening of existing problems with renal failure, cardiovascular disease, and respiratory illness; pollen-borne allergens could increase due to a longer pollination season [9]. It is possible that there will be an increased risk of transmission of infectious, water-borne, and food-borne diseases.

Clearly evident from recent events, unsafe levels of smoke from local and regional wildfires will fill our sky with growing frequency. We anticipate that we may see more years with large wildfires and that these fires may persist throughout the later summer months, possibly into the autumn. Resulting impacts on our health may include increased cases of asthma, bronchitis, and pneumonia. Children suffering from these problems could miss more school days. Also, if these fires burn into our communities, we may see loss of property and disruptions that can impact the physical and mental well-being of those most directly affected.

It is likely that the problems discussed here will disproportionately affect the elderly and the children within our community, as well as the poor and people with underlying health issues. Our responses must be well-targeted to help those who are most vulnerable.



Potential actions and information needs

To protect our people from climate-related health and safety risks and to support the continued development of the Climate Adaptation Plan, particularly on the reservation lands of the Yakama Nation, the Tribal Council directs that the following actions be evaluated and that recommendations for future actions be provided. Additional items may be included during the Phase 2 analysis as new information becomes available.

RESEARCH AND MONITORING

1. **Work with the Washington State Department of Health, community hospitals, and health organizations** to monitor and predict heat waves and smoke-related air quality issues.
2. **Work with the State of Washington Department of Ecology to evaluate existing and long-term air quality monitoring opportunities** on tribal reservation lands.

MANAGEMENT AND IMPLEMENTATION

1. **Inventory the availability of cooling centers** for use on extreme heat days by community members who don't have air conditioning at home. Consider offering additional public cooling spaces at tribal facilities.
2. **Assess the capacity of local clinics** to respond to emerging health threats and to integrate climate preparedness into their hazard response plans and daily operations. Talk to doctors and nurses about how climate change can affect allergen abundance and disease vectors and what they will need to be prepared.
3. **Evaluate drinking water management plans** in terms of long-term climate adaptation and potential for diminished supplies.
4. **Evaluate the need to improve or retrofit tribal housing**, especially for those most vulnerable to temperature or precipitation extremes.
5. **Develop local committees to help proactively implement climate change adaptation measures** for the most vulnerable.
6. **Consider the need for expanded preparedness planning**, which includes coordination, training, equipment, exercises, evaluations, and corrective measures.
7. **Develop outreach and education materials** that will inform the tribal community of the real and potential dangers of climate change and help the community prepare for these changes. For example, these materials could include information to help people know how they can protect their homes and property in the face of increased wildland and range fire hazards. Develop and implement a public awareness and outreach campaign that notifies people how to get information about, prepare for, and respond to extreme heat and wildfire smoke events.



TRIBAL INFRASTRUCTURE

Introduction

The Yakama Nation spans approximately 1.2 million acres. Much of our land is either forested and managed for a variety of natural resource values and forestry products or consists of lower-elevation agriculture and community developments. With such diversity, the Yakama Nation Economic Development Department has the directive to recommend and provide opportunities that create jobs and increase revenue for the Yakama Nation through advancement of a sustainable economy while preserving our traditional and cultural values.

Many tribal enterprises exist within our government. Two large tribal enterprises that may be affected by climate change are Yakama Forest Products and Yakama Land Enterprise.

The Yakama Nation Engineering Department manages much of the necessary infrastructure to support these enterprises and serve the collective needs of our people. It also manages and maintains non-county roads, tribal property, and the Wapato Irrigation Project (WIP) delivery system.

Anticipated climate impacts and vulnerability

As is discussed throughout this Climate Adaptation Plan, one of the most direct anticipated climate change impacts in our region is on water availability. From an infrastructure perspective, water supply is important for fire management and road construction; the reservation is mainly rural and spread over a mix of forest, range, and desert landscapes, and wildfires are also expected to increase both in forested and non-forested lands. We need to have water available at withdrawal sites to enable fire response as well as dust prevention. Water availability is also important to WIP's ability to provide water to lands leased by the tribe.

Meanwhile, changes in precipitation, runoff, and streamflow could lead to increased erosion or temporary flooding of roads in the wet season. Stress from higher temperatures may reduce the lifespans of some infrastructure assets; thermal stress may also degrade asphalt pavements more rapidly and slow asphalt curing time, increasing the time needed to perform road repairs. Demand for electricity is likely to go up in the summer as more intense heat leads to a need for more cooling capacity; this could increase operations costs at tribal facilities.

We need to continue to evaluate how climate change impacts could affect our enterprises, irrigated lands, and community infrastructure and develop plans to address these concerns.



Courtesy of Tom Ring



Potential actions and information needs

To increase the resilience of our community infrastructure and support the development of the Climate Adaptation Plan, particularly on the reservation lands of the Yakama Nation, the Tribal Council directs that the following actions be evaluated and that recommendations for future actions be provided. Additional items may be included during the Phase 2 analysis as new information becomes available.

RESEARCH AND MONITORING

- 1. Inventory water withdrawal sites for fire suppression and dust management use** on tribal roads and lands. Describe their anticipated future capacity and availability with projected diminished water supplies.
- 2. Develop a future workforce projection and action plan** for workforce development within the Yakama Nation. Identify job availability and training opportunities for Yakama youth to be educationally stronger and more culturally aware; ensure that the trainings cover anticipated climate change impacts and how planning, maintenance, and operations practices aim to build resilience.

MANAGEMENT AND IMPLEMENTATION

- 1. Identify and prioritize transportation infrastructure improvements where necessary due to anticipated climate change impacts**, such as enlarging road crossings and culverts to prepare for flooding.
- 2. Consider climate change impacts when planning new assets or rehabilitating existing assets.** For example, use asphalt and concrete mixes and/or designs that perform well under higher temperatures.
- 3. Update operations and maintenance strategies.** For example, conduct more frequent storm drain and culvert cleaning, debris removal, and performance monitoring.
- 4. Develop redundant transportation, power, and communications services** to accommodate system disruptions due to flooding and more frequent storms.
- 5. Consider climate change adaptation benefits when determining the relative priority of proposed projects.**
- 6. Align management decisions for Forest Products and Land Enterprise with what we know about the future climate;** these enterprises depend heavily on the water budget and water availability.
- 7. Include climate change considerations when proposing and assessing the viability of new ventures.** Consider whether the proposed enterprise or infrastructure asset can reasonably be anticipated to be viable and sustainable in the coming decades as the climate changes, and plan for measures to increase its resilience. Factor climate change considerations into planned operations and management budgets for enterprises and assets that are expected to be vulnerable.



LANDS AND AGRICULTURE

Introduction

The people of the Yakama Nation enjoy a variety of economic opportunities. Many of those derived from our lands include forest products, dry land grazing, mining, and irrigated agriculture. Our lands have always provided a living for our people. It is through this tradition that we are always mindful of our responsibility to manage our lands sustainably so that they are healthy and can be passed on and enjoyed by future generations.

The heart of the Yakama Nation reservation has productive, irrigated lands and a thriving agricultural sector. Adjacent to the Yakima River, Satus Creek, and Toppenish Creek are nearly 72,000 acres owned by tribal members and leased to tenants that produce a wide variety of foods. It is estimated that roughly six to seven million dollars are annually collected by tribal members for the use or rental of these and other lands. The secondary benefits to the local economy have not yet been precisely quantified, but it is clear that the agricultural activities on the reservation are essential to the economy of the Yakama Nation.

Anticipated climate impacts and vulnerability

For these lands to continue to be productive and profitable, they must have a reliable and adequate supply of water. Climate change is likely to shift the patterns of rain and snow in our mountains and lower-elevation reserved lands. Changes in snowpack accumulation and melt rates, timing of runoff, streamflow, summer drought, winter flooding, changes in water temperature, and sedimentation are all important issues that must be considered. Irrigation water shortages already occur in the Toppenish-Simcoe Unit west of White Swan and are likely to worsen. Irrigation distribution inequalities on the Wapato Irrigation Project will likely also be exacerbated since the project infrastructure is antiquated and not designed to run at less than full capacity. These problems were apparent in the 2015 drought, when we had about 70 percent water supply for the project. Clearly, these stresses can directly impact tribal revenues from our irrigated lands.

Regulatory policies will become even more important and may have pronounced effects. Enforcement of the tribal water code, particularly in light of changes in water supply, may lead to additional restrictions on irrigation wells and surface water pumping and more stress on existing irrigation systems. All of these things are complicated and will continue to require careful planning and implementation.

The 2015 drought may give us a glimpse into the future. Certainly, members of our agricultural industry have dealt with and are mindful of the effects of periodic drought on annual water management practices. However, a prolonged exposure to reduced water supplies will necessitate changes in agricultural practices and water use efficiencies. Water-thirsty crops may need to be exchanged for others that are more drought-tolerant. Investments and innovations in water use and efficiency may offset many of these effects. If water shortage is pronounced

“As we consider improvements to the Wapato Irrigation Project, let’s not retool a system from 1902. Let’s rebuild a system for 2020 and beyond.”

Workshop Participant



Courtesy of Yakama Nation staff



enough, it is possible that croplands will come out of production, which in turn will reduce rents paid to tribal members for use of their ancestral lands. Economic consequences will ripple throughout our local economy.

Existing programs that contribute to resilience

The Yakama Nation is currently doing many things to increase the efficiency of our water use and to build resilience within our developments and natural ecosystems. Water conservation plans have been completed and are being implemented in many areas of our reservation. An aquifer recharge project implemented on Toppenish Creek has recently been expanded to Simcoe Creek. Implementation of the Toppenish Corridor Enhancement Plan, irrigation demonstration projects, and FEMA floodplain and flood zone mapping will continue to contribute to our long-term goals. In particular, the continued implementation of the Yakima River Basin Water Enhancement Project and the Yakima Basin Integrated Water Resource Management Plan will guide improvements to infrastructure, thereby increasing available water supply and water conservation.

Potential actions and information needs

To support the resilience of our agricultural lands and protect the local economy and to continue development of this Climate Adaptation Plan, the Tribal Council directs that the following actions be evaluated and that recommendations for future actions be provided. Additional items may be included during the Phase 2 analysis as new information becomes available.

RESEARCH AND MONITORING

1. **Conduct a groundwater study** to determine the impacts of excessive aquifer draw down on flows to Toppenish and Simcoe Creeks.
2. **Develop a plan to improve the network of real-time water and weather stations** (e.g., gaging stations, SNOTEL, local weather), which are fundamental for drought and flood warning and forecasting, water supply forecasting and monitoring, and long-term water resources planning.
3. **Develop watershed models to describe forestry and snowpack interactions** in order to project changes in runoff, temperature, and precipitation and to inform changes in forest management practices to maximize water retention.
4. **Consider using models to improve seasonal water supply forecasts** and thereby inform irrigation allocation, drought declaration, and planning and regulation of instream flows.
5. **Develop a plan to obtain stable funding** for the collection and analysis of water data, consolidated stream gaging, and a networked database.
6. **Evaluate the potential for lost land and agricultural revenues** due to climate change to highlight the challenge and motivate action.
7. **Study the potential for increases in pests, diseases, or invasive species** that could affect crops and livestock.
8. **Evaluate the climate change vulnerability of current and potential agricultural practices** to understand and better prepare for potential impacts to—or opportunities for—land owners, resource groups, and communities. As part of this evaluation, consider the relative sensitivity of different types of crops and livestock.

“The irrigation districts are not floating in money, and our knowledge of what we need to know has outpaced our ability to do certain things, much less the ability to pay for them.”

Charles Burt, irrigation consultant, CalPoly



Courtesy of Yakama Nation staff



MANAGEMENT AND IMPLEMENTATION

- 1. Update the 2011 Yakama Nation Water Resources Management Plan to further consider climate change.**
Develop policy recommendations for the Water Code to specifically address irrigation wells and surface allocation on tribal lands.
- 2. Evaluate the long-term adequacy of water delivery infrastructure** to ensure that changes in hydrological patterns (e.g., increases in flooding frequency or reduction of late summer water availability) can be anticipated and managed effectively.
- 3. Evaluate opportunities to improve real-time forecasting of soil moisture content and local weather conditions** to improve efficiencies in water delivery and other agricultural practices. Identify ways to improve retention of soil moisture, such as appropriate application of manure or other organic materials.
- 4. Develop a plan to improve water storage** through continued and expanded recharge within the Toppenish and Simcoe Creek alluvial fans.
- 5. Engage farmers in research and outreach efforts and develop educational programs and materials** that can be distributed to members of the tribal and agricultural communities to provide information about potential climate change vulnerabilities or opportunities. These materials should include water conservation practices, opportunities for rain water collection, and use of gray water where appropriate. They should also explore alternative energy sources and distribution mechanisms such as the use of solar panels.
- 6. Continue to evaluate and implement all best management practices** to improve efficiencies in water use on crops, including choosing hybrids or other heat-resistant crop varieties best suited to arid land agriculture, using drip systems to optimize water and nutrient applications, using plastic cover between crops to reduce water loss and growth of noxious weeds, and making improvements to soil condition to increase water retention.
- 7. To support recharge of aquifers, evaluate the ability to apply water to croplands outside of the normal growing season** in years when excess water is available.
- 8. Decrease toxic materials released back into the rivers.** As climate change intensifies and pest and disease incidence changes, farmers may apply more chemicals and pesticides in order to respond to the changing environment. Environmentally-friendly alternatives should be considered. Improve water efficiencies in diversion, conveyance, delivery, and use in order to minimize return flows and toxic materials back into rivers.
- 9. Evaluate and implement a series of measures in the Wapato Irrigation District, including:**
 - a. Implement facility and operational improvements to increase efficiencies in water diversion, conveyance, and delivery.**
 - b. Install devices to accurately measure water use at all turn-outs** and throughout the system at appropriate locations.
 - c. Improve enforcement capabilities** to control unauthorized water use throughout the District.
 - d. Recognize current under-staffing of District operations and evaluate long-term staffing needs** that will support a high level of efficiency in water delivery, system operations, maintenance, and enforcement.
 - e. Evaluate locations, costs, and benefits associated with building one or more re-regulating reservoirs** in strategic locations within the District. Consider undertaking a storage assessment to understand the potential of the Wapato Irrigation Project or other sources (e.g., the Yakima River) to provided irrigation water to the Toppenish - Simcoe Unit.
 - f. Evaluate the costs and benefits associated with implementing technological improvements that would automate the entire District** to improve delivery timing, water conveyance, and use efficiency.
 - g. Develop strategies that acknowledge potential future water savings** and provide alternate uses for this additional water, including but not limited to community consumption, benefits to native fish and aquatic species, alternative crop production practices, and alternative options for industry and commerce.





Courtesy of Yakama Nation staff

6 Environmental Resources

FORESTRY

Introduction

The western part of the 1.37-million-acre Yakama Reservation has approximately 650,000 acres of productive forest and woodland. Generally situated on the eastern slopes of the Cascade

Mountains, these areas contain stands of ponderosa pine (25%), pine and Douglas fir (23%), mixed conifer (such as grand fir, Douglas-fir, western larch and other species; 32%), and true fir and mountain hemlock (15%). The remaining area (5%) consists of lodgepole pine, Engelmann spruce, western red cedar, and other minor species. Figure 3 maps the forested lands and identifies management emphasis areas.

Over the last century, a number of changes in forest health have occurred on the Yakama Reservation—very similar to the changes that have occurred throughout the inland west. Selective timber harvesting removed large ponderosa pine trees; grand fir and Douglas-fir often regenerated in place of the pines. Livestock grazing changed the amount and species composition of ground vegetation. Less ground vegetation resulted in reduced amounts of fine fuels, which prevented surface fires from burning across the landscape as they did historically. Practices to suppress natural fires also prevented them from performing important ecosystem functions such as recycling nutrients, regulating species composition, and regulating forest stand densities.

From a cultural perspective, forests provide foods and medicines that our ancestors have gathered and used since time immemorial. The Yakama timber resource, meanwhile, is essential to our economic, social, and cultural needs. The Yakama Nation has the largest volume of forestlands within the Bureau of Indian Affairs, containing an estimated 10 billion board feet of timber. The Yakama Nation generates a significant amount of revenue directly from the sale of timber. Timber is sold to Yakama Forest Products (YFP), a wholly owned Yakama tribal enterprise employing over 200 people; over 90 percent of these employees are tribe-affiliated. More than 2,000 jobs are directly related to the Yakama forest and an estimated five times that many people benefit indirectly.

“It is difficult to explain some of the intricate things that we know of the past and of the present. I think this is going to be a great test upon all of us.”

Workshop Participant



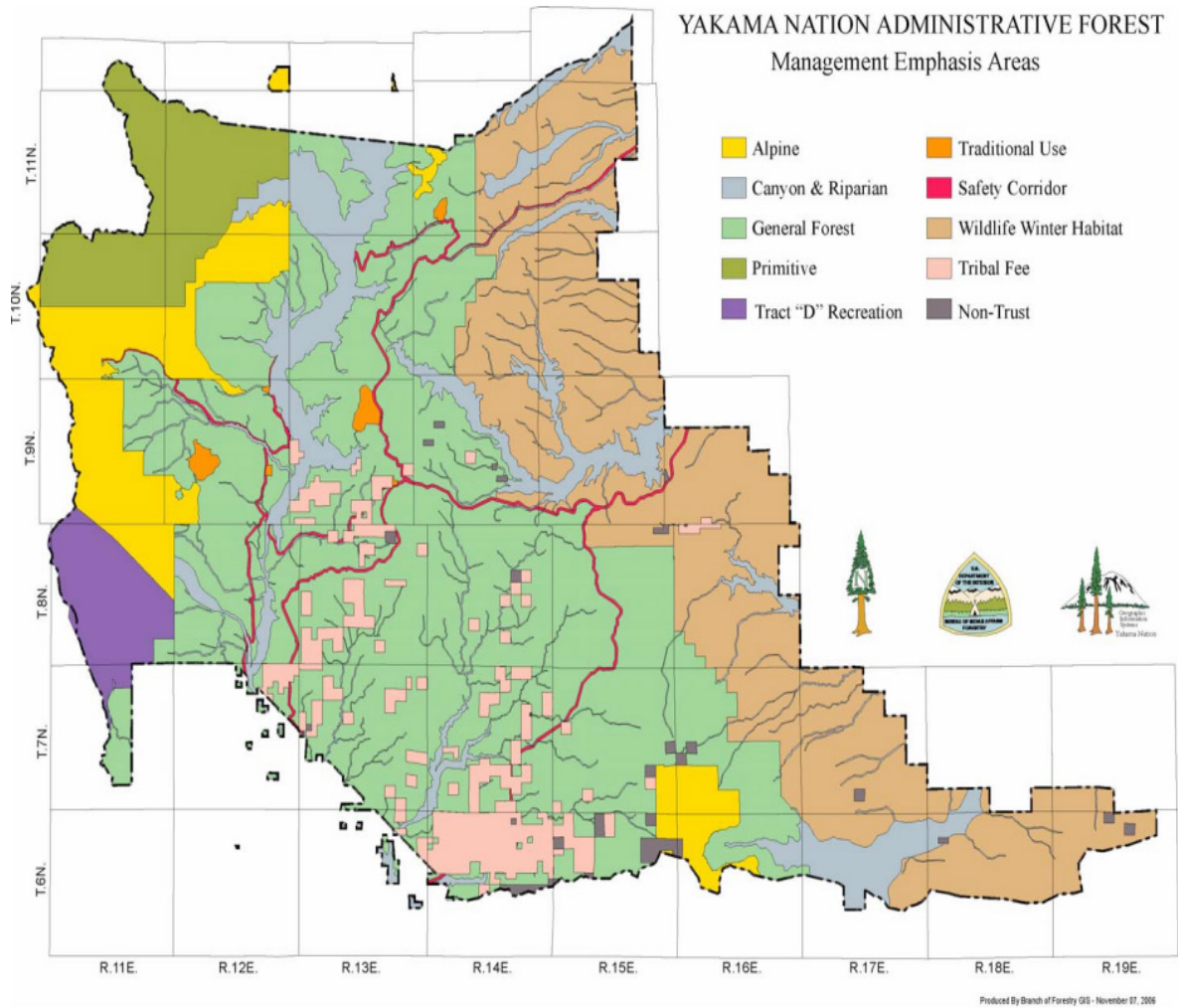


Figure 3. Areas within the Yakama Nation Administrative Forest

Anticipated climate impacts and vulnerability

The climate influences nearly all aspects of our forests, and changes in the climate are therefore expected to directly affect forest ecosystems. Temperature increases will be apparent, especially in winter. Drought duration and intensity are projected to increase. Warmer and possibly drier summers in Washington may increase tree growth at higher elevations and decrease growth in lower elevations and drier areas [10]. Some forest species may not adapt well to anticipated changes and may therefore adjust their range or distribution northward or to higher elevations where the new climate is more suitable [11]. Increased mortality may occur in older forests.

Changes in climate can affect forest pest and disease responses in two fundamental ways: first, by lengthening or shortening the seasons when pests reproduce and complete their life cycles, and second, by weakening the host trees and leaving them more susceptible to insect attacks and plant disease. Specific effects in our region are difficult to predict at this time. For example, in some places in the Pacific Northwest, mountain pine beetles are projected to decline, and in other places they are expected to become more prevalent.



Increased carbon dioxide within our atmosphere is also expected, which in turn could be beneficial to general plant growth and productivity. Although speculative at this time, this condition might actually help protect trees from pests and disease. Regardless, close monitoring and preparedness will continue to be an ever-increasing need as we move into an uncertain future.

According to the Washington State Department of Ecology, “rising temperatures, more frequent and longer lasting heat waves, and drier summers are expected to contribute to larger, more severe wildfires. Researchers project that the area burned by fire each year in the Columbia Basin will double or triple by the 2080s. Wildfire risk to communities, the environment and wildlife and the costs of fighting those fires are expected to rise.” [12] Models suggest an increase in both fire area burned and biomass consumed. One of the primary challenges for forest and wildfire managers today and in the future is to reduce the risk of stand replacement fires and the resulting catastrophic consequences.

After fire disturbance, seedlings need to take root. The impact of climate change on suitability for seedlings is therefore important. Only 15 percent of the area currently suitable for ponderosa pine, lodgepole pine, and whitebark pine in Washington is projected to remain suitable for all three species by the 2060s [13].

Existing programs that contribute to resilience

The Yakama Nation has taken an active role in managing and improving its forested lands, using an ecosystem approach, by implementing a complex and comprehensive Forest Management Plan (FMP). Implementation of the FMP is intended to enhance and maintain a diversity of forest conditions, maintain sustainable production of commercial and noncommercial resources, and thereby maintain the forest resource as a dependable source of spiritual renewal, food and medicinal plants, revenue, and employment for the Yakama people. The FMP is a collaborative effort of the Yakama Nation and BIA natural resources programs, including Archaeology and Cultural Resources, Environmental Quality, Fisheries, Forestry, Range, Roads, Soil, Vegetation, Water Code, Water Resources, and Wildlife. The main topics within the FMP include, but are not limited to, big-game habitat, forest health, old growth, revenue and employment, threatened and endangered species, and water quality.

An important element of the FMP is the identification and explanation of five specific and distinct programs, which together aim to protect and enhance the forestlands of the Yakama Reservation. These five programs are as follows:

- **Resource Protection Plan:** Provides direction for protecting the Yakama Reservation forestland from fire, insects, diseases, and trespass.
- **Timber Management Program:** Provides direction for conducting timber management activities while protecting all resources.
- **Forest Development Program:** Provides direction for timber sale follow-up activities such as planting, pre-commercial thinning, fuel management, and prescribed burning.
- **Woodland Management Program:** Provides direction for managing woodland resources outside of the Yakama Administrative Forest.
- **Human Resources Program:** Recruits Yakama Nation members into the forestry program and promotes their development as technicians and professionals.



Courtesy of Yakama Nation staff



It is through each of these programs that future actions, designed to address the effects of climate change, will continue to rebuild adaptability and resilience within Yakama Forest.

Potential actions and information needs

To support the increased climate resilience of our forests, particularly on the reservation lands of the Yakama Nation, the Tribal Council directs that the following actions be evaluated and that recommendations for future actions be provided. Additional items may be included during the Phase 2 analysis as new information becomes available.

MANAGEMENT AND IMPLEMENTATION

1. **Evaluate staffing needs and infrastructure support needs for each of the five FMP programs and how those needs will evolve as the climate changes.** The primary drivers towards long-term ecosystem management are stand density management, species composition, and fuels reduction and management. We need to have the capacity to continue long-term, sustainable forestry practices that will achieve high levels of forest health in all habitat types and priority management units.
2. **Continue to evaluate the Yakama sawmill,** specifically its long-term needs and necessary changes to increase efficiency and prepare for changes in forest ecosystems and tree species. This may include adaptations to make use of new forest products that thrive in a changing climate.
3. **Evaluate and develop a long-term monitoring strategy for exotic and invasive species** within priority habitat types and management units.
4. **Continue to implement and evaluate the success of various management approaches to maintain existing huckleberry fields and establish new ones** as a routine component of forestry management.
5. **Review the potential to apply newly developed climate change models** when making decisions about long-term forestry practices and wildfire and fuels management. The initial focus of these efforts should be on habitat types considered to be most vulnerable to future climate change effects, such as those along the eastern forested margins (ponderosa pine, Douglas-fir, and Grand fir associations). High elevation associates along the western perimeter of the Yakama Forest, such as the sub alpine fir, hemlock, and Pacific silver fir, should also be considered.
6. **Evaluate the use of hydrologic models to manage and increase water production** as a specific outcome of timber harvest, fire management, and other forestry practices.
7. **Develop strategies and methods to markedly increase the application of prescribed fire** as a fundamental tool for forestry management and long-term ecosystem health.
8. **Continue to collect seed stocks** from locally successful timber stands and other desired and vulnerable tree or plant species (such as white bark pine or traditional foods and medicines). Evaluate collection strategies that will facilitate stand persistence or migration as needed due to climate change.
9. **Continue to build capacity and partnerships across jurisdictional boundaries** to monitor and respond to climate changes and vulnerabilities in forested lands.



WATER AND WETLANDS

Introduction

Water is the very fabric of life for the Yakama Nation. Its importance cannot be overstated. Water is central to our religion, our culture, and our heritage, and it is essential to our health and our economy. The snow and the rain feed our streams and wetlands, which quench our thirst and sustain our fish, wildlife, foods, and medicines. Water is all things to all that are living and all yet to be born.

Anticipated climate impacts and vulnerability

Over the next 10 to 20 years and beyond, we could see many important changes to our water resources as a result of climate change. Increasing temperatures, reduced snowpack, and earlier snowmelt will elevate peak streamflows in the late winter months while leaving many of our rivers shallow and warm in the summer months. Figure 4 and Figure 5 show anticipated changes in streamflow in the Yakima and Columbia rivers, respectively. Many valuable wetlands and smaller streams may be dry in the months when water is needed most. Low flows can put stress on salmon and increase the concentration of contaminants—from agrochemicals, wastewater, pollutants, and other runoff—in rivers and streams.

Wetland plants and animals are particularly sensitive to small, permanent changes in conditions because they are located in a transition zone between aquatic and terrestrial environments [14]. As the climate changes, higher temperatures can lead to drying that reduces wetland size [15]. Shallow seasonal ponds, bogs, and fens that provide breeding grounds for amphibians and other animals may shrink or disappear [16].

On the rangelands, the precious water remaining in streams and wetlands will be a magnet to unmanaged livestock, causing increasing abuse of fragile aquatic and riparian ecosystems through overgrazing of the plants and trampling of the stream banks and wetlands. Continued reductions in water supply are likely, which will continue to cause competition for water between municipalities and agricultural interests. These issues are complicated by the ever-increasing populations and demands throughout the territories of the Yakama Nation.

Today, there are water shortages in the Yakima Basin in approximately 14 percent of years. Towards the end of this century, we can expect that there will be water shortages for many irrigators in 43 to 68 percent of years if we don't change our management practices or take adaptive measures [1].

Meanwhile, higher winter flows could produce more severe flooding in lower areas and a persistent challenge to infrastructure associated with our communities and transportation systems (e.g., roads, bridges, and culverts). Landslides may become more frequent and cause road closures, higher maintenance costs, and disrupted access in steep and vulnerable areas. Heavier flows can also increase erosion and sedimentation.



Courtesy of Yakama Nation staff



Still, we must remember that climate change impacts are not the only pressures on our natural resources. Since the time of our Treaty, there have been many changes. Land management practices, irrigation facilities and reservoirs, hydropower developments, and flood control measures have completely altered natural streamflow patterns well beyond what might be expected from climate change. For example:

- The proliferation of roads in our forested areas has accelerated surface water movement on the road surface, intercepting and concentrating sub-surface flows, picking up sediments and pollutants, and carrying all quickly into the stream.
- Irrigation has dewatered some streams to the point of drying them entirely. Many other streams subject to irrigation diversions may someday be too low and too warm to sustain healthy populations of cool-water species.
- Roads, railroads, and flood control dikes isolate overflowing streams from their floodplains. This not only accelerates runoff timing, but also reduces the ability for flooding rivers to recharge our dwindling aquifers.
- Large reservoirs have long since been developed in the headwaters of the Yakima, Naches, and Tieton rivers, significantly changing natural flow patterns and severely damaging our natural resources.

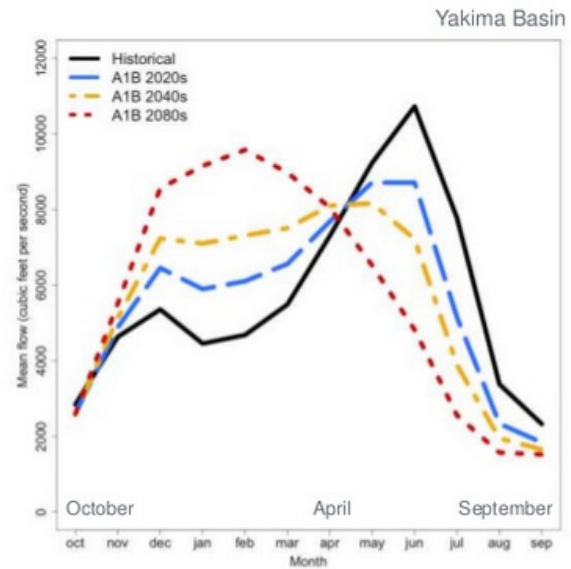


Figure 4. Anticipated changes in Yakima Basin streamflow timing and volumes in the 2020s, 2040s, and 2080s [17].

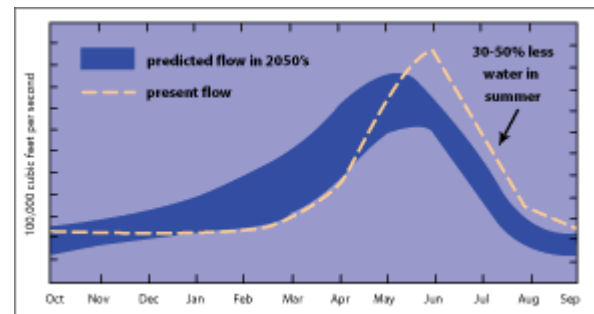


Figure 5. Changes in streamflow expected in the Columbia River Basin by the 2050s [18]

In sum, land and water practices throughout our territories continue to alter water runoff patterns and in turn affect natural biological and ecological cycles. Unfortunately, climate change will add to these concerns.

Existing programs that contribute to resilience

The Yakama Nation is already taking actions that help to conserve water and manage floods. These activities will be increasingly important in light of anticipated changes in the climate. Relevant activities include:

- Buying floodplain land, moving dikes, and removing infrastructure from flood zones.
- Working to minimize water losses along primary stretches of the Wapato Irrigation Project and setting up measurement mechanisms at delivery points to better understand usage (Yakima Tributary Access and Restoration Program).
- Implementing an aquifer recharge effort on Agency Creek and Toppenish Creek, new as of 2014. If successful, this could be considered for replication elsewhere. In the past couple of years, the Tribe has also been trying to raise water tables in the alluvial fan.



- Undertaking drought contingency planning, including the use of drought decision-support tools.
- Implementing water conservation practices such as drip irrigation and reuse; this is being done by some of the farmers on Yakama Nation lands. The Tribe is also planning for irrigation upgrades and seeking funding for implementation.
- Working in the tributaries to restore river-floodplain interactions and surface water-groundwater interactions. The Fisheries and Wildlife Programs turned a gullied flashy tributary into wetlands and beaver complexes.
- Improving species diversity and hydrologic resilience through meadow restoration efforts, such as the recent Lincoln, Renschler, and Starvation projects.
- Making a commitment to put about 100 cubic feet per second of conserved water into the river, following 1994 enhancement legislation that established the Basin Conservation Program. This will help nudge summer flows a bit higher, helping to offset the drops that could occur as a result of climate change
- Pursuing a coordinated interdisciplinary approach to manage water in agricultural areas, in collaboration with the Water Resources, Fisheries, and Engineering programs. One outcome has been the Toppenish Creek Corridor Plan.
- Noting climate change as an issue for consideration within the 2011 Water Resource Management Plan.
- Working with Yakima County to manage the mainstem of rivers as they relate to floods. The County puts together comprehensive flood zone management plans; climate change should be more explicitly integrated into those plans in the next update.

In addition, there is a Yakama Nation project to restore wetlands and riparian habitats along floodplains and streams in agricultural lands, which has received financial support from the Bonneville Power Administration [19]. Plans laid out two decades ago include a goal to protect, restore, and manage 27,000 acres of floodplain lands along the Yakima River and Satus and Toppenish Creeks by purchasing large pieces of land and their water rights and establishing natural vegetation. Between 1,000 and 3,000 acres have been secured annually. Ongoing monitoring of vegetation and hydrology at these locations may help to provide early indications of climate change impacts and inform a discussion about management practices that may need to be adjusted.

Potential actions and information needs

To support the continued reliable supply of water resources for a variety of uses throughout the territories of the Yakama Nation, the Tribal Council directs that the following actions be evaluated and that recommendations for future actions be provided. Additional items may be included during the Phase 2 analysis as new information becomes available.

RESEARCH AND MONITORING

- 1. Continue to inventory, identify, and prioritize stream reaches, floodplains, riparian areas, and wetlands for protection and for restoration** in collaboration with fisheries and wildlife experts. Take into account areas that are expected to be particularly resilient or particularly vulnerable in the context of a changing climate.
- 2. Continue to inventory, identify, and prioritize areas where aquifer recharge is feasible and effective.**
- 3. Evaluate the need to modify existing integrated water resource management plans or develop new plans** for each sub-basin, and incorporate climate change considerations into those plans.



4. **Develop or work to improve existing models** to help managers better anticipate, and where appropriate, control instream flows to protect and enhance beneficial uses.
5. **Improve understanding of water use and conservation potential by encouraging and incentivizing the use of meters.**

MANAGEMENT AND IMPLEMENTATION

1. **Work with the State of Washington, the U.S. Forest Service, and other appropriate entities to evaluate the need and establish priorities for removing roads** which disrupt riparian and floodplain function or intercept precipitation and ground water and accelerate its movement into stream systems.
2. **Identify and prioritize transportation infrastructure** where improvements are needed in light of climate change projections, such as enlarging road crossings.
3. **Work with the State of Washington and the U.S. Forest Service to identify and implement forestry practices that would improve water-holding capacity** within the watersheds, help maintain water quality, and reduce stream temperatures.
4. **Prioritize and develop livestock water sources away from riparian, wetland, and other vulnerable and important areas.**
5. **Identify and encourage water conservation measures in residences and towns** in collaboration with the public and local municipalities. Water conservation measures may include, but are not limited to, promoting water reuse, converting existing landscaping, and establishing policies to encourage or require native and/or drought-tolerant landscaping, including replacing lawns.
6. **Increase coordination within the communities to understand the extent of exempt and emergency wells and their impact on flows.** Promote tying such wells to mandatory conservation.
7. **Make use of the strategies and collaboration mechanisms in the Yakima River Basin Integrated Water Resource Management Plan; potentially expand the Plan to make sure climate change impacts are being considered.**
8. **Continue to explore opportunities for increasing irrigation efficiency** and returning diverted water back into stream channels during critical flow periods. Look at the Wapato Irrigation Project and the Rosa Project, for example, as places that may have the largest difference in temperature between withdrawal and returns.
9. **Work with the public and local municipalities** to identify additional actions to promote conservation of water resources in our cities and homes.



Courtesy of Yakama Nation staff



FISHERIES

Introduction

Salmon are perhaps the most important of our First Foods. According to our creation story, the salmon was the first to agree to care for the Indian people. The First Foods nourish us, and we must protect them and the habitats that support them. We therefore have a reciprocal relationship with salmon. The salmon’s spirit has not changed over the years; what has changed is the environment that once sustained that powerful spirit.

When we think about salmon in our cultural context, we think of a broad category of important species that includes steelhead, lamprey, freshwater mussels, trout, and other fish. We understand that bringing back our salmon, lamprey, and other fish important to the Yakama Nation will require us to restore a variety of important habitats that they need; this has become a high priority.

Anticipated climate impacts and vulnerability

Streamflows throughout the territories of the Yakama Nation are highly dependent upon winter snowpack. As temperatures warm and these mountain systems become more rain-dominated, late summer flows are expected to decrease rapidly, as we have witnessed in recent drought years. Low flow conditions through summer and autumn will severely reduce and impair critical fish habitat. Low flows can also bring water temperatures to dangerous, if not lethal, levels. Figure 6, from the Yakima Basin Storage Alliance, shows that the Lower Yakima is one of 16 basins that already has a critical water shortage for fish and that climate change is expected to have a severe impact on summer low flows by 2040. By the 2080s, 19 percent more stream locations in eastern Washington are projected to experience weekly summer stream temperatures stressful to adult salmon (in excess of 67° F) [1].

In the same timeframe, the duration of summertime stream temperatures that cause thermal stress and migration barriers to salmon is projected to at least double for many areas in eastern Washington and along the lower Columbia River [1].

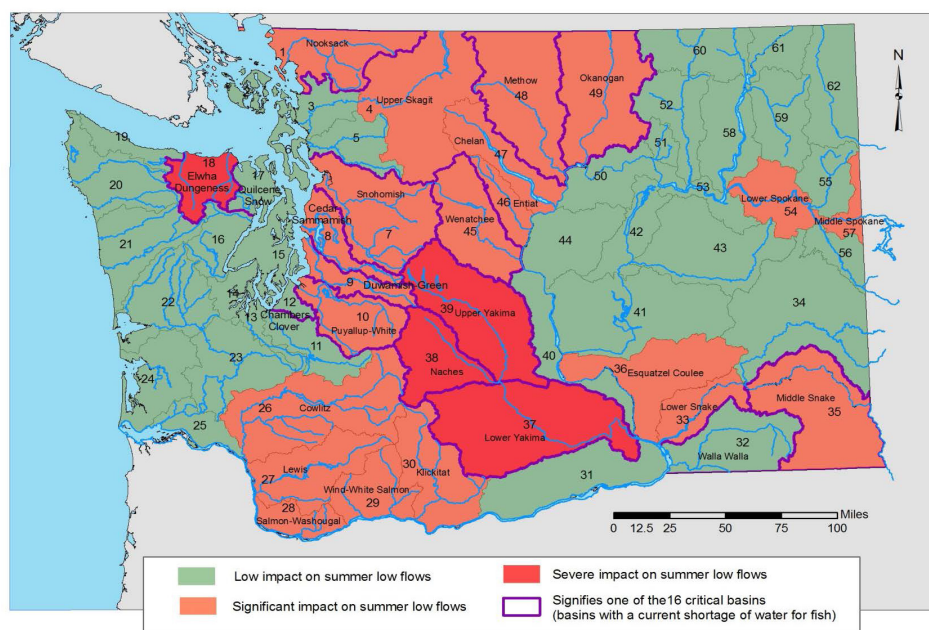


Figure 6. 2040 projected climate change impact on summer flows, by Water Resource Inventory Area (WRIA) [20].



For fish, direct consequences of these conditions include thermal stress, increased pre-spawning mortality, loss of egg and milt viability, and increased susceptibility to disease and parasites. We will likely also observe changes in migration and life history patterns, increased competition for space and food with warm-water species such as bass and Northern Pikeminnow, and alterations in aquatic food webs.

An example of altering migration patterns is that sockeye migrations are happening earlier; the median passage date is advancing at a rate of 1.5 days per decade [21]. Sockeye that come in later, when temperatures are warmer, return less successfully [22]. It remains to be seen whether the fish can keep shifting their migration timing to adapt or whether they will eventually reach a point where they can no longer do so. Earlier migration also means the sockeye spend less time in the ocean, leading to lower fat reserves.



Courtesy of Tom Ring

With changes in river runoff patterns, we anticipate there will be increasing winter and spring floods that can reduce survival of fragile eggs, larvae, and very young age classes. More frequent flooding may impact already-degraded fish habitat and destabilize channels. Without healthy riverine and floodplain function, we can also expect a reduction in recharge to our important aquifers and wetlands.

Increasing wildfire risk is also likely to lead to greater inputs of sediments into adjacent streams. These sediments can smother eggs and aquatic foods important for overall stream ecology and fish abundance.

Existing programs that contribute to resilience

The Yakama Nation Fisheries Program and its partners have been working very hard throughout much of our territories towards fish recovery and stream restoration. These include activities to help salmon and other fish thrive despite stressors like physical obstructions and irrigation diversions. Considerable investments have been made in the Upper Columbia, the Yakima, and the mid-Columbia regions, not only in development of our hatcheries to support recovery of salmon and lamprey, but also in substantial and large-scale restoration actions that focus on holistic measures to protect and restore fish habitats and ecosystem function. Habitat restoration and salmon recovery actions are also occurring in the Lewis and Cowlitz sub-basins, consistent with the goals of the Lower Columbia Salmon Recovery Board and under the purview of hydropower settlement and relicensing agreements. The Yakama Nation is an active participant in many regional forums working to ensure fish passage throughout the territories, whether it be through Columbia River hydroelectric dams, irrigation facilities, or culverts in smaller headwater tributaries.

Examples of ongoing efforts include:

- Changing adult collection sites and release locations to colder water sources when temperatures rise.
- Keeping streams cool with shaded riparian zones.
- Improving fish passage at culverts and in the main stem of the Yakima.
- Piloting the innovative Whooshh system, which can help to enhance fish passage around barriers.
- Collaborating with the Kittitas Reclamation District to get more water back into tributaries.



As the climate changes, we will need to expand these strategies and evaluate the need to implement new actions to help fish thrive.

Potential actions and information needs

To continue efforts to increase the climate resilience of fish and aquatic resources throughout the territories of the Yakama Nation, the Tribal Council directs that the following actions be evaluated and that recommendations for future actions be provided. Additional items may be included during the Phase 2 analysis as new information becomes available.

RESEARCH AND MONITORING

1. **Use existing or new models to get more information on forecasted stream temperatures and changing hydrologic regimes** in order to better understand potential climate change impacts to fishery resources. Critical impacts may include, but are not limited to, changes in life history patterns and overall productivity.
2. **Develop a long-term integrated monitoring, evaluation, and reporting program**—that clearly identifies the intended function and staffing requirements—in order to track the status and trends of fish, fish habitat, and hydrologic resources.
3. **Identify seasonal refugia** and fish use of those thermal refugia, in order to prioritize conservation efforts.

MANAGEMENT AND IMPLEMENTATION

1. **Continue to evaluate—and adjust, as necessary—practices at hatcheries** to manage fish stocks for increased resilience in the context of anticipated climate change impacts. For example, change adult collection sites and release locations to colder water sources as needed; take juveniles to facilities in cooler locations; vary release dates relative to streamflows; and develop guidance for hatchery facility managers that takes into account anticipated climate variability and change.
2. **Evaluate the need to increase restoration efforts in critical stream, side channel, riparian, and floodplain areas.** Identify critical areas where restoration should be prioritized and summarize the types of actions most needed to maintain or reduce stream temperatures, return flow patterns to more normative conditions, improve the quality and quantity of both spawning and rearing habitats, and regain riverine function and resilience.
3. **Continue to evaluate opportunities and means for improving irrigation efficiency** and returning diverted water back into stream channels during critical flow periods.
4. **Continue to develop management actions to control the abundance of excessive predators, non-native fish, or other aquatic organisms or aquatic plant species that thrive in warmer waters.** Evaluate the feasibility and use of flow management at critical life stages as a potential new management tool.
5. **Identify opportunities for reallocation and redistribution of water in critical basins** through water transfers, water transactions, water markets, and water banks, with the goal of increasing streamflow to benefit fisheries and riparian habitats.
6. **Evaluate the potential to purchase water rights** to be used exclusively for fishery benefits.
7. **Continue to evaluate the use of the Whooshh System** to facilitate fish passage, including around warm stream stretches.
8. **Aggressively seek funding** for restoration actions that focus on holistic measures to protect and restore fish habitats and ecosystem function.



SHRUB-STEPPE AND RANGELANDS

Introduction

The shrub-steppe is a dominant and important landscape. It is also a key component of our culture, providing essential foods and medicines to the Yakama people. The shrub-steppe is found throughout the eastern extent of the Yakama Nation territories, from the eastern foothills of the Cascade Mountains to the Columbia River and continuing up to the intensively cultivated lands of the Columbia plateau. Shrub-steppe vegetation types cover over 1.8 million acres in this region and contain unique ecological communities in riparian areas, wetlands, sand dunes, and other micro-environments [23]. This landscape contains a variety of vegetative communities consisting of plants such as Wyoming big sagebrush, bitterbrush, currant, and serviceberry. The primary bunchgrasses include bluebunch wheatgrass and Idaho fescue. The soils tend to be shallow; some areas are grasslands historically maintained by fire. Stiff sagebrush and shrubby buckwheats are found together with Sandberg bluegrass. These lands of sage and grass support rare shrub-steppe plants and wildlife, including 30 wildlife species identified as priorities for conservation by the Washington State Department of Fish and Wildlife and 47 species of rare plants [23] [24]. Important rivers and streams flow through these lands, including the Methow, Entiat, Wenatchee, and Yakima Rivers; the Crab, Satus, Toppenish, and Rock Creeks; and many others. Typical climate in the shrub-steppe is relatively cold in the winter, with long periods of hot, dry days in the summer.

Anticipated climate impacts and vulnerability

Even in the absence of climate change, our shrub-steppe and rangelands have been subject to many pressures. Because of the natural abundance of many grasses throughout the shrub-steppe, European settlers used these lands extensively for cattle, then later for sheep grazing. Cultivation for agriculture followed where it was practical. Throughout the entire period of these developments, numerous non-native species were introduced and have since flourished. As a result, these fragile plant and animal communities have changed drastically over the past 150 years. Today, most of these lands continue to be used for agricultural purposes, with few large, connected areas left to persist in a natural or semi-natural state.



Courtesy of Joel Geffen

On our own reservation, our rangelands have been and continue to be substantially altered by the overabundance of feral horses and, in some cases, the mismanagement of cattle. The 2015 horse census estimated that close to 10,000 horses roam freely about the reservation with little management. Their grazing habits favor the production of cheatgrass at the expense of native grasses. Due to their numbers, they compete with and deplete the abundance of food for many of our wildlife species, such as sage grouse, deer, antelope, rabbits, and many others. Cattle and horses that dwell in sensitive riparian areas trample stream banks, which in turn accelerates erosion and disturbs many areas where we find our cultural foods and medicines.



Frequent large wildfires are removing large areas of sagebrush. Historically, natural fire occurred in these communities once every 30-100 years [25]. Today, cheatgrass and other invasive plants provide fuel for more frequent large fires. Most of these fires are human-caused, occurring near roads, military training ranges, and residential developments located near wildlands.

We have a limited understanding of how climate change may affect the shrub-steppe and the rangelands, but we know that it will add to the other stresses already mentioned. In general, we can expect that there will be a change in species composition, distribution, and abundance; changes in habitat suitability and invasive species; and an increased frequency of disturbance (such as fire or disease) [26]. However, we lack a clear understanding of how specific changes will be reflected on our landscape.

It is possible that climate change impacts on our rangelands will be minimal. Many of the vegetative species may already be well-adapted for the warmer, drier conditions expected in the future. Climate change may actually benefit our rangelands in some ways. Increases in carbon dioxide in the atmosphere, for example, may be favorable for many of the key species. Rangelands at higher elevations may also find an advantage with higher temperatures because it gives them a longer growing season. But, these future conditions are unknown, and there is much to learn and prepare for.

Existing programs that contribute to resilience

The Yakama Nation has 36 range units, covering 900,000 acres of which approximately 400,000 are in open rangeland or shrub-steppe. The remainder is in forest [27].

The Range Program administers grazing permits and manages livestock in order to help preserve rangeland so that it can continue to provide a number of different services and values. For example, we are working with the Bureau of Indian Affairs (BIA) to decide how many cattle to permit. About once every ten years, the BIA also updates the grazing regulations. The Yakama Nation continues to undertake efforts to manage the over-populated wild horses. Effectively managing cattle and horse impacts on rangelands can help make those lands more resilient to other pressures, like climate change.

The Yakama Nation is also engaged in shrub-steppe restoration, seeding native grasses, using herbicides to control cheatgrass, and planting native shrubs like sagebrush.

Effective management of non-climate stresses on the rangelands can leave them in a healthier condition to cope with emerging climate change stresses, although adaptation efforts to specifically manage climate change impacts may also be necessary.



Courtesy of Jonalee Squeochs



Potential actions and information needs

To maintain the largest contiguous area of sagebrush country left in the state of Washington and support the development of the Climate Adaptation Plan, particularly on the reservation lands of the Yakama Nation, the Tribal Council directs that the following actions be evaluated and that recommendations for future actions be provided. Additional items may be included during the Phase 2 analysis as new information becomes available.

RESEARCH AND MONITORING

1. **Study how vegetation patterns in our region might change over time**, drawing conclusions about how these changes may impact important non-native species and wildlife abundance and distribution. Use these findings to adjust rangeland management practices.
2. **Develop a long-term integrated monitoring, evaluation, and reporting program** to track the status and trends of important vegetative species and communities and inform management decisions. As this program is developed, the function and staffing requirements should be made clear.

MANAGEMENT AND IMPLEMENTATION

1. **Accelerate the implementation of the Horse Management Plan** to enhance environmental benefits and long-term resilience to climate change for severely depressed native species and plant communities throughout the areas where wild horses persist.
2. **Update and implement the 2009 Integrated Weed Management Plan** to account for potential changes or increases in invasive species due to climate change impacts.
3. **Revise grazing policies**, including timing and allotments, to increase the resilience of native sagebrush-grass and similar ecosystems.
4. **Accelerate implementation of known rangeland best management practices** such as preventing livestock from unplanned entry into riparian, wetland, and natural spring sites; providing designated water sources in uplands and other suitable areas; and increasing protection measures and enhancements that will increase climate resilience.
5. **Evaluate and identify areas** where shrub-steppe communities are relatively healthy and warrant special protection and areas that should be prioritized for restoration. Recommend general protection and restoration strategies and specific actions that could be employed; these could include the complete removal of livestock and horses from key sites.
6. **Consider designing a native plant nursery and seed bank** to support long-term restoration efforts. Identify focal species such as grasses, berries, and roots that are important for ecosystem health as well as sources of cultural foods and medicines.
7. **In restoration projects, emphasize the use of plant species that will be robust** in the face of climate change.
8. **Identify appropriate public outreach approaches** and related materials to inform stakeholders of the rationale behind improved rangeland management practices that account for future climate change.
9. **Develop appropriate materials to inform the tribal community and tribal leadership** of the vulnerabilities of tribal rangeland and natural resources, climate change risks, and potential consequences of management decisions.



WILDLIFE AND VEGETATION

Introduction

The territories of the Yakama Nation have a rich variety of ecosystems and a diversity of plant and wildlife communities. All native species are important to the Yakama people and central to our religion, culture, and heritage. Although the Yakama people are considered a salmon tribe, honoring both salmon and water, the Yakamas also value roots, berries, and deer as “First Foods” which are celebrated at the beginning of their respective seasons. Through the passing seasons of each year, our people move about the landscape, following the availability of these and other foods and medicines and using the various plants and animals for traditional clothing, tools, artistic works, and many other things essential to our culture. In addition, some animals and plants are important for economic reasons and/or indicators of ecosystem health.

Table 3. A sample of the plants and animals important to the Yakama Nation

All of our native plant and animal species are culturally important. We need to watch and manage carefully for our important foods and for the wildlife that has traditionally lived on these lands. At the workshops, tribal program managers mentioned the following plants and animals as particularly important:	
Huckleberries	Deer
Currants	Elk
Chokecherries	Bear
Service berries	Wolves
Roots	Bats
Quail	Coyote
Pheasant	Mink
Eagles	Otter
Hawks	Antelope
Sage sparrow	Bullfrog
Sage thrasher	Tail frog
Cottonwood	Domesticated Ungulates
White Headed Woodpecker	

Within the realm of our natural resources, everything is connected. The spring sun warms the land, insects appear, and the swallows return. The osprey return from their winter homes, which coincides with the migrations of the fish. With the melting snow, deer and elk return to the cover of the forest and the fresh grasses and shrubs of the meadows. Essentially, all wildlife are connected to the vegetation of the riparian and wetland areas, the shrub-steppe, the forests, and the alpine areas. As such, management of our vegetation communities is essential to management of our wildlife.

Courtesy of Yakama Nation staff



Anticipated climate impacts and vulnerability

Past and ongoing management practices, coupled with the changing climate, present an ever-growing threat to our way of life. Climate change impacts on wildlife and vegetation include potential loss of habitats, shifts in species ranges and diversity, invasive species, impacts on the food web and on our First Foods, and increased fire risk. We continue to work to restore and manage our lands to increase resilience, yet our approach may need to be modified in the face of future climate conditions. The projected consequences of climate change are likely to magnify the existing primary threats to our ecosystems. All of these impacts can contribute to the slow decay of traditional Yakama culture.

In fragmented landscapes, climate change is altering habitat composition and the timing of plant development cycles. Areas suitable for many plant communities are expected to decline in the future. It is possible that a variety of plant and animal species will not be able to keep up with the climate and geographic shifts in these ecosystems. Local declines or extirpations of wildlife and the loss of migration corridors and connectivity between summer and winter habitats may become increasingly severe.

Ecosystems and places that may be particularly vulnerable include:

- Riparian areas, wetlands, and floodplains essential for aquatic wildlife, waterfowl, other birds, beavers, otters, mink, and raccoons.
- Shrub-steppe communities that are home to numerous species, including sage- and sharp-tailed grouse, pronghorn, wintering elk and deer, and those that provide important foods and medicine.
- Mountain meadows that are important for water storage, camas, beaver, and ungulates.
- Forests communities, which harbor huckleberries, roots, oaks, western gray squirrels, spotted owls, fisher, bear, deer, elk, songbirds, and many other species.
- Alpine and subalpine ecosystems and headwaters that are important for water storage and home to local populations of whitebark pine, Clark's nutcracker, mountain goats, pikas, wolverines, ptarmigans, lynx, and the American marten.

Although some animals like deer and elk seem to be more resilient and survive across many landscapes, from rangelands to fringe and forest, they may see changes in their critical habitats (including wintering areas) driven by the expansion of invasives such as cheatgrass. A resulting decrease in native forage may increase competition and lead to diminished populations. Animals may turn to less suitable forage such as riparian trees and shrubs, which may then be affected by overgrazing.

We have already observed earlier budding and flowering of plants and are concerned about potential impacts to migrating species, which depend upon the timing of these cycles. Changes in plant calendars also affect the timing of our feasts, which have occurred earlier over the years. Berries ripen quickly and die out faster than in the past, which affects not only our ability to gather, but also the broader food web. For example, if bears have less food available to them, they will be less able to store adequate fat for overwinter hibernation.

Our tradition has always been to periodically, yet routinely, use fire as a tool to protect the forest and refresh the many vegetative communities contained therein. Now, for too many years fires have been suppressed,



which disrupts the natural cycles. Fuels loads are too high, and summers are becoming unusually hot and dry. Uncontrolled wildfire is now becoming too common, threatening the plant communities upon which many of our precious wildlife species depend. Meanwhile, we are also seeing increasing outbreaks of forest disease and bug infestations.

Existing programs that contribute to resilience

The Yakama Nation has taken great steps towards holistic management approaches that are consistent with our heritage and cultural interests. This is demonstrated through our management plans as well as through our fish, wildlife, law and order, and other codes protecting these resources. Progress has been made towards management of our riparian areas and controlling invasions of Russian olive. Restoration activities have restored thousands of acres of riparian and shrub-steppe habitats and have reconnected dozens of miles of anadromous streams to their floodplains and surrounding wetlands. Integration of multiple resource interests continues to improve within our forestry practices. Our wildlife program is re-introducing sage grouse and pronghorn, managing elk and deer, and monitoring migratory waterfowl, horses, and bighorn sheep. Our ability to inventory and learn about the status and trends concerning our resources continues to improve.

Additional initiatives that the Yakama Nation Wildlife, Range, and Vegetation Resources Management Program is undertaking that are already contributing directly or indirectly to climate resilience (or that could be modified or expanded to help build climate resilience) include:

- Conducting a meadow assessment to evaluate stressors and their impacts on meadow condition and continuing ongoing efforts to remove invasive trees. Sporadic funding for this program has made it difficult to ensure its robustness.
- Adjusting the terms of agricultural leases to include clauses that protect wildlife habitat.
- Managing riparian and wetland habitats with an eye to protecting local waterfowl and other wetland creatures like beaver, otter, and mink. Climate change projections could be considered more explicitly within this project to ensure an understanding of how climate change could present additional risks to key species and their habitats.
- Purchasing farm properties from willing landowners in order to convert agricultural land in riparian areas back into native habitat and shifting farmland to non-riparian zones.
- Protecting habitats and biodiversity by tackling invasive plant species through an Integrated Weed Management Plan for the Yakama Reservation and a Priority Invasive Plant List. Key plants on this list include the scotch thistle, Japanese knotweed, purple loosestrife, yellow starthistle, and Russian olive. If we can better understand how climate change could intensify or counteract the spread of these and other invasive plants, it would help us optimize our management decisions. The impacts of some invasive species—such as the Russian olive, which puts pressure on water reserves—may also be exacerbated by climate change impacts that affect water and other resource availability [28].
- Assisting Tribal members in the lower valley—White Swan, Wapato, and Toppenish—through the Nuisance Animal Management Program. For example, the program can trap bears and release them farther away from populated areas [29]. The program may need to be expanded if climate change impacts at other elevations and in primary habitats drive large mammals to make more inroads into human communities.



Courtesy of Yakama Nation staff



These efforts are critical but will likely not be enough over time. We will need to continue integrating climate adaptation into all of our ongoing and future planning and implementation efforts.

Potential actions and information needs

To support the development of the Climate Adaptation Plan throughout the territories of the Yakama Nation (Planning Area) the Tribal Council directs that the following actions be evaluated and that recommendations for future actions be provided:

RESEARCH AND MONITORING

- 1. Gather more detailed information** to understand climate vulnerabilities and risks to native species and develop recommendations to address these issues. In particular, consolidate and summarize the status and trend of the Threatened, Endangered and Sensitive species found within the Territories and partner with agencies and universities on research to better understand how climate change will exacerbate threats to these species.
- 2. Develop an inventory and monitoring plan** to continue tracking the range, distribution, and viability of important species in the context of a changing climate.
- 3. Seek to better understand habitat connectivity needs in the context of climate change.** Analyze the relationship between culturally important wildlife “indicator species” and the associated vegetative characteristics on which they depend throughout the annual cycle. Relate this analysis to future climate change projections with an emphasis on understanding connectivity of various habitats through migration corridors and the overall projected ecological health of these communities. At a minimum, this analysis should consider the following vegetation-types: alpine/subalpine, mixed pine and fir dominant forests, shrub-steppe, prairie/rangelands and agricultural/irrigated lands.
- 4. Monitor predators (e.g., bears and cougars) and develop a safety awareness campaign** related to large predator interactions with communities, as they may interact more with human populations as development continues and their habitats are affected by climate change.

MANAGEMENT AND IMPLEMENTATION

- 1. Protect and enhance priority floodplains and riparian areas** that provide habitat for riparian-dependent species and important foods and medicines that could be adversely impacted by climate change.
- 2. Use beaver to help restore riparian habitat.** Recognize the importance of beavers as a keystone species to the stream and riparian ecosystems and one that can help with water storage in the context of a changing climate and changing hydrology. Develop a comprehensive plan that will re-introduce, enhance, and maintain beaver populations on the reservation lands. Identify places throughout the Planning Area where these pilot efforts should be expanded.
- 3. Consider operating plant nurseries and seed banks** that can support reseeding and reforestation efforts in response to future wildfires, ecosystem restoration actions, and other climate adaptation strategies. Collect seeds of native plants and plants that are expected to be resilient to the future climate.
- 4. Continue to work to address the issues associated with uncontrolled wild horse populations** on the reservation lands, as these are an additional stressor that interacts with climate change pressures on vegetation and habitat.
- 5. Incorporate climate change considerations into management plans** for protecting sensitive and vulnerable species.
- 6. Continue to pursue efforts to implement a substantially increased controlled burn program** in priority areas.
- 7. Evaluate long-term funding needs to staff and appropriately fund wildlife activities** associated with climate change.



TOXICS

Introduction

Throughout the Columbia Basin, our soil, ground water, and streams are contaminated from toxic chemicals. Some of these chemicals are naturally occurring but many were manufactured for use in industry, agriculture, and personal care. Certain contaminants, such as PCBs, PBDEs, DDT, and mercury are found at elevated concentrations in many locations and are known to produce adverse effects on fish, wildlife, and humans. Negative effects of contaminants on reproduction, behavior, the immune system and other aspects of the biology of our fish and wildlife resources within the Columbia River Basin have been documented although not widely studied.

Anticipated climate impacts and vulnerability

There is a growing body of knowledge that climate change will have broad negative impacts on both the distribution and the toxicity of contaminants. Exposure to climate-related stress is likely to make fish and other organisms more sensitive to toxic contaminants, and exposure to contaminants is likely to make organisms more vulnerable to changes in climatic conditions. Rising temperatures, more intense storms, and droughts are changing the way contaminants interact with the environment, and this may have serious consequences for ecosystems and organisms.

The effects of climate change may also lead to an increased use of toxic chemicals in agricultural areas of the Columbia Basin. Researchers have observed that, as air temperatures increase and winter temperatures become more mild, there may be related increases of agricultural pests such as insects, weeds, and fungi. As a result, growers may need to use more pesticides to respond to these pests.

With more intense storms and flooding, there will be greater runoff and erosion, increasing the input of sediment- or soil-bound contaminants such as pesticides, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs) into water bodies. Moreover, increases in the intensity and frequency of storm events linked to climate change could lead to more severe episodes of chemical contamination of water bodies and surrounding watersheds.

Scientists predict increased fire activity as a result of increased drought. Fire damage from fire at locations where harmful chemicals are located could result in toxic chemicals leaching into the local environment through the air and soil.



Courtesy of Yakama Nation staff



Potential actions and information needs

To support the development of the Climate Adaptation Plan throughout the territories of the Yakama Nation (Planning Area), the Tribal Council directs that the following actions be evaluated and that recommendations for future actions be provided:

RESEARCH AND MONITORING

1. **Identify cleanup sites and areas of toxic contamination where changes in surface and groundwater flow due to climate change** (e.g. larger floods, erosion, fire) will result in new or greater releases of toxic substances to the environment.
2. **Identify problems that might occur in reservoir forebays** with respect to toxics (e.g., mobilization of contaminated sediments deposited behind dams and of industry contaminants located along those river reaches).

MANAGEMENT AND IMPLEMENTATION

1. **Develop an education and outreach strategy** focus on the ongoing and potential effects of increased exposure to toxic materials on the community and natural resources due to climate change.
2. **Educate people about known contamination issues** to prevent unintended consequences associated with land use conversion and climate change impacts.
3. **Coordinate with local and regional toxics cleanup regulators** to update climate change adaptation planning and implementation guidance.
4. **Partner with agricultural extension offices** to encourage sustainable farming practices that are aligned with future climate conditions to prevent the overuse of pesticides and fertilizer.



Courtesy of Yakama Nation staff



Appendix 1: Key Terms

The following definitions are primarily derived from the EPA Glossary of Climate Terms, the USDA Forest Service Climate Change Glossary, the Intergovernmental Panel on Climate Change (IPCC), the U.S. Fish and Wildlife Service TEK Fact Sheet (2011), Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments [31], and the Saint Regis Mohawk Tribe Climate Adaptation Plan.

Adaptation: Actions in response to actual or expected climate change and its effects, that lessen harm or exploit beneficial opportunities. It includes reducing the vulnerability of people, places, and ecosystems to the impacts of climate change.

Climate: The average pattern for weather over a period of months, years, decades, or longer in a specific place.

Climate change: Any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period of time (decades or longer). Climate change may result from natural factors and processes and from human activities that change the atmosphere's composition and land surface.

Climate-resilient community: A community that takes proactive steps to prepare for (i.e., reduce the vulnerabilities and risks associated with) climate change impacts.

Exposure: The nature and degree to which a system is exposed to significant climate variations.

Greenhouse gas (GHG): Any gas that absorbs infrared radiation in the atmosphere; examples include carbon dioxide, methane, nitrous oxide, ozone, and water vapor.

Measure of resilience: A quantitative or qualitative judgment that you make and track over time to determine how well your actions meet the preparedness goals you have set.

Peak streamflow: The maximum instantaneous discharge of a stream or river at a given location.

Planning areas: The areas in which a government or community manages, plans, or makes policy affecting the services and activities associated with built, natural, and human systems. Planning areas can be as broad or as specific as necessary.

Preparedness action: The activity or activities that your government or community undertakes to achieve its preparedness goals.

Preparedness goal: What you want to accomplish in your priority planning areas through preparedness action.

Priority planning areas: The planning areas which your community or government determines to be most important for focusing your preparedness efforts, based on your community's vulnerabilities to climate change and associated risks.



Projection: A potential future evolution of a quantity or set of quantities, often computed with the aid of a model. Projections are different from predictions in that projections involve assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realized.

Resilience: The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.

Sensitivity: The degree to which a built, natural, or human system is directly or indirectly affected by changes in climate conditions (e.g., temperature and precipitation) or specific climate change impacts (e.g., sea level rise, increased water temperature). If systems in a planning area are likely to be affected as a result of projected climate change, then that system should be considered sensitive to climate change. For instance, a community of coldwater fish at the southern edge of its range is highly sensitive to changes in climate, because even a slight warming may make its habitat unsuitable. In turn, regional economies based on fisheries solely targeting those fish would also be highly sensitive to changes in climate.

Systems: The built, natural, and human networks that provide important services or activities within a community or region. Built systems are networks of facilities, buildings, and transportation infrastructure like roads and bridges. Natural systems are ecological networks of fish, wildlife, and natural resources like water. Human systems are networks of public health clinics, courts, and government.

Traditional Ecological Knowledge (TEK): The evolving knowledge acquired by indigenous and local peoples over hundreds or thousands of years through direct contact with the environment. This knowledge is specific to a location and includes the relationships between plants, animals, natural phenomena, landscapes, and timing of events that are used for lifeways, including but not limited to hunting, fishing, trapping, agriculture, and forestry.

Vulnerability: The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. It is a function of the sensitivity of a particular system to climate changes, its exposure to those changes, and its capacity to adapt to those changes.

Weather: The atmospheric conditions at a specific place at a specific point in time.



Appendix 2: References

[1]	A. K. Snover, G. S. Mauger, L. C. Whitely Binder, M. Krosby and I. Tohver, "State of Knowledge Report: Climate Change Impacts and Adaptation in Washington State," University of Washington Climate Impacts Group, Seattle, 2013.
[2]	Yakima Herald-Republic and The Associated Press, "High temps add up to Yakima's warmest June on record," Yakima Herald, 1 July 2015.
[3]	D. Fears, "As salmon vanish in the dry Pacific Northwest, so does Native heritage," The Washington Post, 30 July 2015.
[4]	R. Courtney, "Hazy days: Fires leave local skies a murky mess," Yakima Herald, 2 August 2015.
[5]	USGS, Climate Change Viewer.
[6]	Presentation by Dan Isaak, USFS., 2015.
[7]	H. Adelman and J. Ekrem, "Preparing for a Changing Climate: Washington State's Integrated Climate Response Strategy," Washington State Department of Ecology, 2012.
[8]	J. S. Littell, E. E. Oneil, D. McKenzie, J. A. Hicke, J. A. Lutz, R. A. Norheim and M. M. Elsner, "Forest ecosystems, disturbance, and climatic change in Washington State, USA," Climatic Change, 2010.
[9]	R. F. Noss, "Beyond Kyoto: Forest Management in a Time of Rapid Climate Change," Conservation Biology, vol. 15, no. 3, pp. 578-590, 2001.
[10]	A. S. Weed, B. J. Bentz, M. P. Ayres and T. P. Holmes, "Geographically Variable Response of Dendroctonus ponderosae to Winter Warming in the Western United States," Landscape Ecology, vol. 30, no. 6, pp. 1075-1093, 2015.
[11]	B. J. Bentz, J. Regniere, C. J. Fettig, E. M. Hansen, J. L. Hayes, J. A. Hicke, R. G. Kelsey, J. F. Negron and S. J. Seybold, "Climate Change and Bark Beetles of the Western United States and Canada: Direct and Indirect Effects," BioScience, vol. 60, no. 8, pp. 602-613, 2010.
[12]	C. L. Raymond, D. L. Peterson and R. M. Rochefort, "Climate change vulnerability and adaptation in the North Cascades region, Washington," U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, 2014.
[13]	Washington Department of Ecology, "Climate Change and the Columbia River Basin," [Online]. Available: http://www.ecy.wa.gov/programs/wr/cwp/cr_climate.html . [Accessed 2 February 2016].
[14]	V. Burkett and J. Kusler, "Climate Change: Potential Impacts and Interactions in Wetlands of the United States," Journal of the American Water Resources Association, vol. 36, no. 2, pp. 313-320, 2000.
[15]	National Wildlife Federation and Washington Department of Fish and Wildlife, "Climate Change Effects on Freshwater Aquatic and Riparian Habitats in Washington State," National Wildlife Federation and Washington Department of Fish and Wildlife, 2011.
[16]	M. Ryan, Modeling climate change effects on the hydrology of North Cascades wetland ecosystems, National Park Service.
[17]	Yakama Nation Wildlife, Range, and Vegetation Resources Management Program, "Wetlands and Riparian Restoration Project," 3 May 2011. [Online]. Available: http://www.ynwildlife.org/wetlandsmainpage.php . [Accessed 2 February 2016].



[18]	Columbia River Inter-Tribal Fish Commission, "Wy-Kan-Ush-Mi Wa-Kish-Wit Plan Update," 2014.
[19]	Yakima Basin Storage Alliance, "Attempts at Drought Relief in the Yakima Basin," [Online]. Available: http://ybsa.org/ . [Accessed 2 February 2016].
[20]	C. e. al., 2011.
[21]	K. e. al., 2008.
[22]	R. a. V. R. M. P. Yakama Nation Wildlife, "Vegetation and Invasive Plant Management," [Online]. Available: http://www.ynwildlife.org/invasiveplantprogram.php . [Accessed 2 February 2016].
[23]	Yakama Nation Wildlife, Range and Vegetation Resources Management Program, "Nuisance Animal Management," [Online]. Available: http://www.ynwildlife.org/nuisanceanimalprogram.php . [Accessed 2 February 2016].
[24]	A. K. Snover, L. Whitely Binder, J. Lopez, E. Willmott, J. Kay, D. Howell and J. Simmonds, "Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments," 2007.
[25]	J. Kusler, "Common Questions: Wetland, Climate Change, and Carbon Sequestering," Association of State Wetland Managers, Inc., and the International Institute for Wetland Science and Public Policy, 2006.
[26]	J. W. Day, R. R. Christian, D. M. Boesch, A. Yanez-Arancibia, J. Morris, R. R. Twilley, L. Naylor, L. Schaffner and C. Stevenson, "Consequences of Climate Change on the Ecogeomorphology of Coastal Wetlands," <i>Estuaries and Coasts</i> , vol. 31, pp. 477-491, 2008.
[27]	Washington Department of Fish and Wildlife and the National Wildlife Federation, "Summary of Climate Change Effects on Major Habitat Types in Washington State," 2011.



Notes



