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PUBLIC UTILITY
DISTRICT NO. 1
of Whatcom County

WHATCOM COUNTY DROUGHT CONTINGENCY PLAN

Prepared for Public Utility District No. 1 of Whatcom County

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WPUD 116.142

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PREFACE

Public Utility District No. 1 of Whatcom County (PUD) applied for and received a grant from the U.S. Bureau of Reclamation (Reclamation) to prepare the Whatcom County Drought Contingency Plan (DCP). To ensure broad involvement of local stakeholders, the PUD created the Drought Contingency Plan Task Force, which met periodically and provided information to the PUD's consultant, RH2 Engineering, Inc., (RH2). Details about the Task Force may be found in the DCP in the section entitled **Drought Contingency Plan Task Force,** and the membership is listed in **Table 1**.

At the Task Force meeting on February 21, 2019, the Task Force voted to approve the February 2019 Final Draft of the DCP for submittal to the PUD Commissioner's for their approval and subsequent submittal to Reclamation for review and approval. With the approval by the Task Force, the PUD committed to convene a meeting of the Task Force within 30 days of the approval of the DCP by Reclamation. The purpose of that meeting is to identify and prioritize Whatcom County-specific mitigation measures and identify Task Force parties responsible for the development and implementation of those elements of the DCP.

EXECUTIVE SUMMARY

This Whatcom County (County) Drought Contingency Plan has been prepared to guide local agencies responsible for planning for, and responding to, drought conditions in the County and for coordinating such activities with the State of Washington. The DCP was prepared by the PUD's consultant, RH2, with the assistance of the Whatcom County Drought Contingency Plan Task Force, which consists of a broad spectrum of local stakeholders. Funding for development of the DCP was provided by a grant from the U.S. Bureau of Reclamation, with matching funds provided by the PUD.

The DCP relies on the ongoing water supply monitoring efforts conducted by the State of Washington and establishes a process to ensure local involvement in those efforts. The State's definition of drought is when an area is projected to receive 75 percent or less of normal water supply and where that is expected to create an undue hardship. The DCP proposes involvement of the Task Force in the State's activities related to Whatcom County, specifically by providing input on whether a projected deficit of water is expected to create undue hardship.

The DCP is organized around requirements of the U.S. Bureau of Reclamation as conditions of the grant. Required elements are:

1. Drought Monitoring
2. Vulnerability Assessment
3. Mitigation Actions (defined as actions taken during non-drought periods to alleviate the adverse impacts of a drought)
4. Response Actions (defined as actions taken during a drought to alleviate adverse impacts of a drought)

5. Operational and Administrative Framework
6. Plan Update Process
7. Communication and Outreach

RH2 worked with Task Force members to develop details of the DCP, including the discussions of sector-by-sector vulnerability, mitigation measures, response actions, and the anticipated impacts of climate change.

With the approval of the DCP by the Task Force, the DCP was submitted to the Commissioners of the PUD for approval and then submitted to Reclamation for final review and approval. Future work of the Task Force will focus on identification, prioritization, and implementation of Whatcom County-specific mitigation measures aimed at reducing the impacts of future droughts.

PURPOSE OF THE PLAN

This Whatcom County (County) Drought Contingency Plan (DCP) has been prepared to guide local agencies responsible for planning for, and responding to, drought conditions in the County and for coordinating such activities with the State of Washington. The State's lead agency in drought response is the Department of Ecology (Ecology), which is granted emergency powers in times of drought to take expedited actions to address water supply shortages caused by drought conditions. Washington State recently updated its Drought Contingency Plan with the assistance of a WaterSMART grant from the U.S. Bureau of Reclamation (Reclamation). Whatcom County currently does not have a DCP. Public Utility District No. 1 of Whatcom County (PUD) is leading the development of this DCP with the assistance of the DCP Task Force. The Task Force is discussed in more detail in the section entitled **Drought Contingency Plan Task Force**. The most recent version of the State Drought Contingency Plan can be viewed at https://www.ezview.wa.gov/site/alias__1962/view_our_committees_drought_contingency_plan/37293/drought_contingency_plan.aspx.

The Whatcom County DCP will be coordinated with the State DCP but will focus on local issues and solutions. Specifically, the State monitors water supply conditions throughout Washington in conjunction with several partners that comprise the Water Supply Availability Committee (Committee), including the U.S. Geological Survey, the Washington State Climatologist, the National Weather Service, the Natural Resources Conservation Service, the U.S. Bureau of Reclamation, the U.S. Army Corps of Engineers, and the Bonneville Power Administration. The Whatcom County DCP will rely on this Committee for monitoring and forecasting water supply conditions. When the forecast indicates that all or part of the County is expected to receive less than 75 percent of its normal water supply, the local DCP Task Force will assist the Governor's Executive Water Emergency Committee in determining whether this water supply shortage is expected to result in undue hardships in the County. If it is, the Task Force will urge the Committee to recommend that the Governor declare a drought emergency for the affected area.

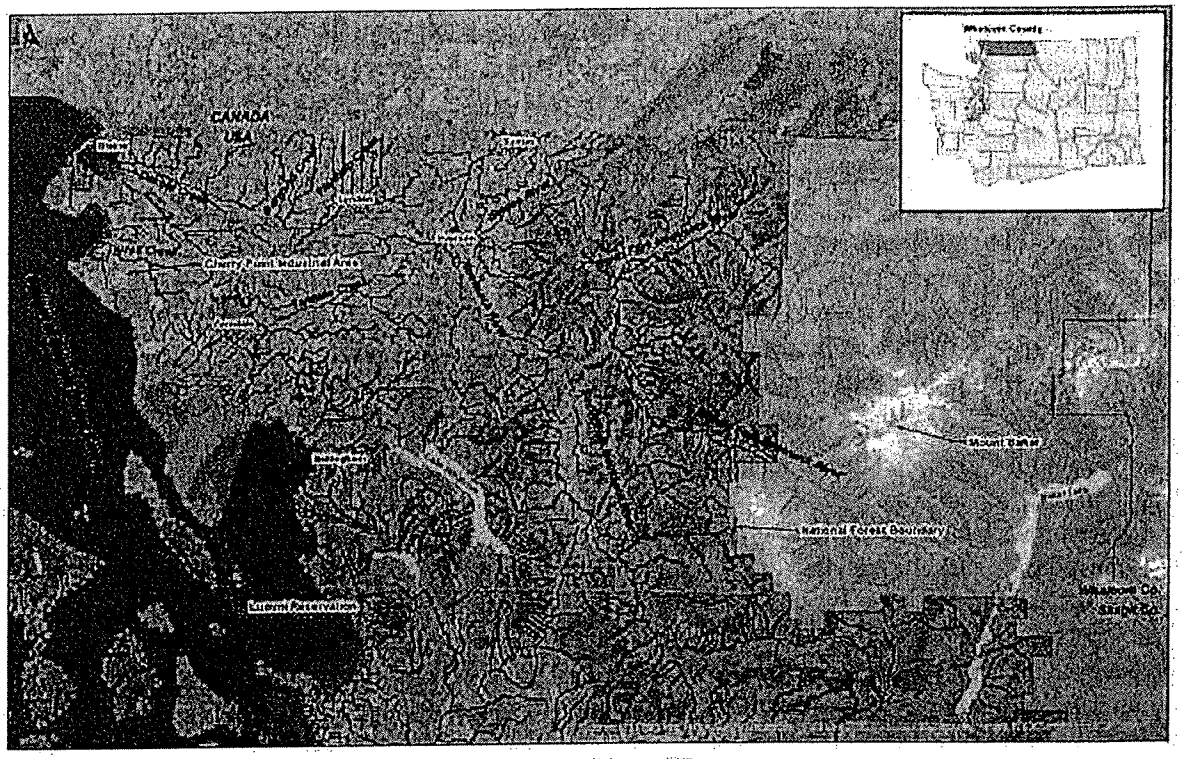
Perhaps more importantly, this DCP will serve as the foundation or platform for future actions designed to mitigate drought impacts and improve the effectiveness of local drought response actions in the County. This will occur through continued work by the Task Force which, under the guidance of the PUD, will be charged with identifying Whatcom County-specific mitigation measures and response actions and determining the best means of implementing those measures.

BACKGROUND

Whatcom County is in the northwest corner of Washington State and covers over 2,503 square miles, of which about 2,107 square miles are land and 397 square miles are water. Elevations range from sea level to the top of Mount Baker at about 10,780 feet. The County is home to over 215,000 people. The PUD applied for and received a grant from Reclamation to develop this DCP. The total project cost is $100,000, with half from Reclamation and the remaining match from the PUD.

The development of the DCP is expected to focus on all the County west of the Mount Baker-Snoqualmie National Forest Boundary; however, the DCP identifies some drought mitigation and response actions that are appropriate for lands within the National Forest (**Figure 1**). These measures were provided by representatives of the U.S. Forest Service.

Figure 1
Whatcom County Site Map



In addition to the Whatcom County DCP, the County recently adopted an update to its *Coordinated Water System Plan* (CWSP). The CWSP identified several issues, policies, and procedures related to the management of public water systems in the County, including an assessment of the water demands under current and full build-out conditions and an analysis of each system's water rights and their ability to meet current and future water demands. The CWSP identified systems that will have a surplus of water after meeting future demands, systems with adequate water rights to meet their full projected demand without a surplus supply, systems with enough water to meet current demands but not enough to satisfy future demands, and systems that have an existing deficit (i.e., they do not have legal water rights to meet their existing demands, let alone future build-out). Systems with a surplus of water at full build-out are shown in **Table 4** in the **Mitigation Measures** section.

Depending on their existing source of water, some public water systems are subject to potential hardships during droughts. This DCP will build on the information provided in the CWSP as the elements related to public water systems are developed. The CWSP may drive the identification and development of drought-related mitigation and response actions related to public water systems included in the DCP. For example, the systems with more water rights than needed to meet future demand (surplus water) will be evaluated as potential sources during times of drought.

If water system surplus is to be evaluated, it may include the construction of interties to connect the systems with surplus water to systems that may experience drought hardships. This is discussed in more detail in **Mitigation Measures**. Proposed interties are reviewed by both the

Washington State Department of Health (DOH) and Ecology. DOH is responsible for engineering and capacity considerations, and Ecology is responsible for any water rights related issues. The time required for approval will vary depending on several factors, including the size and complexity of the project from an engineering standpoint, the complexity as it relates to water rights, and the workload of DOH and Ecology staff.

The state has engaged in watershed planning in numerous watersheds across the state. In the County, a watershed plan was adopted in June 2005 for Water Resources Inventory Area (WRIA) 1. The adoption was followed by several actions and reports, including the *Detailed Implementation Plan* (DIP) in 2007 and the *State of the Watershed Report* in 2010.

Since 2016, watershed management and salmon recovery programs in WRIA 1 have been coordinated and integrated through the WRIA 1 Watershed Management Board. The County's DCP has been developed in consideration of the WRIA 1 watershed management project and the Watershed Management Board decision-making structure, which is discussed in more detail in the **Operational and Administrative Framework** section. In addition, the agricultural community has established six Watershed Improvement Districts (WIDs) in the County, and the DCP has been coordinated with the WIDs via involvement of the local Ag Water Board that was created, in part, to coordinate the actions of the individual WIDs. The Ag Water Board is a member of the DCP Task Force.

In addition, public water systems are encouraged to prepare water shortage response plans as part of their Comprehensive Water System Plans that they submit to DOH. DOH also has published an Emergency Response Planning Guide[1] in which public water systems may identify Response Actions for Specific Events (Section 10), including sub-sections J (Reduction or loss of water in the well) and K (Drought). In Section 11 (Alternative Water Sources), systems are asked to identify interties with adjacent water supply systems and evaluate emergency supply sources, and in Section 12, describe plans to curtail water usage. While not all systems are required to provide this level of detail, water systems with perceived vulnerabilities to drought would be well-advised to consider these elements as they develop or update their water system plans.

HYDROLOGIC SETTING

The Nooksack River and its tributaries are a major source of water in Whatcom County (**Figure 1**); however, the City of Bellingham withdraws the bulk of its water from the Lake Whatcom drainage. The North Fork and Middle Fork of the Nooksack River are glacially fed but are partially dependent on lower elevation melt of snowpack and rainfall. In 2017, there were 148 glaciers and glacierets in WRIA 1 that cover 15.75 square miles. Approximately 12 square miles are in the North Fork drainage, and about 3.3 square miles are in the Middle Fork drainage. During the summer of 2015, 60 to 90 percent of the flows in the North Fork were comprised of glacial melt water. The South Fork drainage has only about 0.4 square miles of glacier[2] and, as a result, flows in the lower elevation South Fork are dependent on snowpack and precipitation.

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[1] Washington State Department of Health. (2017, January). *Emergency Response Planning Guide for Public Drinking Water Systems.* DOH Pub. 331-211 https://www.doh.wa.gov/Portals/1/Documents/Pubs/331-211.pdf

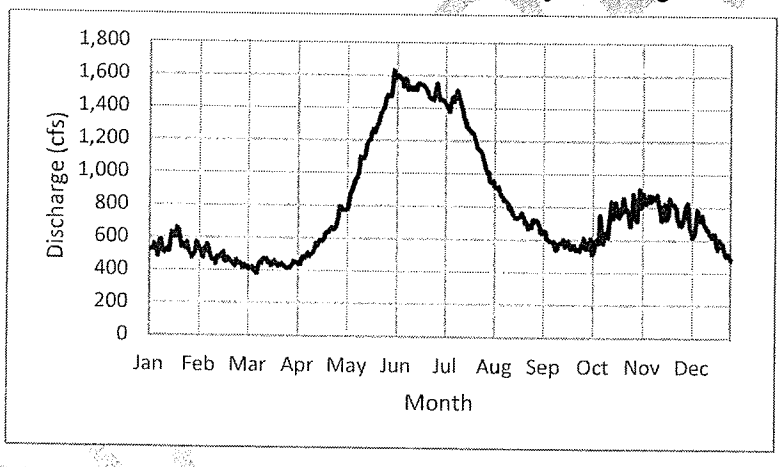
[2] Grah, Oliver. (2017, June 1 and 2). *Impacts of Climate Change on Water Supply as a Result of Glacier Ablation and Altered Hydrologic Regime of the Nooksack River.* Speech presented to Tribal Waters in the Northwest, Law Seminars International, Seattle, WA.

Historically, there have generally been three distinct streamflow regimes in the Nooksack River basin:[3]

> Streams which head at the glaciers of Mt. Baker and adjacent peaks have a characteristic high-water period early each summer, a well-sustained flow during late summer and early fall, and a low-water period during the winter. The high-water period in spring and early summer represents water coming out of storage in the form of snowmelt from large packs accumulated during winter months. The sustained late summer flow is maintained for the most part by melt water from glaciers and high snow fields, while the low period during winter is the result of freezing temperatures which prevent accumulating snows from melting and running off.

Figure 2 illustrates the North Fork Nooksack River Mean Daily Discharge, which is a typical hydrograph of a stream with glacial melt and snowmelt dominated flows.

Figure 2
North Fork Nooksack River Mean Daily Discharge



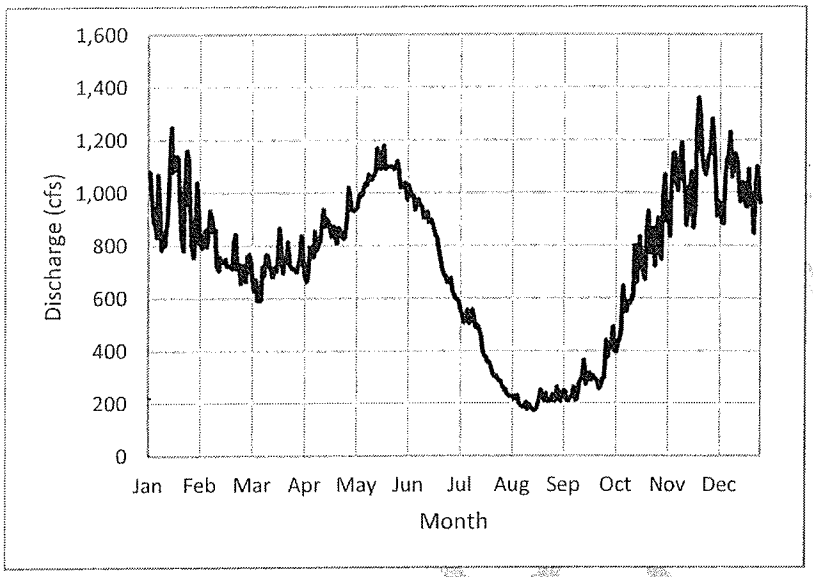
> In the second category are streams that originate in mountainous areas where winter precipitation at higher altitudes is largely in the form of snow, and at lower altitudes is rain. In this environment, a large portion of the annual runoff occurs during winter but is followed later in the year by a second high-water period derived from melting of accumulated winter snows. The low-water period occurs late in summer and early fall because these watersheds lie below the elevation necessary to sustain perennial snow and ice.

Figure 3 illustrates South Fork Nooksack River Mean Daily Discharge, which is a typical hydrograph of a stream with snowmelt, precipitation, and groundwater dominated flows.

[3] State of Washington. Department of Conservation. (1960). *Water Resources of the Nooksack River Basin and Certain Adjacent Streams.* Water Supply Bulletin No. 12, 34-40.

Figure 3

South Fork Nooksack River Mean Daily Discharge



The third category includes streams whose basins lie largely at low altitudes. Some winter precipitation may be the form of snow, but in general the snow is short-lived. Annual runoff of these streams follows the general pattern of annual precipitation with the period of maximum discharges occurring from October to February and then gradually decreasing along with the precipitation trend to minimum flows during August and September.

The timing and magnitude of streamflow in the Nooksack River basin is influenced strongly by temperature and precipitation. Most of the Nooksack River basin consists of rainfall and transitional areas between snow melt dominated and rainfall dominated, with the smaller snow melt dominated areas occurring primarily above an elevation of 3,000 feet. Future climate forecasts made by general circulation models (GCMs) predict increases in temperature and variable changes to precipitation in Western Washington, which will affect streamflow, snowpack, and glaciers in the Nooksack River basin. Simulations of future streamflow and snowpack in the Nooksack River basin predict a range of magnitudes, which reflects the variable predictions of the climate change forecasts and local, natural variability. Simulation results forecast increased winter flows, decreased summer flows, decreased snowpack, and a shift in timing of the spring melt peak and maximum snow water equivalent. Modeling results for future peak flow events indicate an increase in both the frequency and magnitudes of floods, but uncertainties are high for modeling the absolute magnitudes of peak flows.[4]

In other words, **the historical patterns of water supply and runoff are changing, and it is likely that low stream flows and elevated water temperatures often associated with drought conditions will, in fact, become much more common.** In addition, the typical pattern of higher

[4] Dickerson, Susan E. (2010, May). *Modeling the Effects of Climate Change Forecasts on Streamflow in the Nooksack River Basin.*

water use during the driest part of the year is often exacerbated during droughts, where hotter and drier weather increases water use above normal levels at a time when water availability is even more limited.

DROUGHTS IN WHATCOM COUNTY

In 1977, Governor Dixie Lee Ray established an Ad Hoc Executive Water Emergency Committee to deal with problems associated with the 1976/1977 drought. In a report entitled *The History of Droughts in Washington State* (1977), the Committee cited the U. S. Weather Service in reporting that there had been 19 drought occurrences in the State of Washington since 1900. Since then, there have been several additional droughts. Because droughts were not defined in statute in Washington State until 1988, drought occurrences prior to that time were identified by other means such as the Palmer Drought Severity Index.

In 1934 and 1935, Western Washington experienced the longest drought period recorded. In 1977, the state experienced a statewide drought with the lowest precipitation, snowpack, and stream flows recorded to that time. In 2001, Governor Gary Locke declared a statewide drought emergency and, in 2010, the City of Bellingham imposed mandatory water use restrictions.[5]

Unlike classic droughts that are characterized by extended precipitation deficits, 2015 was the year of the "snowpack drought." Washington State had normal or near-normal precipitation over the 2014/2015 winter season. However, in October through March the average statewide temperature was 40.5 degrees Fahrenheit, 4.7 degrees above the twentieth century long-term average and ranking as the warmest October through March on record. Washington experienced record low snowpack because mountain precipitation that normally fell as snow instead fell as rain.

In the spring of 2015, the snowpack deficit was compounded as precipitation began to lag behind normal levels in early spring and into the summer. With record spring and summer temperatures, and little to no precipitation over many parts of the state, the snowpack drought morphed into a traditional precipitation drought, causing injury to crops and aquatic species. Many rivers and streams experienced record low flows. Some cities and towns turned to voluntary or mandatory water use restrictions to save water.[6]

Because of its reliance on lower elevation snowpack and precipitation, the County is susceptible to drought impacts such as those that occurred in 2014 and 2015. The average daily discharge of the Nooksack River at the United States Geological Survey (USGS) gage in Ferndale, Washington (USGS 12213100 Nooksack River at Ferndale, WA) for the period 1967 through 2016 is 3,883 cubic feet per second (cfs). On August 27, 2015, the river flow at Ferndale was 934 cfs, which is about 52 percent of the mean daily discharge for that date over nearly 50 years of record. During the summer of 2015, several holders of interruptible irrigation water rights from the Nooksack River were not able to divert water because of the low flows of the river. The conditions of water year 2015 are used to project what conditions might be with continued climate change by mid-to late century. For example, when USGS gage data for 2015 is compared to the median flows, it suggests that minimum instream flows would be met less frequently. For

[5] Whatcom Unified Emergency Management. (2010, August). *Whatcom County Hazard Identification and Vulnerability Analysis.* http://www.whatcomready.org/wp-content/uploads/2014/07/Whatcom-HIVA-2010.pdf

[6] Washington State Department of Ecology. Washington Drought Watch 2016. http://www.ecology.wa.gov/drought/index.html

the South Fork Nooksack River, the minimum instream flow during the late summer and fall is 300 cfs. This threshold amount is not met approximately 133 days for the median flows, but in 2015, was not met approximately 194 days, a difference of 61 days. This emphasizes the likelihood that minimum instream flows will be met less frequently in the future with climate change, and such a deficit will further exacerbate the availability of water to junior water right holders. Further, comparing water year 2015 hydrograph to the hydrograph for 2070 using the Distributed Hydrology Soils and Vegetation Model (DHSVM) reveals a strong correlation between the two. This further illustrates the utility of using 2015 conditions as an indicator of future conditions.[7][8]

Ecology also regulates groundwater rights when those rights have been issued subject to minimum instream flows; however, it does not appear that any groundwater rights were curtailed in WRIA 1 during the 2015 drought.

During the winter of 2014 and 2015, much of the precipitation in the mountains fell as rain rather than snow due to above average temperatures. The snowpack is essentially a "third reservoir," and is an important water source for rivers, as lowland precipitation tapers off in the late spring/early summer. This resulted in low snowpack and was the initial driver of the 2015 drought.[9]

The magnitude of the 2015 drought is illustrated with streamflow records from three gages on the Nooksack River. **Figure 4** depicts flow data for the lower Nooksack River at Ferndale and includes data for 2016. **Figures 5** and **6** depict flow data for the South Fork and North Fork, respectively. The long-term average discharge is depicted by the red line.

[7] Grah, Oliver. (2017, June 1 and 2). *Impacts of Climate Change on Water Supply as a Result of Glacier Ablation and Altered Hydrologic Regime of the Nooksack River.* Speech presented to Tribal Waters in the Northwest, Law Seminars International, Seattle, WA.

[8] Based on Robert Mitchell research as reported by Grah, Oliver. (2017, June 1 and 2). *Impacts of Climate Change on Water Supply as a Result of Glacier Ablation and Altered Hydrologic Regime of the Nooksack River.* Speech presented to Tribal Waters in the Northwest, Law Seminars International, Seattle, WA.

[9] Washington State Department of Agriculture. (2015, December). *Interim Report: 2015 Drought and Agriculture*, Publication No. [AGR PUB 104-395]. http://agr.wa.gov/FP/Pubs/docs/104-495InterimDroughtReport2015.pdf

Figure 4
Discharge from April through September 2015 Relative to Long-Term Average at Nooksack River at Ferndale, WA (USGS Site No. 12213100)

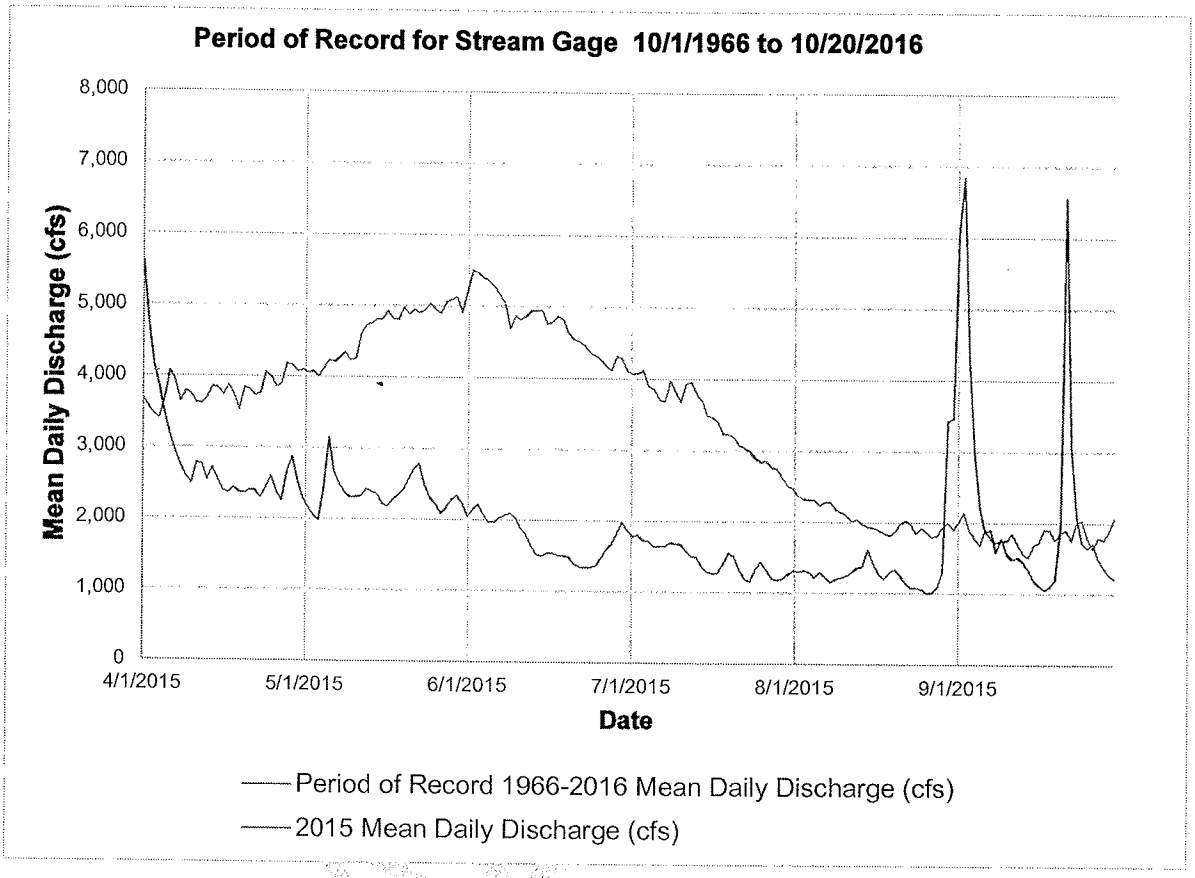
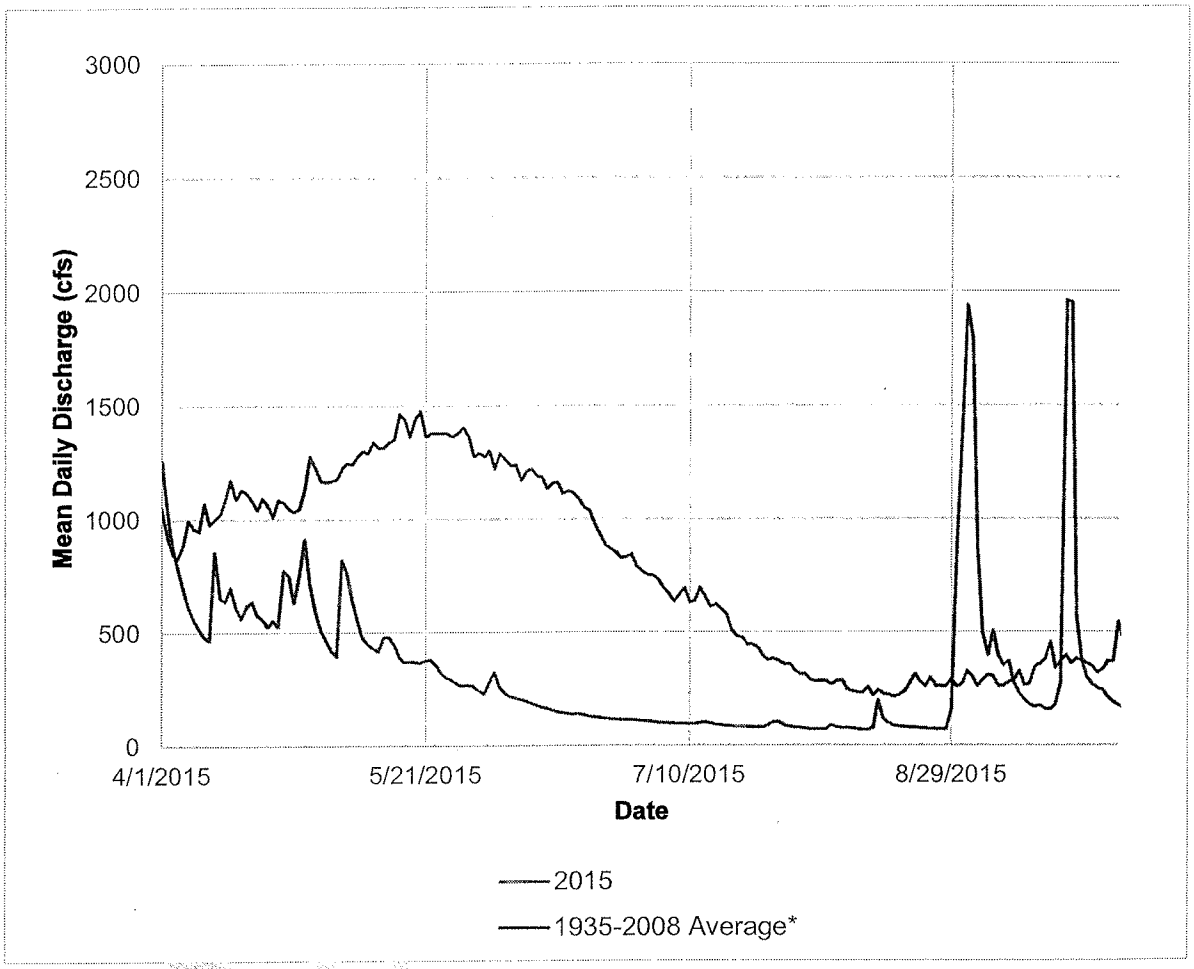


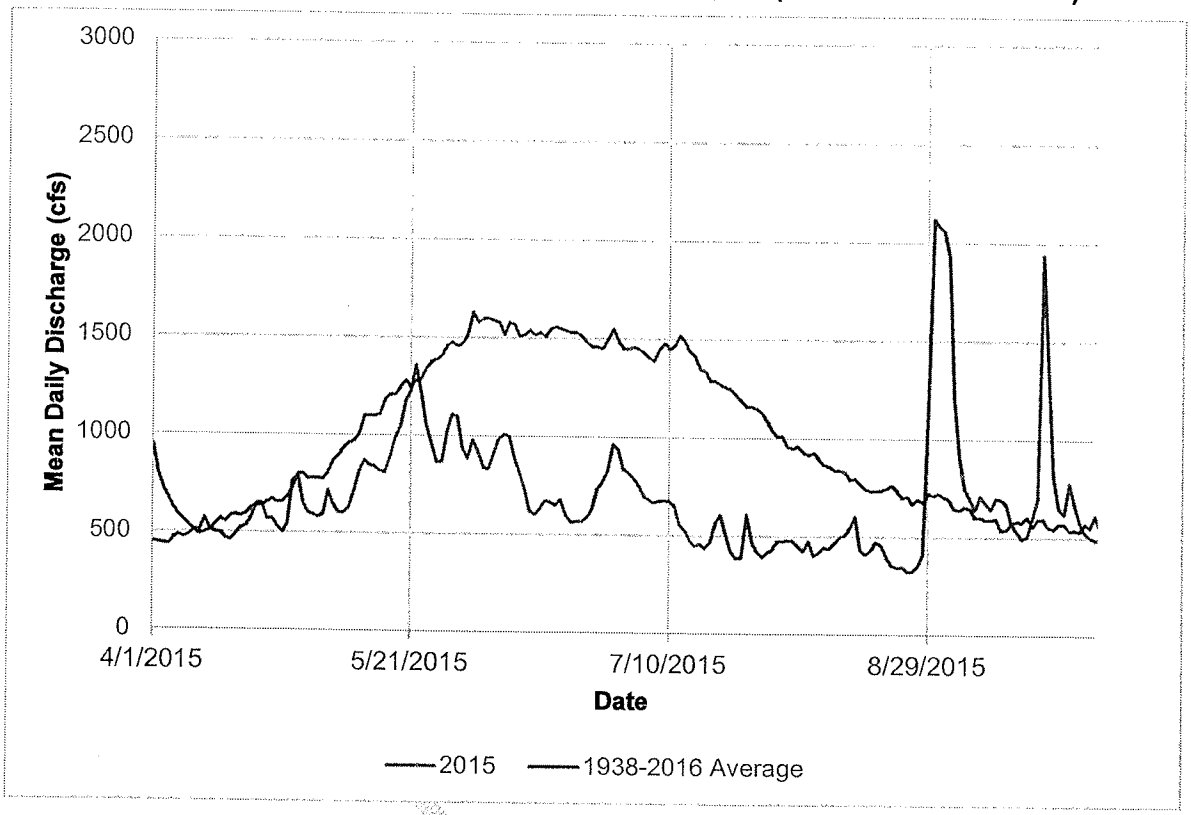
Figure 5

Discharge from April through September 2015 Relative to Long-Term Average at South Fork Nooksack River at Saxon Bridge, WA (USGS Site No. 12210000)



*Note: Period of record for the stream gage begins October 1, 2008. The Wickersham gage (12209000) operated from May 1, 1934 through September 30, 2008. The long-term daily mean values for Wickersham have been adjusted to the Saxon gage using a scaling factor of ~1.25 (129/130) that accounts for differences in the watershed area above each gage. Source: Treva Coe, Nooksack Indian Tribe.

Figure 6
Discharge from April through September 2015 Relative to Long-Term Average at North Fork Nooksack River below Cascade Creek near Glacier, WA (USGS Site No. 12205000)



During the 2015 drought, Western Washington growers reported impacts on crop yield, size, and quality. Prior to harvest, growers estimated that in a normal year, production would have been approximately 112 million pounds. The final harvest totals for 2015 were only 104 million pounds, a loss of 8 million pounds. Meetings with producers attributed all that loss to high temperatures immediately before and during harvest. The estimated loss of 8 million pounds (Washington State Blueberry Commission, 2015) at an assumed price of $0.97 per pound for processed blueberries based on U.S. Department of Agriculture National Agricultural Statistics Service (NASS) 5-year price average (NASS, 2015a) was approximately $7.76 million.[10]

Washington State is the largest producer of frozen red raspberries in the nation. In 2015, Washington State recorded 12,528 acres planted in red raspberries or other caneberries, of which 84 percent was in northwest Washington (Skagit and Whatcom Counties). Red raspberry growers in this region reported both size and quality impacts from the 2015 drought and extreme heat. The estimated loss of 26 percent of crop (based on 2014 yield of 72.6 million pounds, Washington State Red Raspberry Commission, 2015) at an average price of $0.735 per pound (5-year price average, NASS 2015a) was approximately $13.9 million.

[10] Washington State Department of Agriculture. (2017, February). *2015 Drought and Agriculture: A Study by the Washington State Department of Agriculture.* Publication No. AGR PUB 104-395.

Impacts of the 2015 drought were widespread and will be ongoing. In the agricultural industry, a drought is not a single point of impact, simply because crop growing periods, seeding, drought-damaged plants, and other issues take time to resolve. The long-term impacts of a drought take time to be understood completely. If climate and weather conditions like the 2015drought persist and become more regular, many farming operations are expected to struggle to stay solvent, despite their technological innovation and adaptation of new farming practices.

The 2015 drought also resulted in fishing closures across the state. In the Nooksack basin, sport fisheries in the South Fork Nooksack River were closed on July 16, 2015, and in the North Fork and its tributaries, Middle Fork and its tributaries, and mainstem Nooksack on August 27, 2015. Fishing was reopened in the lower Nooksack River (Slater Road to Deming) on September 2, 2015 and elsewhere on September 11, 2015. In addition to fishery closures, low instream flows associated with the 2015 drought reduced habitat capacity and productivity for salmon in the Nooksack basin. The economic impacts of the 2015 drought, both in terms of the short-term impact of sport fishing closures and the longer-term impacts of reductions in salmon production, have not been quantified.

WATER USE IN WHATCOM COUNTY

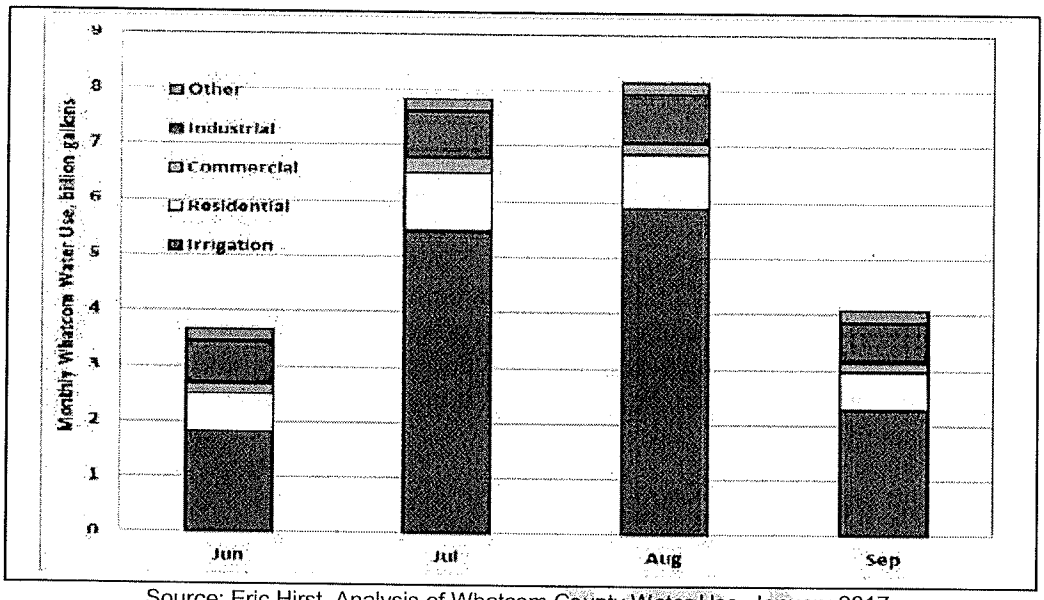
The population of Whatcom County in 2016 was 216,800.[11] The eastern third of Whatcom County is dominated by forested lands under the jurisdiction of the U.S. Forest Service and National Park Service. Land use in the western portion supports agriculture, urban, and residential development, commercial and industrial development, and forestry, each of which require a secure supply of high-quality water. Agricultural irrigation is the largest user of water in the County, followed by industrial and domestic uses. Irrigation use peaks in July and August. Agricultural irrigation uses about 44 percent of the total water, followed by industrial (24 percent) and residential (20 percent). Other uses (livestock, aquaculture, mining, and commercial) use about 12 percent of the total.[12]

Water use by sector for June through September of 2016 is illustrated in **Figure 7**.

[11] https://www.census.gov/quickfacts/fact/table/WA,whatcomcountywashington#viewtop
[12] Hirst, Eric. (2017, January). *Analysis of Whatcom County Water Use.* Bellingham, WA.

Figure 7

Water Use by Sector (June through September)



Source: Eric Hirst, Analysis of Whatcom County Water Use, January 2017

PUBLIC WATER SYSTEMS AND DOMESTIC WATER SUPPLY

More than 80 percent of the County's 216,000 residents obtain their drinking water from public water systems. There are approximately 283 Group A water systems and 293 Group B water systems.[13] [14] The remaining 20 percent that does not obtain its drinking water from a public water system obtains water from private water systems, including individual wells.

The City of Bellingham (Bellingham) is the County seat and the largest city (population 86,720 in 2017).[15] Other cities and towns include Blaine, Ferndale, Everson, Lynden, Nooksack, and Sumas. The total County population is forecast to increase to approximately 290,000 by 2040.[16] This population growth will increase the importance of the wise and efficient use of water and amplifies the need for an effective drought response plan to mitigate the impacts of future droughts in the County.

Bellingham's primary water supply source is the Lake Whatcom watershed, which is not part of the Nooksack watershed. However, the City also has a right to divert water from the Middle Fork Nooksack River into Lake Whatcom and then into the City's water system.

When Bellingham elects to augment lake levels by diverting water from the Middle Fork Nooksack River, the water flows by pipeline to Mirror Lake/Anderson Creek and then into the

[13] https://fortress.wa.gov/doh/eh/portal/odw/si/FindWaterSystem.aspx

[14] A Group A system is a system that services 15 or more connections or 25 or more people per day for 60 or more days per year. A Group B water system is a system that serves less than 15 connections and less than 25 people per day or 25 or more people per day during fewer than 60 days per year.

[15] City of Bellingham Population Growth. https://www.cob.org/services/maps/population

[16] Washington Office of Financial Management. December 2017 GMA Projections. https://ofm.wa.gov/sites/default/files/public/dataresearch/pop/GMA/projections17/gma_2017_high_low_charts.pdf

south end of Lake Whatcom. In recent years, Bellingham has minimized the use of the Middle Fork diversion, relying solely on Lake Whatcom water generated by its watershed. Bellingham withdraws and treats water from Lake Whatcom and distributes that water to its customers via a water treatment and pumping plant located near the north end of the lake.[17]

The low elevation Lake Whatcom watershed is a rain-dominated watershed with minimal snow contribution and no accumulation of significance. The Middle Fork Nooksack River watershed is fed by rain, snowpack, and the Deming Glacier on Mount Baker. Meltwater from the Deming Glacier helps to sustain flows in the Middle Fork during the late summer and early fall when snowpack melt contribution is minimal.

AGRICULTURAL IRRIGATION

Irrigation accounts for most of the water used in the County.

Washington is third largest producer of blueberries in the United States. Approximately 65 percent of the state's production occurs in northwest Washington (Whatcom and Skagit Counties). In 2014, Washington State recorded 12,596 acres planted in red raspberries or other caneberries. Of this acreage, 84 percent is in northwest Washington (Skagit and Whatcom Counties).[18]

On November 7, 2017, the Bellingham Herald reported that the 2017 harvest of raspberries in Whatcom County was 68.3 million pounds, the fourth highest in the past 17 years and just under the record harvest of 73.9 million pounds in 2016. As reported in the Bellingham Herald, according to the Washington State Red Raspberry Commission, about 95 percent of the nation's raspberry crop is from Washington State, and in 2017, nearly 98 percent of the Washington crop came from Whatcom County. Over the last few years, the raspberry harvest in Whatcom County has been as follows.

- 2017: 68.3 million pounds
- 2016: 73.9 million pounds
- 2015: 50.5 million pounds
- 2014: 68.6 million pounds
- 2013: 62.7 million pounds

Water use associated with irrigation increased by an estimated 25 percent between 2000 and 2005. The 2012 census reports Market Value of County crops was $357 million over 1,702 farms, and the County led the state in the production of milk, raspberries, and blueberries.

In 2012, the Department of Revenue and Employment Security Department reported that gross sales attributed to the food processing industry in Whatcom County accounted for sales of $959 million and 1,774 jobs, ranking Whatcom County in the top 10 of Washington's 39 counties.[19]

The U.S. Department of Agriculture (USDA) 2012 Census of Agriculture reported a "farm gate value" of $326,450,000 for agricultural products in the County, making Whatcom County 1st of

[17] Fogelsong, Clare. City of Bellingham, E-mail dated February 20, 2018.
[18] Whatcom Farm Friends.
[19] Based on 2012 Census of Agriculture date and compiled by Whatcom Farm Friends.
http://www.agcensus.usda.gov/Publications/2012/Full Report/Volume 1, Chapter 2 County Level/Washington/

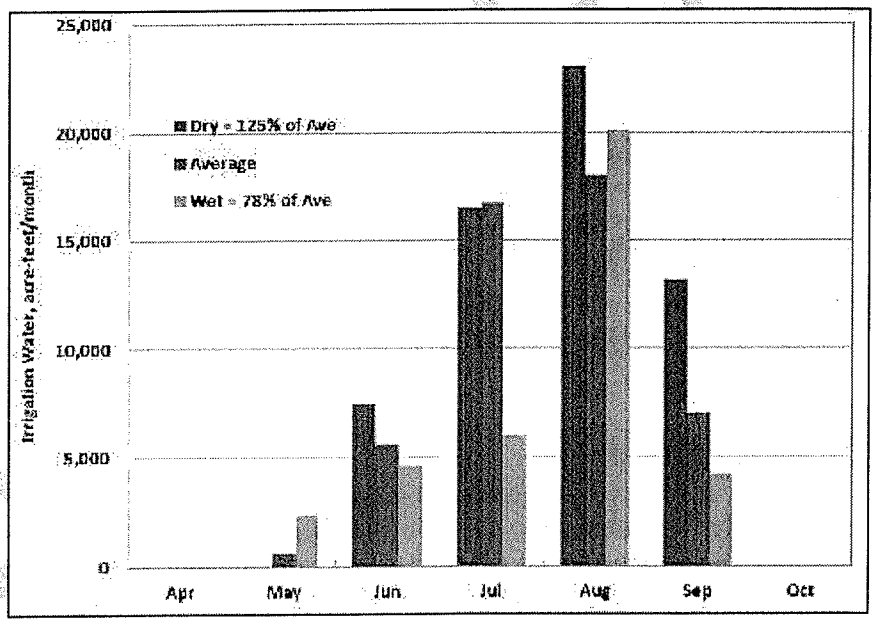
17 counties in Western Washington, 6th of 39 counties in the state, and 78th out of 3,075 farm counties in the US (top 3 percent). According to the USDA, Washington State is second behind California in total agricultural exports.[20]

While the precise amount of land irrigated in the County varies as cropping patterns and other factors change from year to year, a recent study was conducted based on irrigation data provided by the Washington State Department of Agriculture that included information on the primary and rotation crop types, irrigation methods, acres irrigated, and locations of the irrigated parcels. Based on this study, there are approximately 41,000 acres of irrigated land in the County using approximately 60,000 acre-feet of water.[21] Irrigation is an important water use in the County and is very much affected by interruptions in water supply due to drought or other causes.

Hay and silage account for the highest water use by irrigated agriculture. This is due to the relatively high crop water demand and the use of relatively inefficient irrigation methods, such as moveable wheel lines and big gun sprinklers. A recent study indicated that irrigation water use in the County is 25 percent higher in dry years and 22 percent lower in years that are wetter than average[22] (**Figure 8**).

Figure 8

Water Use in Dry, Average, and Wet Years



As a result, water demand in drought years for agriculture is greater than in normal or wet years.

[20] Whatcom Farm Friends.

[21] RH2 Engineering, Inc. (2016, December). *Quantification of Agricultural Irrigation Water Use and Water Rights.* Prepared for PUD No. 1 of Whatcom County.

[22] Hirst, Eric. (2017, January). *Analysis of Whatcom County Water Use, Bellingham, WA.* Unpublished report.

INDUSTRIAL WATER USE

Nearly all the water used for industrial purposes in the County is provided by the PUD at the Cherry Point Industrial Zone (Cherry Point).

The Cherry Point Heavy Industrial Zone (in western Whatcom County) is home to two oil refineries, one aluminum smelter, and several smaller industries. The larger industries are significant at a national scale. Cherry Point also is the location of two gas-turbine electric generating facilities that require water for evaporative cooling. The PUD provides industrial grade (non-potable) water to industrial and irrigation customers at Cherry Point. The PUD draws its water from the Nooksack River under two perfected water rights. The average daily consumption by the industrial customers is 17 million gallons (MG).[23] In addition, the PUD provides up to 5.7 MG per month or about 0.2 million gallons per day (MGD) to 30 irrigation customers from its industrial supply system during the irrigation season.[24]

The PUD owns and operates two treatment facilities that draw water from the Nooksack River. The plants provide primary treatment, which lowers turbidity levels, before conveying water to PUD customers. A minimal amount of chlorinating is done to prevent algae growth in the settling basins. The PUD's Plant 1 is located downstream of the City of Ferndale. The maximum intake flow is 50 cubic feet (approximately 374 gallons) per second. Plant 2 is located upstream of the City of Ferndale. The maximum intake flow is 28 cubic feet (approximately 209 gallons) per second.[25]

Reliable flows in the Nooksack River are critical to retaining this important economic sector of the County. The PUD's water delivery system does not include significant amounts of water storage, and most of the industrial demand is continuous due to the ongoing production of a major aluminum smelter and oil refineries. Therefore, the PUD's water delivery system and its industrial customers would be impacted significantly by even short-term interruptions in water delivery due to droughts or other factors.

Additional industrial use takes place within the cities and in food processing facilities located throughout the western part of the County. For these users, water comes from either a public water system or a private well.

FISHERIES AND INSTREAM FLOWS

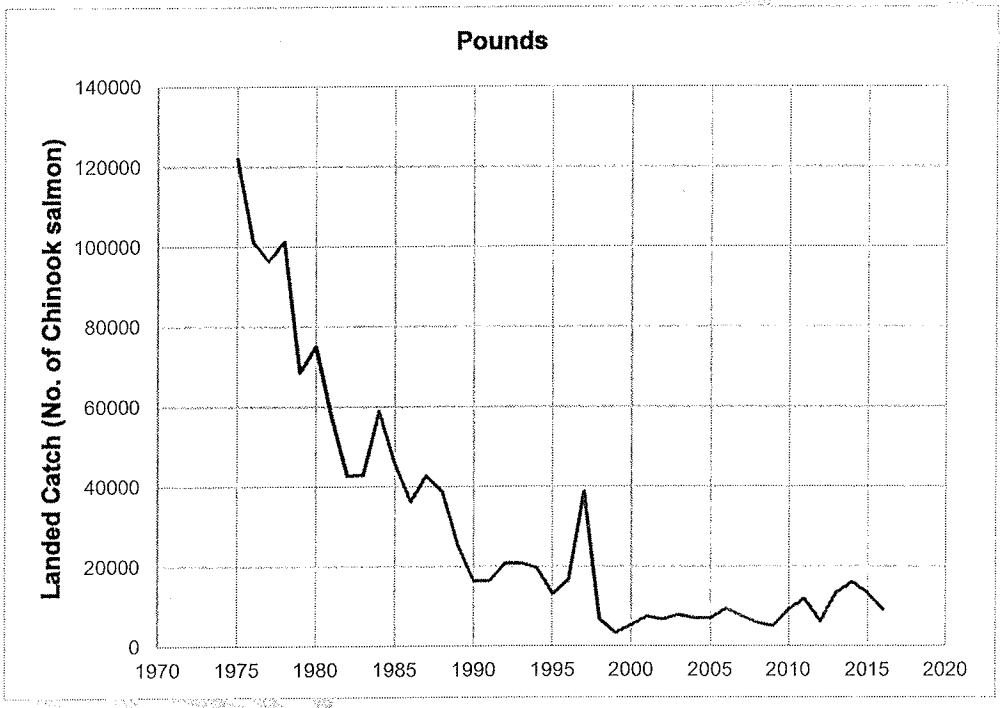
Annual economic activity associated with commercial and sport fishing in Washington State totals $2.5 billion annually,[26] yet abundances have declined substantially from historic levels. Less than 10 percent of the historic salmon runs in the late 1800's occur today (Lackey, 2000).[27] Puget Sound Chinook salmon and Puget Sound steelhead, in addition to bull trout in the coterminous United States, are listed as threatened under the Endangered Species Act (ESA). All

[23] http://www.pudwhatcom.org/services/water-service/
[24] PUD No. 1 of Whatcom County. (2010, January). *Water Supply Comprehensive Plan*, 2-2.
[25] http://www.pudwhatcom.org/services/water-service/
[26] Washington State Department of Ecology. (2017, September). *Washington State Drought Contingency Plan*, 70.
[27] Lackey, R. (2000). *Restoring Wild salmon to the Pacific Northwest: Chasing an Illusion?* In: What We Don't Know about Pacific Northwest Fish Runs --- An Inquiry into Decision-Making. Patricia Koss and Mike Katz, Editors, Portland State University, Portland, Oregon, pp. 91 - 143. Retrieved from http://www.epa.gov/wed/pages/staff/lackey/pubs/illusion.htm

three species occur in the Nooksack River watershed, and recovery of the two independent Chinook populations – North/Middle Fork Nooksack Early Chinook salmon and South Fork Nooksack Early Chinook – are essential for recovery of the broader Puget Sound Chinook Evolutionarily Significant Unit. The decline of local salmon populations has reduced treaty and non-treaty fisheries harvests substantially. The average annual landed marine catch of Chinook salmon in the vicinity from 2010 to 2015 is less than 22 percent of that from 1980 to 1985[28] (**Figure 9**). In addition to ESA-listed species, the County also provides habitat for coho salmon, pink salmon, chum salmon, sockeye salmon (riverine sockeye and land-locked kokanee), rainbow trout, cutthroat trout, and Dolly Varden trout.

Figure 9

Landed Catch of Chinook Salmon in the San Juan Area[29]



The Nooksack River, its forks, and its tributaries have minimum requirements for streamflow as established by Chapter 173-501 Washington Administrative Code (WAC). The purpose of these instream flow requirements is to retain perennial rivers, streams, and lakes in the basin with instream flows and levels necessary for preservation of wildlife, fish, scenic, aesthetic, other environmental values, navigational values, and recreation and water quality. Such instream flows constitute a water right with the priority date of the rule, which is January 1986. Low instream flows throughout the Nooksack River limit salmon production. The South Fork Nooksack River and Bertrand and Fishtrap Creeks are 303(d)-listed for instream flows, and many other Nooksack tributaries fail to meet minimum instream flows.

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[28] Pacific Salmon Commission Joint Chinook Technical Committee. 2017. *Annual report of catch and escapement for 2016.* Retrieved from file:///C:/Users/tcoe/Downloads/tcchinook-17-2.pdf

[29] Pacific Salmon Commission Joint Chinook Technical Committee. (2017). *Annual Report of Catch and Escapement for 2016.* Retrieved from file:///C:/Users/tcoe/Downloads/tcchinook-17-2.pdf

> Whatcom County is home to seven species of salmon, including chinook, chum, coho, pink, sockeye, steelhead, and kokanee (land-locked sockeye). Other salmonids (fish that are closely related to salmon) are also found in Whatcom County, including bull trout and dolly varden (native char), sea-run cutthroat, resident cutthroat, rainbow trout, and brook trout (a non-native char). Populations of several of the species have seen a decline over the past decades. Three Puget Sound species found in Whatcom County – chinook, bull trout, and steelhead – are listed as "threatened" under the Federal Endangered Species Act. Two chinook populations, which are the North/Middle Fork and South Fork Nooksack early chinook, are genetically unique and together make up one of five genetic diversity units in Puget Sound, and are the only two populations in the Strait of Georgia Region. These populations are considered to be essential to recovering Puget Sound Chinook.[30]

The National Marine Fisheries Service (NMFS) identified Puget Sound/Strait of Georgia coho salmon as a species of concern in 1997. Existing stressors to salmon populations include habitat loss, fragmentation, and degradation; water of insufficient quantity and quality; alteration of historical disturbance regimes (e.g., flood regime, sediment regime); and historical overharvest. Cumulatively, these stressors have caused significant declines in salmon populations (e.g., abundance, productivity, genetic diversity, life history diversity) and reduced the resilience of salmon to future disturbances. Many of the stressors that are negatively affecting salmon today will be exacerbated under future climate scenarios, including droughts.

Grah and Beaulieu (2013) state that "the possible extinction of salmonids, particularly spring Chinook salmon, from the Nooksack River is unacceptable because the Tribe is dependent on these species, and being place-based, the Tribe cannot move its geographic base or homeland to where salmon will be located under future climatic conditions." [31] There are nine species of salmon in the watershed that the Nooksack Indian Tribe depends on for cultural, subsistence, and economic uses. Climate change is an additional, new threat to salmon that has caused and will continue to cause an increase in winter flow, decreased summer baseflow, and increased summer water temperatures.[32]

TRIBAL INVOLVEMENT

The Lummi Nation (Lummi) and the Nooksack Indian Tribe (Nooksack) are federally recognized Indian tribes with Reservation and trust lands and usual and accustomed fishing grounds located within WRIA 1 or Whatcom County. Since early 2015, the Lummi Nation has been developing a settlement package (initially called the Lummi Nation Water Settlement

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[30] WRIA 1. (2011, June 30). *2010 State of the Watershed Report.* Retrieved from www.nwr.noaa.gov/salmon-recovery-planning/recovery-domains/Puget-Sound.

[31] Grah O, Beaulieu J. (2013). The effect of climate change on glacier ablation and baseflow support in the Nooksack River basin and implications on Pacific salmonid species protection and recovery. Climatic Change. DOI 10.1007/s10584-013-0747-y.

[32] Pelto, Mauri, Glaciologist, Nichols College. (2014, May 6). *Nooksack River Glacier Runoff Importance.* https://glacierchange.wordpress.com/2014/05/06/nooksack-river-glacier-runoff-importance/

Initiative) intended to resolve issues related to tribal treaty rights, the management of water resources, the protection of instream flows, and salmon recovery in WRIA 1. As one component of this settlement package, the Lummi has initiated a Civil Engineering and Planning Project, the goal of which is to develop recommended water supply elements that would be an integral part of any comprehensive water resources settlement agreement. The objectives of the Civil Engineering and Planning Project are to evaluate alternative water supply systems to:

- Supply water for out of stream water uses;
- Supply water for instream water uses to improve salmon and shellfish habitat; and
- Increase the resilience to anticipated climate change impacts in portions of WRIA 1.

The Lummi retained the services of RH2 Engineering, Inc., (RH2) to develop the water supply element of their settlement package. Although this project is on hold, the Lummi Nation has provided input to the development of the DCP and is a member of the Task Force.

The Nooksack Indian Tribe is conducting a basin-wide study on the impacts of climate change on the hydrology of the Nooksack River and tributaries, and subsequent impacts on fish and salmon recovery. This work has involved contemporary modeling using the Distributed Hydrology, Soils, and Vegetation Model (DHSVM) of glacier ablation and snowmelt dynamics, streamflow, and stream temperatures with continued climate change, and subsequent impacts on salmon. The results of the modeling are available for future water supply planning under various climate scenarios. Particular focus has been placed on the South Fork Nooksack River through Nooksack's teaming with the U.S. Environmental Protection Agency (EPA), Ecology, and Tetra Tech, Inc., on the impacts of climate change on the river. This collaboration resulted in the EPA's Climate Change Pilot Research Project, which was completed in support of the temperature Total Maximum Daily Load project being prepared by EPA and Ecology. The climate change project focused on how to integrate climate change planning in clean water act compliance and endangered species recovery. It also developed information on detailed hydrologic and stream temperature responses to climate change and how to plan restoration actions that are climate ready.[33] As part of the South Fork Nooksack River project, the Nooksack Indian Tribe initiated and completed an intensive public outreach and stakeholder engagement project focused on developing a South Fork Nooksack River Watershed Conservation Plan that could be used by the community.[34] Like the Lummi Nation, the Nooksack Tribe has been an active participant in the development of the DCP and has provided a large amount of information related to their fishery interests and climate change work.

DROUGHT CONTINGENCY PLAN TASK FORCE

To ensure that this DCP meets the needs of the local community, the PUD has convened a DCP Task Force (TF) comprised of representatives of various stakeholder groups covering the broad sectors of water uses and water users in the County.

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[33] U. S. Environmental Protection Agency (EPA). 2016. *Qualitative Assessment: Evaluating the Impacts of Climate Change on Endangered Species Act Recovery Actions for the South Fork Nooksack River, WA.* Washington, DC. Publication No. EPA/600/R-16/153.

[34] Nooksack Indian Tribe Natural Resources Department. (2017, May). *South Fork Nooksack River Watershed Conservation Plan.* Retrieved from https://www.sfnooksack.com/wp/wp-content/uploads/2017/01/SFNR-Watershed-Conservation-Plan-DRAFT-5-17-17.pdf

As the DCP is developed, the TF will involve stakeholders with interests in both instream and out of stream water uses to ensure that the mitigation and response actions that are developed will address the broad range of anticipated drought impacts in the County.

Table 1 lists the individuals and organizations that have been invited to participate as TF members.

Table 1
Whatcom County Drought Continency Plan Task Force

Name	Organization	Email Address	Status (invited, accepted)
Doug Allen	Washington State Department of Ecology	doua461@ecy.wa.gov	Accepted
Steve Banham	City of Lynden	BanhamS@lyndenwa.org	Accepted
Henry Bierlink	Ag Water Board	henry@agwaterboard.com	Accepted
Sue Blake	WSU Extension	sgblake@wsu.edu	Accepted
George Boggs	Whatcom Conservation District	gboggs@whatcomcd.org	Accepted
Brendan Brokes	Washington Department of Fish and Wildlife	Brendan.Brokes@dfw.wa.gov	Accepted
Treva Coe	Nooksack Indian Tribe	tcoe@nooksack-nsn.org	Accepted
Dan Eisses	Birch Bay Water and Sewer District	dan@bbwsd.com	Accepted
Clare Fogelsong	City of Bellingham	Cfogelsong@cob.org	Accepted
Oliver Grah	Nooksack Indian Tribe	ojgrah@gmail.com	Accepted
Eric Hirst	Environmental Caucus	EricHirst@comcast.net	Accepted
Steve Jilk	PUD No. 1 of Whatcom County	steve@pudwhatcom.org	Accepted
Kara Kuhlman	Lummi Nation	karak@lummi-nsn.gov	Accepted
Mike Murphy	PUD No. 1 of Whatcom County Commissioner	Whatcommike.murphy@gmail.com	Guest
Mike Olinger	City of Ferndale	MikeOlinger@CityOfFerndale.org	Accepted
Dave Olson	Water System Services, Inc.	cmihome@comcast.net	Accepted
Mark Personius	Whatcom County Planning and Development Services	MPersoni@whatcomcounty.us	Accepted
Tyler Schroeder	Whatcom County Executive Office	tschroed@co.whatcom.wa.us	Accepted
Gary Stoyka	Whatcom County Public Works Department	gstoyka@co.whatcom.wa.us	Accepted
Ravyn Whitewolf	City of Blaine	rhwitewolf@cityofblaine.com	Accepted
Dick Whitmore	Forestry Caucus	rwhitmore49@gmail.com	Accepted
Task Force Support			
Jim Bucknell	RH2 Engineering, Inc.	jbucknell@rh2.com	Support
Rebecca Schlotterback	PUD No. 1 of Whatcom County	rebeccas@pudwhatcom.org	Support

REQUIRED ELEMENTS OF THE DROUGHT CONTINGENCY PLAN

The Reclamation grant requires that the DCP develop recommendations related to each of the following elements:

1. Drought Monitoring
2. Vulnerability Assessment
3. Mitigation Actions (defined as actions taken during non-drought periods to alleviate the adverse impacts of a drought)
4. Response Actions (defined as actions taken during a drought to alleviate adverse impacts of a drought)
5. Operational and Administrative Framework
6. Plan Update Process
7. Communication and Outreach

DROUGHT MONITORING AND FORECASTING

WASHINGTON STATE WATER SUPPLY MONITORING AND FORECASTING

Ecology has a well-established process for monitoring water supply conditions and forecasting droughts. It is not practical to replicate the State's monitoring efforts at the local level. The State's process includes information from, and coordination with, a wide variety of organizations and programs, including the National Oceanic and Atmospheric Administration (NOAA), the Nation Integrated Drought Information System (NIDIS), the Western River Forecast Centers (WRFC), the Earth System Research Laboratory Physical Sciences Division (PSD), and the Climate Prediction Center.

Goals of the NIDIS are to improve accessibility, dissemination, and use of early warning information for drought risk management and to build a network of drought early warning systems (DEWS) to create a National Drought Early Warning System. The Pacific Northwest DEWS was officially launched in February 2016 and will be conducting drought and climate webinars every 2 months designed to provide stakeholders and other interested parties in the Pacific Northwest with timely drought and climate information. Information about NIDIS is available at www.drought.gov.

Because of the State's level of effort, the Whatcom County DCP will rely on the State's monitoring and forecasting process and will commit to working with the State to coordinate efforts related to monitoring water supply conditions, forecasting droughts, and responding to droughts. The local Drought Contingency Plan TF is encouraged to access the State's information process, including NIDIS, to monitor drought and climate conditions affecting the County. Details on the state's monitoring and forecasting efforts are provided in the *Washington State Drought Contingency Plan*, which will be posted on Ecology's website once it is approved in final form by Reclamation.[35]

[35] Information is available at https://www.ezview.wa.gov/site/alias__1962/view_our_committees_drought_contingency_plan/37293/drought_contingency_plan.aspx

It should be noted that the State is continuing to evaluate existing and new technologies related to monitoring and forecasting drought conditions and climate change and will implement new and modified approaches as conditions warrant.

Water Supply Availability Committee – In order to effectively monitor drought and water supply conditions, the State has established the Water Supply Availability Committee (WSAC), which is chaired by Ecology and consists primarily of state and federal agencies with expertise in water supply forecasting, drought monitoring, and climate. WSAC members include the following:

- Department of Ecology (chair)
- Office of Washington State Climatologist
- U.S. Geological Survey
- National Weather Service
- Natural Resources Conservation Service
- U.S. Bureau of Reclamation
- U.S. Army Corps of Engineers (optional)
- Bonneville Power Administration (optional)

WSAC invites representatives of major water utilities (e.g. Seattle, Tacoma, Everett, and Puget Sound Energy) to attend and provide updates as well. The WSAC meetings are public meetings and, with the adoption of the Whatcom County DCP, the PUD will work with the Task Force to identify one or more representatives to attend the WSAC meetings and ensure that the representative(s) receives information about the WSAC from Ecology. The WSAC meets periodically during the year and about every 4 to 6 weeks in winter months as water supply conditions become clearer for the following year.[36]

WSAC meetings address the following topics:

- Recent trends and anomalies in regional temperature and precipitation.
- Ocean conditions and probabilities for the development of El Niño or La Niña conditions, either of which can affect northwest weather in the coming months.
- Seasonal water supply forecasts NOAA and National Resources Conservation Service (NRCS).
- Long-term temperature and precipitation forecasts or other models (e.g., National Multi-Model Ensemble (NMME)).
- Mountain snowpack and precipitation status.
- Status of major water supply projects (e.g., storage status, special forecasts).
- Current streamflow and groundwater conditions (e.g., percentage of rivers above or below normal).
- Water supply impacts.
- Other indicators of drought conditions.

[36] During the year, Ecology monitors water supply conditions and those updates are available at https://ecology.wa.gov/Water-Shorelines/Water-supply/Water-availability/Statewide-conditions/Water-supply-monitoring.

When the forecast is less than 75 percent of normal, WSAC needs to decide whether the forecast is expected to hold and whether to recommend the convening of the Executive Water Emergency Committee (EWEC), which is convened and chaired by the Governor's Office. The EWEC's task is to determine whether water users within the water short areas identified by the WSAC will likely incur undue hardships as a result of the water shortage. In the past, membership on the EWEC has included representatives of the following agencies:

- Governor's Office (chair)
- Washington State Conservation Commission (WCC)
- Washington State Department of Agriculture (WSDA)
- Washington State Department of Commerce (Commerce)
- Washington State Department of Ecology (Ecology)
- Washington Department of Fish and Wildlife (WDFW)
- Washington State Department of Health (DOH)
- Washington State Department of Natural Resources (DNR)
- Washington State Military Department, Emergency Management Division (EMD)

On April 11, 2018, Ecology adopted Chapter 173-166 WAC, Emergency Drought Relief. WAC 173-166-050(2) says that, "Ecology may solicit input from local authorities to aid Ecology in determining the anticipated level of hardship and will make that information available to the Executive Water Emergency Committee (EWEC)."

Consistent with this section, with the development and adoption of the Whatcom County Drought Contingency Plan, the local Task Force plans to assist the WSAC and EWEC in the determination of whether forecasted drought conditions in Whatcom County are expected to result in undue hardships to water users in the County. It is also hoped that local entities with an adopted drought contingency plan will receive some benefit from the State in terms of priority funding for drought-related relief efforts.

With the update of the *Washington State Drought Contingency Plan* and the adoption of an updated Emergency Drought Relief rule (Chapter 173-166 WAC), the State has adopted new procedures and standards related to the declaration of droughts.

The following summary of drought stages and triggers is excerpted from the draft State plan.

Summary of Drought Stages and Triggers

Stage 1 – Advisory

Conditions: Long-term forecast indicates drought of any level of severity may occur, or short-term forecast indicates minor drought conditions may occur in at least some area of the state.

Triggers:

- Water supply trigger: Consideration of the following factors suggest a strong likelihood of reduced water supply, that careful management of water supply and demand is advisable, and that concerns should be conveyed to natural resource managers, water users, and the public:
  - Below normal snowpack;

- Below normal river forecasts;
- Below average reservoir refill or carry-over from the previous year;
- Depleted soil moisture or groundwater;

- Extended precipitation deficit (e.g., the Standardized Precipitation Index is -1 or below); and/or
- Forecasts of high temperature or low precipitation for an extended period.
- Hardship trigger: There is a potential for hardships to water users and uses in the affected area due to drought conditions.

Stage 2 – Emergency (Issue Declaration)

Conditions: Short-term forecast indicates high probability that drought conditions meeting the statutory definition will occur at least in some areas of the state; or drought conditions have actually materialized in at least some area of the state (at any level of severity – minor to severe).

Triggers:

- Water supply trigger: Forecasted seasonal runoff is likely to be less than 75 percent of normal; and/or other water supply indicators, as summarized above, have deteriorated to more extreme levels.
- Hardship trigger: There is high confidence of existing or imminent hardships to water users in the affected area due to the drought conditions.

Response: Issue Drought Declaration for affected areas. Communicate existing monitored conditions and forecasted short term climate outlooks (1-3 months). Coordinate communication with local water managers and affected governments (state, local, tribal). Activate state systems for response actions defined in the state's Drought Contingency Plan. (Note: Water users would need to provide evidence of imminent or demonstrated hardship when requesting permits or funding for specific actions under the emergency drought provisions of state law.) Seek emergency funding as needed from the Legislature and coordinate with OFM.[37]

As of November 2018, Ecology has proposed legislation amending Chapter 43.83B RCW related to drought preparedness and response. Ecology's proposal would:

[37] Washington State Department of Ecology. Water Resources Program. (2017, September). *Washington State Drought Contingency Plan*, 37.

- Create a more certain and stable funding source by establishing a permanent account for Ecology to draw from for drought preparedness and response projects.
- Build long-term drought resiliency among water users by authorizing Ecology to fund drought resiliency and preparedness projects during non-drought years.
- Ensure that projects designed to support public water systems, agriculture, and environmental protection during droughts are all equitably eligible for grant funding.
- Improve Ecology's communication during water shortages by authorizing a drought advisory warning.
- Establish a pilot program to investigate the use of long-term water right leases as a drought preparedness strategy.
- Modernize the statute to better reflect current funding structures, accounts, and practices. These changes would repeal or decodify sections of the existing statute that are inactive or outdated.

As with any proposed legislation, the outcome is not known but the PUD and the Task Force will continue to monitor State activity related to any proposed changes in statutes, regulations, or policies related to drought preparedness and response.

Planning for Climate Change

While Washington State's Drought Response Framework emphasizes emergency response, long term climate change will push the Pacific Northwest into a more frequent state of "snowpack drought." Washington State's Integrated Climate Response Strategy lays out a framework that decision-makers can use to help protect Washington's communities, natural resources, and the economy from the impacts of climate change. As Washington State's climate warms and snowpack declines, it will become increasingly critical for the state to find solutions which compensate for the loss of natural storage in the form of snow and ice. Water markets, water reuse and reclamation, new technology, and conservation and efficiency measures will be key, but may not be enough to totally offset the loss of snowpack.[38]

Ecology, in conjunction with the EPA and the Nooksack Tribe, developed and published a temperature Total Maximum Daily Load (TMDL) study for the South Fork of the Nooksack River. The EPA Office of Research and Development (ORD) executed the EPA Climate Change Pilot Research Project as applied to the South Fork to address the primary clean water act beneficial use of the river for salmon. The Pilot Research Project's goal was to achieve a better understanding of the potential impact of climate change on achieving water quality and salmon recovery goals.

The objectives of the project were to:

- Assess the potential impacts of climate change on stream temperature and stream flow for a temperature TMDL Implementation Plan;
- Help stream restoration actions under climate change for ESA salmon recovery planning;

[38] Washington State Department of Ecology. (2012, April). *Preparing for a Changing Climate: Washington State's Integrated Climate Response Strategy.* Publication Number 12-01-004. Retrieved from https://fortress.wa.gov/ecy/publications/documents/1201004.pdf

- Guide implementation of EPA's *National Water Program 2012 Strategy: Response to Climate Change*; and
- Support EPA's national tribal science priorities for climate change and integration of traditional ecological knowledge.

The results of the project indicate that the risk of higher water temperatures and reduced flows will accelerate over time. Predicted increases in heat inputs and lower summer flows, combined with a reduction in the storage of winter snowpack, will exacerbate summer water temperature extremes. Restoration of riparian shading would significantly (30 to 60 percent) mitigate increasing water temperatures.

Additional information about climate change and its expected impacts on the County and Western Washington are included in **Appendix B** and in the **Tribal Involvement** section.

Mr. Ryan D. Murphy completed a Master's Thesis at Western Washington University entitled *Modeling the Effects of Forecasted Climate Change and Glacier Recession on Late Summer Streamflow in the Upper Nooksack River Basin* (Winter 2016). Mr. Murphy concludes that:

> ...a projected decrease in summer streamflows and an increase in winter flows as snowpack and glacier ice volume is decreased have the potential to strain water resources and valuable fish spawning habitat. Glaciers have historically provided a natural water storage buffer to support late summer baseflows but with a reduction in glacier volume, the water available during warmer months will be reduced. In the face of such changes, improved water resource conservation and planning may become imperative to protect our natural resources.

The Nooksack Tribe has conducted a climate change project that has reached similar (and more detailed) conclusions. Based on current models and projections, climate change is expected to have significant impacts on water supply in the County. As temperatures increase and glaciers recede, a larger portion of the watershed will be rainfall dominated. Historically, glaciers in the Nooksack River watershed have contributed about 16 percent of streamflows. **However, the glacier melt contribution during warm spells in the summer can reach 60 to 90 percent of total flow in the North Fork. This demonstrates the importance of glacier melt contribution to river flows during critical low flow periods.** The melting glaciers are expected to result in a greater contribution of glacier melt to streamflow (51 percent in 2025) until about 2050, and then the contribution will decline to about 38 percent in 2075. In the North Fork, the glacial melt contribution to flow is currently about 15 percent. By 2075, flows in the North Fork in January are expected to be about 153 percent of the current January flows and about 75 percent of current levels in July. The entire watershed is expected to experience higher peak flows, lower low flows, increased stream temperatures (2 to 5 degrees Celsius), and increased sediment (because receding glaciers expose previously covered sediments). As a result, flows will be higher when the demand for water is lowest, and flows will be lower when the demand for water is greatest. These changes are expected to adversely impact all life stages of salmon throughout the year.[39]

[39] Grah, Oliver. (2017, June 1 and 2). *Impacts of Climate Change on Water Supply as a Result of Glacier Ablation and Altered Hydrologic Regime of the Nooksack River.* Speech presented to Tribal Waters in the Northwest, Law Seminars International, Seattle, WA.

Mr. Murphy's conclusions are consistent with the findings and conclusions of the Nooksack Tribe's climate change project. Mr. Murphy concluded that:

> Based on these conclusions, it appears that what are now considered drought conditions are likely to become more normal and frequent in the future and this, in turn, places increased emphasis on the importance of designing and implementing effective mitigation measures to minimize the adverse impacts associated with droughts and other low-water scenarios.

Ecology has stated that it expects more temperature-driven droughts, but there is no indication that the state will experience more frequent precipitation deficit droughts. Summers are expected to be somewhat (approximately 5 to 20 percent) drier and warmer, which has implications for the demand side of the water availability equation.[40]

VULNERABILITY ASSESSMENT

INTRODUCTION

There are many different activities in the County that rely on a secure supply of high-quality water. Each of these are affected by drought conditions. The nature and severity of the effects vary depending on the water use and the severity and length of the drought conditions.

Washington State, including Whatcom County, experienced a snowpack drought in 2015. The following description is from Ecology's *2015 Drought Response Summary Report*:

> Unlike classic droughts, characterized by extended precipitation deficits, 2015 was the year of the "snowpack drought." Washington State had normal or near-normal precipitation over the 2014-2015 winter season. However, October through March the average statewide temperature was 40.5 degrees Fahrenheit, 4.7 degrees above the 20th century long-term average and ranking as the warmest October through March on record. Washington experienced record low snowpack because mountain precipitation that normally fell as snow instead fell as rain.
>
> The snowpack deficit then was compounded as precipitation began to lag behind normal levels in early spring and into the summer. With record spring and summer temperatures, and little to no precipitation over many parts of the state, the snowpack drought morphed into a traditional precipitation drought, causing injury to crops and aquatic species. Many rivers and streams experienced record low flows.

[40] Marti, Jeff. Washington State Department of Ecology. (2018, October 17). Comment on draft Whatcom County Drought Contingency Plan.

OVERVIEW OF DROUGHT HAZARDS AND VULNERABILITIES

The following overview of drought-related vulnerability was extracted from the draft *Washington State Drought Contingency Plan* and provides a good summary of the vulnerabilities of various water uses. Additional details specific to the County are provided in the sections that follow.

> Sectors which rank highest for vulnerability to drought are irrigators with junior water rights and fisheries. Most municipal drinking water systems are highly resilient to drought impacts. Smaller water systems, which are more likely to depend on single sources or shallow wells (or both) are more vulnerable, but data regarding how small water systems managed during recent droughts is not formally tracked. Energy is highly resilient due to regional coordination and trading of power. In the recreation sector, ski resorts reported massive drops in ski visitors in the winter of 2014-2015. Whitewater boaters also reported a large drop in the number of days that rivers were runnable.[41]

In addition to this general description, the Lummi Nation's *Multi-Hazard Mitigation Plan* included the following, more detailed overview of drought hazards and vulnerabilities in the County.

> Drought is a condition of dryness resulting from a long period of abnormally low precipitation that is severe enough to reduce soil moisture, water, and snow levels below the minimum necessary for sustaining plant, animal, and economic systems. Unlike most natural disasters, droughts typically occur slowly, but can last for extended periods of time. Over the past century, the Pacific Northwest has experienced many drought episodes, including several that lasted for more than a single season (e.g., 1928-32, 1992-94, 1996-97). The most severe Washington State droughts on record occurred in 1977, 2001, and 2005 (Washington State Emergency Management Division (2008). The severity of a drought depends upon the degree and duration of low precipitation and the size of the affected area. Depending upon its severity, a drought can have a widespread impact on the environment and the economy. The economic impacts of drought occur primarily in the agriculture, forestry, and energy sectors. Irrigated and non-irrigated agricultural operations alike are vulnerable to and often adversely affected by drought conditions. Drought also increases the threat of wildfire, which can result in substantial losses of harvestable timber. Many areas experience increased erosion following a wildfire. Increased sedimentation can cause significant damage to aquatic ecosystems, irrigation systems, and energy development facilities. Reduced hydroelectric power generation and increased

[41] Washington State Department of Ecology. Water Resources Program. (2017, September). *Washington State Drought Contingency Plan*, 14. https://fortress.wa.gov/ecy/publications/SummaryPages/1117xxx.html

energy costs during drought have resulted from both the direct effects of decreased water availability and storage and the indirect effect of reservoir sedimentation. Social and environmental impacts are also significant, although it is difficult to assign a precise monetary cost associated with these impacts.

Drought can also reduce groundwater resources, although there is generally a time lag between when surface water impacts are observed and when groundwater impacts are observed. Reduced replenishment of groundwater can lead to a reduction in groundwater levels and associated problems with reduced pumping capacity, dry wells, and, in coastal areas, saltwater intrusion. Reduced groundwater levels can also affect surface waters. For instance, the flow in some streams is generated by groundwater and can be particularly important during the summer months when precipitation is seasonally low and discharge from snowmelt slows. Finally, it is important to note that climate change impacts in the Pacific Northwest include changes in the seasonality of precipitation, which is likely to result in generally drier summers and generally wetter winters. Given these conditions, the frequency and intensity of summertime drought is expected to increase over the coming decades.[42]

DROUGHT VULNERABILITIES IN WHATCOM COUNTY

Public Water System Vulnerabilities

Drought-related impacts on public water systems vary significantly according to a variety of factors, including but not limited to:

- The duration of the drought (i.e., is it short-term (a few months) or longer, potentially multi-year?).
- The degree of the water supply shortfall. Are precipitation and runoff deficits expected to result in undue hardship for public water systems in Whatcom County?
- What is the source of the water? Systems relying on surface water from small streams may experience hardships relatively soon as streamflows drop during a drought. However, it should be noted there are few small systems that rely on surface water in the County. Systems relying on groundwater are generally less susceptible to short-term drought impacts, assuming their wells are drilled to sufficiently penetrate their source aquifers and the aquifers were recharged to normal or near-normal levels prior to the incidence of the drought. As longer duration droughts occur, groundwater levels may be depleted and the impacts of droughts on public water systems relying on groundwater sources will increase.

[42] Lummi Natural Resources Department. (2015). *Lummi Nation Multi-Hazard Mitigation Plan, 2015 Update.* Retrieved from https://www.lummi-nsn.gov/userfiles/79_MHMP%202015%20Update%20FINAL%20wAPPENDICES.pdf

- When does the drought occur? Does it occur during the high demand summer period? Does it occur after a normal winter and spring so that groundwater aquifers are fully recharged at the outset of the drought?
- Does the system have sufficient storage capacity to enable it to sustain water use during drought conditions of varying lengths and severity?

The impact of a drought will vary depending on the source and user due to the severity (degree and length) and any associated mitigation/management options available to bridge different levels of severity. Severity of a drought is also impacted by typical seasonal demand (i.e., spring drought may not impact a groundwater source because recharge is complete, but a prolonged drought may result in impacts on the groundwater source). Further, demand in spring is typically lower for indoor and outdoor use and peaks during the summer season.

Public water systems typically plan for their water needs based on the system's average daily demand (ADD) to determine the annual source quantity needed. The maximum daily demand (MDD) is often calculated as twice the ADD or, where the system has sufficient information available, may be based on the average of the 3 highest days of use. Public water systems typically design their pumping and storage capacity to meet the system's needs during the calculated MDD event.

When a drought occurs, precipitation is less than normal, and, in most cases, temperatures are higher than normal. In such cases, the demand for water experienced by the system may exceed the planned levels in terms of the instantaneous quantity of water needed to meet peak time of day instantaneous demand and/or replenish storage during off peak time of day demand during a typical MDD period. The length of the peak demand period may extend well beyond the planned 3-day MDD event. In this scenario, the actual system demand may exceed the system's capacity, resulting in the system's inability to pump enough water to refill its available storage or an inability to meet peak system demands because the infrastructure was not designed to provide this quantity of water (i.e., the existing wells are at capacity even if groundwater is available).

An additional issue may arise when the quantity of water needed to meet demands during a drought exceeds the amounts authorized by state water rights issued to that system.

In the County, the 2015 drought resulted in a number of impacts to public water systems, a few of which are highlighted below.

- At least two Group B systems with groundwater that were trucking water for at least 90 days at great expense are still struggling to recover from the financial impacts associated with the trucked water.
- One larger system servicing more than 600 customers with groundwater could not withdraw water from groundwater sources fast enough to replenish its storage and was within days of having to implement mandatory aggressive outdoor water restrictions. They did have adequate water rights, but not enough wells constructed to provide the needed instantaneous demand.
- Several smaller (50 to 200 connections) Group A systems believe they had adequate groundwater supply but needed more water rights. Their infrastructure was installed to pump up to their legal water rights but not more. Therefore, even if temporary water

rights were authorized, they did not have adequate infrastructure to pump more in the short term without immediate capital improvements.

- Several other smaller (50 to 200 connections) Group A systems have the capacity to exceed their water rights. This is generally the result of redundancy planning through installation of multiple wells to serve their system. This gives the system the ability to supply their system and/or other systems if granted permission from Ecology; such systems would be good candidates for the potential issuance of emergency drought permits to allow them to supply water to other systems during droughts. These systems also may be good candidates for the creation of emergency interties to allow the movement of water during droughts.
- Based on experience, residential systems can most likely survive a short- and medium-term event by limiting outdoor water use if the groundwater table does not drop dramatically.
- Larger systems typically have a minimum of 24 to 48 hours of storage. With limited outdoor use, they can bridge short- and medium-term events assuming that their groundwater source remains available.
- In long-term and/or severe droughts, most groundwater systems have no alternate source or interties with other utilities.

DOH has provided information about the vulnerability of the County's public water systems to drought conditions. A source's vulnerability to drought is not easily defined due to the uniqueness of each source (well, spring, surface water, etc.). DOH used available source and hydrogeological data and established ranked tiers to identify water systems that may be impacted during drought. Due to a lack of redundancy and limited recharge during a drought, systems with a shallow (less than 50 feet), single source of supply were determined to be most at risk (Tier 1).

In addition to Tier 1, other tiers were developed using source and hydrogeologic data to estimate risk from drought. These include:

- Tier 2 – systems that have a combined source capacity of less than 10 gallons per minute (gpm); this tier includes systems with only one source.
- Tier 3 – systems that have a single source with a depth of 51 to 100 feet.
- Tier 4 – systems with a combined source capacity between 10 and 20 gpm; this also includes systems with only a single source.
- Tier 5 – systems with a single source and no depth information, as well as systems with zero or missing capacity information.

DOH's tiered ranking of drought vulnerability of public water systems in Whatcom County is shown in **Table 2** and further described below and in **Appendix D**.

All other systems outside these criteria are believed to be at a lower risk to impacts from drought. However, this tiered ranking system only includes source construction and hydrogeologic data. Other factors, such as maintenance, operations, demand, etc., could result in diminished capacity during a drought.

Maps for Tiers 1 and 2 for Group A and Group B water systems in the County are included as **Figure 10, Figure 11, Figure 12,** and **Figure 13** and were provided by DOH for this DCP. Maps of the other tiers can be created using DOH data.

Drought vulnerabilities in the County are summarized in **Appendix D** and in the narrative discussions that follow.

Table 2

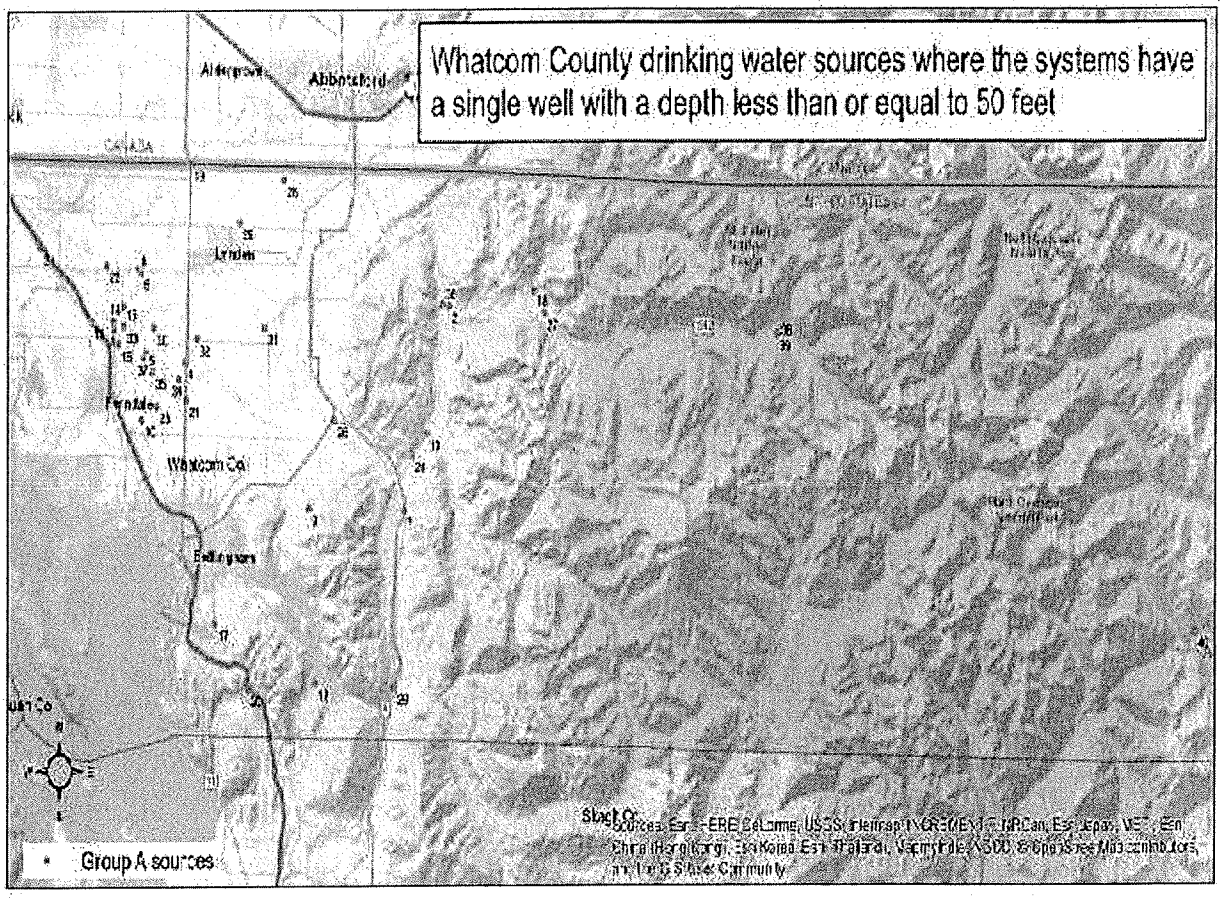
Drought Vulnerability of Public Water Systems in Whatcom County

Description	No. of Systems	Drought Risk
Group A systems with a single source and depth between 1 and 50 feet	40	Tier 1A
Group B systems with a single source and depth between 1 and 50 feet	99	Tier 1B
Group A systems with combined source capacity less than 10 gpm. This includes all Group A system types: comm, ntnc, and tnc. This also includes systems with only a single source (#SRC=1).	20	Tier 2A
Group B systems with combined source capacity less than 10 gpm. This includes systems with only a single source (#SRC=1).	55	Tier 2B
Group A systems with a single source and depth between 51 and 100 feet	26	Tier 3A
Group B systems with a single source and depth between 51 and 100 feet	41	Tier 3B
Group A systems with combined source capacity greater than 10 gpm and less than 20 gpm. This includes all Group A system types: comm, ntnc, and tnc. This also includes systems with only a single source (#SRC=1).	14	Tier 4A
Group B systems with combined source capacity greater than 10 gpm and less than 20 gpm. This includes systems with only a single source (#SRC=1).	57	Tier 4B
Group A systems with zero or missing source capacity. This includes all Group A system types: comm, ntnc, and tnc. This also includes systems with only a single source (#SRC=1).	7	Tier 5A
Group B systems with zero or missing source capacity. This includes systems with only a single source (#SRC=1).	21	Tier 5B
Group A systems with a single source and no depth.	11	Tier 6A
Group B systems with a single source where depth equals blank or zero.	12	Tier 6B

Source: Washington State Department of Health

Figure 10

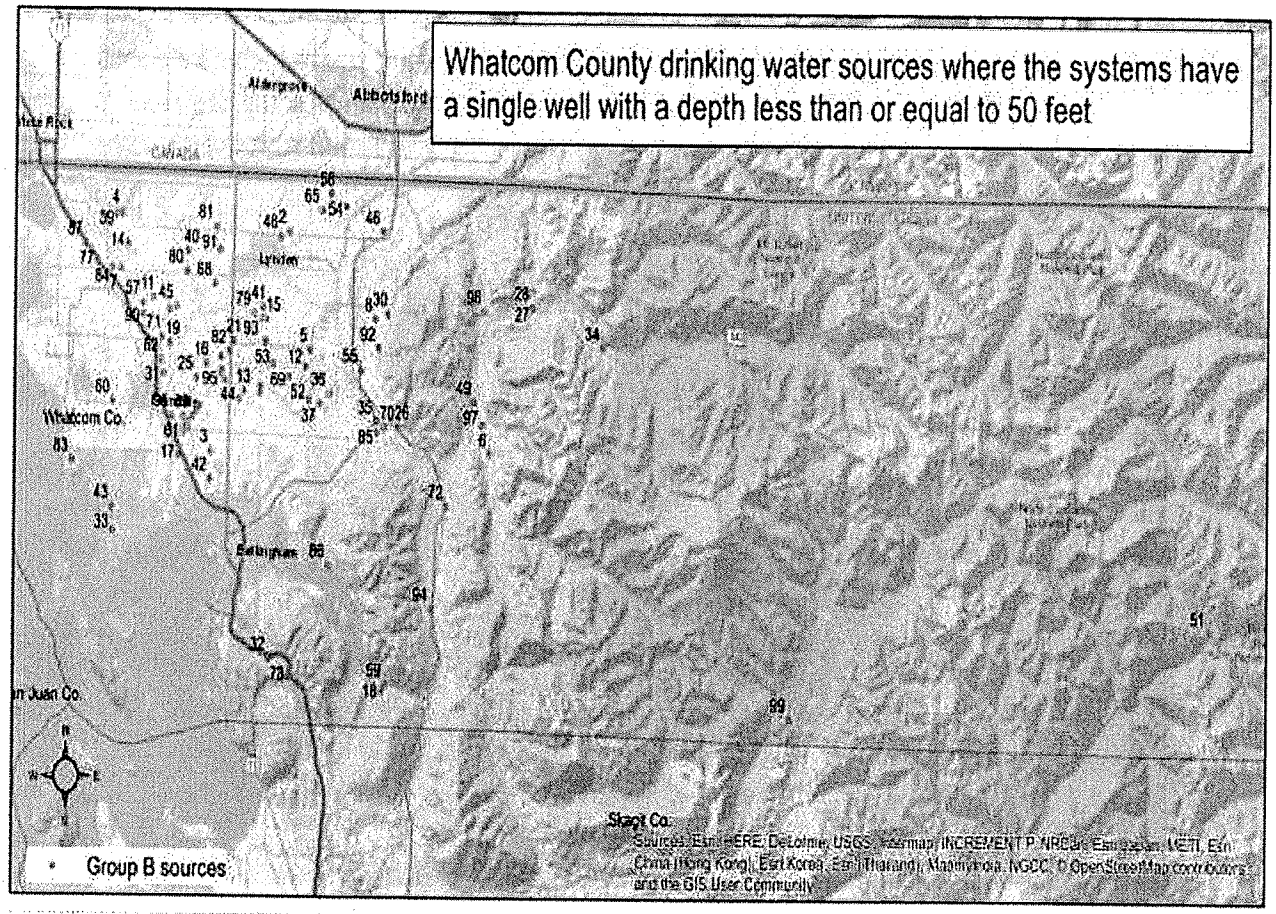
Tier 1 Group A Sources



Listnum	SystemName	Listnum	SystemName	Listnum	SystemName
1	MOUNTAIN VIEW KINGDOM HALL WS	15	ENTERPRISE TERRACE WATER ASSN.	28	EHLERS LABOR CAMP
2	PARADISE MARKET 2	16	EVERGREEN MOBILE PARK & SALES	29	BLUE MOUNTAIN GRILL WATER SYSTEM
3	BIRCH BAY SQUARE WATER OPERAT ON	17	EVERGREEN RETREAT MHP	30	WISER LAKE KINGDOM HALL JEHOVAHS
4	CALMAN JAMES L.	18	MOUNT BAKER BIBLEWAY CAMP	31	RODEDERLAND WATER ASSOCIATION
5	CENTURY WATER ASSOCIATION	19	LYNDEN B.S.-GSA, BELLINGHAM FMT	32	ROYAL COACHMAN MOBIL EST
6	NORTHWEST MOBILE HOME PARK	20	LAKE SAMISH TERRACE PARK	33	TALL CEDARS ESTATES WATER ASSOC.
7	EVERYBODYS STORE	21	LAUREL WEST WATER ASSOCIATION	34	SLAVIC GOSPEL CHURCH
8	DELTA GROCERY WATER SYSTEM	22	MABERRY PACKING LLC	35	BOXX BERRY FARM WATER SYSTEM
9	RIVER OF LIFE COMMUNITY CHURCH	23	MANTHEYS COUNTRY MOBILE PARK	36	NORTH FORK COMM LIBRARY - KENDALL
10	COUNTRY HAVEN WATER ASSOC	24	IL CAFFE RIFUGIO WATER SYSTEM	37	THE CHEESE FARM
11	DOUBLE L MOBILE HOME PARK	25	RADER FARMS LABOR CAMP	38	SILVER FIR CAMPGROUND WEST
12	SMALLWOOD SHORES WEL	26	MOUNTAIN VIEW BUSINESS PARK	39	SILVER FIR CAMPGROUND EAST
13	WELCOME STORE	27	STARVIN SAM S #15 KENDALL WATER SYS	40	NORTH CASCADES ENV LEARNING CENTER

Figure 11

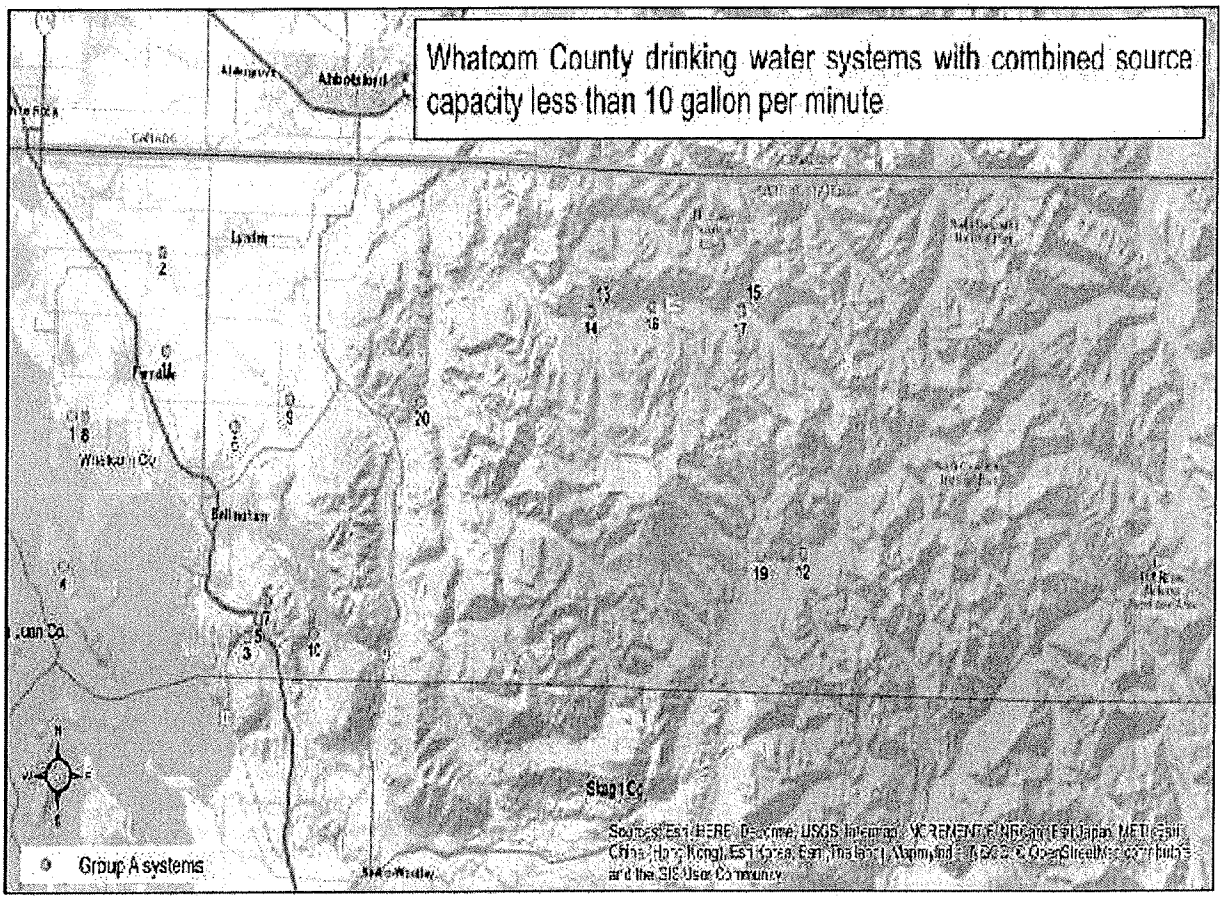
Tier 1 Group B Sources



Lithium SystemName	Lithium SystemName	Lithium SystemName	Lithium SystemName	Lithium SystemName
1 KALE LANE WATER SYSTEM	21 GURU NANAK GURSHH TEMPLE	41 VAN WERDEN WATER WATER ASSOC.	61 NELSEN WATER SYSTEM	81 BERTRAND CREEK ESTATES WATER SYSTEM
2 VOGEL, HARRIET A	22 MT BAKER AUTOMOTIVE WATER SYSTEM	42 SESSIONS WELL SYSTEM	62 MORK WATER SYSTEM	82 MERIDIAN MEADOWS WATER SYSTEM
3 GILLIAMSVILLE WATER SYSTEM	23 SWINNER WATER SYSTEM	43 HARNDEN ISLAND VIEW WATER ASSOC	63 LAUREL WOOD WATER ASSOCIATION	83 CEDERS OFF SUCIA WATER SYSTEM
4 VINCE S WATER SYSTEM	24 BOOTS HILL WATER ASSN	44 FIELLMAN WATER ASSN	64 KAMAR WELL	84 CUSTER SPORTSMANS CLUB WATER SYSTEM
5 MCDOUGAL SHORT PLAT WATER SYSTEM	25 KOSHEA BLUEBERRY FARM	45 BISON RIDGE WATER	65 PARKBORN WATER ASSOC	85 ELLIS DENTISTRY WATER SYSTEM
6 WELCOME SR ACTIVITY CENTER	26 MOUNT BAKER VINEYARDS WATER SYSTEM	46 EAST BADGER WATER ASSOCIATION	66 BAILEY ELIZABETH WATER SYSTEM	86 OLSON CREEK WATER SYSTEM
7 CAROL JEAN WATER SYSTEM	27 CASCADE WEST RECREATION CLUB C-1	47 NORTHWEST ROAD WATER ASSN	67 PRIVATE DRIVE WATER SYSTEM	87 BEACON INDUSTRIAL CENTER WS
8 ST. INNOCENT CHURCH WATER SYSTEM	28 CASCADE WEST RECREATION CLUB A-1	48 LANE ROAD WATER ASSOC	68 LYNDEN VALLEY VIEW ASSOC	88 NORTH VIEW ESTATES WATER SYSTEM
9 LHS W. S.	29 FABER BROTHERS WATER SYSTEM	49 RIVERVIEW WATER ASSOCIATION	69 WISER SHORE LANE ASSOC	89 LIVELY WATER SYSTEM
10 EVERGREEN DRIVE WATER ASSN	30 GREAT WESTERN LUMBER COMPANY	50 ORTIZ SHORT PLAT WATER	70 WHATCOM COUNTY FIRE DISTRICT #1	90 HENRY HALL WATER SYSTEM
11 PINE WATER SYSTEM	31 DELTA LINE ROAD ASSOCIATION	51 DIABLO WORKBOAT MOORAGE	71 WCFD #7 ENTERPRISE WATER ASSOC	91 CRABTREE WATER SYSTEM
12 BOGAN SHORT PLAT	32 CHUCKANUT FALLS WATER SYSTEM	52 AHREN S POND	72 VAN ZANDT COMMUNITY HALL WATER SYST	92 CLOUD MOUNTAIN
13 FULLER WATER SYSTEM	33 ROWLANDS WATER ASSOCIATION	53 SOUTHSIDE PROPERTIES WATER SYSTEM	73 FINNEY CREEK WATER SYSTEM	93 HICKEY
14 HINTERLAND WATER ASSN	34 SEVEN LOAVES RESTAURANT	54 BATHE LABOR CAMP	74 KAY GEE WATER SYSTEM	94 ACME CREAMERY
15 OLTMAN WATER ASSOCIATION	35 KOONS, JOHN	55 ALTERA FARMS	75 GEE KAY WATER SYSTEM	95 CRYSTAL VIEW RASPBERRY WATER SYSTEM
16 OMEGA NUTRITION	36 FAZON ROAD WATER ASSOCIATION	56 BODE FARMS HANSELL FIELD	76 GITTS WATER SYSTEM	96 SPRINGWOOD SHORT PLAT
17 RIEFER WATER WORKS	37 VANDE KAMP WATER	57 BODE FARM & PROCESSING PLANT	77 PORTAL WATER SYSTEM	97 MISTY RIVER RANCH WATER SYSTEM
18 SOUTH BAY BED & BREAKFAST W.S.	38 KAMOT WELL	58 ROBILLON FARM	78 SMYTH WATER SYSTEM	98 KENDALL BUSINESS PARK
19 BOOTHE 5 GRANDVIEW ACRES	39 YOUNGS WATER SYSTEM	59 RANCHETTE, THE (HAMBURGER STAND)	79 NORTHRIDGE PLAT WATER SYSTEM	99 KOLVO KULSHAN GUARD STATION
20 ENTERPRISE FOUR PLEX	40 ORTHODOX CHR. REFORMED CHURCH	60 ADAIR WATER SYSTEM	80 KEIZER MEATS WATER SYSTEM	

Figure 12

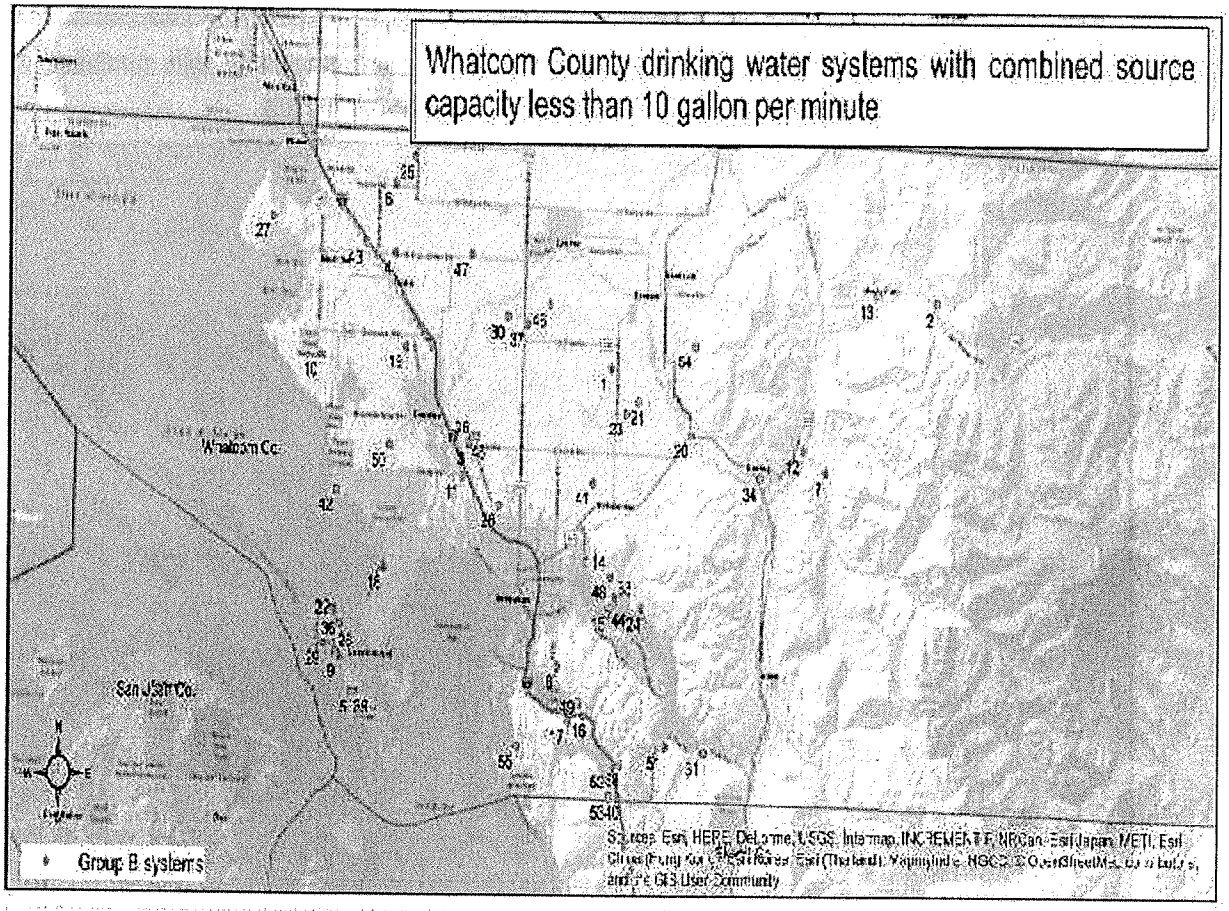
Tier 2 Group A Sources



Listnum	SystemName	Listnum	SystemName
1	BARLEANS	11	BOKK BERRY FARM WATER SYSTEM
2	DELTA GROCERY WATER SYSTEM	12	SHANNON CREEK CAMPGROUND
3	SAMISH PARK	13	DOUGLAS FIR CAMPGROUND - EAST
4	HILLTOP WATER OWNERS ASSOCIATION	14	DOUGLAS FIR CAMPGROUND - WEST
5	NORTH LAKE SAMISH SHELL MARKET	15	SILVER FIR CAMPGROUND WEST
6	KELLY ROAD WATER ASSOCIATION	16	EXCELSIOR GROUP SITE CAMPGROUND WS
7	PLANTATION RANGE	17	SILVER FIR CAMPGROUND EAST
8	STARVIN-SAM S NO 19/SLATER ROAD WS	18	ROSS LAKE RESORT
9	WAHL WATER ASSOC	19	PANORAMA POINT CAMPGROUND
10	WILDWOOD RESORT CONDO ASSN WS	20	WELCOME STORE

Figure 13

Tier 2 Group B Sources



Listnum WS_Name	Listnum WS_Name	Listnum WS_Name	Listnum WS_Name
1 BOUMA SHORT PLAT	15 DELLESTA PARK WATER ASSN	29 SUNNY HILL WATER SYSTEM	43 PORTAL WATER SYSTEM
2 CFO	16 DMS WATER ASSOCIATION	30 INTERNATIONAL SCIENCE OF MIND FARM	44 NORTH SHORE RIDGE #2 WATER SYSTEM
3 KALE LANE WATER SYSTEM	17 CHUCKANUT FALLS WATER SYSTEM	31 RANCHETTE, THE (HAMBURGER STAND)	45 SMYTH WATER SYSTEM
4 CAROLJEAN WATER SYSTEM	18 ROWLANDS WATER ASSOCIATION	32 MILLER WATER ASSOC	46 NORTHRIDGE PLAT WATER SYSTEM
5 BAKERS WATER SYSTEM	19 BROWNFIELD WATER ASSOC	33 NORTHSHORE RIDGE ASSOC	47 KEIZER MEATS WATER SYSTEM
6 VINCES WATER SYSTEM	20 KOOYS, JOHN	34 HOLLINGSWORTH WATER ASSOC INC	48 WILLOWS H WATER SYSTEM
7 WELCOME SR ACTIVITY CENTER	21 FAZON ROAD WATER ASSOCIATION	35 BAILEY ELIZABETH WATER SYSTEM	49 SOUTH WHATCOM FIRE AUTHORITY WS
8 YEW TREE ACRES WATER ASSOCIATION	22 SECRIG A VIEW ASSOCIATION	36 RICHARDSON WATER ASSOCIATION	50 WD MEYER WATER SYSTEM
9 FLARRY WATER SYSTEM	23 VANDE KAMP WATER	37 WISER SHORE LANE ASSOC	51 DEBS LINE WATER SYSTEM
10 FRONTIER WATER SYSTEM	24 NORTH SHORE SOLAR ACRES	38 MANLEY ROAD - CARDINAL WAY WS	52 SAMISH WOODS NORTH
11 PHEIFER WATER WORKS	25 H STREET ROAD WATER ASSOC	39 LUMMI ISLAND HERITAGE TRUST WS	53 SAMISH WOODS EAST
12 TEAMOUSEY TEAPOT	26 SESSIONS WELL SYSTEM	40 SAMISH WOODS SOUTH WATER ASSN	54 CLOUD MOUNTAIN
13 CASCADE WEST RECREATION CLUB WA-1	27 SCIENCE OF SPIRITUALITY	41 VARTA VYAN WINERY WATER SYSTEM	55 REIMBERT WATER SYSTEM
14 WILLOW WATER	28 TUTTLE LANE WATER	42 CHANNEL VIEW CLUSTER WATER SYSTEM	

City of Blaine and Birch Bay Water and Sewer District – The City of Blaine (Blaine) and the Birch Bay Water and Sewer District's (District) primary source of water are groundwater production wells that are completed in a deep, highly confined aquifer that appears to have an extensive recharge area. Groundwater intercepted by Blaine/District wells is likely tens and possibly hundreds of years removed from its original recharge area. Because of this, the deep groundwater supply utilized by Blaine/District is not significantly vulnerable to short-term drought conditions (1 year or less) and likely not significantly vulnerable to impacts from moderate drought conditions (1 to 5 years). The data is not available to assess the vulnerability of Blaine's/District's deep groundwater supply to severe droughts lasting longer than 5 years.[43]

City of Ferndale – The City of Ferndale (Ferndale) currently operates a well field consisting of two wells: the Shop and Douglas Road Wells. The wells are located in the Mountain View Upland area and are completed within coarse-grained, nonglacial and glacial sediments generally referred to as the Regional Aquifer. The Regional Aquifer is generally semi-confined to confined in nature and is separated from the ground surface by a thick sequence of low permeability glaciomarine soil. Groundwater flow direction in the Regional Aquifer is radial off the Mountain View Upland. Water intercepted by Ferndale's wells is likely tens of years removed from the ground surface recharge area. There are no significant seasonal variations in the groundwater flow direction observed in the Regional Aquifer.

Based on the estimated travel time between the groundwater recharge area and Ferndale's current production wells, it appears that the production wells are not significantly vulnerable to impacts from moderate drought conditions (1 to 5 years). However, the currently available data indicates that Ferndale's wells likely have an increased potential for impact from severe drought conditions (droughts lasting longer than 5 years).

City of Bellingham – Bellingham's water supply is the Lake Whatcom reservoir, augmented by periodic diversions from the Middle Fork Nooksack River, which is fed, in part, by melt from the Deming Glacier. Computer modeling determined that drought impacts on the water supply system would only occur after three or more atypically dry summer/fall seasons. Should this weather pattern occur, the diversion system would be utilized during winter storm events to recharge the reservoir and meet Bellingham's municipal water supply demands.

City of Lynden – The City of Lynden (Lynden) draws water from the lower main stem of the Nooksack River. The water intake structure was relocated in 1962 to its present location on the south side of the river immediately upstream of the Hannegan Road Bridge. Relocating the intake to the south took advantage of the deeper channel on the south side in that reach.[44] The pump station is built over a caisson-type intake, split into two compartments. Raw water flows through a 42-inch-diameter passive, fish-friendly, drum screen before splitting into two caisson compartments. Each compartment has two vertical turbine, 125 horsepower (hp) pumps with variable frequency drives, each with the capacity to pump 1,000 to 3,000 gallons per minute (gpm). There must be at least 2 feet of water in the caissons for pumping. The intake structure has emergency power provided by a 275-kilowatt diesel generator. Surface water can be vulnerable to drought, but the vulnerability for Lynden would be under extreme low flow conditions in the Nooksack River. Current low flows in the Nooksack River exceed 600 cfs

[43] Bill Bullock, City of Blaine Public Works Department via e-mail March 13, 2017.

[44] USGS Gage No. 12208000 Nooksack River near Deming, shows the mean flow for 34 years of record is 564 cfs. The City's withdrawal of 5 MGD is approximately 8 cfs.

(approximately 388 MGD), with Lynden's current peak day flow of 5 MGD representing a small fraction of the river's flow within this reach. Because the Nooksack River is a water source primarily fed by glaciers on Mt. Baker, short-term drought likely is less of a concern than longer term climate change. Operationally, low flow conditions are normally associated with less turbidity; therefore, less treatment is required. Lynden has 9 MG of storage and conservation policies in place to withstand most short duration interruptions.

City of Everson – The City of Everson (Everson) draws its water supply from three groundwater wells located in the Strandell neighborhood. Everson has two shallow wells, 28 feet and 32 feet deep, respectively, and one deep well at 150 feet that is the main source of water for Everson. Everson also has three reservoirs for a total of 480,000 gallons of capacity, which provide Everson with 1 to 3 days reserve of water, depending on the season. Everson maintains a monthly well log of each of its groundwater wells. In the last 20 years, Everson has experienced only a 6-foot seasonal difference in well levels in all three wells. With moderate rainfall, the aquifer seems to recharge quickly. Everson has an intertie with the City of Nooksack (which purchases water from the City of Sumas) for use during emergency situations. Everson has not experienced any adverse impacts from drier conditions during historic drought years.

City of Nooksack – The City of Nooksack is supplied water by the City of Sumas.

City of Sumas – The City of Sumas' (Sumas) water source is the Abbotsford-Sumas Aquifer, and the recharge area extends into Canada as far as the Abbotsford, B.C. airport. Sumas' water system supplies Sumas, Sumas Rural Water Association, Nooksack Rural Water Association, and the City of Nooksack. The Abbotsford-Sumas Aquifer is replenished constantly via groundwater infiltration. Their wells are artesian, and the water levels are measured on a regular basis. During the driest conditions experienced in Sumas, the aquifer has never lost artesian flow. Although drought conditions should always be a concern, it is secondary to the concern of contamination.

Self-Supplied Residential Water Vulnerabilities

While the County government represents all residents in Whatcom County, the County administration wants sufficient water for residential, industrial, and agricultural uses, as well as sufficient instream flows for salmon and other instream resources. Most of these interests are represented on the DCP TF and will be able to speak to their particular vulnerabilities. In addition, the County has an interest in ensuring there is sufficient water to meet rural residential needs, most of which are supplied by individual wells, as those interests are not otherwise represented on the TF. Individual water right permit-exempt wells are generally not susceptible to short-term droughts because of the relative abundance of water in shallow groundwater aquifers but could be susceptible to long-term droughts. Because of the diffuse geographic nature of these individual wells, often they are not well-suited to receive water from other sources such as pipelines or interties and may have to resort to other supply solutions such as trucked water during severe droughts.[45]

Lummi Reservation Water Supply Vulnerabilities

The entire population on the Lummi Nation Reservation is directly or indirectly vulnerable to drought events. Residents may be directly affected by a reduced water supply, which may result

[45] Gary Stoyka, Whatcom County Public Works Department, via e-mail February 22, 2017.

in reduced well production, dry wells, and/or saltwater intrusion, as well as potential water use restrictions and increased water rates. The potential reduction of groundwater due to drought could have significant negative impacts on the Reservation; over 95 percent of the potable water supply comes from two potable aquifer systems. Current problems with over pumping and saltwater intrusion can be expected to worsen under drought conditions.

Residents who rely on low production wells will be more vulnerable than those with more productive wells or those who are connected to the Lummi Tribal Sewer and Water District system. The majority of wells most vulnerable to drought are located on the Lummi Peninsula. With current land uses, the effect on agriculture will be limited to the floodplain, the only area where commodity crops are currently grown on the Reservation.[46]

Nooksack Tribe Domestic Water Supply Vulnerabilities

Nooksack tribal lands are spread out over portions of Whatcom County from the South Fork of the Nooksack River near Van Zandt up to the Canadian border near Lynden. Buildings, critical facilities, and infrastructure are generally clustered within five neighborhoods (Nooksack Tribe, 2012):

- Northwood allotment, located near Northwood Road and Halverstick Road, includes the Northwood Casino, a wastewater facility, and five homes.
- Mission Road, located along or near Mission Road, includes housing at Suchanon Drive, multi-family housing along Mission Road, and tribal facilities (e.g. medical clinic, dental clinic, behavioral health office) at Sulwhanon Drive, and numerous individual allotment lands used for private housing, as well as the Education Department.
- Deming, located in the town of Deming, includes the reservation, Tribal Government buildings (Tribal Council, Police, Administration, Early Childhood Education, Tribal Works, Planning, Legal, Social Services) and Tribal businesses (Nooksack Market Centre, Nooksack Automotive).
- Rutsatz, located off Rutsatz Road, consists of 47 homes.
- Five Cedars, located on the west bank of the South Fork Nooksack River near Van Zandt, includes 31 homes, Elders Housing, Elders community center, a neighborhood community center.

Tribal housing areas are served by five local water systems. There have been no known interruptions to date in water supply due to drought, but there is potential for a severe, long-term drought to affect water supply.

[46] Lummi Natural Resources Department. (2015). *Lummi Nation Multi-Hazard Mitigation Plan*, 122.

Fisheries and Instream Flow Vulnerabilities

Droughts may have a significant impact on the environment in a variety of ways. Given the great range of County environments, from ocean shoreline to alpine, the environmental factors vulnerable to water shortages are substantial. Because of the importance of salmon to the Whatcom County area, the following discussion focuses on instream flows needed to support healthy salmon and other fish populations.

As illustrated in **Figures 2** and **3**, flows in the Nooksack River in 2015 were significantly lower than the historic average flows except for a few brief periods of heavy rain. As discussed previously, water year 2015 provides an indication of the hydrologic conditions forecast to occur in the mid- to late-century with continued climate change.

Droughts have the potential to profoundly impact Nooksack salmon by impeding the recovery of imperiled species and reducing harvestable surplus of more abundant species. Washington State and the County have a mix of wild salmon stocks and hatchery stocks, both of which are vital to the well-being of the Nooksack River watershed and the County.

WDFW provided the following statements related to wild fish as part of the *Washington State Drought Contingency Plan*. Although these comments generally refer to fish resources statewide, they apply to the Nooksack Basin and provide a good summary of the issues.

- Sport and commercial fishing's contribution (wild and hatchery stocks) to the state's economy is $2.5 billion.
- Low flows expose physical blockages to up and downstream movement, potentially stranding migrants, resident adults, and rearing juveniles in dewatered stream segments.
- Low flows shrink rearing habitats, reducing juvenile survival (crowding, low dissolved oxygen, increased disease, low food abundance, increased risk of predation).
- High temperatures in certain stream reaches can cause thermal blockages that upstream migrants will not pass.
- High stream temperatures, caused by low flow conditions and/or high air temperatures, can directly cause fish mortality.
- Low flows reduce riffle depth or dry-up stream reaches, preventing upstream migrants from entering streams or reaching normal spawning grounds.
- Low flows congregate migrating fish, which are affected by crowding, low dissolved oxygen, increased risk of predation, and potential higher disease incidence, all of which can increase pre-spawning mortality.
- Low flows shrink spawning habitats, causing fish to spawn in sub-optimal habitats (habitats that produce lower egg survivals), or to superimpose nests, which also leads to low egg survival.
- In streams with many agricultural diversions, drought conditions can further exacerbate the reduction in flow, inhibiting migration and reducing habitat suitability.

Similar concerns apply to fish hatcheries in the County:

- Hatchery fish will need more frequent medication due to virulence of disease organisms at lower flows and higher water temperatures.

- Hatchery water supplies may need to be modified, or alternative water supplies employed, to provide adequate water supply and/or maintain adequate water quality. This includes both state and tribal hatcheries in the County.
- Fish may need to be released earlier or relocated to safe havens, which results in higher trucking costs and increased handling stress and mortalities.
- In 2015, Lummi Skookum Creek Hatchery staff were forced to develop and implement a contingency plan to reduce juvenile coho salmon production at the facility by 20 percent due to a lack of water availability (i.e., low instream flows in Skookum Creek). The water supply at the Skookum Creek Hatchery is already vulnerable during drought and/or low summer streamflow, both of which are expected to become more frequent with climate change. Similarly, production at the Lummi Bay hatchery would be jeopardized if the water supply and/or water intake system from the Nooksack River at the Marine Drive Bridge was rendered inadequate. In addition, hatcheries are particularly vulnerable to water quality degradation, climate induced or otherwise, because of the high-density rearing conditions under which salmon are raised to meet production goals.[47]
- The non-potable water supply to the Lummi Nation's salmon hatchery programs, which are culturally and economically significant to the Lummi Nation and its members, uses both groundwater and surface water. Climate change impacts to surface waters include changes in the quantity and timing of streamflow and increases in stream temperature. There are currently no suitable alternative water sources on or near the Reservation that could be used to support hatchery operations.[48]

In the Nooksack Basin, the highest priorities for recovery are the two early-timed Nooksack chinook populations: North Fork/Middle Fork (NF/MF) Nooksack early chinook, and South Fork (SF) Nooksack early chinook. Estimated historic abundances (WRIA 1 Salmon Recovery Board, 2005) were 26,000 (NF/MF) and 13,000 (SF); however, recent escapements of natural-origin spawners have averaged 194 (NF/MF) and 49 (SF) for the years 2011 through 2015 (Lummi Nation, Nooksack Tribe, and WDFW, unpublished data).

An assessment of the vulnerability of South Fork Nooksack River salmonids to climate change impacts has been completed (EPA, 2016), and those findings, especially with respect to effects of low flows and increased temperatures, are applicable to drought vulnerability assessment. Drought directly affects salmon by reducing instream flows, which reduces the availability of holding, spawning, and rearing habitat. Low flows can dewater redds or confine spawning to main channel thalwegs where incubation success can be poor during floods. Low flows may create temporary blockages or delays for upstream migration, increasing pre-spawn mortality, and reducing reproductive success (Beamish et al., 2009, cited in EPA, 2016) or affecting spawn timing and distribution. Low flows can also increase the occurrence of isolated pools in the active channel and on the floodplain that strand rearing juvenile salmonids and render them vulnerable to higher temperatures, low dissolved oxygen, and terrestrial predators. Reduced velocities associated with reduced discharge may increase the time of smolt outmigration and exposure to predation, thereby reducing smolt survival. Indirect effects of drought on salmon

[47] Lummi Natural Resources Department. (2016, February 16). *Lummi Nation Climate Change Mitigation and Adaptation Plan: 2016-2026*, 56.

[48] Ibid. https://www.lummi-nsn.gov/userfiles/360_Climate%20Change%20Assessment%20FINAL.pdf

include increased water temperatures, reduced dissolved oxygen, and increased human activities that further stress salmon (e.g., tubing, water withdrawals). Increased temperatures can have either lethal or sublethal effects, including increased physiological stress, metabolic costs, and susceptibility to disease, which together may lead to reduced survival and/or reproductive success (McCullough et al., 2001, cited in EPA, 2016). High temperatures also can create thermal barriers to migration (Sauter et al., 2001), affecting spawn timing and distribution. Long-or moderate-term severe droughts also can impact groundwater levels (Ecology, 2017a). Diminished groundwater recharge reduces base flow and raises temperatures in surface waters. Riparian vegetation suffers, which reduces shading and further raises stream temperatures.

Vulnerability of species and life stages of Nooksack Basin salmon to drought depends on timing, magnitude, and duration of the drought relative to the distribution (WRIA 1 Salmon Recovery Board, 2005) and periodicity of WRIA 1 salmonids (Anchor Environmental, 2001). The most vulnerable species are those that migrate upstream during summer (early Chinook, summer steelhead, bull trout) and that rear for extended periods in freshwater (Chinook, coho, and sockeye salmon; steelhead, cutthroat, and bull trout). Short-term droughts that extend through summer may affect survival of holding and over summer rearing life stages,[49] delay timing of upstream migration and spawning, and limit spawning distribution of summer-migrating salmonids. Low flows limit migration upstream through the fish passage barriers on the South Fork Nooksack River at river mile (RM) 25 (a partial Chinook barrier) and RM 31 (full Chinook barrier, partial barrier for summer steelhead and bull trout) and into tributaries where access is limited during summer by flow.

Longer-term severe droughts spanning multiple years could reduce survival of multiple brood years and cause decline or extirpation of salmonid populations. The species with adult life stages most vulnerable to drought conditions (early Chinook, summer steelhead, and bull trout) are also listed under the ESA as threatened. Further declines could warrant endangered listings, which would further constrain fisheries and land use. The presence of temperature and flow refugia will likely help buffer the effects of drought.

South Fork Nooksack River early Chinook are already strongly limited by high temperatures and low flows; drought conditions would exacerbate these limiting factors. Life stages potentially impacted include river entry, upstream migration and holding, spawning, rearing, egg survival, and outmigration (i.e. low flows and high temperatures can adversely impact all life stages that occur in freshwater). High temperatures in the South Fork are associated with observations of Chinook pre-spawn mortality. Columnaris, a pathogen associated with high temperatures (McCullough et al., 2001), has been confirmed in pre-spawn mortalities of Chinook in the South Fork in August or September 2003, 2006, 2009, and 2013, years when the 7-day average of daily maximum temperatures in the lower South Fork exceeded 22 degrees Celsius (EPA, 2016). During the 2015 drought, the worst on record for the state of Washington (Ecology, 2017b), flows in the South Fork (**Figure 3**) during June and July were less than 17 percent of the long-term average (1935 to 2008). No pre-spawn mortalities were detected that year; however, it may be because early chinook held in the lower Nooksack River for longer before moving into the South Fork. Spawning survey data (Nooksack Natural Resources Department, unpublished

[49] Both NF/MF and SF Nooksack early Chinook populations can out-migrate from freshwater as fry (soon after emergence), parr (rear in freshwater weeks to months), or yearlings (rear in freshwater >1 year). Yearling life history (WRIA 1 Salmon Recovery Board, 2005).

data) indicate that the first Chinook was detected in the South Fork on September 9th in the reach between RM 8.6 and RM 12.9, and September 10th in the reach between RM 4.3 and RM 8.6 (State Highway 9 Bridge at Acme); by contrast, in 2014, the first chinook was detected between RM 8.6 and RM 12.9 (Saxon Road Bridge) on July 21st and between RM 4.3 and RM 8.6 on August 1st. [50]

In the North and Middle Forks, by contrast, where instream flows and cool temperatures have historically been sustained by glacial melt, early Chinook are limited by high channel instability that destroys or dewaters redds and flushes rearing juveniles. Stable side channels are important for providing refuge from floods, but access and use is often limited by a lack of sufficient flow. Drought conditions would reduce accessibility and use of side channels, concentrating spawning in the main channel, where incubation success is low. For example, daily flows in the North Fork from late May through late August were considerably lower than the long-term average (**Figure 2**), with daily flows from August 1 through August 28, 2015, between 43 and 76 percent of the long-term average (1938 to 2016; USGS stream gage data). Dissolved oxygen in the South Fork at the Potter Road bridge also dropped below the water quality standard to protect aquatic life (9.5 milligrams per liter (mg/L)) for the first time since the Nooksack Tribe's monthly sampling began in 2010, with measurements of 8.46, 8.81, and 9.1 mg/L on June 9, July 7, and August 4, 2015, respectively (Nooksack Tribe, unpublished data). Previous minimum dissolved oxygen measurements by year were 10.02 mg/L (2010), 9.8 mg/L (2012), 9.6 mg/L (2013), and 9.73 mg/L (2014).

ESA-listed Chinook salmon and steelhead are especially vulnerable to streamflow-related water quality issues given their early river entry, summer holding and migration, and extended freshwater rearing (weeks to more than 1-year post-emergence for Chinook; 1 to 3 years for steelhead).[51]

In addition to Chinook, drought could negatively impact other salmon species of importance to the Nooksack Tribe. Pink salmon (in odd years) and chum salmon have been the most abundant species, providing the greatest harvest opportunity in recent years. Drought conditions could delay pink salmon entry and upstream migration and limit spawning distribution in the South Fork, which is already characterized by low flows. During 2015, the first live pink salmon were recorded in McDonald Creek (a tributary to the North Fork at RM 53) on August 10th, with increasing numbers through August (150 on August 13th, 700 on August 19th, and 2,000 on August 25th; Nooksack Tribe, unpublished data). However, in the South Fork, the first pink salmon were recorded in a pool just above the confluence (~16.5 miles downriver from MacDonald Creek) on August 21st (200 live), with increasing numbers through mid-September (500 on September 7th, and 2,000 on September 14th).

[50] Pacific Northwest River Basins Commission, Hydrology and Hydraulics Committee. (1968, April). River Mile Index, Stillaguamish River, Skagit River, Samish River, Nooksack River, Puget Sound Basin, British Columbia, Washington.
[51] Treva Coe, Nooksack Indian Tribe, via e-mail June 13, 2018.

Chum salmon migrate upstream in late summer and spawn in fall (Anchor Environmental, 2001), but drought conditions that lower groundwater levels could reduce the availability and extent of groundwater-fed channels that are preferred by chum.[52]

Agricultural Vulnerabilities

Agriculture is a very important activity in the County, and droughts can have serious impacts on agricultural production. **Figure 14** indicates historic raspberry production in the County reported by 79 growers. Production in 2015 was affected by the drought. It is impossible to attribute the entire drop in production to drought, but it was a prime factor. It should be noted that the impact on the production of crops in the County was due to both reductions in precipitation and increased air temperatures.

[52] Citations for Nooksack Indian Tribe Natural Resources Climate Change Vulnerability Assessment:

Anchor Environmental. (2001). *Fish Distribution and Periodicity in WRIA 1. Final Draft, March 2001.* Prepared for City of Bellingham, Public Works Department. Seattle, WA. http://wria1project.whatcomcounty.org/Resource-Library/Studies-And-Reports/Habitat-and-Instream-Flow/71.aspx

Nooksack Indian Tribe. (2012). *Tribal Hazard Mitigation Plan.* Prepared under Hazard Mitigation Grant Program DR-1734, Contract No. E09-114. Deming, WA.

U.S. Environmental Protection Agency (EPA). (2016). *Qualitative Assessment: Evaluating the Impacts of Climate Change on Endangered Species Act Recovery Actions for the South Fork Nooksack River, WA.* EPA/600/R-16/153. Western Ecology Division, National Health and Environmental Effects Research Laboratory, Corvallis, OR. https://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=530415

Water Resource Inventory Area (WRIA) 1 Salmon Recovery Board. 2005. WRIA 1 Salmonid Recovery Plan. October 11, 2005 Bellingham, WA. 323pp. plus appendices. http://salmon.wria1.org/resources/documents

Washington State Department of Ecology. (2016). *2015 Drought Response: Summary Report.* Publication No. 16-11-001. Olympia, WA. https://fortress.wa.gov/ecy/publications/SummaryPages/1611001.html

Washington State Department of Ecology. (2017a). https://ecology.wa.gov/Research-Data/Data-resources/Geographic-Information-Systems-GIS

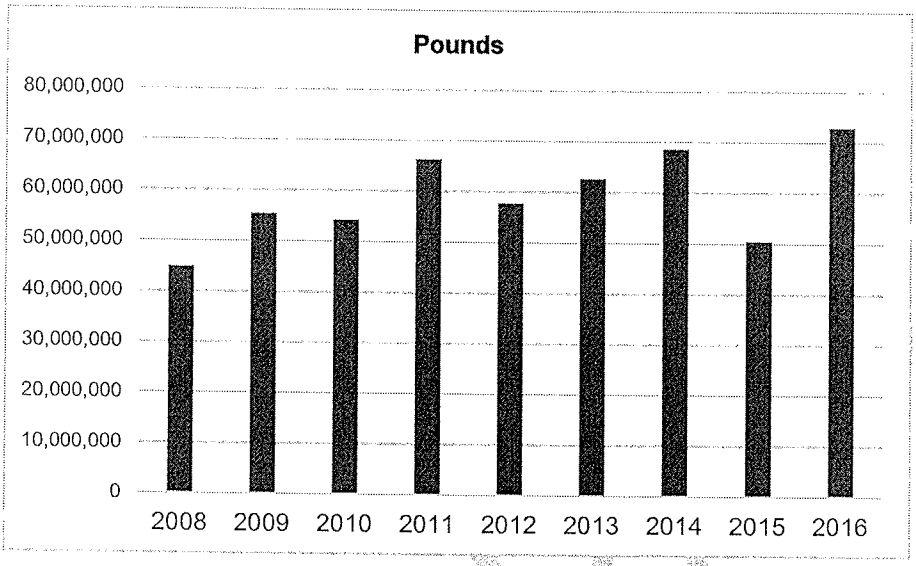
Washington State Department of Ecology. (2017b). http://www.ecy.wa.gov/programs/wr/supply/index.html

Washington State Department of Natural Resources. (2008). Washington State Department of Natural Resources Fire Statistics, 1970-2007. Resource Protection Division. Olympia, WA. http://www.dnr.wa.gov/GIS

Washington State Department of Natural Resources. (2016). Washington State Department of Natural Resources Fire Statistics, 2008 - Present. Resource Protection Division. Olympia, WA. http://www.dnr.wa.gov/GIS

Figure 14

Historic Raspberry Production in Whatcom County

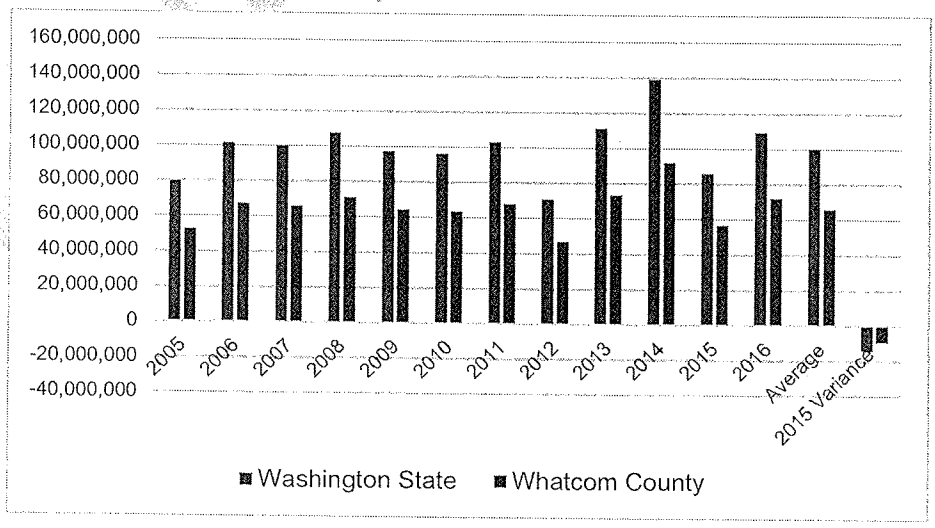


The average production for the period of 2008 through 2016 was 59,276,047 pounds of raspberries. The 2015 production of 50,508,651 pounds was 8,767,396 pounds below the average.

Blueberries and dairy forages also were affected by the 2015 drought. Statistics related to the production of seed potatoes in Washington State and the County are shown in **Figure 15**. In 2015, both the statewide and the County production of seed potatoes declined by about 14 percent, with a loss of 9,339,832 pounds in the County compared to the average production over the period of 2005 to 2016.

Figure 15

Historic Whatcom County Seed Potato Production



Agriculture is susceptible to short-term droughts, as shown in the effects of the 2015 drought. Few farmers ran out of water, but the existing irrigation systems were often inadequate to meet the increased and prolonged demand. Berry production, seed potato production, and grass and corn forage crops simply could not get enough water in a timely manner to maintain optimum production. This was due, in part, to the increased demand for water by the plants caused by increased ambient air temperatures.

Some locations are limited by inadequate water rights. Still other rights are subject to the minimum instream flows adopted in 1986 and are interruptible when flows drop below the required levels. Much of the watershed is closed year-round to new water rights. While this year-round closure may inhibit some alternative water resource management strategies, such as storage of peak river flows for use during the dry season, some options still exist. For example, Ecology routinely issues seasonal water right change approvals in the County to provide flexibility in water use; the processing of seasonal changes can be expedited when a drought declaration has been made by the State.

Long-term, multi-year droughts have not been a concern for farmers yet, but if lower summer flows or a gradual depletion of the aquifer due to climate changes is experienced, the concern would heighten.

Terrestrial Wildlife

Terrestrial wildlife is important to the County on several levels. The wildlife plays an important role in the economy and culture of the tribes and is important for recreation and hunting activities in the watershed. Terrestrial wildlife is susceptible to adverse impacts due to drought conditions as described below.

- Terrestrial water shortages for birds, small game, and big game.
- Impacts to waterfowl, amphibians, and other species as wetlands recede.
- Loss of forage grasses and shrubs.
- Increased disturbance, road kill, predation, and incidents of problem and dangerous wildlife as animals are forced to seek water and food near more populated areas.

In addition to these freshwater effects, low streamflows and high stream temperatures can adversely affect marine wildlife in estuaries and other near-shore areas. Droughts could affect marine water salinity, temperatures, and habitat suitability, although analysis of these impacts and design of effective mitigation and response measures for marine waters is beyond the scope of this DCP.

The Washington State DCP update included the following vulnerabilities related to low flows for sport and commercial fisheries.

- Low flows expose physical blockages to migration and can strand migrants in dewatered stream segments.
- Low flows or reservoir levels shrink habitat, causing crowding, low dissolved oxygen, disease, less food supply, and higher mortality of juvenile and adult fish.
- High stream temperatures, due to low flow and/or higher air temperatures, can kill fish and create thermal blockages that upstream migrants will not pass.

- Low flows reduce riffle depth or dry up stream reaches, preventing upstream migrants from entering streams or reaching normal spawning grounds.
- Low flows shrink spawning habitats, leading to low egg survival.
- Reservoir outflows can be curtailed by drought conditions, causing low-flow problems downstream.

The unprecedented high temperatures in the mainstem Columbia and Snake Rivers led to catastrophic loss of sockeye fish during the 2015 drought. The Okanogan River reached 85 degrees Fahrenheit (29.44 degrees Celsius – significantly above the lethal threshold of 68 degrees Fahrenheit (20 degrees Celsius)). WDFW staff recorded 312 locations in 17 watersheds where fish migration was impeded by low flows or by man-made rock dams.[53]

Other Species

In addition to salmon, Nooksack Tribal members hunt and gather a wide variety of animal and plant species. Important wildlife species include deer, elk, cougar, mountain goat, bear, and duck. Long-term, severe droughts may affect the availability of forage or prey, thereby impacting the distribution and abundance of wildlife for hunting. Important plant species include western red cedar, wetland wapato, bog cranberry, Labrador tea, cattail, sweetgrass, and native huckleberries. Survival of plant species may be impacted by reduced water availability associated with long-term, severe droughts, which in turn may negatively impact access and availability for gathering. The Nooksack Indian Tribe contracted the University of Washington Climate Impacts Group to conduct a climate vulnerability assessment of species and plant communities of interest to the tribe (Climate Impacts Group, 2017).[54] The resulting report provides substantial information on the vulnerabilities of wildlife in the County to climate change.

Forest Vulnerabilities

Increased Risk of Wildfires and Potential Social and Cultural Effects

The Forestry Caucus stated that, from a forestry stand point, the discussion of drought is focused on three forest designations: Federal; State; and Private. Federal lands are managed by the U.S. Forest Service (USFS), and part of the watershed in managed by the National Park Service as part of the North Cascades National Park. State forest lands are managed by the Washington State Department of Natural Resources (DNR). Private forests are managed by private land owners. The Washington Forest Protection Association (WFPA) is a trade association representing private forest landowners in Washington State whose members grow, harvest, and re-grow trees on about 4 million acres in the State.

During droughts, wildfires are the primary concern for the forested lands of Whatcom County. In addition to the fires themselves, the threat of wildfire is also an issue. Based on Washington state fire data[55] for non-federal lands, there have been 145 recorded wildfires in the watershed of the

[53] Washington State Department of Ecology. Water Resources Program. (2017, September). *DRAFT Washington State Drought Contingency Plan*, 70.
[54] Morgan, H., and M. Krosby. (2017). *Nooksack Tribe of Indians Natural Resources Climate Change Vulnerability Assessment.* Climate Impacts Group, University of Washington.
[55] http://data-wadnr.opendata.arcgis.com/datasets/dabefcb8f03549b49bee7564d4c3c4b5_8 (retrieved June 13, 2018).

North, Middle, and South Forks of the Nooksack River since 1970. The clear majority (116) have burned one acre or less, while six fires burned over 50 acres, including 1973 (75 acres), 1974 (95 acres, 630 acres), 1979 (130 acres, 582 acres), and 2009 (61 acres).[56]

Since 2008 through March 30, 2018, DNR has reported 140 wildfires in the County. The largest fire was at Panther Creek, which burned 243 acres in 2009. Panther Creek is in Whatcom County but is not part of the Nooksack River Basin. On the Mt. Baker-Snoqualmie National Forest, fires regularly occur in heavy recreation areas, including Baker Lake, and at high elevations where lightning strikes tend to occur during dry summer conditions. As of August 2018, a fire on the Mt. Baker Highway east of Glacier burned approximately 6 acres in May; several lightning-caused fires near Baker Lake burned over 40 acres causing temporary trail and campground closures in June; and a human-caused fire on the east side of Baker Lake burned approximately 4 acres in July.

There were 17 wildfires recorded on non-federal land during the drought year of 2015, most of which were very small. The largest of those burned 32 acres on Stewart Mountain. On federal lands in 2015, the Upper Skagit Complex in North Cascades National Park burned 8,505 acres and led to the temporary evacuation of local residents, closure of State Route 20, shut down of Seattle City Light transmission lines, and economic losses by local businesses that rely on visitors travelling to or through the park.

Since 1996, DNR has been reducing wildfire risk by implementing an activity restriction system tied to Industrial Fire Precaution Levels.[57] As the temperature increases and the humidity goes down, timber harvesting and industrial activities are limited at different levels, up to a total shutdown. If a shutdown lasts for an extended period, a lack of supply of raw materials to the mills would occur. As a result, not only are the woods workers out of a job, but the mill workers would be at risk to lose their jobs. This could cause permanent closures for some companies who cannot stand the lack of cash flow over an extended period.[58] As fire seasons continue to start sooner and last longer, Industrial Fire Precaution Level (IFPL) restrictions may be in place for more of the year, which reduces efficiency and increases cost per unit of timber volume harvested. Over the past 10 years, the probability of IFPL Level II or III partial shutdowns has risen to approximately 70 percent for the months of July, August, and September.[59]

The Lummi Nation expressed a concern with fire hazard as it relates to the Lummi Indian Reservation. Approximately 30 percent of the Reservation is forested and many of the homes on the Reservation are located along the wildland-urban interface. During a drought, many structures and forest-based cultural resources would be at an increased risk of fire.

Management of forest lands influences the hydrology of the Nooksack watershed. Recent research at Oregon State University suggests that forest harvest may reduce late summer flows by as much as 50 percent when compared to adjacent watersheds with mature and old growth forest cover (Perry and Jones, 2016). These results relate to several factors, the most significant

[56] Samantha Chang, USFS. (2018, August 29) E-mail RE: Forestry Review indicated the best information for historic fire data is at https://www.nifc.gov/fireInfo/fireInfo_statistics.html

[57] Treva Coe, Nooksack Indian Tribe, e-mail March 17, 2017.

[58] Dick Whitmore, Forestry Caucus, e-mail September 18, 2017.

[59] Samantha Chang, U.S. Forest Service, e-mail comments RE: Forestry Review, August 29, 2018.

of which is that regenerating forests use substantially more water than mature and old growth forests.[60]

Drought has the potential to impact access to hunting, fishing, gathering, and culture resource sites by increasing the risk of wildfire in the forested foothills of the North Cascades in Northwest Washington state. Wildfire could also threaten cultural materials that may be stored in those areas. Longer-term droughts would be more likely to increase wildfire risk than shorter-term droughts.

During the 2015 drought, smoke blanketed the county from wildfires. The Washington State Department of Natural Resources (DNR) local conservation crews left the county to fight fires in other counties leaving local first responders to spend many hours fighting local fires. Recreational opportunities, including campfires and dirt biking, were curtailed; and elk were not pushed down to the lowlands by snow as typically occurs.[61]

In addition to fires, drought conditions of reduced moisture and higher temperatures stresses the forests, often with long term impacts.

For landowners and land managers, it is challenging to know how to adapt to uncertain, upcoming climate changes. In a changing climate it is more important than ever that DNR encourage and educate landowners to improve stand resistance to forest pests and resilience to recover from damage. Stand resistance to disturbance can be defined as the influence of stand structure and composition on the severity of disturbance. Resilience can be defined as the influence of a disturbance on the post-disturbance structure and composition (DeRose and Long, 2014). Stand resistance and resilience can be increased by doing activities that increase tree vigor, reduce competition, promote appropriate species diversity for the site, maintain appropriate age cohorts and vertical structures (i.e. canopy layers), maintaining appropriate horizontal structures (i.e. spatial patterns), and retain or plant species best adapted to the site.

One strategy for forests is to reduce stocking to site appropriate levels via active management (mechanical treatments, prescribed fire) and foster site appropriate species composition so the forests will be better adapted to the current and changing climate. As drought conditions are expected to worsen over the coming decades, this forest health climate change adaptation strategy is designed to address the reduction of the tree carrying capacity of many sites.[62]

Table 3 illustrates the relative tolerance of Pacific Northwest forest species to drought conditions.

[60] Perry, T. D., and Jones, J. A. (2016), *Summer streamflow deficits from regenerating Douglas-fir forest in the Pacific Northwest, USA.* Ecohydrology. Retrieved from https://doi.org/10.1002.eco.1790

[61] Amy Ramsey, Washington State Department of Natural Resources, e-mail November 22, 2017.

[62] Amy Ramsey, e-mail RE: Forestry language for Drought Contingency Plan August 30, 2018.

Table 3

Relative Tolerance of Pacific Northwest Forest Species

Relative Tolerance of Pacific Northwest Species						
Species	Shade Tolerance	Drought Tolerance	Excessive Moisture Tolerance	Frost Tolerance	Temperature Response	Fire Resistance
Pacific silver fir	Very high	Very low	N/a	Moderate	Low/moderate	Low
Western hemlock	High	Low	Low	Low	Moderate	Low
Western red cedar	High	Moderate	High	Low	Moderate	Low
Mountain hemlock	High	Very low	High	Moderate/high	Low/moderate	Low/moderate
Subalpine fir	Moderate/high	Moderate	High	Moderate	Low/moderate	Low
Grand fir	Moderate/high	Moderate	Moderate	Moderate	Moderate	Low
Sitka spruce	Moderate/high	Low	Moderate	Moderate	N/a	Low
Alaska yellow cedar	Moderate/high	Low	High	Moderate	N/a	Low
Western white pine	Moderate	Moderate	N/a	High	N/a	Low/moderate
Douglas fir	Moderate	High/moderate	Low	Low	High	Moderate/high
Engelmann spruce	Moderate	High/moderate	N/a	High	N/a	Low
Lodgepole pine	Low	High	High	High	Low	Low/moderate
Western larch	Low	Moderate	N/a	N/a	N/a	High
Ponderosa pine	Very low	High	Moderate	Moderate/high	High	High

Provided by Amy Ramsey, DNR. Original source unknown.

Because the local forest products industry is heavily reliant on Douglas-fir, western red cedar, and western hemlock, there are concerns about long-term impacts on these species as climate change occurs. Appropriate questions include: Are there other species better suited to the future Whatcom County climate? Would mixed forests and selective logging be beneficial to the long-term health of our forests?

Promoting and retaining mature and old growth forest stands, which are more drought resistant and resilient, not only protects the forest, but generally promotes more stream flow during the late summer in drought and non-drought years.

Federal lands in the County include the Mt. Baker-Snoqualmie National Forest and North Cascades National Park. National Forest System lands are subject to management requirements under the *Northwest Forest Plan* and *Mt. Baker-Snoqualmie National Forest Land and Resource Management Plan*, which include land allocations similar to County zoning. Large areas of the National Forest within the County are Congressionally designated wilderness (where timber harvest is prohibited) or allocated as Late Successional Reserves, where forest management is generally limited to thinning to enhance forest characteristics that provide habitat for wildlife species dependent on old forest structure. There are areas of Matrix allocation in the Canyon Creek area where timber management is emphasized, and the USFS is currently planning a landscape-level project that includes timber harvest in both Matrix and Late Successional Reserves in the North Fork Nooksack watershed. The USFS provides opportunities for stakeholders to engage in USFS projects.

The Forestry Caucus expressed concerns with the rate at which forest lands in Washington state are being converted into uses other than forestry and believe that the damage being done by this conversion is more detrimental and will happen faster than any anticipated adverse impacts associated with climate change. It is their goal that private forest lands will continue to be

managed to ensure long-term sustainability of those forests. Between 1976 and 2006 in western Washington, 493,000 acres of non-federal forest land was converted to other land uses. The majority of this change was from privately owned non-industrial forest to low-density residential use, and the highest rates of conversion took place in the Puget Sound region. Private structure densities within 1 mile of federal lands doubled during the same period.[63]

Climate change projections suggest that Washington will have changes in temperatures and precipitation during the growing season in the future. Temperatures for the Pacific Northwest are projected to increase 2.1 degrees Celsius by the 2040s and 3.8 degrees Celsius by the 2080s (Littell, et al., 2011). Temperature is projected to increase in all seasons, with the largest increases during the summer months. This seasonal difference would be a change in the trend observed in the twentieth century, which indicate more warming in the winter (Mote, 2003).[64] Precipitation is projected to increase slightly, but the summer months are projected to have a 10-percent decrease in precipitation by the 2040s.[65] Warming temperatures are likely to increase the frequency and severity of droughts, regardless of small changes in mean annual precipitation, leading to episodes of tree dieback or mortality, insect outbreaks, and fire.[66] This will undoubtedly contribute to tree stress, making them more susceptible to insects and diseases. Increases in tree mortality are likely to occur. The extensive droughts of 2012 and 2015 contributed to greater than expected tree mortality and damage across the state. Exceptional weather events are likely to become more frequent in years to come, with more similar events. Major forest pests that are known to increase damage following droughts (via increase in tree stress and therefore a predisposition to damage by the pest) and extreme weather events include bark beetles, root diseases and foliar diseases. Any changes in the population dynamics of forest insects and pathogens in response to climate will be dependent on the biology and phenology (climate-influenced recurring annual events, such as budding) of the species in question, their hosts and their natural enemies; all with varying responses to environmental conditions. To make matters more complicated, changes may vary by ecoregion. Research on climate change in these complex ecosystems is challenging and still evolving. However, a few themes have emerged:

- If climate change results in more frequent and intense droughts we can expect to see more mortality from insect outbreaks and root diseases due to increased tree stress. However, these pests will still require their range of suitable hosts to maintain outbreaks.

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[63] Littell, J.S., M.M. Elsner, G.S. Mauger, E. Lutz, A.F., Hamlet, and E. Salathé. (2011). *Regional Climate and Hydrologic Change in the Northern US Rockies and Pacific Northwest: Internally Consistent Projections of Future Climate for Resource Management.* Project report: April 17, 2011. Retrieved from http://cses.washington.edu/picea/USFS/pub/Littell_etal_2010/Littell_etal._2011_Regional_Climatic_And_Hydrologic_Change_USFS_USFWS_JVA_17Apr11.pdf

[64] Mote, P.W. (2003). Trends in temperature and precipitation in the Pacific Northwest during the twentieth century. Northwest Science. 77: 271-282.

[65] Raymond, C.L., D.L. Peterson, and R.M. Rochefort. (2014). Climate Change Vulnerability and Adaptation in the North Cascades Region, Washington. General Technical Report, PNW-GTR-892. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, 279.

[66] Peterson, D.W., B.K. Kerns, and E.K. Dodson. (2014). *Climate Change Effects on Vegetation in the Pacific Northwest: A Review and Synthesis of the Scientific Literature and Simulation Model Projections.* General Technical Report, PNW-GTR-900. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, 183.

- In a warmer climate, insects can reduce their development time. For some bark beetle species, this may shorten the length of generation time or allow them to occupy ranges farther north in latitude or at higher elevations. In recent years, mountain pine beetle has been documented killing pines outside of its historic range in northern Canada. For some defoliators, the outcome of shorter development time may be more uncertain because they rely heavily on synchrony in time with their hosts.
- Unseasonable extremes in temperatures can affect forest insects, but in various ways. Warmer winters could lead to greater survival of some bark beetles, with the greatest effect at higher latitudes and elevations where extreme cold has excluded them in the past. Early spring warmups could influence some insects to emerge out of synchrony with their hosts or expose larval stage defoliators to late freeze events. Sustained temperatures above or below an insect's developmental thresholds may slow activity and delay development, possibly exposing them to natural controls longer.
- Not all forest pests will respond to climate change with similar patterns or intensities. Any disease caused by a forest pathogen requires the interaction of a susceptible host (the host tree), a virulent pathogen (the pest), and favorable environmental conditions.[67] Many forest pathogen life cycles are tightly linked to weather conditions, especially precipitation. It is therefore difficult to predict forest pathogen responses to changing short- and long-term weather as accurate precipitation pattern predictions are difficult to make. Success of some forest pathogens are also linked to their host tree's health. In these cases, we would expect pathogens to be more successful on host trees stressed by drought (refer to Sturrock et al. 2011, Woods et al. 2010). Root disease pathogens are examples of pathogens that could cause more growth loss and mortality on drought-stressed trees.[68]

Local forests grow in soil nourished over thousands of years by the return of salmon loaded with nutrients from the sea to die and be consumed by bears and eagles that carry the nutrients into the forest. Drought further weakens salmon, endangering their long-run survival, and forest health.

Concerns about an extended period of drought include young tree survival and catastrophic fire events that could destroy a significant amount of the timber supply.[69] Other considerations would be: mortality of recent regeneration activities (including plantings during spring or fall of a drought year); mortality of saplings; mortality of all sizes of trees and species depending on site factors, primarily soil types; reduced growth and volume; increased stress, top and branch mortality due to secondary pests; increased stress and susceptibility to other mortality agents several years following a drought event (the impacts won't just be seen in the year the drought occurs, residual impacts will continue for multiple years).[70]

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[67] Stevens, R.B. (1960). *Plant Pathology, an Advanced Treatise, Vol. 3.*
J.G. Horsfall and A.E. Dimond, eds. Academic Press, NY.
Agrios, G. N. (2005). *Plant Pathology* (5th edition). Elsevier-Academic Press. San Diego, CA, 357-429.
[68] Woods, A. J., Heppner, D., Kope, H. H., Burleigh, J., & Maclauchlan, L. 2010. Forest health and climate change: a British Columbia perspective. The Forestry Chronicle, 86(4), 412-422.
[69] Dick Whitmore, Forestry Caucus.
[70] Amy Ramsey, Washington State Department of Natural Resources, e-mail November 22, 2017.

Energy Vulnerabilities

There are several sources of energy production in the County, some of which could be adversely impacted by drought conditions. The Nooksack Falls Hydroelectric Power Plant (1,500-kilowatt (kW) capacity), originally constructed in 1906, is located at Nooksack Falls on the North Fork Nooksack River. Because the North Fork is primarily glacial fed but partially dependent on lower elevation snow pack and precipitation, a severe and long-term drought could adversely impact power production. As climate change continues, impacts could become more common and more severe.

Puget Sound Energy (PSE) owns four natural gas fired plants in the County that require water for energy production:

- Ferndale Generating Plant (460-megawatt (MW) capacity): The monthly water use varies but this plant used 228 MG in 2017, with a high of 42 MG in August and a low of 3 MG in March.
- Whitehorn Generating Station at Point Whitehorn (147 MW): This plant only runs at times of high energy demands on the PSE system. Water use for energy production and maintenance in 2017 was less than 1 MG for the entire year.[71]
- EncoGen Generating Station on the Bellingham waterfront (167 MW).
- Sumas Generating Station (125 MW).

Both the Ferndale plant and Whitehorn Station are provided water from the PUD. As a result, the stations are vulnerable if flows in the Nooksack River become sufficiently low that the PUD diversion works are no longer able to withdraw the necessary water.

The EncoGen station is located on the Bellingham waterfront and is supplied water by Bellingham. Therefore, the station is subject to the same vulnerabilities as the Bellingham municipal water system. The Sumas Generating Station is supplied water by the City of Sumas.

Recreation Vulnerabilities

The County's environment presents numerous opportunities for a wide range of outdoor activities, many of which are water related; therefore, these opportunities are susceptible to potential drought impacts.

- Winter sports, such as skiing, snowboarding, and snowmobiling, have a high vulnerability to drought due to their reliance on snowpack accumulation. Droughts in 2005 and 2015 showed about a 60- to 80-percent drop in ski resort visitors.
- Sno-Park permit sales drop significantly with low snowpack, reducing park revenue.
- Rafting and kayaking need sufficient stream flows to draw participants and to make it possible to safely pass rocky reaches. Flow in popular river reaches dropped below optimal flow rates at least 30 days early in 2015.
- Forest use restrictions arising from increased risk of wildfires limit forest-related recreational opportunities.

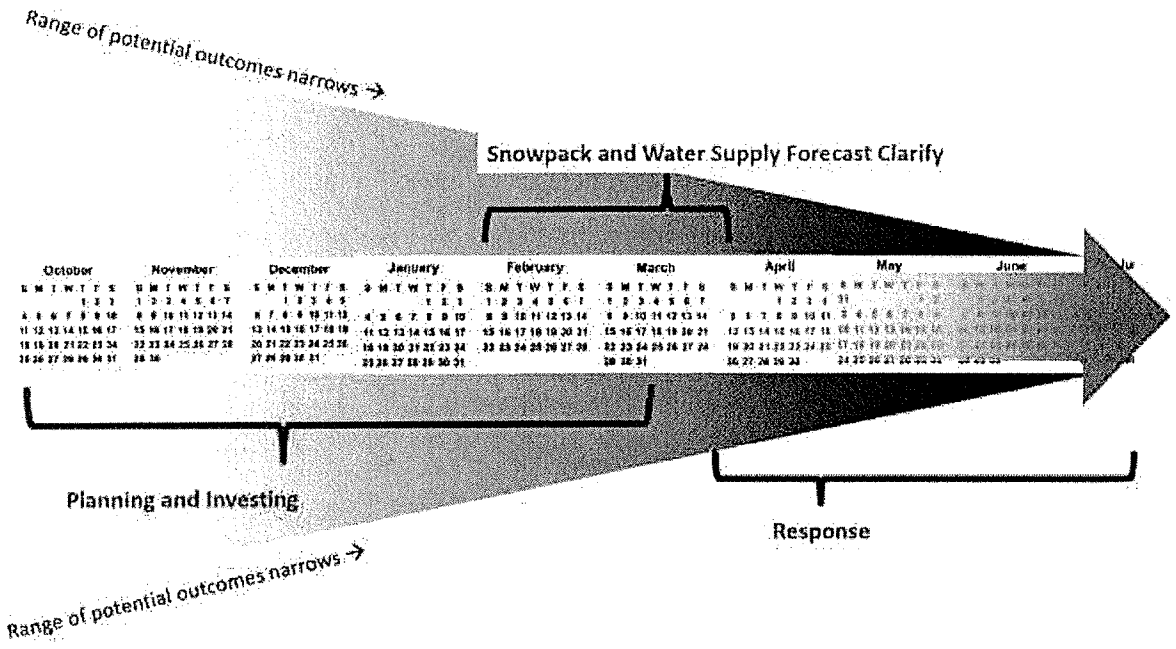
[71] Water use data for the Ferndale Generating Station and the PSE Whitehorn station was provided by Steve Jilk, Manager, PUD No. 1 of Whatcom County, via e-mail June 14, 2018.

MITIGATION MEASURES

Drought is often described as a slow-moving disaster, but conditions can develop rapidly, challenging society's ability to respond in a timely manner. **Figure 16** illustrates the challenge associated with planning and responding to drought conditions.

Figure 16

Forecasting Certainty in Relation to Water Supply Planning and Drought Response[72]



The difficulty to respond in time means it is important to identify mitigation actions that can be taken during non-drought years. When implemented, these actions will reduce adverse drought impacts when droughts occur, alleviating many of the problems associated with providing quick and meaningful response to droughts while the drought is underway.

Entities responding to drought conditions need to become more agile and adopt practices that reduce the time and effort required to mobilize and deploy resources.

Mitigation actions are defined as actions that can be taken in non-drought periods to help minimize the adverse impacts of droughts when they occur. These actions are generally outside of regular water management activities and are intended to decrease sector vulnerabilities and reduce the need for response actions. There are some activities that are best undertaken as mitigation actions (i.e., undertaken during non-drought years) but that also are appropriate as response actions (i.e., undertaken during a drought) when they were not accomplished prior to the drought. For example, fishery interests could identify barriers to fish passage that will be problematic to fish during low flows associated with drought and could remove those barriers in

[72] Washington State Department of Ecology. Water Resources Program. (2017, September). *DRAFT Washington State Drought Contingency Plan*, 33.

non-drought years as a mitigation action. Identification and removal of such barriers during a drought is also beneficial but would fall under the category of drought response actions.

Within the scope of this DCP, the following measures to improve drought mitigation should be prioritized. These measures also emphasize the improvement of the emergency drought response framework. The existing TF will continue to meet periodically and, under leadership of the PUD, develop a strategy and workplan to evaluate the feasibility of the drought mitigation measures included in this DCP and prioritize actions to implement those measures. This will include coordination with other entities in the watershed, such as the Watershed Management Board, Whatcom County, State agencies, the Lummi Nation, the Nooksack Tribe, cities, the Agricultural Water Board, the Whatcom Conservation District, and others.

INTEGRATED WATER MANAGEMENT

Integrated water management strategies should be pursued to resolve major water supply imbalances, such as occur in the County where some areas have adequate water supplies and others do not. Improving the ability to move water to where it is needed within the County would help mitigate the adverse impacts of droughts. Interties between public water systems are an example of such actions. This DCP helps identify opportunities to improve the integration of local water management strategies and can be an important step in establishing the foundation for a more comprehensive water supply management plan for the County. For example, the recently updated *Whatcom County Coordinated Water System Plan* should be used as the basis for discussions to evaluate the feasibility of moving water within the County from areas with relative surplus to areas of deficit. Similarly, the 2016 *Quantification of Agricultural Irrigation Water Use and Water Rights Report* could be used as the basis for discussions about water banking and agricultural water use efficiency opportunities.

PRE-AGREEMENTS

Front-line responders to natural disasters such as fires, floods, and earthquakes understand the importance of pre-staging critical tools and supplies where they can be deployed quickly. This same principle can be applied to executing administrative requirements necessary to support drought resiliency and response activities. Reducing response time can help compensate for the inherent uncertainty in the forecasting of drought conditions.

- Pre-agreements can expedite responses by having interagency agreements, work plans, budgets, and scopes of work available prior to the onset of drought. This will speed the disbursement of money from Ecology to other agencies and organizations needing drought response funding. For example, if the DCP is able to successfully establish an entity that can coordinate with Ecology and other agencies for the provision of drought relief assistance, the development of pre-agreements could be beneficial in getting effective relief to those areas and entities most in need of the assistance.
- The Washington Water/Wastewater Agency Response Network allows water and wastewater systems to receive rapid mutual aid and assistance from other systems in an emergency. Utilities sign the network's standard agreement, which then allows them to share resources with any other system in Washington that also has signed the agreement. Mutual aid agreements between water users can specify that participating systems will make equipment and other resources available in the event of a water supply emergency.

Local water and wastewater systems are encouraged to participate in this network (**Appendix C**).

- Some water right transfers may be recurrent in drought years. To the extent the participants require state authorization to proceed with the transfer, parties should work with Ecology to obtain prior approval for measures that can proceed on the basis of simple notification to Ecology.
- Public water systems with municipal purpose water rights should consider updates to their comprehensive water system plans and/or other planning documents to ensure that their water rights place of use and their water system service areas are consistent with any changes that may accompany either the receipt or provision of water to/from another water system.

Ecology administers contingency funds for drought response. Ecology has proposed legislation which, among other things, would create a more stable funding source by establishing a permanent account for Ecology to draw from for drought preparedness and response projects. This fund would allow drought-related projects to be funded during non-drought years, which would improve the readiness, reduce drought impacts, and allow for a quicker provision of drought funds during a drought declaration. In addition, the Whatcom County Sheriff's Office Division of Emergency Management (Division) works to secure drought declarations by the County Executive, which would authorize Whatcom County government agencies to expend resources to address the emergency. The proclamation would be forwarded by the County's Division to the Washington State Military Department Emergency Management Division, which would begin the process of the Governor's proclamation. If the effect of the drought is large enough, the State would then make a request to the Federal Emergency Management Agency for a Federal Declaration. The Division would lead the collection of effects, damages, and costs of the drought in support of any proclamation submitted to the State. The role of the Emergency Management Division is discussed in more detail under the **Operational and Administration Framework** section.

PUBLIC WATER SYSTEM MITIGATION MEASURES

Public water systems should identify existing emergency interties available to their water system and take steps to ensure that the intertie can be put into operation quickly when needed. Measures include reviewing any contractual agreements that exist between the water systems and updating the names and contact information for the people at each system who are responsible for activating the intertie to ensure that it can be placed into operation quickly when needed.

The 2016 update of the Whatcom County CWSP evaluated the water rights for public water systems and their anticipated future demand for water. **Table 4** lists the public water systems that were identified that are projected to have a water rights surplus after they have achieved full build-out of their service areas. This list includes both Group A and smaller Group B systems; in some cases, the volume of surplus water is not enough to justify the cost of connections with other systems for sharing the surplus water.[73]

[73] RH2 Engineering, Inc. (2016, August). *Whatcom County Coordinated Water System Plan Update.* Prepared for PUD No. 1 of Whatcom County.

Table 4 should be used as the basis for discussions about potential interties between public water systems. These interties could provide an additional source of water during drought and redundancy of supply as climate change continues to occur.

Table 4

Water Systems with Projected Water Surplus at Full Build-Out

Water System Name (All Group A)	Projected Surplus (acre-feet per year)	Water System Name (All Group A)	Projected Surplus (acre-feet per year)
Acme Water District #18	95.8	Lake Terrill Water Association	68.4
Agate Bay Trailer Park	2.4	LISECC (Lummi Island Scenic Estates Community)	1,424.1
Aldergrove Water Association	52.7	Combined Lake Whatcom Water & Sewer District (Agate Heights, Eagleridge, South Shore)	1,815.8
Anderson Creek Water Association	4.1	Lynden Water Department	3,734.7*
Belfern Water Association	21.7	Mantheys Country Mobile Home Park	38.8
Belfern West	14.5	Mount Baker Mobile Home Park	2.9
City of Bellingham, Water Division	147,435.3	Neptune Beach Water Association	20.7
Berthusen Road Water Association	77.5	North Star Water Association	31
Calmor Cove Club	13.5	Northwest Mobile Home Park	13.8
Cedar Lynn Water Association	29.8	Northwest Water Association	80.7
Century Water Association	10.7	Northwood Water Association	85.2
Chuckanut Trails Water System	37.6	Orchard Water Association	62.5
Double L Mobile Home Park	3.4	Paradise Park Water Association	17.3
Enterprise Estates Water Association	48.1	Point Roberts Water District #4	504.2
Enterprise Terrace Water Association	19.8	Raspberry Ridge Water Association	24
Evergreen Retreat Mobile Home Park	3.1	Rathbone Park Water Association	25.3
Fairfield Mobile Home Park	7.7	Roederland Water Association	34.6
Ferndale Mobile Village	15.5	Sumas Water Department	841.5
Georgia Manor Water Association	20	Sunsent Water and Maintenance Association	10.3
Glacier Springs Water Association	118.8	Wahl Water Association	15.9
Glacier Water District	449.4	Whatcom Water District #2	1,633.3
Grandview Beach Water Association	20.3	Whatcom Water District #7	678.8
Hilltop Water Owners Association	14.1	Whatcom Water District #13	295.9
Isle Aire Beach Association	28.6	Willeys Lake Terrace Water Association	20.9
Kelly Road Water Association	11.3		

*The City of Lynden and Ecology entered into a Memorandum of Agreement (MOA) (2004) due to a disagreement between the parties related to the extent of the City's water rights. While the MOA is in place, the parties will work together to secure a reliable water supply for the City to meet current and future growth obligations.

As water supply conditions deteriorate and the state issues a drought advisory or a drought declaration, public water systems should provide information to their customers about the need to conserve water and use water efficiently.

Public water systems should review their existing comprehensive water system plans or small watershed plans to ensure that provisions for dealing with potential drought impacts are addressed adequately.

Public water systems should ensure they comply with DOH guidelines for water use efficiency and identify and implement actions to achieve compliance if they are not.

Using the drought vulnerability maps and matrix provided by DOH, identify systems vulnerable to the declared drought and prioritize the efforts to focus on those systems.

Public Utility District No. 1 of Skagit County (Skagit PUD) has established two bulk water fill stations in Skagit County where customers can purchase water and fill their own water tanks. The 24-hour bulk water fill stations are sites where commercial business, agricultural operations, and the general public can purchase large volumes of water at easily accessible locations. Customers can fill smaller tanks up, including large commercial tanker trucks. Referred to as "Water ATM machines," a customer must first establish an account with Skagit PUD and obtain a Bulk Water Fill Station Water Use Permit. The water rate is 2.5 cents per gallon. For health and safety reasons, water passing the Skagit PUD meter is not warranted by Skagit PUD as suitable for domestic-potable use, but the water provided is treated by Skagit PUD as it enters their distribution system. Additional detail about these bulk water stations is available from Skagit PUD at 1415 Freeway Drive, Mount Vernon, WA 98272, (360) 424-7104, or at www.SkagitPUD.org

Water systems in Whatcom County should evaluate the feasibility of creating similar facilities as a means of supplying water to people whose normal supply of water is unavailable due to drought conditions.

SELF-SUPPLIED RESIDENTIAL WATER

Owners of private wells may have relatively few options when it comes to mitigating impacts of droughts. While ground water is relatively abundant in most of Whatcom County, a prolonged drought can threaten such supplies. Well owners are encouraged to monitor the water levels in their wells and develop a database relating to how their well behaves during seasonal changes over the years. This monitoring can help them identify if supplies are, in fact, being affected by drought conditions and can provide "early warning" for them to explore options including deepening their well, connecting to an alternative water supply, developing rainwater catchment, or making provisions for hauling water from a more secure source.

FISH AND WILDLIFE MITIGATION MEASURES

As previously discussed, fish and wildlife and vital resources to the County. Planning for drought occurrences should fully account for the importance of these resources. Potential mitigation measures include the following:

- Establish a WRIA 1 Management Board Staff Team Fish Passage Sub-Committee to identify and prioritize needed fishery-related mitigation measures.
- Remove fish-passage barriers from prime spawning and rearing habitat to improve resiliency.
- Identify and address low flow barriers to fish passage.
- Prioritize habitat for protection and restoration to provide temperature and flow refugia during drought periods.

- Develop and implement a Low Impact Development policy for future developments in all or portions of Whatcom County.
- Evaluate the feasibility of providing an alternate water supply for the Skookum Creek fish hatchery.
- Evaluate the feasibility of establishing cold water refugia areas with water provided from wells and implement preferred options.
- Restore riparian areas as a means of improving both water temperatures during the warm summer months and water quality.
- Restore watershed processes that will reduce the magnitude and duration of low flows and increase high quality habitat abundance and diversity.
- Promote the retention of mature and old growth forest stands to facilitate late summer streamflow.
- Purchase water rights to restore flows in critical areas with flow-limited fish habitat. (Refer to the **Water Rights Bank/Exchange Program** section.)
- Prioritize improvements for hatcheries most vulnerable to drought, such as modifying intake systems, installing chillers, or installing back-up wells.
- Work with water managers in highly diverted systems to develop coordinated pulse flow programs that provide temporary, adequate flows for upstream migration and which avoid potential problems such as stranding.
- Augment stream flows (or pulse flows) through acquisitions, temporary source exchanges, or leases and/or transfers of surface and ground water rights, including the South Fork of the Nooksack River.
- Implement irrigation scheduling, where practical, to minimize adverse impacts on instream resources, including the South Fork of the Nooksack River.
- Conduct public outreach with agricultural operators on the impact of water diversion from the Nooksack River when flows fall below minimum instream flow thresholds.
- Develop and implement a rapid identification and response program aimed at preventing unlawful diversions from streams and rivers to protect fish habitat and promote fish survival.
- Work with hatchery managers to ensure they have drought mitigation response plans in place.
- Implement measures that ameliorate climate change impacts on salmon or increase salmon resilience to climate change (Beechie et al., 2013; EPA, 2016[74]). The *Qualitative Assessment: Evaluating the Impacts of Climate Change on Endangered Species Act Recovery Actions for the South Fork Nooksack River* (EPA, 2016) prioritizes actions for each reach and watershed of the South Fork Nooksack River. It is anticipated that similar

[74] U.S. Environmental Protection Agency. (2016). *Qualitative Assessment: Evaluating the Impacts of Climate Change on Endangered Species Act Recovery Actions for the South Fork Nooksack River, WA.* EPA/600/R-16/153. Western Ecology Division, National Health and Environmental Effects Research Laboratory, Corvallis, OR.

levels of specificity for other areas of the Nooksack River watershed will be developed over time. **Tables 5** and **6** identify recommended restoration actions for South Fork Reaches and Subbasins. **Table 7** provides specific recommendations for climate change adaptation, many of which are relevant to drought contingency planning.

Table 5

Recommended Restoration Actions for South Fork Reaches to Address Impacts of Climate Change on Salmon

Beechie et al., 2013

Category	Analogous South Fork Technique	Ameliorates Climate Change Effects?					Priority of Action (by Reach)				
		Ameliorates Temperature Increase	Ameliorates Base Flow Decrease	Ameliorates Peak Flow Increase	Ameliorates Sediment Increase[1]	Increases Salmon Resilience	1	2	3	4	5
Longitudinal connectivity (barrier removal)	Improve passage at natural barriers	O	O	O	O	●	N/A	N/A	Mod	Mod	N/A
Floodplain reconnection	Hydromodification removal/setback	●	O	●	●	●	High	Low	Low	Low	Low
	Log jams to reconnect floodplains	●	●	●	●	O	High	Low	Mod	Low	Low
Stream flow regimes	Reduce water withdrawals	●	●	O	O	O	High	Low	N/A	N/A	N/A
	Restore floodplain wetlands	●	●			O	High	Low	Mod	Low	Low
Erosion and sediment delivery	Reduce stream-adjacent sediment inputs (wood placement to reduce toe erosion)	O	O	O	O	O	Low	Low	Low	Low	Low
Riparian functions	Planting (trees, other vegetation)	●	O	O	O	O	High	High	High	High	High
	Thinning or removal of understory	O	O	O	O	O	High	High	High	High	High
	Remove non-native plants	◒	◒	O	O	O	High	High	High	High	High
Instream rehabilitation	Placement of log jams, other wood	◒[2]	O	O	O	O	High	Low	High	Low	Low

[1] Beechie et al. (2013) did not evaluate potential for actions to ameliorate increases in sediment. Call is based on best professional judgment.
[2] Instream restoration can ameliorate temperature increase by creating temperature refuges, increasing hyporheic exchange by encouraging bedform diversity, and narrowing active channel and increasing effective shade.

Ability to Ameliorate Climate Change Effects		Action Priority	
●	Positive effect		Low
O	No effect		Moderate (Mod)
◒	Context-dependent		High

Recommended restoration actions for reaches of the South Fork Nooksack River to address impacts of climate change on salmon. Actions that ameliorate temperature increase and base flow decrease and/or increase temperature resilience also serve to mitigate the impacts of a drought. Note: Reach 1: RM 0-14.3; Reach 2: RM 14.3-18.5; Reach 3: RM 18.5-25.4; Reach 4: RM 25.4-31; Reach 5: RM 31+. Source: EPA, 2016.

Table 6

Recommended Restoration Actions for South Fork Subbasins to Address Impacts of Climate Change on Salmon

Category	Common Techniques	Analogous South Fork Techniques	Ameliorates Climate Change Effects?					Priority of Action in Subbasins						
			Ameliorates Temperature Increase	Ameliorates Base Flow Decrease	Ameliorates Peak Flow Increase	Ameliorates Sediment Increase	Increases Salmon Resilience	Acme	Hutchinson	Skookum	Edfrol Cavanaugh	Plumbago/ Deer	Howard	Upper South Fork
Longitudinal connectivity	Barrier or culvert replacement/	Barrier or culvert replacement/	○	○	○	○	●[1]	Mod	Mod	Low	Low	Low	Low	Low
		Improve passage at natural barriers	○	○	○	○	●[2]	Low	Low	Mod	Low	Low	Low	Low
Stream flow regimes	Reduce water withdrawals, restore summer baseflow	Reduce withdrawals	●	●	○	○	○	High	Low	Low	Low	Low	Low	Low
		Restore floodplain wetlands	●[3]	●	○	○	○	High	Low[3]	Low[3]	Low[3]	Low[3]	Low[3]	Low[3]
	Disconnect road drainage from streams	Disconnect road drainage from streams	○	○	●	●[4]		Low	Low	Low	Low	Low	Low	Low[4]
Erosion and sediment Delivery	Landslide hazard reduction (sidecast/ fill removal)	Landslide hazard reduction (sidecast/ fill removal)	○	○	○	●[4]	○	Low[7]	Low[7]	Low[7]	Low[7]	Low[7]	Low[7]	Low[7]
Riparian functions	Planting (trees, other vegetation	Riparian treatments	●	○	○	○	○	High	High	Mod	Mod	Mod	Mod	Mod
	Thinning or removal of understory		○	○	○	○	○							
	Remove non-native plants		◐	◐	○	○	○							
Instream rehabilitation	Addition of log structures, log jams	Placement of log jams, other wood	◐	○	○	○	○	Mod/ low[8]	Mod/ low[8]	Mod/ low[8]	Mod/ low[8]	Mod/ low[8]	Mod/ low[8]	Mod/ low[8]

[1] Techniques and amelioration effects not cited individually are from Beechie et al. 2013.
[2] Beechie et al. 2005, Waples et al. 2008
[3] Pacle et al. 2009, Arrigoni et al. 2008
[4] Beechie et al. 2005
[5] Prioritization deferred pending analysis of beaver restoration potential.
[6] Upper South Fork subbasin is federal ownership, USFS is underfunded for road maintenance, so more information is needed to evaluate priority.
[7] Prioritization deferred pending development of sediment budget to quantify relative contributions of sediment sources.
[8] Moderate priority applies to cold-water tributaries (temperatures >2°C cooler than South Fork.

Ability to Ameliorate Climate Change Effects		Action Priority	
●	Yes		Low
○	No		Moderate (Mod)
◐	Context-dependent		High

Recommended restoration actions for subbasins of the South Fork Nooksack River to address impacts of climate change on salmon. Actions that ameliorate temperature increase and base flow decrease, and/or increase temperature resilience also serve to mitigate the impacts of a drought. Note: Reach 1: RM 0-14.3; Reach 2: RM 14.3-18.5; Reach 3: RM 18.5-25.4; Reach 4: RM 25.4-31; Reach 5: RM 31+. Source: EPA 2016.

Table 7
Summary of Restoration Action Types and Their Ability to Ameliorate Climate Change Effects on Peak Flow, Low Flow, Stream Temperature, or to Increase Salmon Population Resilience*

Table III. Summary of restoration action types and their ability to ameliorate climate change effects on peak flow, low flow, stream temperature, or to increase population resilience.

Category	Common Techniques	Ameliorates Temperature Increase	Ameliorates Base Flow Decrease	Amerliorates Peak Flow Increase	Increases Salmon Resilience
Longitudinal Connectivity (Barrier Removal)					
	Removal or breach of dam	●	●	○	●
	Barrier or culvert replacement/removal	○	○	○	●
Lateral Connectivity (Floodplain Reconnection)					
	Levee removal	●	○	●	●
	Reconnection of floodplain features (e.g., channels, ponds)	●	○	●	●
	Creation of new floodplain habitats	●	○	●	●
Vertical Connectivity (Incised Channel Restoration)					
	Reintroduce beaver (dams increase sediment storage)	●	●	●	●
	Remove cattle (restored vegetation stores sediment)	●	●	●	○
	Install grade controls	●	●	●	○
Stream Flow Regimes					
	Restoration of natural flood regime	●	●	○	◒
	Reduce water withdrawals, restore summer baseflow	●	●	○	○
	Reduce upland grazing	○	◒	◒	○
	Disconnect road drainage from streams	○	○	●	○
	Natural drainage systems, retention ponds, other urban stormwater techniques	○	◒	●	○
Erosion and Sediment Delivery					
	Road resurfacing	○	○	○	○
	Landslide hazard reduction (sidecast removal, fill removal)	○	○	○	○
	Reduced cropland erosion (e.g., no-till seeding)	○	○	○	○
	Reduced grazing (e.g., fencing livestock away from streams)	◒	○	○	○
Riparian Functions					
	Grazing removal, fencing, controlled grazing	●	○	○	○
	Planting (trees, other vegetation)	●	○	○	○
	Thinning or removal of understory	○	○	○	○
	Remove non-native plants	◒	◒	○	○
Instream Rehabilitation					
	Re-meandering of straightened stream, channel realignment	◒	○	○	◒
	Addition of log structures, log jams	◒	○	○	○
	Boulder weirs and boulders	◒			
	Brush bundles, cover structures	○	○	○	○
	Gravel addition	○	○	○	○
Nutrient Enrichment					
	Addition of organic and inorganic nutrients	○	○	○	○

Actions are grouped by major processes or functions they attempt to restore: connectivity (longitudinal, lateral and vertical), watershed-scale processes (stream flow and erosion regimes), riparian processes, instream rehabilitation, and nutrient enrichment. Filled circles indicate positive effect, empty circles indicate no effect, and partially filled circles indicate context-dependent effects. See text for supporting citations.

*Actions that ameliorate temperature increase and base flow decrease and/or increase temperature resilience also serve to mitigate the impacts of a drought. Source: Beechie et al., 2012.

ONGOING FISHERY HABITAT MITIGATION MEASURES

Habitat restoration is a cornerstone of local salmon recovery efforts and, to the extent it supports recovery of viable salmon populations by improving abundance, productivity, spatial structure, and diversity, it can help buffer the impacts of drought on salmon. Through the 1990s and 2000s, hundreds of riparian, sediment reduction, fish passage, and instream habitat restoration projects were implemented throughout the watersheds of the Nooksack River and independent coastal tributaries in WRIA 1 (http://waconnect.paladinpanoramic.com/File/360/1861). Project sponsors include Bellingham, the Nooksack Salmon Enhancement Association, the Nooksack Tribe, Lummi Natural Resources, U.S. Forest Service, Whatcom Conservation District, Whatcom County Public Works, and Whatcom Land Trust.

The *WRIA 1 Salmonid Recovery Plan* (WRIA 1 Plan) (WRIA 1 SRB, 2005) identified priority geographic areas, limiting factors, and restoration strategies for Nooksack early Chinook and other salmonids.

The WRIA 1 Plan also identified the most important salmon recovery actions to take in the near term (10-year timeframe; see Appendix B of the WRIA 1 Plan). Near-term actions included:

1. Restore anadromous fish passage at the Middle Fork Diversion Dam and Canyon Creek;
2. Restore habitat in the forks, mainstem, and major early Chinook tributaries;
3. Integrate salmon recovery needs into floodplain management planning;
4. Integrate salmonid habitat protection and the County's critical areas ordinance and shoreline management program;
5. Establish a South Fork Nooksack gene bank/supplementation program;
6. Establish new instream flows in WRIA 1;
7. Restore estuarine and nearshore marine areas; and
8. Restore functioning riparian and water quality conditions and reconnect isolated habitat in lowland tributaries (mainstem) and independent tributaries to the Fraser River and the Strait of Georgia.

Implementation of salmon recovery projects and programs is coordinated through the WRIA 1 Watershed Management Board (formerly the WRIA 1 Salmon Recovery Board).[75] Currently, there is an effort underway to compile, analyze, and report on status and trends, implementation, and effectiveness monitoring to inform adaptive management of the WRIA 1 Plan.

Since 2005, salmon recovery funding granted by the Salmon Recovery Funding Board has been targeted locally to projects that maximize benefit to two local native Chinook populations: North Fork/Middle Fork Nooksack early Chinook and South Fork Nooksack early Chinook. Both Nooksack early Chinook populations are considered essential for Puget Sound Chinook salmon Evolutionary Significant Unit (ESU) recovery, but current abundances of Nooksack natural-origin spawners are critically low. Salmon recovery priorities are presented and updated

[75] WRIA 1 Salmon Recovery Board (SRB). (2005). *WRIA 1 Salmonid Recovery Plan.* Bellingham, WA. Retrieved from http://salmonwria1.org/webfm_send/23

annually in project development matrices (http://salmonwria1.org/resources/documents, Annual Project Development Matrices).

Current priorities include construction of log jams to restore habitat diversity and reconnect floodplains; reforestation of historic channel migration zone plus 300-foot buffer; acquisition of properties at risk of degradation or necessary to facilitate restoration; and removal/setback of floodplain infrastructure (levees, bank hardening). Construction of log jams to restore habitats and habitat-forming processes in the Nooksack River Forks is prevalent due to the relative immediacy of benefit delivered; to date, over 35 log jam projects have been implemented in the North, Middle, or South Forks (http://salmonwria1.org/projects/habitat-restoration-nooksack-forks).

Both state and tribal fishery co-managers may implement additional restrictions on fisheries to increase survival during a drought. For example, the State has shortened fishing seasons to protect the resource. The Task Force may elect to evaluate new and ongoing fish habitat mitigation measures and identify those with drought-related benefits as priorities for their further efforts.

AGRICULTURAL MITIGATION MEASURES

- More background information on water rights and irrigated acres in Washington State would be extremely helpful. Involved agencies could develop a report and geodatabase delineating irrigation districts, water sources (surface or ground water), allocation of junior and senior water rights holders, and which users are likely to receive less water in a drought year. This would enable Ecology and the Washington State Department of Agriculture (WSDA) to identify growers likely to be affected by future droughts and make contingency planning more effective.[76] The Task Force should discuss this measure and, if they elect to pursue it, identify a project lead and involved parties, and develop a workplan and budget for completion of this work.
- Environmental Quality Incentives Program (EQIP): The Natural Resources Conservation Service (NRCS) provides conservation assistance to participating farm operations on an annual basis. Several different programs may be available to assist farm operations to install water efficient irrigation methods for crops or firewise-friendly irrigated hedgerows.[77] The Whatcom Conservation District should be consulted to determine the availability of drought-related relief measures.
- Irrigation Water Management Plans: As an approved Technical Service Provider for NRCS, the Whatcom Conservation District could assist irrigators with developing Irrigation Water Management Plans as a component of EQIP contracts. Technologies available for irrigation demand management include the following.
    - Replacing surface water diversions with groundwater withdrawals
        - One of the primary goals of the watershed improvement districts (WIDs) is to replace surface water diversions with groundwater withdrawals to the extent

[76] Washington State Department of Agriculture. (2017, February). *2015 Drought and Agriculture: A Study by the Washington State Department of Agriculture,* 47.

[77] The term Firewise describes a set of practices that homeowners can follow to prevent wildfires from spreading to structures, e.g., by preventing the buildup of dead vegetation on their property.

feasible. Such changes would reduce impacts to streamflow and generally make the water use less susceptible to interruption during a drought as a result of low streamflows. As of the end of 2017, the Bertrand WID has worked with farmers to transfer almost 5 cubic feet per second (cfs) of irrigation water use from Bertrand Creek to irrigation wells to reduce the impact of irrigation water use on flows in Bertrand Creek. In 2017, this effort expanded to the use of irrigation wells to augment the creek with groundwater at critical low flow periods, improving both flow and habitat conditions. Streamflow augmentation water was pumped from two wells to discharge points on Bertrand Creek between September 13th and October 19th.[78] Preliminary results indicate that nearly all the water discharged to Bertrand Creek was measured as increased stream flow at the Rathbone Road gage. In 2018, work will continue on this and similar projects aimed at improving the streamflow, habitat, and water quality of Bertrand Creek.

- Scheduling irrigation
  - Irrigation scheduling should be easily achievable for surface water users via use of the internet and, perhaps, local area networks. Where surface water use results in an immediate impact on streamflow, it makes sense to schedule and "spread out" the diversions over time to minimize the instantaneous impacts on flow. For groundwater uses, the lag time from the withdrawal of groundwater until impacts occur in a nearby stream make this less effective or, at least, more difficult to effectively implement.
- Increasing system uniformity
  - WIDs encourage all farmers to increase the uniformity of their systems to improve their efficiency through the use of similar irrigation components throughout their farms.
- Increasing irrigation efficiency
  - While typically used only for perennial crops, drip irrigation is being used by one potato grower in Whatcom County. Depending on the results in terms of crop production, water use, cost of installation, and cost of removing drip lines after the growing season, this may become a more common practice and would certainly result in improvements in water use efficiency. A significant amount of irrigation is for irrigation of grass and corn, primarily to produce feed for dairy cattle. This irrigation generally uses big gun equipment that is notoriously inefficient. Ecology's Guidance document 1210 lists big gun irrigation as 65-percent efficient, i.e. 65 percent of the water delivered directly benefits the crop.[79] Application of water closer to the ground should be encouraged to increase the efficiency by reducing losses due to wind drift

[78] Associated Earth Sciences, Inc. (2017, November 8). *Bertrand Creek Streamflow Augmentation, 2017 Annual Project Summary Report.*

[79] Washington State Department of Ecology. (Revised April 2018). *Policy for the Evaluation of Changes to Enable Irrigation of Additional Acreage or the Addition of New Purposes of Use to Existing Water Rights.* POL-1210. Retrieved from https://fortress.wa.gov/ecy/wrdocs/WaterRights/wrwebpdf/pol1210.pdf

losses and evaporation of the water before reaching the crop. Big gun irrigation also has poor distribution uniformity. Improved distribution uniformity can improve crop yields, crop uniformity, and quality, facilitate fertigation and chemigation, and lower input costs.[80]

- Recently, manufacturers have adapted the reel big gun to a boom system. Similar to a reel big gun, a boom system is mounted on a traveling cart that is reeled in slowly over a length of a field. However, booms (supported pipes) are cantilevered over both sides of the cart and micro-sprinklers are spaced along the length of the pipe to evenly distribute water over the soil, similar to center pivot or linear-move irrigation systems. A recent study comparing big gun to boom irrigation concluded that:

  The irrigation efficiency and uniformity of a typical boom is significantly greater than a typical big gun. Under ideal conditions and optimal spacing, boom systems have similar distribution uniformity to big gun systems. However, big guns are much more susceptible to poor uniformity in higher wind conditions. Overlap should be increased (fewer rows between pulls) under high wind conditions. In general, the uniformity of all the systems measured could be improved greatly by increasing the overlap.

  The lower pressures required by a boom and subsequent water savings would likely make the transition to a boom system cost-effective due to energy savings alone for those using diesel pumping plants. Those using electric pumping plants will likely see less economic benefits due to energy savings by converting. Although any irrigation system can have very real limitations, good management of existing equipment may be even more important to good crop uniformity and quality than switching to a different system.[81]

  RH2 recently compared the efficiency of big gun irrigation to the use of boom trucks or boom carts. For pasture/turf irrigation, savings would be between 0.04 and 0.05 acre-feet per year of land converted. For a 40-acre parcel, this would yield between 1.6 and 2.0 acre-feet per year of consumptive savings.

- Reducing water evaporation
  - As discussed above, the shift from big gun to boom irrigation would help reduce water losses due to evaporation and improve water use efficiency.
- Reducing soil evaporation (utilizing crop residue or mulch)
  - The use of crop residue or mulch to retain soil moisture and reduce evaporation is being employed by a number of growers in the County and is encouraged as a way of increasing water use efficiency.
- Limiting irrigation (applying less than optimum quantities of irrigation water (also referred to as deficit irrigation))

[80] Western Washington Irrigation Evaluation Scope of Work, Don McMoran, Troy Peters, Tom Walters.
[81] Washington State University. *Irrigating with Booms vs. Big Guns in Northwest Washington.* Extension Fact Sheet, FS003E.

- The Washington Raspberry Commission is helping to fund a study by the USDA entitled *Specialty Fruit Production in the Pacific Northwest: Adaptation Strategies for a Changing Climate*. This study will look at a number of crops and potential climate changes, highlight climate impacts, and explore various adaptation strategies to the climate changes anticipated in the Pacific Northwest.

o Increasing water storage capacity

- Storage could include new off-channel reservoirs, wetland storage, gravel pit storage, lowland lake storage, storage in on-farm lagoons, and groundwater recharge or, potentially, in-channel storage. On-farm lagoon storage could happen when a farm installs a dairy waste processor that produces clean water and reduces the volume of manure waste needing to be stored, thus freeing up lagoon volume for storage of the recovered water and possibly water diverted from streams during high flow events when instream requirements are being satisfied. This water could then be used for a variety of purposes, including irrigating the farm, augmenting stream flows during the low flow season or drought years, or selling/leasing water to another irrigator.

o Recharging groundwater

- According to a hydrologist familiar with the County, there are two areas where groundwater recharge may be a feasible alternative to develop additional water supplies. In most of the County, the groundwater level recharges every year, so there is no room to store additional water most of the time. However, there are two areas with potential: the first is the Regional Aquifer located beneath the Mountain View upland that is mostly unconfined and has a significant amount of sub-surface storage area; the second is the deep confined aquifer at depths greater than 300 feet in the general vicinity of Lynden. The water in this aquifer is saline but may have some potential for aquifer storage and recovery.[82]

o Harvesting rainwater

- Water harvesting is a method of collecting rainwater in above- or below-ground storage tanks; the purpose is to store the water for seasonal use in irrigation or, in limited cases, to increase the water table and/or augment stream flows. In the County, this technique could have some application on a small scale for individual homes and irrigation of small lawns or gardens, but it is not likely to be applicable as a large-scale water supply option. However, while it may not be suited to irrigation of large parcels, widespread use of rainwater collection may have cumulative benefits for WRIA 1.

o Transferring Water

- Water transfers have the potential to be a significant benefit to alleviating drought impacts in parts of the County. Refer to the **Water Rights Bank/Exchange Program** discussion.

[82] Chuck Lindsay, L.G., L.E.G., L.HG., Senior Principal Hydrologist, Associated Earth Sciences, Inc., via e-mail May 18, 2018.

Refer to the discussion of **Fish and Wildlife Mitigation Measures** related to public outreach to agricultural operators related to the impacts of water diversion when flows fall below the minimum instream flow thresholds and the suggestion to develop rapid enforcement related to unlawful diversions of water.

FORESTRY MITIGATION MEASURES

The caucus identified two key issues for watershed health: Water Storage (which should take place in the higher reaches of the watershed), and Habitat (providing high quality habitat in strategic reaches of the watershed.)[83]

Fires or tree mortality due to drought can be major problems. There are many actions that can be taken to mitigate drought conditions and minimize the adverse impacts. The Forestry Caucus reported that many of these actions were in place 30 years ago but have been compromised by changing attitudes to forest management.

The management of the County forests can be broken into five distinct entities:

1. Private industrial and non-industrial forest;
2. State trust lands;
3. National forest;
4. National park; and
5. Land trusts, city and county parks.

Most of the actions that should be taken are applicable to all three of the forest ownerships; Federal, State, and Private. Some actions may be more difficult on some ownerships, but the following is a non-inclusive list of forestry-related mitigation actions that can be taken.

1. An open transportation system for the free flow of fire watch, fire crews, and equipment.
2. A program to reduce fire fuels throughout the forests. Consideration should be given to prioritizing wildland-urban interface areas (forests near residential use) versus all forest due to higher risk of human-caused fires and greater potential for loss of life and property.
3. A forest management plan that will reduce the spread of catastrophic fire.
4. A tree thinning program that will increase the amount of precipitation that reaches the ground. This would include an extensive program of thinning over-stocked stands of timber while also promoting the retention of mature and old growth forest stands to facilitate the late summer stream flows.
5. Increasing the number of available firefighters and equipment, which could include funding and coordinating with local fire districts in the County. DNR and USFS staffing are subject to their respective budget processes and both agencies are focused on firefighting. Additional training specific to wildland fires is recommended and has a separate qualification system. The potential to cross train DNR, USFS, and local fire districts should be explored to improve readiness when fires occur, which could be paid

[83] Dick Whitmore, Forestry Caucus, e-mail February 22, 2018.

for by timber harvest receipts from the extra harvesting for fire prevention. Also, the increased number of woods workers required for the harvesting would increase the number of available firefighters and equipment. Firefighters are required to be qualified under the national training standards (referred to as "redcarded") and must be registered as federal or state contractors for whatever equipment they have. The County should consider investigating the feasibility of providing financial support to provide training for local businesses to become such registered contractors.

6. The increased use of the "Fire Wise" program (www.firewise.org) for residents living in or near forested areas, development of Community Wildfire Protection Plans, and adoption of land use codes recommended by the National Fire Protection Association and International Code Council (http://www.fireadaptedwashington.org/build-a-fire-adapted-community).

Over 50 percent of Whatcom County is covered by forest. Forested portions of the County can be a great sponge of water for the western part of the County. Infiltration of the annual precipitation can be enhanced greatly by managing the County's forested lands. If the forests did not exist, the rain would mostly runoff the land and would not recharge the aquifer. If the forest canopy is very tightly closed, the rain will be curtailed from reaching the ground and evaporate away. Between these two scenarios is a canopy ratio that will minimize unwanted water runoff, minimize water evaporation in the canopy, and maximize the infiltration of water into the streams and aquifer.

The Forestry Caucus has expressed the concern that the Federal lands contain some of the most overcrowded stands of timber in the County. The caucus recommends that these stands of timber be managed differently to maximize water infiltration and extend stream flow into the dry season. However, there is some disagreement about the best management practices. The TF should encourage discussions to identify and resolve differences of opinion and develop a preferred management approach. If this management scenario is implemented, a greater amount of water could be present in the western portion of the County during the dry months of the year. The Mt. Baker-Snoqualmie National Forest has initiated planning for active forest management throughout the North Fork Nooksack watershed over the next several years (https://www.fs.usda.gov/project/?project=53493). There are opportunities for stakeholder engagement in this project and similar projects in the future. The Forestry Caucus should engage in this process to provide its input to the USFS.

The caucus emphasizes that the beneficial forest management practices of harvesting to thin the forest for fire prevention and providing a better balance of water infiltration and runoff are compatible and could be implemented simultaneously.

As drought conditions become a more regular occurrence, it is expected to have an effect on the distribution of tree species. Some of these anticipated changes are:

1. If soils get hotter and drier, western red cedar and Pacific silver fir habitat may decrease;
2. The hotter, drier climate may extend Douglas-fir habitat to higher elevations;
3. The hemlock zone may begin to recede to a higher elevation;
4. More frequent hotter and drier weather may stress trees and make them more susceptible to both primary and secondary insect and disease outbreaks; and

5. Natural regeneration may be negatively affected, changing tree species composition or creating areas of brush where tree establishment is challenging.

In a properly managed forest, these changes can be adapted to by planting the proper species for a specific environment at the appropriate densities in the regular cycle of harvesting and planting trees. A program of thinning tree stands could reduce the impact of tree stress from drought and disease.

As global warming continues and as droughts occur, two critical events will happen:

1. Winter snow packs will be significantly reduced both in area and depth; and
2. Glaciers will melt, causing more runoff during the melt season through the mid-century, after which glacier melt contribution will diminish due to the large volume loss of the residual glaciers.

As previously discussed, if these two events do occur, summer streamflows will be reduced dramatically, causing extreme reduction in the availability of water for a multitude of uses in the County. A potential mitigation measure is to build reservoirs in the upper reaches of streams in the forests above anadromous fish use, although such projects can be controversial and may have a potential for detrimental impacts to riparian habitat and recreational use.

RECREATION MITIGATION MEASURES

- Some ski resorts are taking action to diversify their operations to include revenue-generating activities in the summer, including mountain biking, summer concerts, water slides, etc.
- Ski resorts should start planning now for contingencies related to reduced snowpack by implementing snow-making capabilities.
- Extreme low water conditions due to drought can trigger the need to extend boat launches to keep them open.

WATER RIGHTS BANK/EXCHANGE PROGRAM

What is a Water Bank?

Water banks serve to mitigate the economic impacts of a drought either by increasing the reliability of water supply or by facilitating short-term reallocation of water among users.[84]

A water bank is an entity specifically designed to facilitate the transfer of existing water rights to new uses or new places. A water bank essentially serves as an intermediary between the party with a water right and the party needing a water right. The bank attempts to bring together willing sellers and buyers with the goal of making water available to people and places where it might not otherwise be available. Existing senior water right holders could choose to sell or lease all or a portion of their perfected water rights for use by other users. When water rights are deposited into the water bank and approved by Ecology, they become trust water rights. In some cases, the state may lease water from the water bank to water users.

[84] Research Applications Library, Water Banking and Drought Mitigation, 2019. https://ral.ucar.edu/projects/water-banking-and-drought-mitigation

What is a Trust Water Right?

A trust water right means any water right acquired by the state under Chapter 90.42 Revised Code of Washington (RCW) for management in the state's trust water rights program (TWRP). RCW 90.42.080(1)(a) states that:

> The state may acquire all or portions of existing surface water or groundwater rights, by purchase, gift, or other appropriate means other than by condemnation, from any person or entity or combination of persons or entities. Once acquired, such rights are trust water rights. A water right acquired by the state that is expressly conditioned to limit its use to instream purposes shall be administered as a trust water right in compliance with that condition.

RCW 90.42.110(2) states that:

> An application to transfer a water right to the trust water [rights] program shall be reviewed under RCW90.03.380 at the time the water right is transferred to the trust water [rights] program for administration for water banking purposes, and notice of the application shall be published by the applicant as provided under RCW 90.03.280. The application must indicate the reach or reaches of the stream where the trust water right will be established before the transfer of the water right or portion thereof from the trust water [rights] program, and identify reasonably foreseeable future temporary or permanent beneficial uses for which the water right or portion thereof may be used by a third party upon transfer from the trust water right[s] program. In the event the future place of use, period of use, or other elements of the water right are not specifically identified at the time of the transfer into the trust water [rights] program, another review under RCW 90.03.380 will be necessary at the time of a proposed transfer from the trust water [rights] program.

What is the Significance of a Trust Water Right?

State water law says that if a water right is not used for 5 or more consecutive years without sufficient cause for that non-use, all or a portion of that water right may be relinquished back to the State. This is often referred to as use it or lose it. The advantage of a trust water right is that a water right that is in a water bank is considered to be in use and, as a result, that water right is protected from relinquishment. This allows a water right to be "parked" in the bank and made available for other uses without the risk of relinquishment. If the water right is in the bank and not being used for other purposes, it has the added advantage of benefitting instream flows. If it is being used by someone else, then the beneficial use means it is protected from relinquishment.

Do We Need a Water Bank in Whatcom County?

There are many water users in the County that have valid water rights. There are some users that do not have valid water rights. There are users who have water rights but do not use them all the

time. And there are users that have water rights but need more. For example, there are farmers who opt to fallow certain fields as a part of their farm management. The water rights associated with those parcels may be available for use by other farmers during those periods but neither party may be aware the opportunity exists. A water bank can help make those connections.

There are also a number of streams that suffer from low instream flows. Water rights on these streams could be placed into the water bank, dedicated to instream flows, or available to other uses but, when they are not being used, they would have a beneficial impact on instream flows.

There are farmers in the County whose water rights are interruptible (i.e., they are only allowed to use water when the minimum instream flows are being satisfied). In many cases, these farmers may be interested in obtaining additional, non-interruptible water to supplement their existing water rights as a means of maximizing the agricultural production on their land and being able to irrigate even in a low water year. A water bank could be instrumental in "connecting" those with water rights that are not needed with those that need additional water rights.

Another water bank related option that has been discussed is for water right holders to enter into pre-drought lease agreements for use of water when a drought is declared. In this scenario, a person with a water right would essentially agree to not use the water during a drought. The water could remain in the stream or the aquifer for environmental benefit or could be provided to another user as a secure supply of water during a drought. An example is a farmer growing annual crops that would sign an agreement to cease water use during a drought. In this case, the water could be used to ensure survival of perennial crops such as orchards, vineyards, or berries or could be dedicated to environmental benefits. A water bank could be instrumental in identifying such opportunities and the advantage of pre-leasing is that arrangements would already be in place and would not have to be negotiated during the drought. The downside is that the drought declaration would need to be made early enough in the season to enable the water users to make the appropriate decisions.

The Office of Columbia River (OCR) recommendations for water banking in Washington in the draft 2016 forecast include:

- Seek legislative clarity on mitigation criteria for streamlined bank operation. Mitigation criteria are currently in flux due to recent Washington State Supreme Court cases (Swinomish v. Ecology and Foster v. Ecology).[85]
- Clarify public interest criteria necessary for forming a water bank, since Ecology resources might be used to administer it. As currently structured, each new water bank creates new unfunded obligations on Ecology that detract from other legislatively-prioritized work.

[85] SWINOMISH INDIAN TRIBAL COMMUNITY, a federally recognized Indian tribe, Appellant, v. WASHINGTON STATE DEPARTMENT OF ECOLOGY, Respondent. No. 87672–0.

Sara FOSTER, Appellant, v. WASHINGTON STATE DEPARTMENT OF ECOLOGY; The City of Yelm; and Washington Pollution Control Hearings Board, Respondent. No. 90386–7.

- Identify financing mechanisms appropriate for water banking, to provide Ecology cost-recovery for bank formation and operation.
- Identify criteria for banks whose operation depends on water rights originating from outside the watershed to prevent unintended economic impacts.
- Explore alternatives to conventional operations and monitoring for very small uses that drive bank costs up, including for metering and certified water right examinations.
- Explore alternative contracting options, such as computer-aided transactions and options contracts for water.

One option may be to establish a water transfer working group for the County like the one being used in the Yakima Basin. In the Yakima Basin, the Water Transfer Working Group is a voluntary team of agencies and water users that meet to provide technical review of proposed water right transfers. Prospective water users submit water right transfer proposals to the group for their review, and the process guides applicants to those types of water right changes and transfers that more expeditiously gain approval from the state.[86]

In the 2017 legislative session, the Legislature passed Engrossed Substitute Senate Bill 6091, the Streamflow Preservation Act. This act included creation of a joint legislative task force on water resource mitigation that is charged with reviewing the treatment of surface and groundwater appropriations as they relate to instream flows and fish habitat, developing and recommending a mitigation sequencing process and scoring system to address such appropriations, and reviewing the Washington State Supreme Court decision in Foster v. Department of Ecology, 184 Wn.2d 465, 362 P.3d 959 (2015). The Task Force is charged with providing recommendations to the Legislature by November 15, 2019.

Leasing of Water Rights

To reduce the impact of low instream flows on fishery populations, Ecology may temporarily lease water from irrigators if funding is available. Leasing activity is focused on streams where there is a high fishery value and senior water rights are available that would not be subject to curtailment. The Drought Task Force could assist Ecology in identifying potential opportunities for such a measure.

Establishing emergency water right leasing in the context of a drought year has had mixed success. It has worked well with split-season leases, where farmers forgo a late season cutting of hay, which provides more time to plan and finalize agreements. But where the expectation is for a participating farmer to forgo an entire season's crop, unveiling a leasing program in early spring is too late.

[86] Washington State Department of Ecology. Water Resources Program. (2017, September). *Washington State Drought Contingency Plan*, 65.

Waiting until a drought year to lease water means paying a premium for water. In 2015, the going rate for water in the Yakima Basin was roughly twice what it was in 2005, the previous drought year.[87]

Past experience indicates that leasing is more effective if invitations for leasing are made well before the leasing period. Competition for water is greater during drought years and high prices for water limit the volume of water that can be purchased successfully using state funds.

Executing a single season leasing program requires several actions:

1. Determining a party's willingness and ability to pay;
2. Identifying basins for leasing activity;
3. Determining which entity should take the lead in reaching out to individual irrigators;
4. Holding public workshops to educate users about leasing opportunities;
5. Publishing and notice of invitation to bid;
6. Reviewing bid offers to determine if the water rights meets the state's suitability criteria;
7. Repeating rounds of invitation to bid if necessary;
8. Negotiating and drafting lease contracts; and
9. Ensuring that lessees remain in compliance with the terms of the lease (e.g., by forgoing irrigation).

Past experience also indicates that leasing may be more effective when water users have had time to become familiar with how leasing works and develop trust with the non-governmental organizations who typically facilitate such transactions.[88]

A Potential Water Rights Exchange Program

In Whatcom County, it has been suggested that the South Lynden WID might be a good agency to pilot a water exchange/water bank; however, this decision has not been made. South Lynden is an important agricultural area; there are farmers with and without water rights; there are water rights that are uninterruptible; there is a mix of ground and surface water rights; and there are lowland streams that would benefit from flow augmentation. The following is a preliminary discussion about the South Lynden WID and additional information related to the potential establishment and operation of a water bank/water exchange program.

The South Lynden WID comprises 12,991 acres in the County. It is primarily located in the floodplain of the Nooksack River. Kamm Creek and Mormon Ditch, a tributary of Kamm Creek, are the primary tributaries north of the river, and Scott Ditch and Cougar Creek are tributaries on the south side of the river. Dairies are the dominant land use within these watersheds. Most of the agricultural water users in the South Lynden WID rely on surface waters as their source of supply; as a result, they are very susceptible to water supply shortages during drought years

[87] Washington State Department of Ecology. Water Resources Program. (2017, September). *Washington State Drought Contingency Plan*, 78.
[88] Washington State Department of Ecology. Water Resources Program. (2017, September). *Washington State Drought Contingency Plan*, 6.

when stream flows are lower than normal due to decreased snowpack and rainfall in the watershed.

In some cases, there may be water rights that could be transferred to those experiencing hardships due to droughts. The time to identify those rights and take preliminary steps related to their transfer is during non-drought years when the crisis is not occurring and there is sufficient time to identify candidate water rights.

The water rights exchange program for the South Lynden WID would foster the voluntary, temporary transfer of water rights during drought conditions from those with water rights who are willing to make water available to those that have indicated a need for supplemental water during a drought.

All water right transfers or changes must ultimately be approved by Ecology. However, temporary or seasonal transfers can be accomplished with a letter of approval from Ecology. While permanent transfers must be approved by Ecology, the processing of the change application (the tentative determination of the extent and validity of the right, the evaluation of historic water use, and the preparation of the Report of Examination that recommends Ecology's decision on the change) can be performed by a Cost-Reimbursement Consultant approved by Ecology. Applicants who wish to have their application processed through cost-reimbursement may select a consultant from Ecology's list of approved consultants or ask Ecology to assign their application to one of the consultants.

In Policy 1200, Evaluation of Changes and Transfers to Water Rights, a seasonal change is defined by Ecology as "any temporary change or transfer proposal or its approval to change, amend, or transfer the place of use or point of diversion/withdrawal of a water right for a specified part of the year."

In its initial stages, the South Lynden WID water rights exchange program would likely focus on temporary seasonal changes to water rights that can be approved more quickly than permanent transfers.

An application to change an existing water right (commonly referred to as a "change application") must pass the following legal tests:

- The water right to be changed actually exists;
- The change does not impair existing rights;
- The change is not detrimental to public welfare (for groundwater rights only); and
- The amount of water use determined in the right will not increase if additional acres are to be irrigated or an additional purpose of use is added.

In determining whether to approve a change application, Ecology will confirm that:

- The change does not increase the amount of water used, either instantaneously or annually;
- The water right is eligible to be changed and the entire right or a portion of the right has not been abandoned or relinquished for non-use;
- The source of water will not change;
- The water is being put to beneficial use; and

- The proposed use is not detrimental to the public welfare.

All transfers or changes of water rights need to be submitted to Ecology for approval. If they are applications for permanent changes, the applications will be placed in line with other change applications unless the applicant elects to pursue expedited processing thought the cost-reimbursement process.

For a water right holder to determine whether they wish to submit all or a part of their water right to a bank or exchange, there are a number of questions that should be considered. In order for Ecology to approve a water right transfer, Ecology or a cost-reimbursement consultant must conduct a tentative determination of the extent and validity of the water right. The following information is typically required for such an analysis.

A water right will specify most, if not all, of the elements listed below. The applicant will need to provide the following information from their water right document and about their historic water use for each of the water rights they wish to have evaluated, along with a copy of those documents.

- **Water right identification number:**
    - (Note: This may be a number like G1-12345C. The first letter will typically be a S or G (S=surface water; G=Surface water) or may be SWC (Surface Water Certificate) or GWC (Ground Water Certificate) followed by a sequence of numbers. The numbers may be followed by a letter or letters (C = Certificate, P = Permit, CL = Claim, A or Blank (no letter) = pending application).
- **Priority Date:** This is listed on the water right and is the date the completed application for the original water right was accepted by Ecology or its predecessor agency.
- **Point of Diversion (surface water) or Point of Withdrawal (groundwater) shown on your water right document:** This is the location of the diversion works (for surface water) or the withdrawal facility (well) for groundwater listed on the water right documents and included in the legal notice that was published in a local newspaper. While this typically identifies a ¼- ¼ section of land, other parcel sizes are allowed so the point of diversion description in the original legal notice needs to be checked for each water right being evaluated.
- **Actual Point of Diversion (surface water) or Point of Withdrawal (groundwater) from which water is actually obtained:** This is the actual (on the ground) location. Ideally, it is the same as above but, if not, the differences need to be clearly identified and may, in fact, be the reason for the change application.
- **Place of Use identified on your water right document**: This is where the water right and the legal notice said the water would be used.
- **Actual Place of Use where water has been put to beneficial use**: This is where the water is actually being used. It should be the same as above. It may be different, or it may include the area above and include additional areas. As stated above, the difference could be the reason for submitting a change application.

- **Purpose(s) of Use identified on your water right document:** This is the use or uses identified in the water right application and the accompanying legal notice.
- **Actual uses for which water has been used:** This is the use to which the water has historically been applied.
- **Instantaneous Quantity (Qi) allowed by your water right document**: Note: Expressed in cubic feet per second (cfs) for surface water and gallons per minute (gpm) for groundwater. One cfs is approximately 449 gallons per minute.
- **Actual instantaneous quantify of water used:** The preferred method of measuring the instantaneous rate is by using a properly installed water flow meter and measuring the volume pumped over the course of a short duration, such as a minute. If a flow meter is not installed, another way of estimating the flow rate is through a simple test (pump water into a container of known volume, such as a 5-gallon bucket, and record how long it takes). Another method would be to use the pump curve, which might be available online if the pump and motor nameplate information is known, in conjunction with information on the depth to water pumped and system operating pressure.
- **Annual Quantity (Qa) allowed by your water right document:** Expressed in acre-feet per year for both surface and ground water rights. Not all water rights will specify the Qa. If not specified, enter "Not specified."
- **Actual Annual Quantity of water used:** The preferred method of measuring the annual volume pumped is by using a properly installed water flow meter with the volume recorded on a regular basis. If a flow meter is not installed, other ways of estimating the annual volume must be used. Examples of those other methods include use of dedicated power meter records combined with pump, motor, and system information, regional averages for types of use, the Washington irrigation guide, AgWeatherNet, and more.
- **If the water right is for Irrigation, the number of acres authorized to be irrigated on the water right.**
- **Actual number of acres being irrigated:** The number of acres irrigated can be calculated using aerial photos available on programs such as Google Earth Pro.
- **Provide a narrative history or description of water use under this water right (when was water first used, for what purposes, history of use, etc.):** This may include affidavits from you, family members, relatives, neighbors, etc.
- **To the extent possible, identify whether there have been any periods of 5 or more consecutive years in which all or a portion of the water has not been beneficially used without sufficient cause:** Sufficient cause is defined in RCW 90.14.140-170. If there have been such periods of non-use and if such non-use was for "sufficient cause," explain and provide documentation where possible.

It should be noted that certain elements of a water right cannot be changed through the change process, such as increasing the instantaneous withdrawal rate or annual quantity. There are also some limitations on changes that may be made, based on the status of the water right (perfected or unperfected), and whether the right is to ground or surface water. Water rights should be

evaluated by professionals who are familiar with the state water code and Ecology's policies related to the administration of those water rights.

Candidate Water Rights

In 2017, Ecology's Water Rights Tracking System (WRTS) included a total of 506 water right-related records for the South Lynden WID area. The WRTS database includes the records in the left column in **Table 8**. RH2 screened the data to include only active water right permits, certificates, and long-form claims. The results of that screening are shown in the right column of **Table 8**. Ultimately, these records also will need to be identified by purpose of use because the exchange needs to be able to address all uses of water.

Table 8

Ecology Water Rights Data Summary – South Lynden WID

Full WRTS Data	Document Type	Permits, Certificates, Long-Form Claims
3	Superseding Certificates	3
9	Permits	9
82	Long-Form Claims	82
72	Short-Form Claims	0
7	Change Reports of Examination (ROEs)	7
233	Certificates	233
80	New Applications	0
20	Change Applications	0
506	Total Records	334

A water right exchange program deals only with the exchange of perfected or vested water rights. A water right is established by the continuous beneficial use of water. Such rights are considered "perfected" or "vested." While a general adjudication of water rights in Superior Court is the manner in which the validity of water rights is ultimately resolved, Ecology may make tentative determinations of extent and validity. Such determinations remain subject to adjudication but represent Ecology's best determination of the status of the subject water right.

Water Right Claims

A water right claim is simply that, a claim to a water right for a water use that predates the water permitting system. Its validity can only be confirmed through judicial processes.

In the 1960s, the Washington State legislature realized the need to document water rights established prior to 1917 for surface water and prior to 1945 for groundwater. These water rights are vested rights. A vested right is a water right established through beneficial use of water. A

water right claim is a statement of beneficial use of water that began prior to 1917 for surface water and prior to 1945 for groundwater. In 1967, the Claims Registration Act was passed to record the amount and location of these vested water rights.

The initial statewide opening of the Claims Registry ended June 30, 1974. The legislature has subsequently reopened the Claims Registry three times. The most recent opening occurred from September 1997 to June 1998. Statewide, there are roughly 169,000 water right claims on record.

A claim may represent a perfected water right, but it is not confirmed as valid until the extent and validity is determined in a general water right adjudication (a legal proceeding).

When the State of Washington established the water rights claim registry in 1967, Ecology accepted claims on two forms: short form and long form. The short form was used primarily for domestic supply claims and contains very little information that can be used to evaluate the validity of the claim that a vested water right exists. The long form is more useful and includes information about when the claimed water use was begun and about both instantaneous and annual quantities of water being claimed. Because the short-form claims typically were for permit-exempt water supply and contain very little useful information on which to base a water right transfer decision, potential water rights represented by short-form claims have been excluded from consideration for the South Lynden WID water exchange.

Water Right Permits

A water right permit is one step towards securing a perfected water right. There is a step-by-step application process that, if approved, results in a permit issued by Ecology that allows the water right applicant to construct its water system in accordance with a development schedule and put the water to beneficial use. In the permit stage, the water right is not yet appurtenant to the property and, in the event of a sale of the property, the permit holder must assign the permit to the new owner if the parties wish to transfer ownership of the water right permit as part of the property transaction.

Water Right Certificates

When all conditions of a water right permit are met, the water right is said to be perfected. When Ecology receives information confirming perfection, Ecology issues a certificate documenting that the right has been perfected. (A different type of certificate, an adjudicated certificate, will be issued after a water right has been confirmed to exist through a general water rights adjudication.)

Once a certificate is issued, that water right is appurtenant to the land identified in that water right. If the land is sold, the water rights for which there are water right certificates are sold with the land unless they are specifically excluded from the transaction.

New Water Right Applications

New applications are not being considered for the water rights exchange program because the existence of a pending application does not constitute a legal right to put water to beneficial use; therefore, any such use is not eligible for an exchange program.

Water Right Change Applications

These are applications to change one or more of the attributes of an existing water right (place of use, point of diversion or withdrawal, additional point(s) of diversion or withdrawal, purpose of use). Note that enlargement of either the instantaneous or annual quantity of water authorized for beneficial use is not allowed and any such increase would require a new water right. These change applications are proposing changes to the rights already included under the water right permits and certificates in the database.

Permit-Exempt Groundwater Withdrawals

In most cases, a groundwater right based upon a beneficial use pursuant to the permit exemption in RCW 90.44.050 is not subject to transfer and is not eligible to participate in the potential South Lynden water rights exchange program. (Refer to Ecology Policy POL-1200 4.d.)

RESPONSE ACTIONS

Response actions are defined as actions taken during a drought to alleviate adverse drought-related impacts.

AGRICULTURAL RESPONSE ACTIONS

Funding

The federal government is the primary provider of drought relief to agricultural producers. In times of drought, producers often contact the WSDA to inquire about available drought relief programs. WSDA assists stakeholders in determining eligibility for federal programs and guides them through the necessary steps to apply for relief funding.

Federal drought relief programs are triggered by the U.S. Drought Monitor, which places drought conditions into five increasingly severe categories: abnormally dry (D0); moderate drought (D1); severe drought (D2); extreme drought (D3); and exceptional drought (D4). Eight consecutive weeks at severe drought or higher automatically triggers a federal drought declaration for the impacted counties and contiguous counties. The Secretary of Agriculture or the President can also make disaster designations that trigger program eligibility.

The Farm Service Agency (FSA) administers various disaster assistance programs that can help agricultural producers during drought conditions, including the following.

- Livestock Forage Program: Producers who own or lease grazing land in a county rated by the U.S. Drought Monitor as having severe drought (D2) conditions for 8 consecutive weeks during the normal grazing period are eligible to receive assistance equal to 1 monthly payment. Increasing drought intensity on the drought monitor triggers eligibility for additional payments. An eligibility tool for qualifying is available through http://droughtmonitor.unl.edu/fsa/Home.aspx.
- Emergency Loan Program: This program provides emergency loans to assist producers in recovering from production losses due to drought. These funds can be used to repair or restore property, payment of some production losses, and refinance debts. Producers become eligible for emergency loans when they operate in a county declared a disaster area or a contiguous county and have suffered at least a 30-percent loss in production.

- Tree Assistance Program: This program provides assistance to orchardists and nursery tree growers to replant or rehabilitate trees, bushes, or vines lost from drought. Commercially produced crops are eligible for this program with the exception of trees used for pulp or timber. Trees must have suffered at least 15-percent mortality to become eligible. Losses must be visually observed by an FSA agent and cannot be preventable by reasonable and available means. Producers must replace the trees, bushes, or vines within 1 year from application approval.

Additional information on available FSA programs can be found at https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/.

When the State of Washington declares a drought, Ecology is authorized to provide drought relief assistance.

When drought conditions occur early enough in a year, farmers may have time to make decisions that will affect their water use and reduce their demand for water later in the year. For example, those growing annual crops could decide to forego the crop for that year, they could decide to reduce their late-season water use to help protect stream flows, they could leave certain lands fallow, or they could grow less water-intensive crops. Droughts that occur later in the year do not provide much flexibility for such changes because many of the farmers decisions must be made early in the year, often before the onset of a drought is recognized. This emphasizes the importance of ongoing and accurate water supply monitoring and forecasting.

If a water bank is established in the County, several potential drought relief options may become available. These could include the use of the water bank to identify water rights that could be used to provide environmental benefits during the drought, as well as water rights that could provide supplemental water supplies during the drought.

FISH AND WILDLIFE RESPONSE ACTIONS

The goals for emergency response actions related to fish and wildlife resources include the following.

- Minimize fish mortality or physical impairment of fish occurring in priority basins.
- Minimize the loss of access to spawning habitat for anadromous fish in priority basins.
- Minimize reductions in hatchery production.
- Minimize water shortages for birds, small game, and big game on WDFW managed lands.
- Conduct monitoring efforts sufficient to direct emergency actions to areas of greatest need.[89]
- Use the Hydraulic Project Approval (HPA) permitting authority to ensure that projects in or near the water are designed to protect fish.

[89] Washington State Department of Ecology. Water Resources Program. (2018, April). *Washington State Drought Contingency Plan*, Second Draft Bureau of Reclamation Review. https://fortress.wa.gov/ecy/wrdocs/WaterRights/wrwebpdf/dcp/wa-droughtcontplan-finaldraft.pdf

- Provide technical assistance to encourage and enable the protection and restoration of salmonid habitat, producing aquatic habitat guidance, such as the Stream Habitat Restoration Guidelines.
- Operate the state's hatchery system to support harvestable fisheries and preserve wild stocks.
- Monitor for temperatures, blockages, and passage issues, including recreational rock dams, which can impede fish passage.
- Determine which remediation methods to employ and implement in priority basins: channel modifications (such as trenching, sandbagging, or berming), temporary fishways, trapping and hauling fish, removing rock dams, or other alternatives.
- Work with water managers in highly diverted systems to develop coordinated pulse flow programs that provide temporary adequate flows for upstream migration.
- Augment stream flows (or pulse flows) through acquisitions, temporary source exchanges, or leases and/or transfers of surface and ground water rights.
- Implement signage and outreach at recreation sites to prevent construction of rock dams for recreation and to alert recreational users to the needs of stressed fish.
- Implement rescue operations to relocate fish from lakes and reservoirs suffering poor water quality or barrier issues.
- Prioritize drought-related HPA applications.
- Implement emergency closures or restrictions on HPAs already issued (through permit modifications), as needed, to protect fish.
- Implement emergency rules closing or restricting pamphlet HPA activities, as needed, to protect fish.
- Assess and implement temporary changes to the HPA permit program consistent with the provisions of RCW 43.83B.410 to adequately protect fish life under drought-related emergency conditions.
- Monitor for and respond to disease problems as they occur. Agency fish pathology experts should consult with individual hatchery personnel frequently to address such problems.
- Manage dissolved oxygen levels in holding and rearing ponds with the use of bottled gas, oxygen generator systems, or mechanical aeration.
- Modify hatchery water supplies, as needed, or employ alternative water supplies to provide adequate water supply and/or maintain adequate water quality.
- Release fish earlier or relocate fish to safe havens.
- Modify stream channels or make use of temporary fish collection weirs as needed to ensure fish passage to hatcheries and adequate broodstock collection.

TERRESTRIAL WILDLIFE RESPONSE ACTIONS

- Increase capability to capture and relocate dangerous wildlife that may come in close proximity to the public in search of food or water, or to flee wildfires.
- Manage wildlife areas to provide additional forage for wildlife as necessary, such as reducing grazing leases, especially on winter range.
- Implement an emergency winter feeding program when necessary to ensure survival of wildlife.
- Close facilities as needed to protect wildlife or reduce fire danger.
- Work with landowners and local governments to prioritize and implement actions to protect water sources for fish and wildlife.
- Construct fences and other exclusion structures to restrict wildlife access in selected areas where property damage is likely.
- Where needed, temporarily impound or divert water to critical habitats or to upland watering devices.
- Protect natural water sources with fencing and other infrastructure, such as piping and stock tanks, to provide water while preventing damage to riparian habitats.

RECREATION RESPONSE ACTIONS

- In some cases, gravel and rock berms that are created by repeated boat retrievals must be removed to keep a ramp open.
- Downhill ski resorts and river guide services are private enterprises and generally not eligible for state funding. They may be eligible for Non-Agricultural Economic Injury Loans issued by the federal Small Business Administration.
- Snowmaking machines can compensate for the lack of snow, but their effectiveness is diminished in warm winters. Another strategy is to use machinery to concentrate snow where ski runs need it.
- WDFW has used drought monies in the past to maintain access to fishing opportunities, such as extending boat ramps in drawn down reservoirs and issuing closures to fishing activity to preserve fishing opportunities in the long run.

FORESTRY RESPONSE ACTIONS

- Do not plant seedlings during a drought, or plan for smaller stock types that have better chances of survival and consider using weed or mulch mats to conserve moisture for high value plantings.
- Apply MCH (Douglas-fir bark beetle repellant) in the few years following a drought event if desired to protect limited areas of Douglas-fir stands where mortality and tree stress occurred. USFS cautions that MCH application is expensive and time consuming and is best used in specific locations where it is warranted. It is not considered a large-scale preventative measure. Both the USFS and DNR have said that everyone

should expect to see tree damage and mortality due to droughts and ask that people report observations to DNR Forest Health and the USFS.

- Encourage the planting of drought-tolerant tree species, including blister rust-resistant western white pine. Western white pine was once common throughout the Puget Sound region prior to the introduction of white pine blister rust, a non-native disease that arrived in Washington a century ago and has since spread to several western states. Western white pine is more tolerant to drought than many other native conifer species. Genetically resistant white pine seedlings are available to the public from DNR's Webster Nursery in Tumwater, Washington.
- Identify native forest species cultivars and other species from more drought-prone areas that are drought tolerant now and initiate a program of reforestation with such species and cultivars as soon as possible.
- Practice proper sanitation techniques following mechanical treatments (slash clean-up, etc.) to reduce the attraction of secondary insects to an area.[90]
- Expedite salvage of trees killed by insects, disease, windthrow, or fires to reduce the build-up of secondary insects (such as bark beetles) and retain their economic value, which can help pay for reforestation or drought mitigation treatments.

PUBLIC WATER SYSTEM RESPONSE ACTIONS

There are a number of response actions that public water systems may implement in response to a drought including, but not limited to, the following:

- Initiate use of interties with adjoining water systems where such interties exist.
- Provide information to their customers about water supply and solicit voluntary efforts to reduce water use and improve water use efficiency.
- Consider and implement mandatory water use restrictions when conditions warrant such measures.

OPERATIONAL AND ADMINISTRATION FRAMEWORK

When the Drought Contingency Plan is nearing final approval by the TF, the TF will initiate a public review and involvement process (**Communication and Outreach**) using the existing Whatcom Watersheds Information Network (WWIN).

Once the public comment period has passed and public comments have been evaluated, it is anticipated that the TF will recommend any needed changes and, once those changes are made, will approve the DCP. In approving the DCP, the TF will forward it to the Commissioners of the PUD for approval and adoption. Following approval by the PUD Commission, the DCP will be sent to the WRIA 1 Watershed Management Board (the establishment of which is detailed below) and Whatcom County government for endorsement and consideration for integration into their long-range planning efforts.

[90] Refer to https://www.oregon.gov/ODF/Documents/ForestBenefits/Slash%20management_2016.pdf

In 1998, the Washington State Legislature passed the Watershed Management Act, which was codified as Chapter 90.82 RCW. This act required all participating local governments to develop a watershed plan to address water quantity with the option of addressing water quality, instream flows, and fish habitat. The bill identified initiating governments for the development of the plan. The initiating governments were the County in which the WRIAs are located, the largest city in the WRIA, and the public water supply utility obtaining the largest quantity of water from the WRIA. These three were required to invite Indian tribes with reservation lands in the WRIA. In WRIA 1, the initiating governments are Whatcom County, Bellingham, PUD No. 1 of Whatcom County, the Lummi Nation, and the Nooksack Indian Tribe.

In 1999, an Interlocal Agreement (ILA) created the Watershed Management Project Joint Board, which is comprised of representatives of the initiating governments and formalized the government-to-government relationship essential to the tribes' participation in the process. In 2004, an ILA established the WRIA 1 Salmon Recovery Board. In 2016, these two boards were merged with an ILA that established the WRIA 1 Watershed Management Board with two caucuses (Local Government and Fishery Co-Managers) with a representative from each of the following entities.

- City of Bellingham*
- City of Blaine*
- City of Everson*
- City of Ferndale*
- City of Lynden*
- City of Nooksack*
- City of Sumas*
- Whatcom County*
- PUD No. 1 of Whatcom County*
- Lummi Nation**
- Nooksack Indian Tribe**
- Washington Department of Fish and Wildlife**

*Members of the Local Government Caucus
** Members of the Fishery Co-Managers Caucus

The ILA also described operating and voting procedures for the new integrated board.

In its 2018 session, the Washington State Legislature passed Engrossed Substitute Senate Bill 6091, which was codified as Chapter 90.94. RCW (Streamflow Restoration Act). The Streamflow Restoration Act requires development of an update to the previously adopted Watershed Management Plan to address anticipated impacts resulting from the expected development of domestic groundwater permit-exempt wells in the County and the identification of means to mitigate for the impacts of the consumptive impacts of those wells. Although this process failed to result in an approved amendment to the watershed plan by the deadline of February 1, 2019, local efforts continue to satisfy the requirements set forth by the Washington State Legislature. This update, when completed, may result in the approval of mitigation projects that also would help alleviate drought-related impacts. The Task Force is encouraged to examine the potential interface between the update of the Watershed Management Plan and this DCP to identify any areas of potential conflict or synergy.

Following approval of the DCP, the PUD will forward a copy to Ecology with a request that a designated representative of the Whatcom County Drought Contingency Plan Task Force be invited to attend meetings of the State's Water Supply Availability Committee and be added to the mailing list for drought-related information. The PUD also will request local membership of at least one representative on the Governor's Executive Water Emergency Committee whenever drought conditions affecting WRIA 1 and the County are identified. The intent of this is to assist the Governor's committee with determining whether the forecasted drought conditions are expected to result in undue hardships for water users in Whatcom County.

The Whatcom County Sheriff's Office Division of Emergency Management is responsible for providing emergency management services for unincorporated Whatcom County, the cities of Lynden, Ferndale, Blaine, Sumas, Everson, Nooksack, and the Port of Bellingham under an interlocal agreement and the Revised Code of Washington. The Division is located in the Whatcom Unified Emergency Coordination Center adjacent to the Bellingham International Airport at 3888 Sound Way and was established to maximize capabilities and limited resources between the Division, the Bellingham Office of Emergency Management, the Port of Bellingham, and other public and private partners.

While the Division does not play a role in monitoring water supply conditions, once a drought has been declared, the Whatcom County Sheriff's Office Division of Emergency Management would be the organization that would: 1) seek a local proclamation of emergency for signature by the Whatcom County Executive; 2) request resources from State and Federal authorities that could be employed to mitigate effects of a drought; and 3) in the case of a severe drought, the Division would assist with water rationing and could help with transporting water to areas needing it.

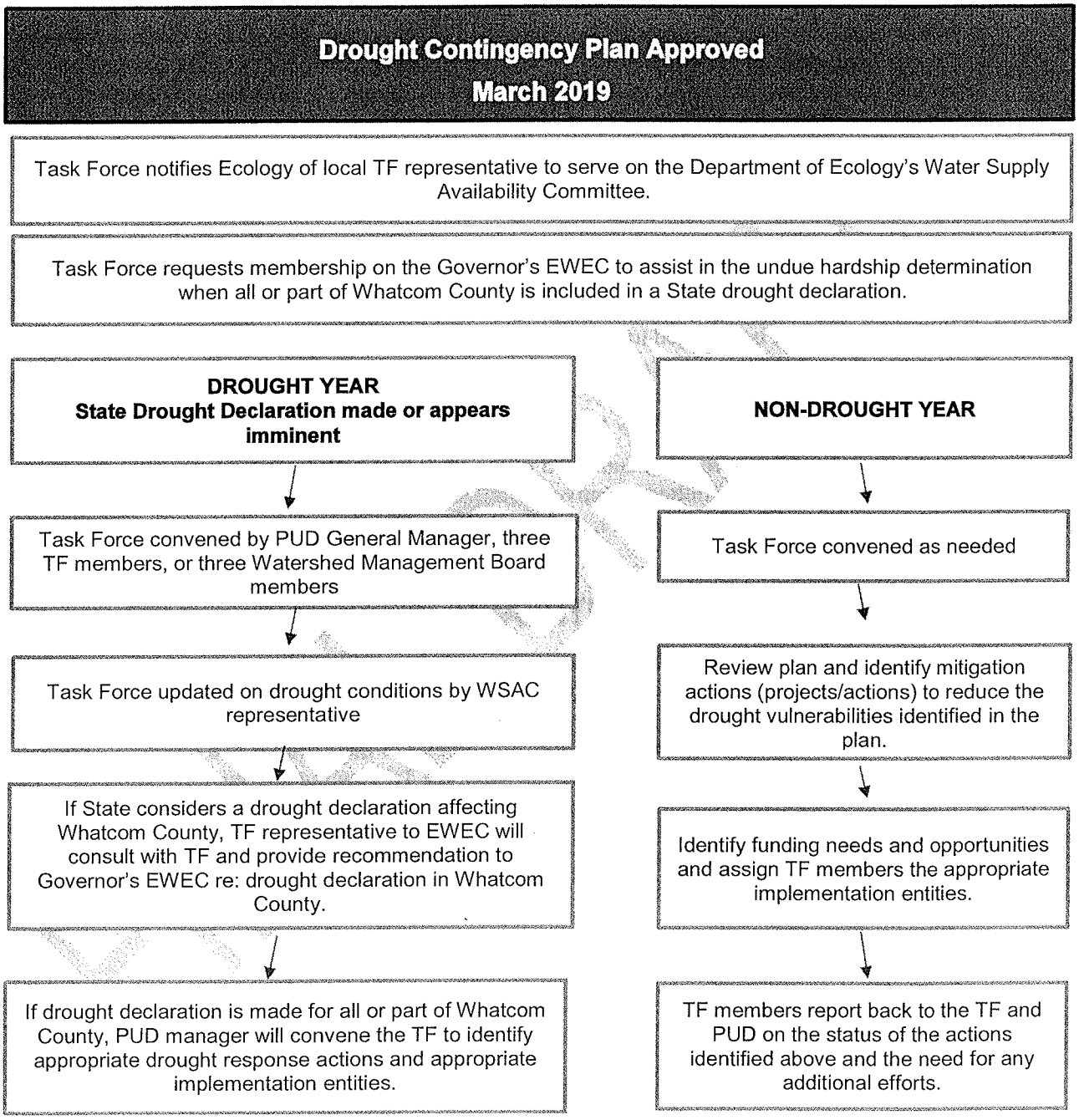
The local proclamation of emergency would authorize the County government agencies to expend resources to address the emergency. The proclamation would be forwarded by the Division to the Washington State Military Department Emergency Management Division, which would begin the process of the Governor's proclamation. If the effect of the drought is large enough, the State would then make a request to the Federal Emergency Management Agency for a Federal Declaration. The Division would lead the collection of effects, damages, and costs of the drought in support of any proclamation submitted to the State.[91]

Figure 17 depicts how the Drought Contingency Plan may be utilized in Whatcom County in both drought and non-drought years to minimize the adverse impacts of droughts.

[91] Gargett, John, Deputy Director, Whatcom County Sheriff's Office, Division of Emergency Management, e-mail dated November 7, 2019.

Figure 17

Drought Contingency Plan Implementation Flow Chart



PLAN UPDATE PROCESS

After approval of the DCP, the TF will continue to exist as a standing committee that can be convened by the PUD manager at his/her own volition or at the request of at least three TF members or at least three members of the Watershed Management Board. The General Manager of the PUD will poll the members of the TF and the Board at least once per calendar year to determine whether any members wish to reconvene the drought TF to address existing or anticipated drought-related issues. TF and Board members may request a reconvening of the TF at any time by making such a request to the General Manager and identifying and explaining the issue to be addressed and, if possible, a recommended solution for consideration by the TF/Board.

When the State of Washington's Water Supply Availability Committee (WSAC) identifies areas within Whatcom County for which water supplies are anticipated to be below 75 percent of normal, the General Manager shall reconvene the TF for the purpose of evaluating whether the water supply forecast is expected to cause undue hardships to water users in the County. The Task Force shall determine whether they wish to have a representative attend the WSAC and/or the EWEC meetings and shall designate their representative to those meetings and request approval to participate from Ecology and/or the Office of the Governor.

With the Task Force's approval of submittal of the DCP to the PUD Commissioners and Reclamation, the PUD committed to convene the Task Force to continue its deliberations, prioritize specific mitigation measures, and develop specific plans to implement those measures in Whatcom County.

COMMUNICATION AND OUTREACH

The Drought Contingency Plan Task Force was selected to represent a broad cross-section of the stakeholders in Whatcom County. Many of the members also are members of other planning-related processes and represent constituents from all walks of life within the County. TF members were charged with representing the interests of their groups and presenting the views of their interests and constituents. In addition, the TF meeting and the meeting of the PUD Commissioners were open to the public, and the public was provided an opportunity to speak at these meetings.

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Appendices

Appendix A
Statewide Water Supply Forecast Needs

STATEWIDE WATER SUPPLY FORECAST NEEDS

In evaluating the development of a WSACwater forecast for 2021 and how data and methods used in Eastern Washington could be applied to Western Washington, the following areas requiring additional investigation were identified.

- Tidal effects in coastal WRIAs are currently not accounted for.
- Some small farm acreage estimates are missing in the Washington State Department of Agriculture land cover dataset and would need to be estimated.
- Livestock consumptive use, not accounted for in the current model, is a large fraction of agricultural water demands in certain WRIAs.
- WRIA-specific groundwater/surface water interactions may become more important, as groundwater accounts for a higher proportion of water withdrawals.
- Western Washington has a greater percentage of smaller WRIAs than in eastern Washington. HOW DOES THIS AFFECT FORECASTING????
- Water reclamation/reuse occupies a greater percentage of municipal demand. THAN WHAT? WHY IMPORTANT???

The 2016 Forecast benefits from a broad stakeholder outreach foundation as the third iteration of this effort. Integrating to a State Water Forecast necessarily will require a broad public, agency, and stakeholder outreach strategy to identify data gaps, integrate local and regional planning goals, and leverage existing planning expertise. [92]

[92] The Water Report, Issue # 150, *The Columbia River Program, Forecasting Washington State's Water Future on the Program's Tenth Anniversary,* by Dan Haller, P.E. Aspect Consulting with Forward by G. Thomas Tebb, LHG, Director, Office of Columbia River. Page 22, Cited with permission.

Appendix B
Anticipated Climate Change Effects

ANTICIPATED CLIMATE CHANGE EFFECTS

The following are excerpts from a report entitled *Implications of 21st Century Climate Change for the Hydrology of Washington State.*[93]

> The hydrology of the Pacific Northwest (PNW) is particularly sensitive to changes in climate because seasonal runoff is dominated by snowmelt from cool season mountain snowpack, and temperature changes impact the balance of precipitation falling as rain and snow. Based on results from 39 global simulations performed for the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR4), PNW temperatures are projected to increase an average of approximately 0.3°C per decade over the 21st century, while changes in annual mean precipitation are projected to be modest, with a projected increase of 1% by the 2020s and 2% by the 2040s. p. 69
>
> April 1 snow water equivalent (SWE) is projected to decrease by an average of approximately 27-29% across the State by the 2020s, 37-44% by the 2040s and 53-65% by the 2080s . . . p.69
>
> In three relatively warm transient watersheds west of the Cascade crest, April 1 SWE is projected to almost completely disappear by the 2080s. By the 2080s, seasonal streamflow timing will shift significantly in both snowmelt dominant and transient, rain-snow mixed watersheds. Annual runoff across the State is projected to increase by 0-2% by the 2020s, 2-3% by the 2040s, and 4-6% by the 2080s; these changes are mainly driven by projected increases in winter precipitation.p.69
>
> The hydrology of the Pacific Northwest (PNW - which typically includes the Columbia River basin and watersheds draining to the Oregon and Washington coasts) is particularly sensitive to changes in climate because of the role of mountain snowpack on the region's rivers. P.70
>
> The west side of the Cascades on average receives approximately 1,250 mm of precipitation annually, while the east side receives slightly more than one-quarter of this amount. Washington, like much of the western US, relies on cool season precipitation (defined as October through March) and resulting snowpack to sustain warm season streamflows (defined as April through September). Approximately 75% of the annual precipitation in the

[93] Elsner, M.M., Cuo, L., Voisin, N., Deems, J., Hamlet, A.F., Vano, J.A., Mickelson, K.E.B., Lee, S-Y., Lettenmaier, D.P. 2009. Implications of 21st century climate change for the hydrology of Washington State. Chapter 3.1 in *The Washington Climate Change Impacts Assessment: Evaluating Washington's Future in a Changing Climate*, Climate Impacts Group, University of Washington, Seattle, Washington. Retrieved from https://cig.uw.edu/publications/implications-of-21st-century-climate-change-for-the-hydrology-of-washington-state/

Cascades falls during the cool season (Snover and Miles, in review). A changing climate affects the balance of precipitation falling as rain and snow and therefore the timing of streamflow over the course of the year. P.70

Small changes in temperature can strongly affect the balance of precipitation falling as rain and snow, depending on a watershed's location, elevation, and aspect. Washington, and the Pacific Northwest as a whole, is often characterized as having three runoff regimes: snow-melt dominant, rain dominant, and transient (Hamlet and Lettenmaier 2007). In snowmelt dominant watersheds, much of the winter precipitation is stored in the snowpack, which melts in the spring and early summer resulting in low streamflow in the cool season and peak streamflow in late spring or early summer (May-July). Rain dominant watersheds are typically lower in elevation and mostly on the west side of the Cascades. They receive little snowfall. Streamflow in these watersheds peaks in the cool season, roughly in phase with peak precipitation (usually November through January). Transient watersheds are characterized as mixed rains and snow due to their mid-range elevation. These watersheds receive some snowfall, some of which melts in the cool season and some of which is stored over winter and melts as seasonal temperatures increase. Rivers draining these watersheds typically experience two streamflow peaks: one in winter coinciding with seasonal maximum precipitation, and another in late spring or early summer when water stored in snowpack melts.

" . . . shifts in seasonal streamflow in these regions toward higher winter flow and lower summer flow have strong implications for water management." P.71

Projected soil moisture changes vary on either side of the Cascade Mountains. In the mountains and coastal drainages west of the Cascades, warming of the climate tends to enhance soil drying in the summer and, in combination with reduced winter snowpack and earlier snowmelt, causes decreases in summer soil moisture. P.89

Although projected increases of annual precipitation are modest, projections of seasonal precipitation change indicate increased winter precipitation and decreased summer precipitation. With 75 % of the annual precipitation falling between October and March (Snover and Miles, in review), cool season precipitation is the primary driver of hydrologic processes in Washington and the PNW. Projections of cool season precipitation range from +2.3% to +3.3% for the 2020s, +3.9% to 5.4% for the 2040s, and +6.4% to +9.6% for the 2080s The importance of cool season

precipitation to the state's runoff is evident: even with increased temperatures and modest, as opposed to significant, annual precipitation increases runoff will be expected to increase but the peak runoff period will move about three weeks earlier, resulting in a longer period of low stream flows in the late spring and summer months. P 89-92

Peak SWE is projected to shift in all watersheds from near week 26 (late March), which is the average historical peak, to near week 23 (early March) by the 2020s and 2040s to near week 20 (mid-February) by the 2080s. (Page 93)

Into the future, the double-peak hydrograph transforms into a single-peak hydrograph associated with increasingly rain-dominant behavior. The streamflow timing shift is mainly due to the less frequent snow occurrence, and faster and early snow melt in these historically snow-rain mixed watersheds. (For Cedar, Sultan, Tolt, and Green River watershed).

Appendix C

The Washington Water/Wastewater Agency Response Network (WAWARN)

THE WASHINGTON WATER/WASTEWATER AGENCY RESPONSE NETWORK (WAWARN)

WAWARN: UTILITIES HELPING UTILITIES

WAWARN is a Water/Wastewater Agency Response Network that allows water and wastewater systems to receive rapid mutual aid and assistance from other systems in an emergency. Utilities sign the WARN standard agreement which then allows them to share resources with any other system in Washington that has also signed the agreement.

Announcing WAWARN mutual aid website service

EPA has developed a new video to increase water sector awareness of the Water/Wastewater Agency Response Network (WARN) initiative and attract new members to existing WARNs. Entitled "WARNs in Action", the video illustrates the types of events in which the mutual aid networks have been utilized and emphasizes the importance of water sector coordination during an emergency. Interviews with WARN representatives provide detail on particular benefits of WARN, explaining how the programs have reduced response time and saved utilities money during emergencies.

The video can be found on the WARN Home tab of the Office of Water's Mutual Aid and Assistance webpage.

All-Hazard L-381 Incident Leadership Class Flyer

HOW TO JOIN WAWARN

Click on Membership Application to register your utility as a member and you will receive a confirming email.

After confirming your email, return to WAWARN, login and complete your full Utility Profile.

Have your Mutual Aid Agreement signed either online or via paper copy. Submit paper copy to WAWARN, %Water/Irrigation, 2301 Fruitvale Blvd. Yakima, WA 98902.

Download the materials and attend local training provided by WAWARN on activation procedures.

For more information, please contact your regional or statewide chair (contact info on Committees page)

Mutual Aid Agreement - PDF

WAWARN Operational Plan

WAWARN Brochure

ABOUT WAWARN

Based on other AWWA models, WAWARN is designed to provide a utility-to-utility response during an emergency.

The WAWARN Web site does this by providing its members with emergency planning, response, and recovery information before, during, and after an emergency. As the nationwide WARN system expands, it will become easier to provide mutual aid to other states as needed.

EPA Small Water System

EPA Small Water Systems are a vital component of WARN. This PDF resource describes the impact that small systems have on the strength of WARN.

National WARN

AWWA's website for Utilities Helping Utilities. Keep track of the progress on the national front. Website provides access to data and other resources associated with WARN.

WARNs in Action

WARNs in Action

How Does a Utility get Assistance During an Emergency?

The WAWARN member who needs help identifies the resources needed to respond. The WAWARN member can either directly contact a fellow WAWARN member who has the necessary resources or use a state specific process of requesting aid.

Through the WAWARN Web site, a member can request emergency equipment (pumps, generators, chlorinators, evacuators, etc.) and trained personnel (eg. treatment plant operators) that they may need in an emergency.

Are Member Utilities Required to Respond and Send Resources?

There is no obligation to respond. It is up to the lending utility to determine if resources are available.

What Role Does the Agreement Play?

During an emergency, the process and procedures to give and receive assistance are governed by articles in the WAWARN agreement. The agreement covers issues such as requesting assistance, giving assistance, reimbursement, workers' compensation, insurance, liability, and dispute resolution.

How is WARN Different from an Existing Statewide Mutual Aid Program Managed by Emergency Management?

WAWARN agreements do not require a local declaration of emergency. Statewide programs do not include private utilities; WAWARN agreements do. Statewide agreements are managed by the state emergency management agency; WARN is managed by utilities.

The WAWARN program provides its member utilities with:

- A standard omnibus mutual assistance agreement and process for sharing emergency resources among members statewide.
- The resources to respond and recover more quickly from a disaster.
- A mutual assistance program consistent with other statewide mutual aid programs.

- A forum for developing and maintaining emergency contacts and relationships.
- New ideas from lessons learned in disasters.

WAWARN BENEFITS

- **No cost to become a member**
- Increased emergency preparedness and coordination
- Enhance access to specialized resources
- A single agreement provides access to all member utilities statewide
- Provides access to resources during an emergency without precontractual limitations or retainer fees
- Signatories have a pre-established relationship under which they are able to share resources during an emergency at the discretion of each participating agency
- Is consistent with the National Incident Management System (NIMS)
- Provides a list of emergency contacts and phone numbers
- Reduces administrative conflicts
- Agreement contains indemnification and workers' compensation provisions to protect participating utilities, and provides for reimbursement of costs, as needed
- Increases hope that recovery will come quickly

There are two sides to this Web site. The public side is open to anyone to view. This side gives you basic information about WAWARN and how to join.

The second side, the resource database, is only open to members **who have signed the agreement**, and it is free!

AGENCIES

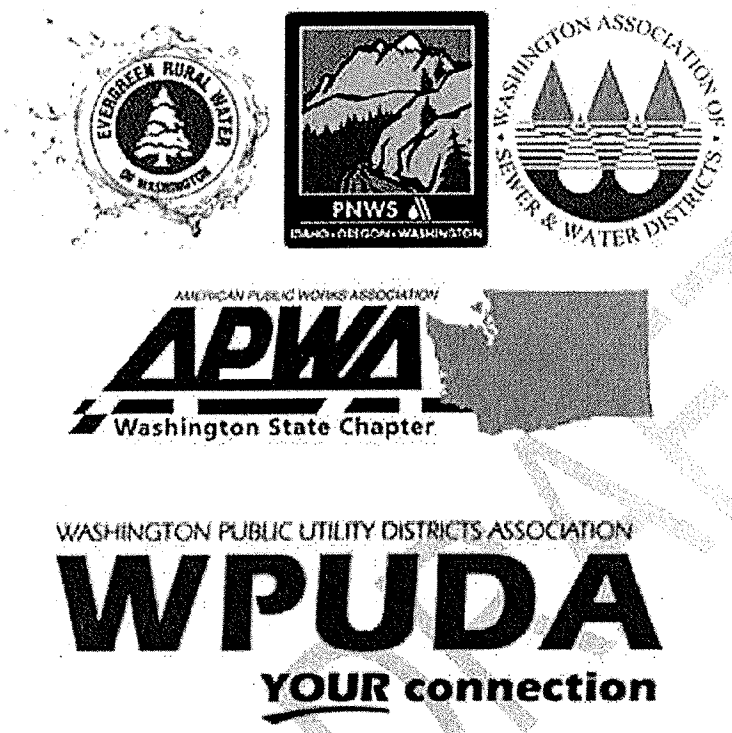
Washington State Department of Health
Environmental Public Health
Office of Drinking Water

Emergency Management
Yakima Valley

EM

Public Health
Seattle & King County

ASSOCIATIONS



Appendix D
Vulnerability Assessment Matrix

VULNERABILITY ASSESSMENT MATRIX

Water User Groups/Task Force Members	Drought-Related Areas of Concern																								
	Surface Water Availability	Ground Water Availability	Storage Capacity	Instantaneous Demand	Average Daily and Maximum Daily Demand	Water Right Limitations	High Cost of Alternate Supplies (e.g. trucking)	Short-Term Drought Concerns	Long-Term Drought Concerns	General Instream Flow Concerns	Salmon & Steelhead General Concerns	Temperature and Dissolved Oxygen Concerns	Fish Migration and Rearing Concerns	Side Channel Accessibility Concerns	Other Plant and Animal Eco-System Impacts	Increased Risk and Severity of Wildfires	Loss of Forest Production	Agricultural Impacts	Industrial Water Supply	Business Impacts	Hatchery Water Supply	Wetlands Impacts	Other Water Quality Concerns	Cultural Impacts to Fishing, Hunting, and Gathering	Marine and Estuary Concerns
Public Water Systems	X	X	X	X	X	X	X	X	X																
City of Blaine/Birch Bay Water and Sewer District									X?																
City of Ferndale									X?																
City of Bellingham																									
City of Lynden																									
Self-Supplied Residential				X	X		X		X																
Environmental Caucus										X	X	X	X	X	X	X	X						X		X
Forestry Caucus									X							X	X			X					
Agriculture	X	X				X		X	X									X		X					
Lummi Nation	X	X						X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X
Nooksack Indian Tribe	X	X						X	X	X	X	X	X	X	X	X	X				X	X		X	