Compendium to the WRIA 14 Watershed Restoration and Enhancement Plan

Draft – Pending for Inclusion with Final Approved Plan

Introduction

The materials in this compendium are not part of the WRIA 14 watershed plan, which was fully approved by the WRIA 14 Committee. This compendium provides background on how the plan was developed, or supplemental materials provided by Committee members. The inclusion of the compendium provides information on the process and shares the diverse opinions of the WRIA 14 Committee members. The documents in this compendium may provide insights on, or qualifications to, an entity's vote to approve the plan; however, they do not change the outcome of a vote by the WRIA 14 Committee to approve the plan. The Committee did not discuss all the documents included, and Committee members did not attempt to reach consensus on the content of these materials. Any opinions expressed in the documents are solely those of the submitting entity and may not reflect the perspective or position of other members of the Committee.

Contents

The documents in this compendium include:

A. Supplemental Write Up on the Salmon Recovery Portal, provided by the Washington Department of Fish and Wildlife
B. Technical Analysis on Irrigated Area Method, provided by Skokomish Tribe (developed by Aspect Consulting)
C. Policy Proposals provided by Committee members used to develop Chapter 6 of the WRIA 13 watershed plan. Chapter 6 reflects the recommendations for policy and adaptive management which the Committee reached agreement on.
D. Forest Stand Age project proposal, provided by Paul Pickett (Squaxin Island Tribe)
E. WRIA 14 climate analysis by Paul Pickett (Squaxin Island Tribe)
F. Statements provided by members (pending)

Supplemental Document Provided by Washington Department of Fish and Wildlife: Project Tracking for WRE Plans

A Framework for Tracking Projects and New Permit-Exempt Wells using Salmon Recovery Portal

This document describes the elements required to track projects from a conceptual stage through completion and monitor new permit-exempt domestic well construction. Project and well tracking are an essential component of implementation monitoring and adaptive management procedures. Therefore, it is recommended that projects be tracked through planning and implementation phases to enhance the Committee's ability to conduct implementation monitoring at the sub-basin and WRIA scale, monitor grant funding, identify plan successes and deficiencies, and streamline project development.

The Committee recommends a pilot program using the Salmon Recovery Portal (SRP; https://srp.rco.wa.gov/about) to conduct project tracking for the streamflow restoration effort under 90.94.030 RCW. As a statewide salmon recovery tracking tool, the capacity for the SRP to allow for goal setting, hierarchical project tiers, supplemental information, and printing of automated reports makes it well-suited for tracking projects associated with streamflow restoration and salmon recovery efforts. As a statewide tool administered by the Recreation and Conservation Office (RCO) and in partnership with salmon recovery Lead Entities (LE), the SRP provides a dynamic platform to track project development, funding, and offsets.

Tracking of projects will consist of two primary phases: (1) uploading required project information from all projects included in this plan into the SRP, and (2) uploading and updating all funded projects, project reports, and completed projects into the SRP database on an annual basis. Phase 1 will be coordinated and funded by the Washington Department of Fish and Wildlife (WDFW) and implemented by trained University of Washington (UW) data stewards in collaboration with RCO staff and Washington Department of Ecology (Ecology) staff. Phase 2 project uploads will be implemented by UW data stewards in consultation with Ecology grant management, RCO, and WDFW staff. To improve harmonization of streamflow restoration efforts with ongoing salmon recovery activities, local salmon recovery LE Coordinators shall be consulted prior to initial data uploads. While input and oversight is welcomed, no commitment of additional work is required from LE Coordinators. Streamflow restoration projects not funded through the streamflow restoration grant program, will be updated by data stewards during any grant reporting to Ecology or RCO. Primary quality control measures will be performed by data stewards. Funds to support initial and ongoing costs of data steward data entry (Phases 1 and 2) will be provided by WDFW.

The Committee recommends, at minimum, the following data fields for streamflow tracking: WRIA, sub-basin, project description, funding source, estimated cost, project spatial boundaries or coordinates, project sponsor (if applicable), estimated water offset or habitat benefits (using Pacific Salmon Recovery Fund (PCSRF) metrics or reference to the PCSRF list), and target project start date. Projects with sensitive locations can be made private or those with

undetermined locations can be entered as a project boundary or defined at the sub-basin scale. New domestic permit-exempt well location data will be drawn from the Ecology Washington State Well Report database[1]. Well location data will be incorporated into the SRP using point coordinates, or at the section or sub-basin scale to support implementation monitoring and adaptive management goals.

To support the implementation of the above program for tracking projects under 90.94.030 RCW, WDFW has initiated pilot projects in two 90.94.020 RCW basins: the Nisqually River Basin (WRIA 11) and the Chehalis River Basin (WRIAs 22/23). These pilots are coordinated by WDFW in conjunction with RCO, Ecology, local LE Coordinators, and the Planning Units. Intended as a proof of concept, these pilots are examining the capacity and effectiveness of the SRP to track streamflow restoration projects.

[1] https://appswr.ecology.wa.gov/wellconstruction/map/WCLSWebMap/default.aspx

DRAFT MEMORANDUM

Project No. 190315

April 30, 2020

To: Dana Sarff, Project Manager
Skokomish Tribe Department of Natural Resources

cc: Seth Book, EPA Grants Coordinator
Skokomish Tribe Department of Natural Resources

From:

Parker Wittman
Associate Data Scientist
pwittman@aspectconsulting.com

Re: **Assessing Precipitation Variability in Outdoor Domestic Water Use Calculations for WRIAs 14 and 15**

Background

As a key part of the requirements of ESSB 6091 and RCW 90.94, the watershed restoration enhancement committees of Water Resource Inventory Areas (WRIAs) 14 (Kennedy-Goldsborough) and 15 (Kitsap) are in the process of developing estimates of consumptive water use for new permit-exempt well withdrawals over a 20-year planning horizon. There are three key pieces of making such an estimate:

1. Estimating the total number of new residences expected to be supplied by permit-exempt wells over this planning horizon
2. Estimating the consumptive indoor water use of each permit-exempt well[1]
3. Estimating the consumptive outdoor water use of each permit-exempt well.

In essence, the total amount of water needed for ESSB 6091 offset and mitigation projects in each WRIA is the sum of the per-residence indoor and outdoor consumptive use estimates times the number of new residences.

[1] *Consumptive* indoor domestic water use is generally much less than outdoor. An estimated quantity for indoor use (60 gpd total use per person or 6 gpd consumptive use per person) is usually taken directly from *ESSB 6091 - Recommendations for Water Use Estimates*—which itself cites a 2016 study by the Water Research Foundation (DeOreo, et al., 2016).

Aspect Consulting, LLC (Aspect) prepared this memorandum to address one element of the above: the estimate of per-residence **outdoor** consumptive water use. In particular, this memo addresses the calculation of outdoor consumptive water use through what is often called the "Ecology Method" – as described in the Washington State Department of Ecology (Ecology) guidance document *ESSB 6091 - Recommendations for Water Use Estimates*.[2] More specifically, the focus of this memo is on the potential variability of lawn irrigation water requirements across time (dry vs. drought years) and geography (north Kitsap Peninsula vs. south Kitsap Peninsula) and the impact that variability might have on outdoor water use calculations using the Ecology Method.

Calculating Outdoor Water Use and the Washington Irrigation Guide

Per *ESSB 6091 - Recommendations for Water Use Estimates*, the calculation for Household Consumptive Outdoor Water Use (HCOWU) is found by:

1. Using the Washington Irrigation Guide (WAIG)[3] to find the Net Irrigation Water Requirement for pasture/turf (IWR_{net}) for a nearby, representative station (see Figure 1).
2. Multiplying this value for IWR_{net} from the WAIG (converted to units of feet per year) by the estimated average size of a permit-exempt well residence lawn (in acres).
3. Dividing by a 75 percent application efficiency rate to account for water loss during the irrigation process (i.e., assume 25 percent lost due to application inefficiencies).
4. Multiplying by 80 percent to account for water that not consumed (i.e., a 20 percent return flow rate to groundwater or surface water systems).

Or:

$$\frac{IWR_{net} \times Irrigated\ Area}{Application\ Efficiency\ (75\%)} \times \%\ Consumptive\ (80\%) = Outdoor\ Consumptive\ Water\ Use$$

Thus, the calculation of outdoor consumptive water use is directly proportional to two factors:

- The estimated lawn size (which is generally established through GIS-based aerial photo review).[4]
- The estimated amount of irrigation water required to maintain it (usually a value or range of values looked up in the WAIG).

The WAIG itself contains tables of irrigation water requirements for various crops and various stations across Washington State. These tables are presented as two appendices: "Appendix A - Climatic Stations for Consumptive Use" and "Appendix B - Crop Irrigation Requirement (CIR) and Crop Consumptive use (CU) West of the Cascades." Appendix A includes data published in 1985 and Appendix B includes data published in a 1992 supplemental update. Each of these publications

[2] https://fortress.wa.gov/ecy/publications/SummaryPages/1811007.html

[3] https://www.nrcs.usda.gov/wps/portal/nrcs/detail/wa/technical/engineering/?cid=nrcs144p2_036314

[4] Estimates for average lawn size have been or are being developed by the WRIA 14 and 15 watershed restoration enhancement committees. This estimate is not the focus of this memo.

give crop water use estimates for what might be considered a normal or average year, with respect to climatological conditions.

There are two WAIG stations in WRIA 14 (Grapeview and Shelton) and one in WRIA 15 (Bremerton). Table 1A (below) shows the annual pasture/turf irrigation water requirements for these (and other regional) stations. Approximate locations for these stations relative to the WRIAs can be seen on Figure 1.

Table 1A. Net Crop Irrigation Water Requirements for Pasture/Turf from WAIG Appendices

Station	WRIA	WAIG Appendix A Crop Irrigation Requirement (net) for Pasture/Turf (inches/year)	WAIG Appendix B Crop Irrigation Requirement (net) for Pasture/Turf (inches/year)
Bremerton	15	16.84	19.49
Grapeview	14	16.62	18.80
Olympia	13	15.75	16.47
Quilcene	17	12.68	17.54
Seattle: Sea-Tac Airport	9	17.25	20.02
Seattle: UW	8	18.10	NA[1]
Shelton	14	16.06	17.84
Tacoma	10	17.64	20.37

Notes:
1) Not Applicable

As an example, applying the pasture/turf net irrigation water requirement value from WAIG Appendix A for Bremerton (16.84 in/yr) to the average estimated outdoor irrigated area being considered for adoption by the WRIA 15 Planning Unit (0.08 acres) gives:

$$\frac{\frac{\mathbf{16.84}\ \frac{in}{yr}}{12\frac{in}{ft}} \times 0.08\ acres}{75\%} \times 80\% = \mathbf{0.12}\ \frac{\boldsymbol{acre\text{–}feet}}{\boldsymbol{year}}\ (or\ 107\ \frac{gal}{day})$$

Table 1B (below) shows this calculation of per-residence outdoor consumptive use using WAIG crop irrigation requirement values in Table 1A.

Table 1B. Calculated Per-residence Outdoor Consumptive Using 0.08 Acre Lawn Size

Station	*Using WAIG Appendix A*		*Using WAIG Appendix B*	
	WAIG Appendix A Crop Irrigation Requirement (net) for Pasture/Turf (inches/year)	**Calculated Annual Outdoor Consumptive Use for 0.08 acre Lawn (gpd)**	**WAIG Appendix B Crop Irrigation Requirement (net) for Pasture/Turf (inches/year)**	**Calculated Annual Outdoor Consumptive Use for 0.08 acre Lawn (gpd)**
Bremerton	16.84	107	19.49	124
Grapeview	16.62	105	18.80	119
Olympia	15.75	100	16.47	104
Quilcene	12.68	80	17.54	111
Seattle: Sea-Tac Airport	17.25	109	20.02	127
Seattle: UW	18.10	115	NA	NA
Shelton	16.06	102	17.84	113
Tacoma	17.64	112	20.37	129

Though WAIG Appendix-based calculations are likely reasonable for estimating consumptive water use impacts in WRIAs 14 and 15,[5] it is still worth considering how and whether modern climate change influences, drought-year water needs, or more-contemporary climatological data might impact (or improve) these estimates for the purposes of planning.

Notably, though *ESSB 6091 - Recommendations for Water Use Estimates* only specifically cites Appendix A (and not B) for looking up pasture/turf irrigation requirements, it does not explicitly say that Appendix A *must* be used—only that crop water use values *such as* those in Appendix A should be used.

Alternate Data Source #1: The Provisional Update to the WAIG

The WAIG is a state-specific supplement to the National Engineering Handbook (NEH), Part 652, Irrigation Guide (National Irrigation Guide). It is intended that state-specific supplements to the National Irrigation Guide are updated as regularly as is necessary to reflect recent climatological data, employ improve calculation methods, and use updated crop coefficient values (based on contemporary research). To date, there have been four versions or supplements for Washington:[6]

- **1969** (Circular 512). *Evapotranspiration (ET) estimated by Blaney-Criddle method.*
- **1982** (Irrigation Requirements for Washington—Estimates and Methodology, or "Bulletin XB0925"). *ET estimated by the Doorenbos and Pruitt Blaney-Criddle method.*

[5] Especially given other notable sources of uncertainty in the calculations, e.g. lawn size and population growth
[6] *See Frequently Asked Questions on Updating the Washington Irrigation Guide* (Ecology Publication #12-11-004) https://fortress.wa.gov/ecy/publications/SummaryPages/1211004.html

- **1985** (the current WAIG, including Appendix A, as referenced above). *ET estimated by the FAO 24 Modified Blaney-Criddle and SCS Modified Blaney-Criddle methods.*
- **1992** (supplemental/updated data for stations west of the Cascades. WAIG Appendix B, as referenced above). *ET estimated by the FAO 24 Modified Blaney-Criddle and SCS Modified Blaney-Criddle methods.*

A fifth update was initiated in 2008 but has yet to be formally adopted and is still considered "provisional." This update (the "Provisional WIG") was intended to incorporate several decades-worth of new climate data and better scientific formulas to estimate crop water needs (with ET calculated by the ASCE Standardized Penman-Monteith method[7]). Data from the Provisional WIG is available online at: http://irrigation.wsu.edu/Content/Calculators/Historic/StationCropDOY.php.

Table 2 (below) lists the values for annual net irrigation water requirements from the Provisional WIG for stations in the general vicinity of WRIAs 14 and 15 as well as the corresponding calculated annual outdoor consumptive use for an example 0.08 acre lawn. Like the values from Appendix A and Appendix B of the WAIG, these values represent a normal or average weather year. They are, however, generally lower than the values from the WAIG.

Table 2. Annual Net Irrigation Water Requirements for Lawn from Provisional WIG for Select Stations

Station	IWR_{net} (in)	Calculated Annual Outdoor Consumptive Use for 0.08 acre Lawn (gpd)
Bremerton	13.2	84
Cushman Powerhouse 2	11.8	75
Grapeview 3 SW	12.2	77
Olympia Priest Pt Park	12.7	81
Port Townsend	15.8	100
Quilcene 2 SW	15.6	99
Seattle-UW	13.4	85
Shelton	12.5	79
Vashon Island	12.2	77
Wauna 3 W	12.7	81

[7] From Ecology Publication #12-11-004: *"Depending on what method is used, the estimate of crop water need can vary by ± 25%. For this reason, the American Society of Civil Engineers did a study of the most appropriate ET method to use when estimating crop water needs and determined that the Penman-Monteith method was preferable.*

Alternate Data Source #2: WSU AWN

Washington State University's (WSU) AgWeatherNet (AWN)[8] provides weather data and weather-related decision-support tools on a public-facing web server. A network of automated weather stations collect data at 15-minute intervals, with parameters including air temperature, relative humidity, soil temperature, rainfall, wind speed, wind direction, and solar radiation. Some stations also measure atmospheric pressure, soil moisture, and/or leaf wetness. The data (and calculated values) provided by AWN can be used to calculate irrigation water requirements for lawn/turf, where:

$$Net\ Irrigation\ Water\ Requirement\ (IWR_{net}) = Grass\ (Pasture/Turf)\ Evapotranspiration\ (ET_c) - \boldsymbol{Effective}\ Precipitation\ (P_e)$$

That is, the amount of irrigation water required to maintain a healthy lawn is the total amount of water required by the crop (crop evapotranspiration or "ET_c")[9] less the amount of precipitation that is actually added to and stored in the soil (effective precipitation or "P_e").

For the purposes of comparing AWN-derived values to those from the WAIG, a selection of AWN stations within the general geographic vicinity of WRIAs 14 and 15 were identified. These stations are listed in Table 3 (below). Among these stations, only "Poulsbo.S" (#355001) falls within either WRIA 14 or 15.

Table 3. AgWeatherNet Stations in the Vicinity of WRIAs 14 and 15

Station	Station Installation Date	Latitude (approx.)	Longitude (approx.)	AWN Link
Chimacum	4/16/2015	48.01	-122.77	https://weather.wsu.edu/?p=90150&UNIT_ID=300220
Langley	12/17/2014	48.00	-122.43	https://weather.wsu.edu/?p=90150&UNIT_ID=300214
Montesano	7/18/2008	46.98	-123.49	https://weather.wsu.edu/?p=90150&UNIT_ID=310022
Olympia.E	2/9/2010	46.95	-122.84	https://weather.wsu.edu/?p=90150&UNIT_ID=330151
Poulsbo.S	**2/26/2013**	**47.66**	**-122.65**	**https://weather.wsu.edu/?p=90150&UNIT_ID=355001**
Puyallup	6/1/1995	47.19	-122.33	https://weather.wsu.edu/?p=90150&UNIT_ID=310102
Seattle	12/16/2011	47.66	-122.29	https://weather.wsu.edu/?p=90150&UNIT_ID=330092
Tumwater	8/11/2011	46.95	-122.96	https://weather.wsu.edu/?p=90150&UNIT_ID=330153

[8] https://weather.wsu.edu/

[9] The AWN glossary entry for evapotranspiration reads: *"The amount of water required to grow a crop consists of transpiration by the plant (T) due to water uptake and the water evaporated from the soil surface (E). Combined these two are called evapotranspiration (ET) and is also referred to as crop water use. ET is measured in inches of water used per day. ETr is the estimated evapotranspiration of a reference surface of fully grown alfalfa crop and is calculated from measured weather parameters. These include solar radiation, air temperatures, relative humidity, and wind speed. The reference ET for alfalfa (ETr) is calculated with the ASCE standardized Penman-Monteith Equation (ASCE - EWRI, 2005)"*

AWN data tables for the selected stations in Table 3 were downloaded and processed for the ten-year period 2010 to 2019.[10] These datasets[11] provide month-over-month (or daily) summary data for selected stations and include values such as (but not limited to) air temperature (minimum, maximum, average), wind direction/speed, total precipitation, and ET values for alfalfa (the "reference" ET or "ET_r") and grass (ET_c). These data were used to compare total annual *growing season* precipitation for each station (to identify representative dry years) and to calculate monthly effective precipitation (P_e) as a function of monthly total precipitation (P_t) and monthly crop ET (ET_c), using the equation:

$$\mathbf{P_e} = 0.921719*(0.70917*\mathbf{P_t}\text{^}0.82416-0.11556)*10\text{^}(0.02426*\mathbf{ET_c})$$

This equation for effective precipitation comes from documentation in the Provisional WIG (citing NRCS), with an assumed 2-inch soil water storage. [12]

These data and the corresponding calculated values are presented in Tables 4A through 4B (below).

Table 4A. April-Sept Total Precipitation (inches) from Ag Weather Net

Station	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Chimacum	--	--	--	--	--	--	6.97	4.30	5.62	6.85
Langley	--	--	--	--	--	5.69	6.03	6.81	8.32	9.23
Montesano	20.04	18.42	11.39	24.76	16.28	6.14	9.02	12.54	14.61	8.89
Olympia.E	18.45	12.43	10.80	21.23	12.23	6.40	6.78	13.92	11.00	9.46
Poulsbo.S	--	--	--	13.76	10.49	5.55	5.28	8.87	7.85	8.54
Puyallup	13.45	13.03	8.93	18.34	11.67	5.62	6.11	9.34	8.75	10.00
Seattle	--	--	7.83	11.71	11.86	7.72	6.80	8.93	8.74	11.66
Tumwater	--	--	9.95	19.82	14.36	6.87	6.97	12.46	10.64	9.10

[10] Not all of the selected AWN stations had data for this time interval. Table 2 (above) includes the installation date of each station.

[11] "Monthly Weather Data" (https://weather.wsu.edu/?p=93150) and "Water Use Model" (https://weather.wsu.edu/?p=97750)

[12] http://irrigation.wsu.edu/Content/ET_IWR_For_WA.php

Table 4B. Calculated April-Sept Effective Precipitation (inches)

Station	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Chimacum	--	--	--	--	--	--	4.29	2.48	3.22	4.20
Langley	--	--	--	--	--	3.60	3.80	3.96	4.60	5.42
Montesano	11.22	10.21	6.49	13.22	9.61	3.84	5.76	7.07	7.78	5.24
Olympia.E	10.17	7.28	6.23	11.22	7.44	3.95	4.30	7.89	5.86	5.63
Poulsbo.S	--	--	--	7.91	6.51	3.52	3.36	5.07	4.27	5.34
Puyallup	7.96	7.65	5.35	10.17	7.32	3.56	4.09	5.45	4.97	6.10
Seattle	--	--	4.81	6.80	7.52	4.76	4.34	5.27	4.80	7.19
Tumwater	--	--	5.79	10.72	8.62	4.23	4.43	7.10	5.63	5.37

Table 4C. April-Sept Lawn Evapotranspiration (ETc) (inches) from Ag Weather Net

Station	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Chimacum	--	--	--	--	--	--	22.66	22.75	19.66	19.58
Langley	--	--	--	--	--	22.99	21.30	21.45	20.29	19.83
Montesano	18.53	20.92	19.87	19.54	23.09	26.05	25.29	24.18	23.23	20.69
Olympia.E	18.52	20.04	20.54	19.09	23.10	23.53	21.43	21.61	22.84	21.35
Poulsbo.S	--	--	--	22.68	22.02	23.29	21.32	21.60	21.40	19.62
Puyallup	20.89	21.83	22.64	22.37	24.18	25.91	23.96	24.00	22.91	21.63
Seattle	--	--	22.20	22.33	23.52	25.02	22.80	23.00	22.45	21.18
Tumwater	--	--	22.87	21.99	24.61	25.80	22.78	23.32	22.31	20.79

Table 4D. Calculated Lawn Net Irrigation Water Requirement (inches)

Station	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	% difference between 2015 and 2018
Chimacum	--	--	--	--	--	--	18.37	20.27	16.44	15.38	--
Langley	--	--	--	--	--	19.39	17.50	17.49	15.69	14.41	24%
Montesano	7.31	10.71	13.38	6.32	13.48	22.21	19.53	17.11	15.45	15.45	44%
Olympia.E	8.35	12.76	14.31	7.87	15.66	19.58	17.13	13.72	16.98	15.72	15%
Poulsbo.S	--	--	--	14.77	15.51	19.77	17.96	16.53	17.13	14.28	15%
Puyallup	12.93	14.18	17.29	12.20	16.86	22.35	19.87	18.55	17.94	15.53	25%
Seattle	--	--	17.39	15.53	16.00	20.26	18.46	17.73	17.65	13.99	15%
Tumwater	--	--	17.08	11.27	15.99	21.57	18.35	16.22	16.68	15.42	29%

Table 4D (above) shows that across a 10-year span (2010 to 2019), the crop irrigation water requirement (and, by extension, domestic outdoor consumptive use) could be about 15 to 40 percent more in a relatively dry year/season (such as 2015) compared to a more normal year/season (such as 2018).

Alternate Data Source #3: PRISM Climate Data: 1990 to 2018

Oregon State University's PRISM[13] Climate Group, in partnership with the NRCS National Water and Climate Center (NWCC), provides digital maps of climate data for the United States.[14] Since PRISM data is not provided by station (like Ag Weather Net) and is instead interpolated into a continuous data set, it is particularly useful in the context of this work. Using GIS, PRISM data can be aggregated and summarized *across each WRIA and subbasin*, creating a more geographically specific estimate.

For this analysis, a variety of PRISM grids (.bil format rasters) were downloaded and processed, including:

- 30-year normals[15] for precipitation, mean temperature, and maximum temperature (annual normals and for all months, January through December)
- Monthly total precipitation grids for every individual month between January 1990 and December 2018

[13] PRISM (the Parameter-elevation Regressions on Independent Slopes Model) uses data from instrumented stations, topography data, and other spatial data sets to generate contiguous, gridded estimates of monthly, annual, and 30-year average ("normal") climatic parameters, such as precipitation and temperature.
[14] http://www.prism.oregonstate.edu/

[15] baseline datasets describing average monthly and annual conditions over the most recent three full decades, 1980 to 2010

Using GIS, the average, minimum, and maximum values across each one of the raster datasets was calculated for each WRIA subbasin area. This process resulted in a dataset that gives an individual result for total precipitation (in inches) for each subbasin for every month between January 1990 and December 2018, as well as the 30-year normal for each subbasin for each month of the year.

Since the analysis of irrigation water requirements is specific to the 6 months in which irrigation is required for lawns,[16] precipitation data for April through September was totaled for each year, yielding a total "irrigation season" precipitation for each subbasin and year. Additionally, the 30-year normal values for the months April through September were totaled to get a 30-year normal total precipitation value for the irrigation season, by subbasin.

Figure 2 (attached) shows irrigation season (total of April through September) precipitation contours (isohyets) across WRIAs 14 and 15 (and surrounding areas). As this map shows, normal precipitation between April and September has a range of about 7 inches in WRIA 15—as the northern end of the Kitsap Peninsula (Hansville area) sees about 8 inches of rainfall during these months, where areas in South Hood Canal see about 15 inches (or about double the rainfall). In WRIA 14, the total range of April through September precipitation is about the same (7 inches difference)—varying from about 11 inches in the Harstine Island area to over 18 inches in the upper Kennedy, Skookum, Mill, and Goldsborough subbasins.

Table 5 (attached) shows a year-by-year breakdown of total April through September precipitation in each subbasin and compares those totals to the 30-year normal, thus identifying dry and wet irrigation season years in WRIAs 14 and 15. Among the 29 years (1990 through 2018), 1998 was the driest across WRIAs 14 and 15, with about half the normal precipitation between April through September. The next-driest irrigation seasons in WRIAs 14 and 15 were 2016 (59 percent of normal), 2003 (64 percent), 2006 (70 percent), and 1999 (70 percent).

Approximating Irrigation Water Requirements with PRISM Data

By itself, PRISM data is inadequate to accurately calculate effective precipitation, ET, and crop irrigation water requirements. In an effort to develop a rough approximation of these values, each subbasin was assigned a "proxy station" from the Provisional WIG (for example, the South Sound subbasin of WRIA 15 was associated with the WAUNA 3 W station). ET values from the Provision WIG at these proxy stations for April through September were used to calculate effective precipitation[17] by year and, by extension, irrigation water requirements. These approximations are limited insofar as each is using precipitation values from PRISM that are specific to a 6-month period of a given year, but long-term average ET values from the Provisional WIG. This has the likely effect of pulling all values towards the middle, since crop ET would be higher in a drier, hotter summer and less in a wetter, cooler summer. Regardless, the results are useful to get a sense of the range of lawn irrigation water requirements by subbasin over the 30-year period (1990-2019).

[16] This is consistent with Ag Weather Net and WAIG data, where the crop irrigation water requirement in the area of interest for lawn/grass/pasture/turf is zero for the months January through March and October through December.

[17] Where Pe = 0.921719*(0.70917*Pt^0.82416-0.11556)*10^(0.02426*ETc)

Table 6 (attached) shows the calculations and results for approximate effective precipitation and net crop irrigation water requirements, by subbasin, by year, as described above.

Conclusions

The results presented in Table 4D (AgWeatherNet-based calculations of IWR_{net}) and Table 6 (PRISM-based approximations of IWR_{net}) suggest that lawn irrigation water requirements in a dry/drought year are (or could be) about 15 to 40 percent greater as compared to more average years. However, given that irrigation water requirement values presented in the Provisional WIG are lower than those presented in Appendix A of the WAIG by roughly 20 to 30 percent, it might be assumed that the Appendix A WAIG numbers are sufficiently conservative to account for dry year water use in a 20-year planning horizon.

Additionally, the range of irrigation season precipitation across the areas of WRIAs 14 and 15 (see Table 5 and Figure 2) is sufficiently wide to warrant consideration of variable outdoor consumptive water use calculations (by subbasin or some other geographic unit)—a consideration that may depend on estimated population growth patterns in the areas of higher or lower normal precipitation.

Limitations

Work for this project was performed for the Skokomish Tribe (Client), and this memorandum was prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This memorandum does not represent a legal opinion. No other warranty, expressed or implied, is made.

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Attachments:
- Table 5 – PRISM Total Precipitation Data: 30-year Normal and Annually, 1990-2018 - by WRIA 14 and 15 Subbasin
- Table 6 – Approximate Effective Precipitation and Irrigation Water Requirements Based on PRISM Data, 1990-2018 - by WRIA 14 and 15 Subbasin
- Figure 1 – WRIAs, Subbasins and Area Irrigation Guide/Weather Data Stations
- Figure 2 – Calculated 30-year Normal Irrigation Season Precipitation in WRIAs 14 and 15

TABLES

Table 5. PRISM Total Precipitation Data: 30-year Normal and Annually, 1990-2018 - by WRIA 14 and 15 Subbasin

DRAFT

Project No. 190315, Shelton, Washington

Wria	Subbasin	PRISM 30-year (1981-2010) Normal Total Precipitation for Irrigation Season (inches)							April through September Precipitation Total by Year (inches) from PRISM																												
		April	*May*	*Jun*	*July*	*Aug*	*Sept*	***Total***	**2018**	**2017**	**2016**	**2015**	**2014**	**2013**	**2012**	**2011**	**2010**	**2009**	**2008**	**2007**	**2006**	**2005**	**2004**	**2003**	**2002**	**2001**	**2000**	**1999**	**1998**	**1997**	**1996**	**1995**	**1994**	**1993**	**1992**	**1991**	**1990**
14	Case	4.4	2.7	2.0	0.9	1.1	1.9	**13.0**	13.2	15.3	7.4	10.2	17.0	21.2	11.1	15.6	18.8	13.7	9.1	11.5	8.4	15.4	12.5	8.1	11.0	14.3	12.5	8.6	5.9	23.7	19.4	12.3	10.4	17.5	11.7	17.1	11.1
	Goldsborough	5.7	3.3	2.2	1.0	1.3	2.5	**16.0**	17.3	17.9	9.4	11.6	20.3	26.0	14.2	20.3	22.4	15.8	11.5	14.2	10.2	19.0	14.8	10.9	13.1	17.5	16.9	10.7	7.0	29.6	23.4	15.8	13.8	21.4	14.3	19.9	13.2
	Harstine	3.8	2.4	1.9	0.8	1.0	1.7	**11.5**	11.4	13.9	6.7	8.6	15.8	20.2	10.7	14.1	18.3	13.2	8.0	10.2	7.8	13.9	11.3	7.3	9.5	12.9	10.7	8.0	5.5	21.1	17.5	10.9	9.1	15.5	10.5	16.1	10.3
	Hood	4.2	2.5	1.9	0.9	1.0	1.9	**12.4**	12.6	14.5	7.0	9.7	16.4	20.2	10.7	15.0	17.8	13.1	8.8	11.0	8.2	14.8	12.3	7.6	10.3	13.8	11.8	8.3	5.8	23.1	18.7	11.9	9.9	16.6	11.3	16.4	10.8
	Kennedy	5.0	3.0	2.2	0.9	1.2	2.3	**14.5**	15.6	16.6	9.2	11.0	19.6	25.4	13.0	18.4	20.5	15.0	10.1	12.6	9.3	17.1	13.7	9.8	11.6	15.5	14.3	9.7	6.8	26.7	21.0	14.1	11.5	19.1	12.5	17.5	12.7
	Mill	4.9	2.9	2.0	0.9	1.1	2.2	**14.0**	14.5	16.0	8.0	10.2	18.5	23.6	12.6	18.2	20.1	14.7	10.0	12.7	9.0	16.6	12.8	9.4	11.3	15.1	14.1	9.5	6.3	26.3	21.1	14.1	11.6	19.0	12.1	17.6	12.4
	Oakland	4.6	2.7	2.0	0.9	1.1	2.1	**13.4**	13.9	15.7	7.5	10.8	17.5	22.4	11.6	16.8	19.2	14.0	9.4	12.2	8.6	15.9	12.8	8.6	11.0	14.5	13.2	8.8	5.9	25.3	20.4	13.2	10.9	18.2	11.8	17.0	11.6
	Skookum	4.8	2.9	2.1	0.9	1.2	2.1	**14.0**	14.5	16.1	8.4	10.3	18.6	23.8	12.7	17.9	20.2	14.8	9.9	12.6	9.0	16.6	12.9	9.4	11.2	15.1	13.9	9.5	6.5	25.8	20.9	13.9	11.4	18.8	12.1	17.6	12.3
15	Bainbridge Island	2.9	2.0	1.7	0.7	0.8	1.4	**9.4**	8.5	9.2	6.0	6.6	11.2	14.1	8.9	10.7	13.0	10.2	8.1	8.6	7.7	12.3	10.5	6.1	7.0	12.0	8.3	7.2	5.5	17.1	14.5	9.9	7.5	12.8	9.5	11.7	8.2
	McNeil Island, Anderson Island, Ketron Island	3.1	2.1	1.7	0.7	0.9	1.4	**10.0**	9.7	12.0	5.9	6.9	14.4	18.3	10.0	12.6	17.3	11.1	7.1	8.8	7.5	12.8	10.3	6.6	8.4	12.1	9.5	7.2	4.8	18.7	15.7	9.5	8.5	13.7	9.4	14.7	9.6
	North Hood Canal	3.1	2.2	1.7	0.8	0.9	1.5	**10.2**	9.6	10.2	6.4	7.6	12.4	15.6	10.1	11.6	14.1	10.6	8.2	8.7	8.1	12.3	10.8	6.2	7.3	11.7	8.6	8.0	6.1	17.6	14.8	10.4	7.8	13.8	9.8	11.9	8.9
	South Hood Canal	4.6	2.8	2.0	1.0	1.1	2.0	**13.6**	14.0	15.7	7.5	10.4	17.4	21.8	11.6	16.0	18.9	13.8	9.4	11.9	8.8	15.9	13.1	8.3	11.1	15.4	12.8	9.1	6.4	24.8	19.8	13.0	10.8	18.4	12.4	17.3	11.1
	South Sound	3.6	2.3	1.8	0.8	1.0	1.6	**11.1**	10.5	13.1	6.7	8.3	15.3	18.9	9.8	13.9	17.5	12.8	8.0	9.5	7.5	13.6	10.8	6.7	9.3	12.7	10.1	7.8	5.2	20.2	16.7	10.1	9.1	14.6	10.0	15.8	10.2
	Vashon - Maury Island	3.0	2.1	1.7	0.8	0.9	1.5	**10.0**	9.2	10.7	6.2	7.6	13.6	17.4	9.3	12.5	15.9	11.6	7.9	8.2	8.1	12.4	10.3	5.9	8.1	12.2	8.9	7.3	5.1	17.3	14.8	9.2	8.4	12.7	9.0	13.4	9.0
	West Sound	3.2	2.2	1.7	0.8	0.9	1.5	**10.4**	9.7	10.9	6.5	7.8	12.7	16.4	9.8	12.0	15.0	11.4	8.4	9.2	8.0	13.2	11.3	6.5	7.7	12.7	9.1	7.9	5.8	18.5	15.3	10.5	8.1	14.1	10.2	12.7	8.8

WRIA	Subbasin	*April*	*May*	*Jun*	*July*	*Aug*	*Sept*	***Total***	**2018**	**2017**	**2016**	**2015**	**2014**	**2013**	**2012**	**2011**	**2010**	**2009**	**2008**	**2007**	**2006**	**2005**	**2004**	**2003**	**2002**	**2001**	**2000**	**1999**	**1998**	**1997**	**1996**	**1995**	**1994**	**1993**	**1992**	**1991**	**1990**
									April through September Precipitation Total as Percent of 30-year Normal by Year																														
14	Case	4.4	2.7	2.0	0.9	1.1	1.9	**13.0**	101%	117%	57%	78%	131%	163%	85%	120%	144%	105%	70%	89%	64%	118%	96%	62%	84%	110%	96%	66%	46%	182%	149%	95%	80%	135%	90%	132%	85%
	Goldsborough	5.7	3.3	2.2	1.0	1.3	2.5	**16.0**	108%	112%	58%	72%	127%	162%	88%	127%	140%	98%	72%	88%	64%	119%	92%	68%	82%	109%	106%	67%	44%	185%	146%	99%	86%	134%	90%	124%	82%
	Harstine	3.8	2.4	1.9	0.8	1.0	1.7	**11.5**	99%	121%	58%	75%	137%	176%	93%	122%	158%	114%	69%	88%	67%	121%	98%	64%	83%	112%	93%	69%	48%	183%	152%	95%	79%	134%	91%	140%	90%
	Hood	4.2	2.5	1.9	0.9	1.0	1.9	**12.4**	102%	117%	56%	78%	133%	163%	86%	122%	144%	106%	71%	89%	66%	120%	100%	62%	83%	112%	95%	67%	47%	187%	152%	96%	80%	135%	91%	133%	87%
	Kennedy	5.0	3.0	2.2	0.9	1.2	2.3	**14.5**	107%	114%	64%	76%	135%	175%	90%	127%	141%	103%	69%	87%	64%	118%	94%	67%	80%	107%	98%	67%	47%	184%	145%	97%	79%	131%	86%	121%	87%
	Mill	4.9	2.9	2.0	0.9	1.1	2.2	**14.0**	103%	114%	57%	73%	132%	169%	90%	130%	143%	105%	71%	91%	64%	119%	91%	67%	80%	108%	100%	68%	45%	188%	151%	101%	83%	135%	87%	125%	88%
	Oakland	4.6	2.7	2.0	0.9	1.1	2.1	**13.4**	104%	118%	56%	81%	131%	167%	86%	125%	144%	105%	70%	92%	64%	119%	96%	64%	82%	109%	99%	66%	44%	189%	153%	99%	82%	136%	88%	127%	86%
	Skookum	4.8	2.9	2.1	0.9	1.2	2.1	**14.0**	103%	115%	60%	74%	133%	170%	90%	127%	144%	106%	70%	90%	64%	118%	92%	67%	80%	108%	99%	68%	46%	184%	149%	99%	81%	134%	86%	125%	88%
15	Bainbridge Island	2.9	2.0	1.7	0.7	0.8	1.4	**9.4**	90%	98%	64%	70%	119%	150%	94%	113%	137%	108%	85%	91%	82%	131%	112%	64%	74%	127%	88%	77%	58%	181%	154%	105%	79%	136%	100%	124%	87%
	McNeil Island, Anderson Island, Ketron Island	3.1	2.1	1.7	0.7	0.9	1.4	**10.0**	97%	121%	59%	69%	145%	184%	100%	126%	173%	111%	71%	88%	75%	128%	103%	66%	84%	121%	95%	72%	48%	187%	157%	95%	85%	138%	94%	147%	96%
	North Hood Canal	3.1	2.2	1.7	0.8	0.9	1.5	**10.2**	94%	100%	63%	75%	122%	152%	99%	114%	138%	104%	80%	85%	79%	121%	106%	60%	72%	115%	84%	78%	60%	173%	145%	101%	77%	135%	96%	117%	87%
	South Hood Canal	4.6	2.8	2.0	1.0	1.1	2.0	**13.6**	103%	115%	55%	76%	128%	160%	85%	118%	139%	101%	69%	88%	65%	117%	97%	61%	82%	113%	94%	67%	47%	182%	146%	95%	79%	135%	91%	127%	82%
	South Sound	3.6	2.3	1.8	0.8	1.0	1.6	**11.1**	95%	118%	61%	75%	138%	170%	88%	125%	158%	115%	72%	85%	67%	122%	97%	60%	84%	115%	91%	71%	47%	183%	151%	91%	82%	132%	90%	142%	92%
	Vashon - Maury Island	3.0	2.1	1.7	0.8	0.9	1.5	**10.0**	92%	107%	62%	76%	136%	173%	92%	124%	159%	116%	79%	82%	80%	124%	102%	59%	81%	121%	89%	73%	51%	173%	148%	92%	84%	127%	90%	133%	90%
	West Sound	3.2	2.2	1.7	0.8	0.9	1.5	**10.4**	93%	104%	62%	74%	122%	158%	94%	115%	144%	110%	81%	88%	77%	126%	108%	62%	73%	122%	87%	76%	56%	177%	147%	100%	77%	135%	97%	122%	84%
							Average		*99%*	*113%*	*59%*	*75%*	*131%*	*166%*	*91%*	*122%*	*147%*	*107%*	*73%*	*88%*	*70%*	*121%*	*99%*	*64%*	*80%*	*114%*	*94%*	*70%*	*49%*	*183%*	*150%*	*97%*	*81%*	*134%*	*91%*	*129%*	*87%*
							Rank		*17*	*19*	*2*	*7*	*24*	*28*	*12*	*22*	*26*	*18*	*6*	*11*	*4*	*21*	*16*	*3*	*8*	*20*	*14*	*5*	*1*	*29*	*27*	*15*	*9*	*25*	*13*	*23*	*10*

Table 6. Approximate Effective Precipitation and Irrigation Water Requirements Based on PRISM Data, 1990-2018 - by WRIA 14 and 15 Subbasin

DRAFT

Project No. 190315, Shelton, Washington

Wria	Subbasin	PRISM 30-yr Normal Precip. (in)	WIG Station Proxy	Provisional WIG Numbers (Apr-Sept) Total Precip (in)	Eff. Precip (in)	ET(c)	Net IWR (in)	April through September Calculated Effective Precipitation (Pe) Total by Year (inches) *Calculated for all months individually, then totalled: Pe(in) = 0.921719*(0.70917*[Pt(in)]^0.82416-0.11556)*(10^(0.02426*[ETc(in)])) - where ETc (in) is the monthly normal for the given proxy station*																													
								2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990
14	Case	13.0	GRAPEVIEW 3 SW	13.7	8.2	20.1	12.2	6.8	8.3	4.6	6.0	9.8	11.5	6.5	8.8	10.6	7.8	5.6	7.2	4.9	8.9	7.5	4.5	6.4	8.7	7.6	5.5	3.7	13.5	10.5	7.6	6.4	9.7	6.7	9.5	6.7
	Goldsborough	16.0	SHELTON	14.8	8.9	21.0	12.5	8.8	9.6	5.8	6.8	11.4	13.9	8.1	11.3	12.4	8.9	7.0	8.8	6.0	10.8	8.7	6.0	7.5	10.3	10.0	6.7	4.4	16.3	12.5	9.5	8.3	11.7	7.9	11.0	7.9
	Harstine	11.5	GRAPEVIEW 3 SW	13.7	8.2	20.1	12.2	6.0	7.7	4.2	5.1	9.2	11.0	6.2	8.1	10.3	7.6	5.0	6.5	4.6	8.1	6.8	4.1	5.6	7.9	6.6	5.1	3.4	12.2	9.6	6.8	5.6	8.7	6.1	9.0	6.3
	Hood	12.4	GRAPEVIEW 3 SW	13.7	8.2	20.1	12.2	6.5	7.9	4.4	5.7	9.4	11.0	6.3	8.6	10.1	7.5	5.4	6.9	4.8	8.6	7.4	4.3	6.1	8.4	7.2	5.3	3.6	13.2	10.2	7.4	6.1	9.3	6.5	9.1	6.5
	Kennedy	14.5	SHELTON	14.8	8.9	21.0	12.5	7.9	9.1	5.7	6.5	11.1	13.5	7.6	10.4	11.5	8.6	6.2	7.9	5.5	9.9	8.1	5.5	6.7	9.3	8.6	6.1	4.2	15.0	11.4	8.6	7.1	10.6	7.1	9.8	7.7
	Mill	14.0	SHELTON	14.8	8.9	21.0	12.5	7.4	8.8	5.0	6.0	10.6	12.7	7.3	10.2	11.2	8.4	6.2	8.0	5.3	9.6	7.6	5.2	6.6	9.1	8.5	6.0	3.9	14.8	11.4	8.6	7.1	10.5	6.8	9.8	7.5
	Oakland	13.4	SHELTON	14.8	8.9	21.0	12.5	7.1	8.6	4.7	6.4	10.0	12.1	6.8	9.5	10.8	8.0	5.8	7.7	5.1	9.2	7.6	4.8	6.4	8.8	8.0	5.6	3.7	14.4	11.1	8.1	6.7	10.2	6.7	9.5	7.0
	Skookum	14.0	SHELTON	14.8	8.9	21.0	12.5	7.4	8.8	5.2	6.1	10.6	12.8	7.3	10.1	11.3	8.4	6.1	7.9	5.3	9.6	7.7	5.3	6.5	9.1	8.3	6.0	4.0	14.6	11.3	8.5	7.0	10.5	6.8	9.8	7.5
15	Bainbridge Island	9.4	BREMERTON	11.4	7.0	20.0	13.2	4.7	5.2	3.8	4.1	6.9	8.0	5.4	6.4	7.6	6.0	5.0	5.6	4.6	7.4	6.5	3.5	4.3	7.5	5.2	4.7	3.5	10.2	8.3	6.2	4.6	7.4	5.8	6.8	5.1
	McNeil Island, Anderson Island, Ketron Island	10.0	WAUNA 3 W	11.8	7.3	20.0	12.7	5.2	6.7	3.6	4.2	8.5	10.1	5.8	7.3	9.8	6.5	4.5	5.7	4.4	7.5	6.2	3.7	5.0	7.4	5.9	4.6	3.0	11.0	8.7	6.1	5.2	7.8	5.5	8.2	5.8
	North Hood Canal	10.2	BREMERTON	11.4	7.0	20.0	13.2	5.3	5.7	4.1	4.7	7.5	8.7	6.1	6.9	8.2	6.2	5.1	5.6	4.8	7.4	6.7	3.5	4.5	7.3	5.4	5.1	3.9	10.5	8.5	6.5	4.8	8.0	5.9	7.0	5.5
	South Hood Canal	13.6	CUSHMAN POWERHOUSE 2	16.2	9.6	20.5	11.8	7.3	8.5	4.8	6.1	10.0	11.8	6.8	9.1	10.7	7.8	5.8	7.5	5.2	9.2	7.9	4.7	6.6	9.3	7.7	5.8	4.0	14.0	10.8	7.9	6.6	10.2	7.1	9.6	6.8
	South Sound	11.1	WAUNA 3 W	11.8	7.3	20.0	12.7	5.6	7.2	4.3	5.0	8.9	10.3	5.7	8.0	10.0	7.4	5.0	6.1	4.4	8.0	6.5	3.8	5.5	7.8	6.2	5.0	3.2	11.8	9.2	6.4	5.6	8.2	5.9	8.8	6.2
	Vashon - Maury Island	10.0	VASHON ISLAND	13.4	8.2	20.1	12.2	4.8	6.0	4.0	4.6	8.1	9.6	5.5	7.3	9.2	6.7	5.0	5.3	4.8	7.4	6.2	3.4	4.9	7.5	5.6	4.7	3.2	10.3	8.3	5.9	5.2	7.3	5.5	7.6	5.5
	West Sound	10.4	BREMERTON	11.4	7.0	20.0	13.2	5.3	6.1	4.1	4.8	7.7	9.1	5.9	7.1	8.7	6.6	5.2	5.9	4.7	7.8	6.9	3.7	4.7	7.9	5.7	5.1	3.7	10.9	8.7	6.5	4.9	8.1	6.1	7.3	5.4

Wria	Subbasin	PRISM 30-yr Normal Precip. (in)	WIG Station Proxy	Provisional WIG Numbers (Apr-Sept) Total Precip (in)	Eff. Precip (in)	ET(c)	Net IWR (in)	April through September Calculated Net Irrigation Water Requirement by Year (inches) *ET(c) - Pe*																													
								2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990
14	Case	13.0	GRAPEVIEW 3 SW	13.7	8.2	20.1	12.2	13.3	11.8	15.5	14.1	10.3	8.6	13.6	11.3	9.5	12.3	14.5	12.9	15.2	11.2	12.6	15.6	13.7	11.4	12.5	14.6	16.4	6.6	9.6	12.5	13.7	10.4	13.4	10.6	13.4
	Goldsborough	16.0	SHELTON	14.8	8.9	21.0	12.5	12.2	11.4	15.2	14.2	9.6	7.1	12.9	9.7	8.6	12.1	14.0	12.2	15.0	10.2	12.3	15.0	13.5	10.7	11.0	14.3	16.6	4.7	8.5	11.5	12.7	9.3	13.1	10.0	13.1
	Harstine	11.5	GRAPEVIEW 3 SW	13.7	8.2	20.1	12.2	14.1	12.4	15.9	15.0	10.9	9.1	13.9	12.0	9.8	12.5	15.1	13.6	15.5	12.0	13.3	16.0	14.5	12.2	13.5	15.0	16.7	7.9	10.5	13.3	14.5	11.4	14.0	11.1	13.8
	Hood	12.4	GRAPEVIEW 3 SW	13.7	8.2	20.1	12.2	13.6	12.2	15.7	14.4	10.7	9.1	13.8	11.5	10.0	12.6	14.7	13.2	15.3	11.5	12.7	15.8	14.0	11.7	12.9	14.8	16.5	6.9	9.9	12.7	14.0	10.8	13.6	11.0	13.6
	Kennedy	14.5	SHELTON	14.8	8.9	21.0	12.5	13.1	11.9	15.3	14.5	9.9	7.5	13.4	10.6	9.5	12.4	14.8	13.1	15.5	11.1	12.9	15.5	14.3	11.7	12.4	14.9	16.8	6.0	9.6	12.4	13.9	10.4	13.9	11.2	13.3
	Mill	14.0	SHELTON	14.8	8.9	21.0	12.5	13.6	12.2	16.0	15.0	10.4	8.3	13.7	10.8	9.8	12.6	14.8	13.0	15.7	11.4	13.4	15.8	14.4	11.9	12.5	15.0	17.1	6.2	9.6	12.4	13.9	10.5	14.2	11.2	13.5
	Oakland	13.4	SHELTON	14.8	8.9	21.0	12.5	13.9	12.4	16.3	14.6	11.0	8.9	14.2	11.5	10.2	13.0	15.2	13.3	15.9	11.8	13.4	16.2	14.6	12.2	13.0	15.4	17.3	6.6	9.9	12.9	14.3	10.8	14.3	11.5	14.0
	Skookum	14.0	SHELTON	14.8	8.9	21.0	12.5	13.6	12.2	15.8	14.9	10.4	8.2	13.7	10.9	9.7	12.6	14.9	13.1	15.7	11.4	13.3	15.7	14.5	11.9	12.7	15.0	17.0	6.4	9.7	12.5	14.0	10.5	14.2	11.2	13.5
15	Bainbridge Island	9.4	BREMERTON	11.4	7.0	20.0	13.2	15.3	14.8	16.2	15.9	13.1	12.0	14.6	13.6	12.4	14.0	15.0	14.4	15.4	12.6	13.5	16.5	15.7	12.5	14.8	15.3	16.5	9.8	11.7	13.8	15.4	12.6	14.2	13.2	14.9
	McNeil Island, Anderson Island, Ketron Island	10.0	WAUNA 3 W	11.8	7.3	20.0	12.7	14.8	13.3	16.4	15.8	11.5	9.9	14.2	12.7	10.2	13.5	15.5	14.3	15.6	12.5	13.8	16.3	15.0	12.6	14.1	15.4	17.0	9.0	11.3	13.9	14.8	12.2	14.5	11.8	14.2
	North Hood Canal	10.2	BREMERTON	11.4	7.0	20.0	13.2	14.7	14.3	15.9	15.3	12.5	11.3	13.9	13.1	11.8	13.8	14.9	14.4	15.2	12.6	13.3	16.5	15.5	12.7	14.6	14.9	16.1	9.5	11.5	13.5	15.2	12.0	14.1	13.0	14.5
	South Hood Canal	13.6	CUSHMAN POWERHOUSE 2	16.2	9.6	20.5	11.8	13.2	12.0	15.7	14.4	10.5	8.7	13.7	11.4	9.8	12.7	14.7	13.0	15.3	11.3	12.6	15.8	13.9	11.2	12.8	14.7	16.5	6.5	9.7	12.6	13.9	10.3	13.4	10.9	13.7
	South Sound	11.1	WAUNA 3 W	11.8	7.3	20.0	12.7	14.4	12.8	15.7	15.0	11.1	9.7	14.3	12.0	10.0	12.6	15.0	13.9	15.6	12.0	13.5	16.2	14.5	12.2	13.8	15.0	16.8	8.2	10.8	13.6	14.4	11.8	14.1	11.2	13.8
	Vashon - Maury Island	10.0	VASHON ISLAND	13.4	8.2	20.1	12.2	15.3	14.1	16.1	15.5	12.0	10.5	14.6	12.8	10.9	13.4	15.1	14.8	15.3	12.7	13.9	16.7	15.2	12.6	14.5	15.4	16.9	9.8	11.8	14.2	14.9	12.8	14.6	12.5	14.6
	West Sound	10.4	BREMERTON	11.4	7.0	20.0	13.2	14.7	13.9	15.9	15.2	12.3	10.9	14.1	12.9	11.3	13.4	14.8	14.1	15.3	12.2	13.1	16.3	15.3	12.1	14.3	14.9	16.3	9.1	11.3	13.5	15.1	11.9	13.9	12.7	14.6

FIGURES

WRIA 18
WRIA 17
WRIA 6
WRIA 8
WRIA 21
WRIA 16
WRIA 15
WRIA 9
WRIA 10
WRIA 14
WRIA 22
WRIA 13
WRIA 12
WRIA 11
WRIA 23
WRIA 24

Chimacum (A)
Langley (A)
QUILCENE
SEATTLE JACKSON PARK
Poulsbo.S (A)
Seattle
SEATTLE-UW
North Hood Canal
West Sound
Bainbridge Island
BREMERTON
SEATTLE BOEING FIELD
South Hood Canal
CUSHMAN DAM
VASHON ISLAND
SEATTLE-SEATAC AIRPORT
Vashon - Maury Island
South Sound
CUSHMAN POWERHOUSE 2
Hood
WAUNA
Case
GRAPEVIEW
Oakland
TACOMA 1
Goldsborough
Harstine
SHELTON
Puyallup
Mill
WSU Puyallup
McNeil Island, Anderson Island, Ketron Island
MC MILLIN RESERVOIR
Skookum
Kennedy
OLYMPIA PRIEST PT PARK
ELMA
OLYMPIA (AIRPORT)
Montesano (A)
Olympia.E (A)
Tumwater (A)
LA GRANDE
OAKVILLE

DRAFT

Washington Irrigation Guide (WAIG) Station (approx.)
WSU (Provisional WIG) Station
PRISM Station
AgWeatherNet Station
Water Resource Inventory Area (WRIA)
Subbasin

N
0 3 6
Miles

WRIAs, Subbasins and Area Irrigation Guide/Weather Data Stations

Assessing Precipitation Variability in Outdoor Domestic Water Use Calculations for WRIAs 14 and 15
Skokomish Tribe
Washington

Aspect Consulting	APR-2020	BY: PPW	FIGURE NO. 1
	PROJECT NO. 190315	REVISED BY: ---	

GIS Path: T:\projects_8\Skokomish_Tribe_Precip_Memo\Fig2_PRISM_Precip.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 4/30/2020 || User: pwittman || Print Date: 4/30/2020

18 17 6 8 9 15 16 14 21 21 21 23 22 12 10 13

QUILCENE 2 SW
SEATTLE JACKSON PARK
Poulsbo.S
Bainbridge Island
North Hood Canal
BREMERTON
West Sound
South Hood Canal
SEATTLE-SETAC AIRPORT
VASHON ISLAND
Vashon - Maury Island
South Sound
CUSHMAN DAM
CUSHMAN POWERHOUSE 2
Hood Canal
WAUNA 3 W
GRAPEVIEW
Oakland
TACOMA 1
Goldsborough
Harstine
SHELTON
Puyallup
Mill
McNeil Island, Anderson Island, Ketron Island
Skookum
Kennedy
OLYMPIA PRIEST PT PARK
Tumwater
Olympia.E

DRAFT

- Irrigation Guide Station (WAIG and/or WSU)
- PRISM Station
- AgWeatherNet Station
- WRIA
- Subbasin

30-year Normal Apr-Sept Total Precipitation (PRISM)
20" or more
0"

0 3 6
Miles

30-year Normal Total Precipitation between April and September (1-inch isohyets) from PRISM

Calculated 30-year Normal Irrigation Season Precipitation in WRIAs 14 and 15

Assessing Precipitation Variability in Outdoor Domestic Water Use Calculations for WRIAs 14 and 15
Skokomish Tribe
Washington

Aspect Consulting	APR-2020	BY: PPW	FIGURE NO. 2
	PROJECT NO. 190315	REVISED BY: ---	

WRIA 14 Policy Proposals – Table of Contents

Please note – Page numbers correspond to the red numbers in the upper right-hand corner of the document

Policy proposal – WRIA 14 WREC

Name: Adaptive Management responses

Entity: Squaxin Island Tribe

Type of policy idea (see list below): Adaptive Management

Description of policy idea (a short abstract)**:**

1. *Identify the potential implementers and other key players.*
    a. Ecology, Counties
2. *Describe proposed actions (including current policies or codes, existing programs and their limitations, problems to be corrected, etc.).*
    a. Counties will track and document permit exempt well construction
    b. Counties (or other entities possibly) would track offset projects
        i. Monitor project status
        ii. Document project completion
        iii. Assess project success and quantify final offset amounts
    c. Counties (or other entities possibly) would provide an annual report to Ecology on PE well construction and offset status by subbasin.
    d. Beginning at the fifth year of implementation, the Counties would assess compare PE well installation and consumptive use amounts (using the methodology designated in the plan) to completed offset project amounts, and if the annual report indicates that offset amounts are behind the cumulative total of PE well consumptive use amounts, take the following actions:
        i. Consult with stakeholders in the WRIA (members of the former WRE Committee, or the implementation organization if it has been established) to determine the status of offset project in process and discuss means to speed up offset project completion.
        ii. Include in the annual report to Ecology the timeline for offset projects to exceed PE well construction and actions being taken to speed up offset project completion.
    e. Ecology will review annual reports and assess progress in quantified offset benefits exceeding consumptive use from new permit exempt wells. Based on the report, if offset amounts are behind the cumulative total of PE well consumptive use amounts, Ecology will consider corrective action to protect senior water rights, which could include:
        i. More restrictive water use restrictions to be into effect for the following year.
        ii. A moratorium on building permits for new PE wells until sufficient progress is made on completed offset projects.
    f. If offset project amounts are exceeding the “high growth” targets (on an annual prorated basis) then Ecology could relax any restrictions put in place, and allow reporting to go a longer cycle, such as every other year.
    g. Ecology should conduct rule-making as necessary to implement
3. *Identify who the action impacts (if different than primary implementer).*
    a. Water use restrictions, if implemented, could impact homeowners.

   b. Could impact developers and home buyers if actions slow development.
4. *Describe benefits and challenges/obstacles.*
   a. Benefits:
      i. Provides clear and substantive responses to PE well use exceeding offset amounts
      ii. Protects against legal challenges to the Plan's effectiveness as a "Hirst fix"
      iii. Is consistent with ESSB 6091's restriction on local governments' authority to allow permit-exempt wells; i.e., authority is conditioned on actions and projects actually offset consumptive water use by permit-exempt wells
      iv. Provides incentives to complete projects in excess of PE well requirements
      v. Support streamflow restoration and the rights of Tribes and senior water rights holders
   b. Challenges:
      i. County resistance to substantive requirements if offsets are falling short
      ii. Workload requirements for County and Ecology
      iii. Need for timeliness in reporting and Ecology action
      iv. Provides incentives to implementation, but the discretion to act could undercut progress.

Description of purpose:

1. *How would this recommendation enhance the WRIA 14 plan? Describe the desired result and its purpose in this plan (we want to be clear how this relates to offsetting impacts from PEW OR be explicit that this is a benefit to the watershed even if not directly related to PEW impacts).*
   a. This would add certainty that the Plan is being fully implemented and provide incentives to fund and complete projects

Description of concerns:

1. *What, if any, concerns with this policy idea have WRIA 14 members expressed or that you anticipate?*
   a. Counties have expressed support in general terms for adaptive management, but specific details have not been discussed
2. *If you have discussed this with concerned members, what was the result of those discussions?*
   a. No discussions yet
3. *Are there other potential downsides or objections to the proposal that you anticipate?*
   a. As described in challenges above
   b. Details of adaptive management create complexity, which may result in confusion, resistance, loopholes, and unintended consequences
4. *In what ways does your proposal address those concerns?*
   a. Trying to be simple and clear, but more discussion and negotiation is needed

Cost and funding sources:

1. *What elements of the proposal are likely to require funding?*
   a. Workload for Counties and Ecology

2. *Provide a rough cost estimate (if known) and discuss potential funding sources and whether funding is one time or ongoing.*
    a. Amounts need to be estimated
    b. PE well fees
    c. State funding
3. *Explain costs to other affected parties besides implementing regulators (for example: costs will increase for well drilling or new requirements on homeowners/home builders).*
    a. Delays in home construction due to moratoriums on wells
    b. Impacts of water use restrictions

*Policy types (not comprehensive list; feel free to add):

- Education: providing information, encouragement and recognition
- Incentives: providing incentives such as subsidies, tax or fee reductions, etc.
- Compensation: reimbursing expenses for the action or for foregoing certain actions
- Regulation: requiring certain actions
- Fees or taxes: increasing the costs of undesired actions

Policy proposal – WRIA 14 WREC

Name: Drought response limit

Entity: Squaxin Island Tribe

Type of policy idea (see list below): Regulation

Description of policy idea (a short abstract)**:**

Drought is an ongoing challenge in western Washington. The State of Washington declared drought emergencies that included WRIA 14 in 2001, 2005, 2015, and 2019. Climate change projections indicate that drought conditions will become increasingly frequent in the future. To protect instream flows, stricter water use is needed during drought years, when flows are lowest and outdoor water use is highest.

1. *Identify the potential implementers and other key players.*
    a. Counties, Ecology
2. *Describe proposed actions (including current policies or codes, existing programs and their limitations, problems to be corrected, etc.).*
    a. Consistent with RCW 90.94.030(4)(b), upon the issuance of a drought emergency order under RCW 43.83B.405, withdrawal of groundwater exempt from permitting under RCW 90.44.050 will be limited to no more than three hundred fifty gallons per day per connection for indoor use only.
    b. A limited exemption is allowed for growing food, maintaining a fire control buffer, or supporting an environmental restoration project.
    c. Support for drought response will be provided by a water conservation program (separate proposal). This education and outreach program will educate the public about water conservation practices.
    d. Ecology will include these requirements in a package for rule-making.
    e. Propose legislation to apply this program to all PE wells statewide.
3. *Identify who the action impacts (if different than primary implementer).*
    a. New Permit exempt wells
    b. Supports tribal treaty rights and rights of senior water rights holders
4. *Describe benefits and challenges/obstacles.*
    a. Benefits:
        i. Addresses increased impacts in dry years compared to average conditions.
        ii. Operates in parallel to ISF rules and closures to protect Tribal Treaty rights and senior water rights.
        iii. Addresses climate change impacts.
    b. Challenges: poor understanding or resistance from home-owners. Requires dedicated resources. Without an education and compliance programs, compliance with the limits will be poor.

Description of purpose:

1. *How would this recommendation enhance the WRIA 14 plan? Describe the desired result and its purpose in this plan (we want to be clear how this relates to offsetting impacts from PEW OR be explicit that this is a benefit to the watershed even if not directly related to PEW impacts).*
    a. Build resilience into the plan to address extreme events of heat, dryness, and low flow
    b. Provide protections for senior water rights holders
    c. Support NEB goals for streamflow restoration.

Description of concerns:

1. *What, if any, concerns with this policy idea have WRIA 14 members expressed or that you anticipate?*
    a. Prefer education first, and a compliance approach over enforcement
    b. Ecology rule-making follows its own process and therefore is uncertain
2. *If you have discussed this with concerned members, what was the result of those discussions?*
    a. Already in law, support for food production exception
3. *Are there other potential downsides or objections to the proposal that you anticipate?*
    a. Addressing only new PE wells may not be fair if existing wells are exempt
    b. Lack of this program could result in a loophole that opens the plan to a legal challenge
4. *In what ways does your proposal address those concerns?*
    a. Proposal has been revised over time to approach the issue in ways that might reach consensus

Cost and funding sources:

1. *What elements of the proposal are likely to require funding?*
    a. Rule-making
    b. Legislative advocacy
2. *Provide a rough cost estimate (if known) and discuss potential funding sources and whether funding is one time or ongoing.*
    a. Cost uncertain – need analysis
    b. Include in Ecology budget
3. *Explain costs to other affected parties besides implementing regulators (for example: costs will increase for well drilling or new requirements on homeowners/home builders).*
    a. Possible costs to impacts on landscaping from outdoor watering ban

Policy proposal – WRIA 14 WREC

Name: **Durability of Implementation**

Entity: Squaxin Island Tribe

Type of policy idea (see list below): Adaptive Management; Regulation

Description of policy idea (a short abstract)**:**

The Plan will identify the mechanisms that add certainty to its implementation over its life. These could include documentation of past practices and standard procedures; and expected linkages to existing policies, regulations, and planning documents.

1. *Identify the potential implementers and other key players.*
    a. Ecology and Counties
2. *Describe proposed actions (including current policies or codes, existing programs and their limitations, problems to be corrected, etc.).*
    a. Provide language for the plan that describes how the plan will be implemented, based on past experience and standard operating procedures.
        i. For Ecology, this could include Plan implementation; and rule development, adoption, and implementation.
        ii. For Counties, this could include past practices and current practices with multi-jurisdictional plans; linkage to existing plans such as the Comprehensive Plan; and implementation through permitting rules.
3. *Identify who the action impacts (if different than primary implementer).*
    a. It will indirectly impact all stakeholders in the Plan since to will improve the likelihood that the Plan will be improved and implemented.
4. *Describe benefits and challenges/obstacles.*
    a. Benefits: documents procedures regarding how the Plan will be implemented, and increases the likelihood of Plan approval.
    b. Challenges/obstacles: These descriptions are based on past or current practices, or they are recommendations. There may be reluctance to include anything in the Plan that looks like a commitment.

Description of purpose:

1. *How would this recommendation enhance the WRIA 14 plan? Describe the desired result and its purpose in this plan (we want to be clear how this relates to offsetting impacts from PEW OR be explicit that this is a benefit to the watershed even if not directly related to PEW impacts).*
    a. It will improve the likelihood that the Plan will be improved and implemented.

Description of concerns:

1. *What, if any, concerns with this policy idea have WRIA 14 members expressed or that you anticipate?*
    a. There is reluctance to include anything in the Plan that looks like a commitment.
2. *If you have discussed this with concerned members, what was the result of those discussions?*

   a. The proposal is based on discussions with the staff with the counties.
3. *Are there other potential downsides or objections to the proposal that you anticipate?*
   a. It takes time to write down and it has no binding impact.
4. *In what ways does your proposal address those concerns?*
   a. The proposal is based on past discussions.

Cost and funding sources:

1. *What elements of the proposal are likely to require funding?*
   a. None anticipated
2. *Provide a rough cost estimate (if known) and discuss potential funding sources and whether funding is one time or ongoing.*
   a. n/a
3. *Explain costs to other affected parties besides implementing regulators (for example: costs will increase for well drilling or new requirements on homeowners/home builders).*
   a. None anticipated

Policy proposal – WRIA 14 WREC

Name: **Funding for Plan Implementation**

Entity: Squaxin Island Tribe

Type of policy idea (see list below): Fees

Description of policy idea (a short abstract)**:**

Two strategies are proposed to fund implantation of the Plan:

- New Permit Exempt Well Fees will be increased to $1,500 per connection, as authorized by RCW 90.94.030 (5)(c). The Plan will identify the specific use of these fees, but the following distribution is suggested:
    - $450/connection: to Ecology for supporting implementation
    - $250/connection: retained by the County for administration and implementation costs
    - $400/connection: to Ecology to distribute to an organization to create capacity to support implementation of the plan. Ecology will identify the organization conducting this work and provide the funding support in accordance with laws and regulations.
    - $400/connection: to Ecology to fund education and technical assistance for conservation and drought resilience. Ecology will identify organizations conducting this work and provide the funding support in accordance with laws and regulations.
- The Plan will request that the legislature provide sustainable, stable funding for implementation of the Plan. This funding will be available statewide to address priority activities in common with all WRIAs with a Plan or Rule developed under RCW 90.94. These activities might include:
    - Ecology's role in implementing the Plan and ensuring compliance with WRIA rules.
    - A statewide education and technical assistance program for water conservation and drought resilience.
    - Monitoring, modeling, and research to collect information collection that supports better water management

  The Plan recommends a dedicated fee rather than reliance on the general fund. An example might be an annual fee on permit exempt wells charged as part of the annual property tax assessment.

1. *Identify the potential implementers and other key players.*
    a. Ecology and Counties
2. *Describe proposed actions (including current policies or codes, existing programs and their limitations, problems to be corrected, etc.).*
    a. Ecology would need to develop and adopt a rule to implement this.
    b. Counties would play a role in managing fees
3. *Identify who the action impacts (if different than primary implementer).*
    a. New home buyers would absorb the fee in their purchase price.
    b. A positive impact to all citizens in the WRIA will occur from funding of implementation
4. *Describe benefits and challenges/obstacles.*
    a. Benefits: support implementation of the Plan and the ultimate achievement of its goals.

b. Challenges/obstacles: resistance to increased fees and homebuyer costs

Description of purpose:

1. *How would this recommendation enhance the WRIA 14 plan? Describe the desired result and its purpose in this plan (we want to be clear how this relates to offsetting impacts from PEW OR be explicit that this is a benefit to the watershed even if not directly related to PEW impacts).*
    a. Funding is critical to have a Plan that is actively implemented and achieves its goals.
    b. Funding from the legislature is highly uncertain, and the law provides a mechanism to fund implementation through fees on new wells.
    c. Funding needs are much larger than can be expected to be supported by local fees, so a parallel track to get statewide funding from the legislature should also be included.

Description of concerns:

1. *What, if any, concerns with this policy idea have WRIA 14 members expressed or that you anticipate?*
    a. Resistance from counties and building industry to fees that add to the cost of homes.
2. *If you have discussed this with concerned members, what was the result of those discussions?*
    a. Some willingness to accept a reasonable fee has been indicated.
3. *Are there other potential downsides or objections to the proposal that you anticipate?*
    a. Committee members want the use of the fees to be clearly described.
4. *In what ways does your proposal address those concerns?*
    a. I have proposed potential uses. As the Plan is more fully developed those uses can be better clarified and refined, or new ones included.
    b. Fee levels are also proposed that be modified as the Committee chooses.

Cost and funding sources:

1. *What elements of the proposal are likely to require funding?*
    a. The proposal is about funding.
2. *Provide a rough cost estimate (if known) and discuss potential funding sources and whether funding is one time or ongoing.*
    a. Summary of PE well fee proposal in the table below.
3. *Explain costs to other affected parties besides implementing regulators (for example: costs will increase for well drilling or new requirements on homeowners/home builders).*
    a. n/a

	Projected Annual			Ecology	County	Implementing Group	Conservation /drought	Total	
				Rate per well					Revenue -
		Revenue –		$ 450	$ 250	$ 400	$ 400	$ 1,500	projected
	# wells	current		Total per month					per year
WRIA 14	215	$ 107,350		$ 8,051	$ 4,473	$ 7,157	$ 7,157	$ 26,838	$ 322,050

Policy proposal – WRIA 14 WREC

Name: Group A Water System Conservation through Infrastructure Improvements **DRAFT**

Entity: City of Shelton and Mason Public Utility District 1

Type of policy idea (see list below): Infrastructure

Description of policy idea (a short abstract)**:**

1. *Identify the potential implementers and other key players.*
    a. Any Group A water system managers
2. *Describe proposed actions (including current policies or codes, existing programs and their limitations, problems to be corrected, etc.).*
    a. Replace leaking drinking water distribution pipes to greatly reduce unaccounted for water (distribution system leakage). Objective is to bring distribution system leakage below 10%. Group A water systems are currently required by WA Dept of Health to bring distribution system leakage below 10%. Start by identifying systems with high DSL, and prioritize them based on quantity of water that can be conserved with infrastructure improvements.
3. *Identify who the action impacts (if different than primary implementer).*
    a. N/A
4. *Describe benefits and challenges/obstacles.*
    a. Benefits: Significantly decreases in waste of pumped groundwater. Water savings would be substantial, equivalent to many households' worth of savings over many years.
    b. Challenges/Obstacles: High cost, possibly difficult to locate leakage.

Description of purpose:

1. *How would this recommendation enhance the WRIA 14 plan? Describe the desired result and its purpose in this plan (we want to be clear how this relates to offsetting impacts from PEW OR be explicit that this is a benefit to the watershed even if not directly related to PEW impacts).*
    a. This is a direct benefit to the watershed, but it does not offset permit exempt wells. It provides substantial water conservation over the 20-year span of the watershed plan, but it does not affect how Group A water systems grow into their inchoate rights.
    b. By reducing system leakage, group A water systems have the ability to expand service territory from the additional connections gained. Expanding service territory decreases the likelihood of nearby PEW being installed.

Description of concerns:

1. *What, if any, concerns with this policy idea have WRIA 14 members expressed or that you anticipate?*
    a. Unknown
2. *If you have discussed this with concerned members, what was the result of those discussions?*
    a. Need to identify any concerns/concerned members.

3. *Are there other potential downsides or objections to the proposal that you anticipate?*
    a. Due to the expense of mainline replacement, the progress is usually slow and incremental as part of capital replacement programs or is funded through grants to reduce DSL (priority funding given to those that have 50% or more DSL).
4. *In what ways does your proposal address those concerns?*
    a. Apply for grant funding from Ecology's streamflow restoration funding program.

Cost and funding sources:

1. *What elements of the proposal are likely to require funding?*
    a. Physical replacement of thousands of feet of drinking water pipe.
2. *Provide a rough cost estimate (if known) and discuss potential funding sources and whether funding is one time or ongoing.*
    a. There is not an exact cost-per-foot for replacement because it varies system-to-system. Boring under roadways, highway work, topography, all this factors into the costs. I small sections were replaced in-house, it is much less expensive than putting projects out to bid, which involves prevailing wage and contractor markup.
3. *Explain costs to other affected parties besides implementing regulators (for example: costs will increase for well drilling or new requirements on homeowners/home builders).*
    a. These costs fall upon Group A water system purveyors. Grant funding for these types of projects are very competitive- there is not enough funding to match the need for pipe replacement. We look to Ecology's streamflow restoration funding for this reason and because it will provide substantial water savings through conservation, especially for a high DSL system nearby a closed basin/ impacted stream.

*Policy types (not comprehensive list; feel free to add):

- Education: providing information, encouragement and recognition
- Incentives: providing incentives such as subsidies, tax or fee reductions, etc.
- Compensation: reimbursing expenses for the action or for foregoing certain actions
- Regulation: requiring certain actions
- Fees or taxes: increasing the costs of undesired actions

Policy proposal – WRIA 14 WREC

Name: **Instream Flow Rule revisions**

Entity: Squaxin Island Tribe

Type of policy idea: Regulation

Description of policy idea (a short abstract)**:**

This proposal requests that Ecology review and revise the WRIA 14 Instream Flow (ISF) Rule (WAC 173-514) to improve protection of streamflows.

1. *Identify the potential implementers and other key players.*
    a. Ecology
2. *Describe proposed actions (including current policies or codes, existing programs and their limitations, problems to be corrected, etc.).*
    Ecology would review the ISF flow rule, focusing on the these potential actions:
    a. Review all streams with salmonid habitat in WRIA 14 tributary to the South Sound, both those currently in the ISF Rule and those currently not included in the ISF Rule. Identify streams with salmon habitat that depend on dry season flows (typically June through October), and add a seasonal closure to those streams for the low flow season.
    b. For all streams with Instream Flows currently designated in the rule, reassess the Instream Flow values for seasons without closures using the most current ISF assessment methodology and salmon habitat information. Add supplemental flow restrictions if the analysis indicates that a higher flow would be protective.
    c. Revise and add any other conditions to the rule identified in the final watershed plan.
3. *Identify who the action impacts (if different than primary implementer).*
    a. May affect future development by requiring mitigation for new water rights if they are likely to affect the new closures and seasonal limitations in the updated ISF rule.
4. *Describe benefits and challenges/obstacles.*
    a. Benefits: updates rule for greater protection of aquatic resources from future water demands.
    b. Challenges: rule-making process may result in a final rule that differs from this proposal; resistance to increased costs and process to obtain a new water right.

Description of purpose:

1. *How would this recommendation enhance the WRIA 14 plan? Describe the desired result and its purpose in this plan (we want to be clear how this relates to offsetting impacts from PEW OR be explicit that this is a benefit to the watershed even if not directly related to PEW impacts).*
    a. This recommendation would update the rule to:
        i. Better protect streamflows from future water demands
        ii. Support implementation of the Plan
        iii. Support the goals of the plan for stream flow restoration and NEB
        iv. Improve protection of Tribal and other senior water rights

Description of concerns:

1. *What, if any, concerns with this policy idea have WRIA 14 members expressed or that you anticipate?*
    a. Uncertainty of rule-making outcomes
    b. Focus on streams where low flow affects salmon habitat, not all streams
    c. Impacts on economic development and purveyors' ability to serve
    d. Workload to develop and implement the rule
2. *If you have discussed this with concerned members, what was the result of those discussions?*
    a. The proposal has gone through several revision to clarify language and address concerns.
3. *Are there other potential downsides or objections to the proposal that you anticipate?*
    a. See #1
4. *In what ways does your proposal address those concerns?*
    a. Science-based approach
    b. Focus on protection of salmonids where low flow habitat is critical.
    c. Final rule changes will be subject to Ecology's rule-making process, that is designed to address many of these concerns.

Cost and funding sources:

1. *What elements of the proposal are likely to require funding?*
    a. Ecology will have to designate resources to implement.
2. *Provide a rough cost estimate (if known) and discuss potential funding sources and whether funding is one time or ongoing.*
    a. Unknown at this time. Funding proposals have been provided separately
3. *Explain costs to other affected parties besides implementing regulators (for example: costs will increase for well drilling or new requirements on homeowners/home builders).*
    a. May increase costs for development if less expensive water supplies are not allowed because of this rule.

Policy proposal – WRIA 14 WREC

Name: Lead Organization for Implementation

Entity: Squaxin Island Tribe

Type of policy idea (see list below): Implementation

Description of policy idea (a short abstract)**:**

Establish a committee or designate an organization to coordinate implementation of the Watershed Plan.

1. *Identify the potential implementers and other key players.*
    a. Current committee members, if willing, with Ecology support
2. *Describe proposed actions (including current policies or codes, existing programs and their limitations, problems to be corrected, etc.).*
    a. This Committee or organization will take responsibility supporting implementation of the Plan, including communication, and organizing and facilitating meetings and other activities.
    b. Ongoing SRC Committee activities are expected to include:
        i. Support for review, revision, and prioritization for grant applications, to ensure consistency with the overall approach of the Plan
        ii. Tracking of offsets and the number of exempt well developments authorized by the counties, both by WRIA and by sub-basin.
        iii. Reporting of Plan progress to Ecology, Committee members and the public.
        iv. Identification and development of long-term stable funding. The Plan proposes funding to provide capacity to the Lead Organization or Committee. The funding strategy is described in a separate proposal.
        v. Development of an Inter-local agreement that establishes roles and responsibilities, including funding, of the participants.
        vi. Developing and maintaining the institutional knowledge needed to provide a continuing approach to implement over the long-term.
        vii. The long-term responsibility for Plan implementation as implied by the RCW.
3. *Identify who the action impacts (if different than primary implementer).*
    a. All stakeholders of the Plan
4. *Describe benefits and challenges/obstacles*.
    a. Benefits: Supports the successful implementation of the Plan. Helps ensure the potential benefits of the Plan are realized.
    b. Challenges/obstacles: Capacity for carrying out the proposed activities, both in terms of time and funding. Ability of a diverse group of stakeholders to work together effectively.

Description of purpose:

1. *How would this recommendation enhance the WRIA 14 plan? Describe the desired result and its purpose in this plan (we want to be clear how this relates to offsetting impacts from PEW OR be explicit that this is a benefit to the watershed even if not directly related to PEW impacts).*
    a. Without an organization to coordinate implementation, the success of the Plan is at risk.

   b. The Nisqually Planning Unit and Chehalis Basin Partnership provide positive examples of the value of this kind of organization.

Description of concerns:

1. *What, if any, concerns with this policy idea have WRIA 14 members expressed or that you anticipate?*
   a. Lack of capacity to participate
   b. Uncertainty about the organization's purpose and scope of duties
   c. Overlap of the organization with the authorities or activities of other existing organizations.
2. *If you have discussed this with concerned members, what was the result of those discussions?*
   a. Developed proposals for funding to provide capacity.
   b. Described specific activities in the proposal.
3. *Are there other potential downsides or objections to the proposal that you anticipate?*
   a. Concerns about additional or redundancy organizations in the community,
4. *In what ways does your proposal address those concerns?*
   a. Provide a process to allow the organization to self-define its purpose, based on input from its members.
   b. Coordinate with other planning organizations to provide complimentary benefits and avoid redundancy.
   c. The organization could consider taking on other issues that may need WRIA-wide attention, such as water quality.

Cost and funding sources:

1. *What elements of the proposal are likely to require funding?*
   a. Staff and facilitator time.
2. *Provide a rough cost estimate (if known) and discuss potential funding sources and whether funding is one time or ongoing.*
   a. $50,000/year, based on estimates from the Nisqually Tribe.
3. *Explain costs to other affected parties besides implementing regulators (for example: costs will increase for well drilling or new requirements on homeowners/home builders).*
   a. Participating entities will need to allocate staff time to this work.

Policy proposal – WRIA 14 WREC

Name: **County Policies to Promote Connections to Group A systems**

Entity: Squaxin Island Tribe

Type of policy idea (see list below): Regulation

Description of policy idea (a short abstract)**:**

Water purveyors in some in situations determine that a new home can connect to their system (through a "timely and reasonable" assessment), but the home builder decides instead to construct or connect to a PE well. Also, a customer of a purveyor may decide to construct a PE well to reduce their reliance on the purveyor. Department of Health discourages these practices, and encourages Counties to establish ordinances to restrict PE wells within service areas through a "right of first refusal" and other restrictions on PE wells when Group A service is available in a timely and reasonable fashion.

1. *Identify the potential implementers and other key players.*
    a. Counties
2. *Describe proposed actions (including current policies or codes, existing programs and their limitations, problems to be corrected, etc.).*
    a. The Plan should encourage Mason and Thurston County will review their current ordinances and plans to determine if a new or revised ordinance would improve the ability of Group A system owners to have a "right of first refusal" and prevent new PE wells for their existing customers.
    b. If opportunities for improvement are identified, the Counties are encouraged to pass ordinances to implement the identified areas of improvement.
3. *Identify who the action impacts (if different than primary implementer).*
    a. Developers and landowners requiring water service for new construction.
4. *Describe benefits and challenges/obstacles.*
    a. Benefits: Reduces the potential number of PE wells and encourages connection to Group A systems. This reduces groundwater consumptive use and provides a safety factor for the overall Plan goal of streamflow restoration.
    b. May increase construction costs for affected parcels. This may result in political resistance to necessary ordinance changes. Ordinances could be rolled back in the future.

Description of purpose:

1. *How would this recommendation enhance the WRIA 14 plan? Describe the desired result and its purpose in this plan (we want to be clear how this relates to offsetting impacts from PEW OR be explicit that this is a benefit to the watershed even if not directly related to PEW impacts).*
    a. These requirements would be consistent with the Plans' goal of streamflow restoration.
    b. Implementation of these rules would provide a safety factor for the goal of providing offsets to exceed new PE well consumptive use.

Description of concerns:

1. *What, if any, concerns with this policy idea have WRIA 14 members expressed or that you anticipate?*
    a. There will likely be resistance to increased costs for new construction, even if limited.
    b. There may be political resistance to tightening development rules.
2. *If you have discussed this with concerned members, what was the result of those discussions?*
    a. Discussions have led to the current revised version.
3. *Are there other potential downsides or objections to the proposal that you anticipate?*
    a. Lack of certainty the these recommendations will be implemented
4. *In what ways does your proposal address those concerns?*
    a. Proposed changes are targeted and narrow.
    b. The power to implement this proposal is entirely at the discretion of the Counties.
    c. Ordinance development to implement these recommendations will likely result in changes to address concerns.

Cost and funding sources:

1. *What elements of the proposal are likely to require funding?*
    a. Some staff time will be necessary to develop the ordinances.
    b. Grants could be obtained to compensate for increased costs (this could be a possible project for the Plan).
2. *Provide a rough cost estimate (if known) and discuss potential funding sources and whether funding is one time or ongoing.*
    a. Unknown at this time.
3. *Explain costs to other affected parties besides implementing regulators (for example: costs will increase for well drilling or new requirements on homeowners/home builders).*
    a. Hookup to a Group A system will likely increase construction costs and require homeowners to pay utility rates.

Policy proposal – WRIA 14 WREC

Name: Mason County-Wide Conservation Outreach Program **DRAFT**

Entity: Brainstorm between Shelton/PUD1/Mason CD/Squaxin - No Sponsoring Entity at this time.

Type of policy idea (see list below): Education, Incentives, may include fees

Description of policy idea (a short abstract)**:**

1. *Identify the potential implementers and other key players.*
    a. Mason Conservation District, Mason County, Support from Squaxin Island Tribe
2. *Describe proposed actions (including current policies or codes, existing programs and their limitations, problems to be corrected, etc.).*
    a. Develop a program for ALL water users in Mason County to provide water conservation education incentives (mailers, websites, special events, tables at community events, free low flow indoor and outdoor fixtures, rain barrels, xeriscapes…). It could be modeled on the HDR "Active Program" examples, with measurable outcomes included. Measurements of success could be included, such as a certification program, a metering study of selected participants, use of signage, or the number of conservation items installed.
3. *Identify who the action impacts (if different than primary implementer).*
    a. All Mason County water users, including Group A and B rate-payers and permit-exempt well owners (individual, two-party, agricultural, and Group B).
4. *Describe benefits and challenges/obstacles.*
    a. Benefits:
        i. Generates awareness and behavior changes in well water users.
        ii. Provides a safety factor by reducing well water use. Encouraging more landowners with wells – whether permitted or exempt – to practice water conservation can potentially result in lowering the impacts on aquifers and surface waters, particularly for those located near sensitive fish-bearing streams, as well as in areas in the watershed without any identified projects.
        iii. While streamflow benefits are not directly measurable, programs could be designed to measure on-site benefits (such as certifications or if meters were installed).
        iv. While not quantifiable (except for specific projects or programs that include voluntary use of meters), the cumulative impact of lower water usage by many well-owners– particularly outdoor irrigation – on a large scale over time can only be beneficial.
        v. Supports drought response and climate change resilience. Non-regulatory approach is widely supported.
    b. Challenges/Obstacles:
        i. Funding must be obtained to fully implement.
        ii. Behavior change is slow and would begin with early adopters.
        iii. Measuring the impact/results of education and incentives, although it can be done (social marketing resources).

iv. Scale of conservation benefits may be small and have a minor benefit as compared to costs.
v. Education should supplement, but not replace, projects that significantly increase recharge, reduce water withdrawals, or adjust water use timing to increase summer flows.

Description of purpose:

1. *How would this recommendation enhance the WRIA 14 plan? Describe the desired result and its purpose in this plan (we want to be clear how this relates to offsetting impacts from PEW OR be explicit that this is a benefit to the watershed even if not directly related to PEW impacts).*

   This benefits the watershed in creating awareness for water conservation and providing a cumulative reduction in groundwater use. The benefits provide a safety factor, but it is not intended to be a quantifiable offset. An effective conservation program also supports drought response and climate change resilience. Overall, the program would support NEB and the Plan's goal of streamflow restoration.

Description of concerns:

1. *What, if any, concerns with this policy idea have WRIA 14 members expressed or that you anticipate?*
   a. This program will have to be funded.
   b. A lead for the proposal needs to be identified.
   c. Tribes are concerned that education not be seen as a panacea and replacement of projects producing significant summer flow improvements.
2. *If you have discussed this with concerned members, what was the result of those discussions?*
   a. This proposal is the result of conversations among several Committee members. The concerns identified above were part of that conversation.
3. *Are there other potential downsides or objections to the proposal that you anticipate?*
   a.
4. *In what ways does your proposal address those concerns?*
   a. This proposal will be considered in the context of the entire plan, together with other proposals for funding and drought response.

Cost and funding sources:

1. *What elements of the proposal are likely to require funding?*
   a. All elements. This could be a request to the legislature for funding, a direction through the committee to Ecology to increase the fee per new permit exempt well, shared funding among participants, or grant proposals.
2. *Provide a rough cost estimate (if known) and discuss potential funding sources and whether funding is one time or ongoing.*
   a. One-time to set up the program, ongoing to implement.
   b. Staff- 0.5 FTE's?
   c. Potential activities requiring funding:

i. Program development
ii. Hold events, track data, create outreach, report…
iii. Cost of maintaining a website.
iv. Cost of event materials.
v. Cost of low flow fixtures.
vi. Metering study to assess effectiveness.

3. *Explain costs to other affected parties besides implementing regulators (for example: costs will increase for well drilling or new requirements on homeowners/home builders).*
    a. Yes, increased cost to homeowners for their conservation practices.

*Policy types (not comprehensive list; feel free to add):

- Education: providing information, encouragement and recognition
- Incentives: providing incentives such as subsidies, tax or fee reductions, etc.
- Compensation: reimbursing expenses for the action or for foregoing certain actions
- Regulation: requiring certain actions
- Fees or taxes: increasing the costs of undesired actions

Policy proposal – WRIA 14 WREC

Name: **Monitoring and Research**

Entity: Squaxin Island Tribe

Type of policy idea (see list below): Information support

Description of policy idea (a short abstract)**:**

The Plan should include a section describing a monitoring and research strategy. Ideas to include:

- An overarching Monitoring and Research Plan as part of implementation
- Flow monitoring at all sites with ISF levels
- Ongoing Improvements in ground water information – data, maps, and models
    - Map and quantify areas of impervious surface and critical recharge zones
    - Improve regional groundwater models
    - Map flow paths and rates for stream baseflow
    - Expand ground water monitoring
- A program for habitat and NEB monitoring
- Monitoring of project implementation and effectiveness

The Plan should propose the development of a comprehensive monitoring and research strategy as part of Plan implementation. This strategy can refine the specific goals, elements, and priorities for monitoring and research.

1. *Identify the potential implementers and other key players.*
    a. Various: Implementation Committee (if created). Ecology, Counties, CDs, Tribes, PUDs
2. *Describe proposed actions (including current policies or codes, existing programs and their limitations, problems to be corrected, etc.).*
    a. A strategy should be included in the Plan, which describes a variety of possible studies and programs. The specific studies proposed will be developed by entities willing to invest time and obtain resources.
3. *Identify who the action impacts (if different than primary implementer).*
    a. The proposed actions will benefit all citizens in the WRIA by providing improved data and information for water planning.
4. *Describe benefits and challenges/obstacles.*
    a. Benefits: improved data and information for water planning.
    b. Challenges/obstacles:
        i. Specific projects or programs need to be defined in detail
        ii. Funding will need to be obtained.

Description of purpose:

1. *How would this recommendation enhance the WRIA 14 plan? Describe the desired result and its purpose in this plan (we want to be clear how this relates to offsetting impacts from PEW OR be explicit that this is a benefit to the watershed even if not directly related to PEW impacts).*
    a. Information on water resources is always in short supply. Decisions are made with limited information, with assumptions made to address uncertainty. As the Plan is

implemented, improved information will support adjustments to the Plan to better focus limited resources on the most significant problems and best solutions.

Description of concerns:

1. *What, if any, concerns with this policy idea have WRIA 14 members expressed or that you anticipate?*
    a. This proposal is general in nature. Different members may interpret it differently or have different priorities for the study or program they'd prefer to focus on.
    b. No funding is identified.
2. *If you have discussed this with concerned members, what was the result of those discussions?*
    a. Discussions are supportive of the concept, although Committee members differ about what to include.
3. *Are there other potential downsides or objections to the proposal that you anticipate?*
    a. Funding is a challenge, leaving implementation uncertain
    b. The proposal is very general, and will likely occur piecemeal, if at all.
4. *In what ways does your proposal address those concerns?*
    a. The proposal for developing a strategy would help to provide a more comprehensive and coordinated approach.
    b. The proposal is intended to indicate the Committee's desires, while leaving the specifics flexible and adaptable.

Cost and funding sources:

1. *What elements of the proposal are likely to require funding?*
    a. All of them
2. *Provide a rough cost estimate (if known) and discuss potential funding sources and whether funding is one time or ongoing.*
    a. Impossible to estimate.
3. *Explain costs to other affected parties besides implementing regulators (for example: costs will increase for well drilling or new requirements on homeowners/home builders).*
    a. Costs will depend on what is proposed and how it gets funded.
    b. A monitoring or research study should not generate subsequent costs.

Policy proposal – WRIA 13 WREC

Name: **Permit Exempt Well Withdrawal Limits**

Entity: Squaxin Island Tribe

Type of policy idea: Regulation

Description of policy idea (a short abstract)**:**

Ecology will establish Permit Exempt Well limitations for this WRIA at levels similar to those set in the WRIA 1 rule:

- Indoor domestic water use shall not exceed 500 gallons per day per connection, and shall not exceed a total of 3,000 gallons per day for a group domestic system; and
- Outdoor domestic water use shall be limited to an area not to exceed a total of one-twelfth of an acre, or 3,630 square feet, for each connections, and one-half acre total for all connections in a group domestic system. Outdoor use limits are in addition to indoor water use.
    - Outdoor water use areas may exceed these limits if all outdoor water use is for food production, fire protection, or an environmental restoration project.
- Water for livestock would still be allowed under a separate permit exemption.
- Review water use in the WRIA to determine if alternative use limits are more appropriate.

1. *Identify the potential implementers and other key players.*
    a. Ecology would be responsible for rule development and implementation.
2. *Describe proposed actions (including current policies or codes, existing programs and their limitations, problems to be corrected, etc.).*
    a. Rule revision would be required.
3. *Identify who the action impacts (if different than primary implementer).*
    a. Owners of homes with new permit exempt wells.
4. *Describe benefits and challenges/obstacles.*
    a. Benefits: reduces potential impact of new wells. Provides consistency with requirements for WRIA 1 and other WRIAs adopting these limits.
    b. Challenges/obstacles: Ecology must expend resources to implement. Compliance may be difficult to achieve and inconsistent.

Description of purpose:

1. *How would this recommendation enhance the WRIA 13 plan? Describe the desired result and its purpose in this plan (we want to be clear how this relates to offsetting impacts from PEW OR be explicit that this is a benefit to the watershed even if not directly related to PEW impacts).*
    a. These limitations provide a "safety factor" by setting limits on PE well use based on good water conservation practices. This improves the net benefits of offset projects as they are completed to restore streamflows and protect senior water rights.

Description of concerns:

1. *What, if any, concerns with this policy idea have WRIA 13 members expressed or that you anticipate?*

   a. There may be resistance from homeowners who might have an expectation that there are no limits on their water use.
   b. Allowance should be made for food production, to support local food security.
   c. Allowance should also be made for irrigating plantings for environmental restoration.
   d. Water limits should be specific to this WRIA.
   e. Public input is needed.
   f. Ecology will have to invest resources to implement this as a rule and requirement.
2. *If you have discussed this with concerned members, what was the result of those discussions?*
   a. There are concerns around compliance and enforcement – who is responsible and how it would occur. Compliance will be addressed in a separate proposal.
   b. Exemptions for food production and environmental restoration were added.
   c. Language was added to acknowledge that final limits might be different for this WRIA.
   d. Rule-making includes public input.
3. *Are there other potential downsides or objections to the proposal that you anticipate?*
   a. No others known
4. *In what ways does your proposal address those concerns?*
   a. See above

Cost and funding sources:

1. *What elements of the proposal are likely to require funding?*
   a. Ecology's rule-making
2. *Provide a rough cost estimate (if known) and discuss potential funding sources and whether funding is one time or ongoing.*
   a. Ecology might be able to estimate from the WRIA 1 experience
3. *Explain costs to other affected parties besides implementing regulators (for example: costs will increase for well drilling or new requirements on homeowners/home builders).*
   a. Reduced water use will likely reduce costs to homeowners.

Proposed Language: Project Tracking

April 16th, 2020

To: Watershed Restoration and Enhancement Committees, 90.94.030 RCW
From: Tristan Weiss, Streamflow Restoration Ecologist, WA Department of Fish and Wildlife

RE: Proposed project tracking language for inclusion in draft watershed plans

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Project Tracking

The Committee has identified the need to track streamflow restoration projects and new domestic permit-exempt wells to: (1) improve the capacity to conduct implementation monitoring of streamflow restoration projects and actions, (2) build grant funding opportunities and track streamflow restoration associated costs, and (3) provide a template for adaptively managing emergent restoration needs. The Committee recommends piloting the Salmon Recovery Portal (https://srp.rco.wa.gov/about), managed by the Recreation and Conservation Office (RCO), for satisfying these needs. The implementation of project tracking through a pilot program using the Salmon Recovery Portal will be coordinated by the Washington Department of Fish and Wildlife in collaboration with the Washington Department of Ecology, RCO, and the Committee. To improve harmonization of streamflow restoration with ongoing salmon recovery efforts, local salmon recovery Lead Entity Coordinators shall be consulted prior to initial data uploads. University of Washington data stewards will be employed to conduct data entry, quality assurance, and quality control (see *Supplemental document: project tracking*).

Supplemental Document: Project Tracking

April 16th, 2020

To: Watershed Restoration and Enhancement Committees, 90.94.030 RCW
From: Tristan Weiss, Streamflow Restoration Ecologist, WA Department of Fish and Wildlife

RE: Proposed project tracking supplemental document for inclusion in draft watershed plans

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1.1. Project Tracking

This section describes the elements required to track projects from a conceptual stage through completion. Project tracking is an essential component of implementation monitoring and adaptive management procedures. Therefore, it is recommended that projects be tracked through planning and implementation phases to enhance the Committee's ability to conduct implementation monitoring at the sub-basin and WRIA scale, monitor grant funding, identify plan successes and deficiencies, and streamline project development.

The Committee recommends a pilot program using the Salmon Recovery Portal (SRP; https://srp.rco.wa.gov/about) to conduct project tracking for the streamflow restoration effort under 90.94.030 RCW. As a statewide salmon recovery tracking tool, the capacity for SRP to allow for goal setting, hierarchical project tiers, supplemental information, and printing of automated reports makes it well suited for tracking projects associated with streamflow restoration and salmon recovery efforts. As a statewide tool administered by the Recreation and Conservation Office (RCO) and in partnership with salmon recovery Lead Entities (LE), the SRP provides a dynamic platform to track project offsets.

Tracking of projects will consist of two primary phases: (1) uploading required project information from all projects included in this plan into the SRP, and (2) uploading and updating all funded projects, project reports, and completed projects into the SRP database on an annual basis. Phase 1 will be coordinated and funded by the Washington Department of Fish and Wildlife (WDFW) and implemented by trained University of Washington (UW) data stewards in collaboration with RCO staff and Washington Department of Ecology (Ecology) staff. Phase 2 project uploads will be implemented by UW data stewards in consultation with Ecology grant management, RCO, and WDFW staff. To improve harmonization of streamflow restoration efforts with ongoing salmon recovery efforts, local salmon recovery LE Coordinators shall be consulted prior to initial data uploads. While input and oversight is welcomed, no commitment of additional work is required from LE Coordinators. Streamflow restoration projects not funded through the streamflow restoration grant program, will be updated by data stewards during any grant reporting to Ecology or RCO. Primary quality control measures will be performed by data stewards. Funds to support initial and ongoing costs of data steward data entry (Phases 1 and 2) will be provided by WDFW.

The Committee recommends, at minimum, the following data fields for streamflow tracking: WRIA, sub-basin, project description, funding source, estimated cost, project spatial boundaries or coordinates, project proponent (if applicable), estimated water offset or habitat benefits, and

target implementation date. Projects with sensitive locations can be made private or those with undetermined locations can be entered as a project boundary or defined at the sub-basin scale. New permit exempt well locations at the section or sub-basin scale may be incorporated into the SRP to support implementation monitoring and adaptive management goals.

To support the implementation of the above pilot program for tracking projects under 90.94.030 RCW, WDFW has initiated pilot projects in two 90.94.020 RCW basins: the Nisqually River Basin (WRIA 11) and the Chehalis River Basin (WRIAs 22/23). These pilots are coordinated by WDFW in conjunction with RCO, Ecology, local LE Coordinators, and the Planning Units. Intended as a proof of concept, these pilots are planned to explore the capacity and effectiveness of the SRP to track streamflow restoration projects.

Policy proposal – WRIA 14 WREC

Name: **Revolving Loan and Grant Fund for Small Public Water Systems**

Entity: Squaxin Island Tribe

Type of policy idea (see list below): Incentives

Description of policy idea (a short abstract)**:**

Thurston and Mason County would investigate the feasibility of establishing and operating a revolving loan and grant fund for public water systems to increase the efficiency of such systems and reduce impacts to streamflows. The fund would be used to enable small water systems to invest in system upgrades, such as a deeper well or more efficient conveyance infrastructure, establish a tiered rate system, expand to more connections, establish professional management, minimize connection fees, or other design upgrades or strategies to reduce and offset impacts to streamflows. The fund would primarily target smaller public water systems, systems not meeting county design standards, and potential new connections with financial limitations.

1. *Identify the potential implementers and other key players.*
    a. Thurston and Mason Counties
2. *Describe proposed actions (including current policies or codes, existing programs and their limitations, problems to be corrected, etc.).*
    a. Investigate the feasibility of establishing and operating a revolving loan fund for Group A public water systems to offset costs for potential new PE wells to connect to a system.
    b. This fund would be established by Counties willing to participate, and would be subject to identifying seed money for the fund (see funding proposals).
    c. Use of the fund would be subject to case-specific feasibility, such as availability of a sufficient water right, consistency with the relevant Water System Plan, and other applicable rules and regulations.
    d. Details of the fund, such as criteria for its use, application procedures, or default procedures, would be developed during the initial feasibility investigation phase.
3. *Identify who the action impacts (if different than primary implementer).*
    a. Developers and landowners requiring water service for new construction.
4. *Describe benefits and challenges/obstacles.*
    a. Benefits: Reduces the potential number of PE wells, which reduces groundwater consumptive use and provides a safety factor for the overall Plan goal of streamflow restoration.
    b. Challenges/Obstacles: Funding would need to be found. Maybe be difficult to implement. May have limited support and use.

Description of purpose:

1. *How would this recommendation enhance the WRIA 14 plan? Describe the desired result and its purpose in this plan (we want to be clear how this relates to offsetting impacts from PEW OR be explicit that this is a benefit to the watershed even if not directly related to PEW impacts).*
    a. This program would be consistent with the Plans' goal of streamflow restoration.

b. Implementation of this program would provide a safety factor for the goal of providing offsets to exceed new PE well consumptive use.

Description of concerns:

1. *What, if any, concerns with this policy idea have WRIA 14 members expressed or that you anticipate?*
    a. Funding would need to be identified to implement the proposal.
    b. Counties are concerned with workload capacity issues regarding setting up this kind of fund.
    c. Eligible projects may be rare, making the investment to set this up difficult to justify.
    d. Site-specific complications and limitations must be considered.
    e. Details would need to be developed for the design and function of the fund.
2. *If you have discussed this with concerned members, what was the result of those discussions?*
    a. This has been a preferred approach for the Counties, with the caveats mentioned above. I've shared this with the counties for their input.
    b. I've also discussed this with WDOH and Kitsap PUD.
3. *Are there other potential downsides or objections to the proposal that you anticipate?*
    a.
4. *In what ways does your proposal address those concerns?*
    a. Proposal begins with an investigation of feasibility.
    b. Funding is not addressed directly, and finding funding may be the first step of implementation.

Cost and funding sources:

1. *What elements of the proposal are likely to require funding?*
    a. Some staff time will be necessary to develop the find funding and organize interested parties to develop the initial study.
    b. Funding would be needed for the investigation study, and any development of the program that follows.
    c. Seed money would be needed to set up the revolving loan fund.
2. *Provide a rough cost estimate (if known) and discuss potential funding sources and whether funding is one time or ongoing.*
    a. Unknown at this time.
3. *Explain costs to other affected parties besides implementing regulators (for example: costs will increase for well drilling or new requirements on homeowners/home builders).*
    a. Parties involved with implementing this proposal may have costs for participation.
    b. This proposal inherently saves money for homeowner.

Policy proposal – WRIA 14 WREC

Name: South Sound Water Steward

Entity: Squaxin Island Tribe

Type of policy idea (see list below): Regulation; Education; Compliance

Description of policy idea (a short abstract)**:**

1. *Identify the potential implementers and other key players.*
    a. Ecology, with support from local governments
2. *Describe proposed actions (including current policies or codes, existing programs and their limitations, problems to be corrected, etc.).*
    a. Ecology creates a new position of "South Sound Water Steward"
    b. The duties of the position would include:
        i. Support implementation of watershed plans developed under RCW 90.94
        ii. Conduct ongoing education, outreach, and technical support for permit-exempt wells owners and water rights holders
        iii. Support drought response through outreach and technical support
        iv. Provide technical support to Ecology water rights decisions in the South Sound
        v. Monitor instream flows, wells, and other relevant water bodies to support implementation of the watershed plan and compliance with state rules
        vi. Support compliance with state rules through education and technical support
        vii. Investigate and enforce against illegal water use
    c. The proposed geographic scope of the water steward (equivalent of water master district) would be:
        i. At a minimum, all of the south sound watersheds inside (west of) the Tacoma Narrows included as part of WRIAs 11, 12, 13, 14, and 15.
        ii. Potentially the entirety of these 5 WRIAs.
    d. The position would include legal authorities consistent, where appropriate, with both a Water Master and a Ground Water Supervisor (RCW 90.03.060; 90.03.070; RCW 90.44.200; WAC Chapter 508-12)
3. *Identify who the action impacts (if different than primary implementer).*
    a. Potentially any water user
    b. Supports tribal treaty rights and rights of senior water rights holders
4. *Describe benefits and challenges/obstacles.*
    a. Benefits:
        i. Provides consistency and effectiveness in implementing the watershed plan and the legal requirements of water use. This benefits all stakeholders and water users.
        ii. Gives Ecology a visible and clear role for compliance.
    b. Challenges:
        i. Requires dedicated funding
        ii. Requires clarity of purpose and job duties
        iii. Local unfamiliarity with Water Masters and ground water supervisors
        iv. Occasional controversy in a particular situation

v. Severe resistance might result in legal challenges

Description of purpose:

1. *How would this recommendation enhance the WRIA 14 plan? Describe the desired result and its purpose in this plan (we want to be clear how this relates to offsetting impacts from PEW OR be explicit that this is a benefit to the watershed even if not directly related to PEW impacts).*
    a. Supports implementation of the Plan
    b. Provides dedicated staff to provide education, outreach, and technical assistance
    c. Supports compliance with water resources laws and regulations and supports Tribal Treaty rights.

Description of concerns:

1. *What, if any, concerns with this policy idea have WRIA 14 members expressed or that you anticipate?*
    a. Discomfort with a visible Ecology presence for water enforcement
    b. Uncertainty with the duties of the position
    c. Uncertainty with funding
2. *If you have discussed this with concerned members, what was the result of those discussions?*
    a. Support in some cases, concern and opposition in others
3. *Are there other potential downsides or objections to the proposal that you anticipate?*
    a. Position depends on state funding and commitment, which is uncertain
    b. Local government support may shift with political changes
4. *In what ways does your proposal address those concerns?*
    a. It attempts to be very clear about proposed purpose and duties

Cost and funding sources:

1. *What elements of the proposal are likely to require funding?*
    a. Position will need funding and there are costs for position creation and hiring
2. *Provide a rough cost estimate (if known) and discuss potential funding sources and whether funding is one time or ongoing.*
    a. Based on the 2019-21 biennial state budget, one water master position would require about $132,000 per year. This would require reassignment of existing staff, or an additional legislative appropriation.
    b. Local governments may wish to consider a contribution to support the water master position, to demonstrate their support and improve chances for Ecology adoption and legislative funding.
    c. All funding would be ongoing.
3. *Explain costs to other affected parties besides implementing regulators (for example: costs will increase for well drilling or new requirements on homeowners/home builders).*
    a. Enforcement could lead to costs for water users who are in violation of state law
    b. Costs are ultimately borne by taxpayers

Policy proposal – WRIA 14 WREC

Name: Sports Field Irrigation Conservation **DRAFT**

Entity: Squaxin Island Tribe - No Sponsoring Entity at this time.

Type of policy idea (see list below): Infrastructure and Education

Description of policy idea (a short abstract)**:**

1. *Identify the potential implementers and other key players.*
    a. City of Shelton. Other sports field owners, such as Shelton School District, Mason County Parks and Rec, South Mason Youth Soccer Association, YMCA. Support from Squaxin Islan Tribe.
2. *Describe proposed actions (including current policies or codes, existing programs and their limitations, problems to be corrected, etc.).*
    a. Review current irrigation practices of sports ball fields.
    b. Develop short conservation plans for each entity.
    c. Develop contingency plans for reclaimed water, and use reclaimed water when it becomes available.
    d. Install water-saving infrastructure at sports fields. May include pipe replacement.
    e. Use existing metering to demonstrate savings from new infrastructure.
3. *Identify who the action impacts (if different than primary implementer).*
    a. City of Shelton, and other owners of sports fields, such as Shelton School District, Mason County Parks and Rec, South Mason Youth Soccer Association, YMCA
4. *Describe benefits and challenges/obstacles.*
    a. Benefits: Irrigation conservation is one of the most effective water savings programs we can generate, because outdoor irrigation is large compared to other uses.
    b. Challenges/Obstacles: Cost. Site-specific feasibility. Owners who might not participate. Conserved water may only have short-term benefits if eventually used for other municipal needs.

Description of purpose:

1. *How would this recommendation enhance the WRIA 14 plan? Describe the desired result and its purpose in this plan (we want to be clear how this relates to offsetting impacts from PEW OR be explicit that this is a benefit to the watershed even if not directly related to PEW impacts).*
    a. This is a benefit to the watershed in reducing groundwater use.
    b. Adds to safety factor planning for growth in future water use**.**
    c. Transition of irrigation to reclaimed water could be quantified as offset.
    d. Supports drought response and climate change resilience.
    e. Supports NEB and the Plan's goal of streamflow restoration.

Description of concerns:

1. *What, if any, concerns with this policy idea have WRIA 14 members expressed or that you anticipate?*

   a. Cost.
   b. Not a substitute for offsets that produce significant streamflow benefits.
2. *If you have discussed this with concerned members, what was the result of those discussions?*
   a. No discussions yet.
3. *Are there other potential downsides or objections to the proposal that you anticipate?*
   a. Willingness of owners to participate.
   b. Site-specific complications.
4. *In what ways does your proposal address those concerns?*
   a. Proposal is general. Funding and participation will be decided as the proposal is implemented.

Cost and funding sources:

1. *What elements of the proposal are likely to require funding?*
   a. Planning and pursuit of funding
   b. Infrastructure improvements
   c. Facility O&M and education

2. *Provide a rough cost estimate (if known) and discuss potential funding sources and whether funding is one time or ongoing.*
   a. Cost unknown.
   b. One-time cost for each infrastructure project.
   c. Ongoing costs for O&M and education.
   d. Potential funding sources include local government investments and grants
3. *Explain costs to other affected parties besides implementing regulators (for example: costs will increase for well drilling or new requirements on homeowners/home builders).*
   a. Facility owners may have to absorb costs for O&M and education.

*Policy types (not comprehensive list; feel free to add):

- Education: providing information, encouragement and recognition
- Incentives: providing incentives such as subsidies, tax or fee reductions, etc.
- Compensation: reimbursing expenses for the action or for foregoing certain actions
- Regulation: requiring certain actions
- Fees or taxes: increasing the costs of undesired actions

Policy proposal – WRIA 14 WREC

Name: Study of County Planning Streamflow Restoration Effectiveness

Entity: Squaxin Island Tribe

Type of policy idea (see list below): Special Study

Description of policy idea (a short abstract)**:**

1. *Identify the potential implementers and other key players.*
    a. Consultant will conduct the study. Ecology or other entity would be lead for contracting.
2. *Describe proposed actions (including current policies or codes, existing programs and their limitations, problems to be corrected, etc.).*
    a. Conduct a study of how planning and permitting in the four south sound counties supports protection and enhancement of streamflow restoration, through protection and enhancement of groundwater recharge and other mechanisms.
    b. The study would evaluate how and why county programs have been effective; gaps or areas where planning has been less effective in promoting streamflow restoration; and propose ways to improve rules to promote recharge enhancement and streamflow restoration.
    c. The study report would be distributed to the study counties and relevant branches of state government to inform decision-making.
3. *Identify who the action impacts (if different than primary implementer).*
    a. The study would have no direct impact.
    b. The findings of the study could influence future state or local decision-making regarding state and county planning and streamflow restoration.
4. *Describe benefits and challenges/obstacles.*
    a. Benefits: develops information to support improvements in planning to promote streamflow restoration
    b. Challenges/obstacles: needs funding and staff resources for scope and grant development. There may be resistance to a review of county planning.

Description of purpose:

1. *How would this recommendation enhance the WRIA 14 plan? Describe the desired result and its purpose in this plan (we want to be clear how this relates to offsetting impacts from PEW OR be explicit that this is a benefit to the watershed even if not directly related to PEW impacts*).
    a. Better information on how county planning and permitting affects streamflows could lead to improvements that support the Plan's goals for streamflow restoration. Such improvements would be one way to add safety factor to the goals of the Plan.

Description of concerns:

1. *What, if any, concerns with this policy idea have WRIA 14 members expressed or that you anticipate?*

   a. This is a new proposal and has yet to be discussed. Counties may be reluctant to have their programs reviewed, or may be concerned with staff workload to provide information to the study.
2. *If you have discussed this with concerned members, what was the result of those discussions?*
   a. No discussions yet.
3. *Are there other potential downsides or objections to the proposal that you anticipate?*
   a. The study may end up "on a shelf" and not result in any improvements.
4. *In what ways does your proposal address those concerns?*
   a. It tries to define its content in a way that is relevant and actionable.

Cost and funding sources:

1. *What elements of the proposal are likely to require funding?*
   a. The study will require funding. Developing the study proposal, providing information for the study, and disseminating results will require funding for staff resources.
2. *Provide a rough cost estimate (if known) and discuss potential funding sources and whether funding is one time or ongoing.*
   a. Unknown at this time. Could be estimated by an experienced consultant.
3. *Explain costs to other affected parties besides implementing regulators (for example: costs will increase for well drilling or new requirements on homeowners/home builders).*
   a. There would be no costs to others from the Study itself.

Policy proposal – WRIA 14 WREC

Name: Upgrade Well Reporting

Entity: Squaxin Island Tribe

Type of policy idea (see list below): Information process improvement

Description of policy idea (a short abstract)**:**

1. *Identify the potential implementers and other key players.*
    a. Ecology
2. *Describe proposed actions (including current policies or codes, existing programs and their limitations, problems to be corrected, etc.).*
    a. See attached document "Proposed Improvements to the Department of Ecology's Well Reporting Processes"
3. *Identify who the action impacts (if different than primary implementer).*
    a. Well drillers, all users of well database information
4. *Describe benefits and challenges/obstacles.*
    a. Benefits: better well location data; streamlined data collection and uploading; improved data access
    b. Challenges: requires resources for development, roll-out, and training.

Description of purpose:

1. *How would this recommendation enhance the WRIA 14 plan? Describe the desired result and its purpose in this plan (we want to be clear how this relates to offsetting impacts from PEW OR be explicit that this is a benefit to the watershed even if not directly related to PEW impacts).*
    a. Accurate well data is critical for all parties to make water management decisions that are protective of the environment and beneficial to communities. Improvements in the quality of well data in Washington State are essential for monitoring and management of shared water resources in the State of Washington. This supports the goals of the Plan.

Description of concerns:

1. *What, if any, concerns with this policy idea have WRIA 14 members expressed or that you anticipate?*
    a. None anticipated, other than perhaps the allocation of limited resources.
2. *If you have discussed this with concerned members, what was the result of those discussions?*
    a. Concept has been discussed, with general support.
3. *Are there other potential downsides or objections to the proposal that you anticipate?*
    a. None anticipated.
4. *In what ways does your proposal address those concerns?*
    a. Proposal stands by itself. Investment in this improvement in the short term will have long-term benefits.

Cost and funding sources:

1. *What elements of the proposal are likely to require funding?*
    a. Platform development, testing, roll-out, and user training and support
2. *Provide a rough cost estimate (if known) and discuss potential funding sources and whether funding is one time or ongoing.*
    a. Not yet known.
3. *Explain costs to other affected parties besides implementing regulators (for example: costs will increase for well drilling or new requirements on homeowners/home builders).*
    a. There may be a small cost to well drillers for technology.

Proposed Improvements to the Department of Ecology's Well Reporting Processes
The "Upgrade Well Reporting" Proposal

Developed by the Squaxin Island Tribe in consultation with Ecology's Well Construction and Licensing Office

Contributors: Ecology - Joe Witczak, Scott Malone, and Tara Roberts
Squaxin Island Tribe - Erica Marbet

Final Draft May 28, 2020

Purpose:
Accurate well data is critical for all parties to make water management decisions that are protective of the environment and beneficial to communities. The quality of well data in Washington State can be improved with changes to how the State collects information from drillers. These improvements are essential for monitoring and management of shared water resources in the State of Washington.

Background:
In 2018, at the request of the Squaxin Island Tribe, Ecology assigned staff to assess the accuracy of water well location reporting in Mason County. The project checked 187 water well reports (2.1% of the 8,910 water well reports from the county). Ecology uses the Public Land Survey system (PLS) to record well locations by township, range, section, quarter and quarter-quarter. Currently wells are mapped by 40-acre quarter-quarter centroids on the State Well Report Viewer. The results showed that 79% of well locations could be verified with the information on the report. Of those that could be verified, 33% had incorrectly reported PLS locations. Ecology performed a similar, statewide assessment of well location data and found a 24% error rate for all types of regulated wells.

As Tribes utilize Ecology's well report database frequently, tribal staff would benefit by improving well location data management and processes. In discussions between Ecology, Squaxin, and Mason County, all agreed that improvements to Ecology's well reporting processes could help reduce the error in water well location reporting.

Ecology is eager to expand their web-based well reporting options. In 2019, Ecology surveyed well drillers to determine their preferences regarding format and features. Of 133 respondents, 63% placed a high importance on a new well location mapping tool that would use recent aerial

imagery to determine a well's PLS location and coordinates. Only 6% responded that this effort would be of low importance. These results showed drillers preferred to submit well reports from a web form in the current well report format.

We propose the following changes to Ecology's well data processes:

1. **New well location mapping tool for drillers**
   An interactive web-based mapping tool that provides an intuitive means of determining PLS location has been implemented in Oregon recently. Ecology is interested in developing their own web tool which provides the PLS and coordinates location (latitude/longitude) for a new well automatically. The Notice of Intent web form would shell into a new GIS application utilizing recent aerial imagery, a parcel overlay, and a tool that updates the quarter-quarter and coordinates on the NOI. The well driller need only click on the interactive map to generate a well location. When a driller finishes a well report, they can utilize the same tool to refine their coordinates and PLS location.

2. **Require coordinates on well reports**
   Coordinates can perfectly describe a well location within a parcel. Adding latitude and longitude on well reports will serve to verify a well's location on the ground accurately and easily. Ecology intends to require well coordinates on reports, though a WAC change may eventually be needed.

3. **New web-based well reporting application**
   Ecology is determining the best approach for implementing a new web-based well reporting application. According to a recent survey of drillers and their support staff, a web-form mimicking the current well report forms that uploads directly to Ecology's database is desired. The benefits of using a web-based well reporting process are numerous:

   - Less backlog of scanning and data entry - more time for Ecology staff to vet well reports
   - Legible text, fewer written responses
   - Digitizing all well report data, not just the fields that were captured by Ecology staff during the scanning process
   - A smart form format can eliminate out-of-range entries

   By capturing digitized well location data, it would be feasible in the future to automate the process of verifying well locations and water right information. Tracking well location and permit-exempt wells is a need of users who download geospatial datasets

from Ecology's GIS data page (https://ecology.wa.gov/Research-Data/Data-resources/Geographic-Information-Systems-GIS/Data).

The Well Construction and Licensing Office at Ecology needs more capacity to vet well reports. Automation from web-based reporting would free up staff to do more vetting, because the office's staff would not have to do as much scanning of paper documents and manual entry of data fields for each report. They need more automation, not FTEs.

Please share this proposal with your RCW 90.94 watershed planning committees ask members to support it. This would include adding it as a proposed action in a watershed plan.

Please contact Mary Verner, Manager of Ecology's Water Resources Program and Tyson Oreiro, Ecology's Tribal Liaison to express your support for the "Upgrade Well Reporting" proposal.

See next two pages for figures.

https://appswr.ecology.wa.gov/wellconstruction/Wells/NoticeOfIntentForm.aspx?form=noiwaterwellform

DEPARTMENT OF ECOLOGY State of Washington

About us

Laws, Regs and Rules › | Notice of Intent Forms | Contact Us

Well Construction and Licensing Search Tools

Step 1 of 3: Enter Information

An asterisk (*) designates the field as required.

Notice of Intent Form to Construct a Water Well

Property Owner Contact Information

‡An organization name or the first and last property owner name is required.

Organization Name‡ (e.g. Daisy Farms LLC)

OR

Last Name‡

First Name‡

Email Address*

Confirm Email Address*

Mailing Address*

City*

State*

Zip*

Phone ( )

International customers cannot submit online. Contact us for assistance.

Consulting Firm Contact Information

Firm Name

Well Location

Township*

Range*

Section*

* Quarter-Quarter Section:

NW	NE	NW	NE
SW	SE	SW	SE
NW	NE	NW	NE
SW	SE	SW	SE

Latitude

Longitude

Well Street Address

Well City

Well Zip Code

Tax Parcel Number

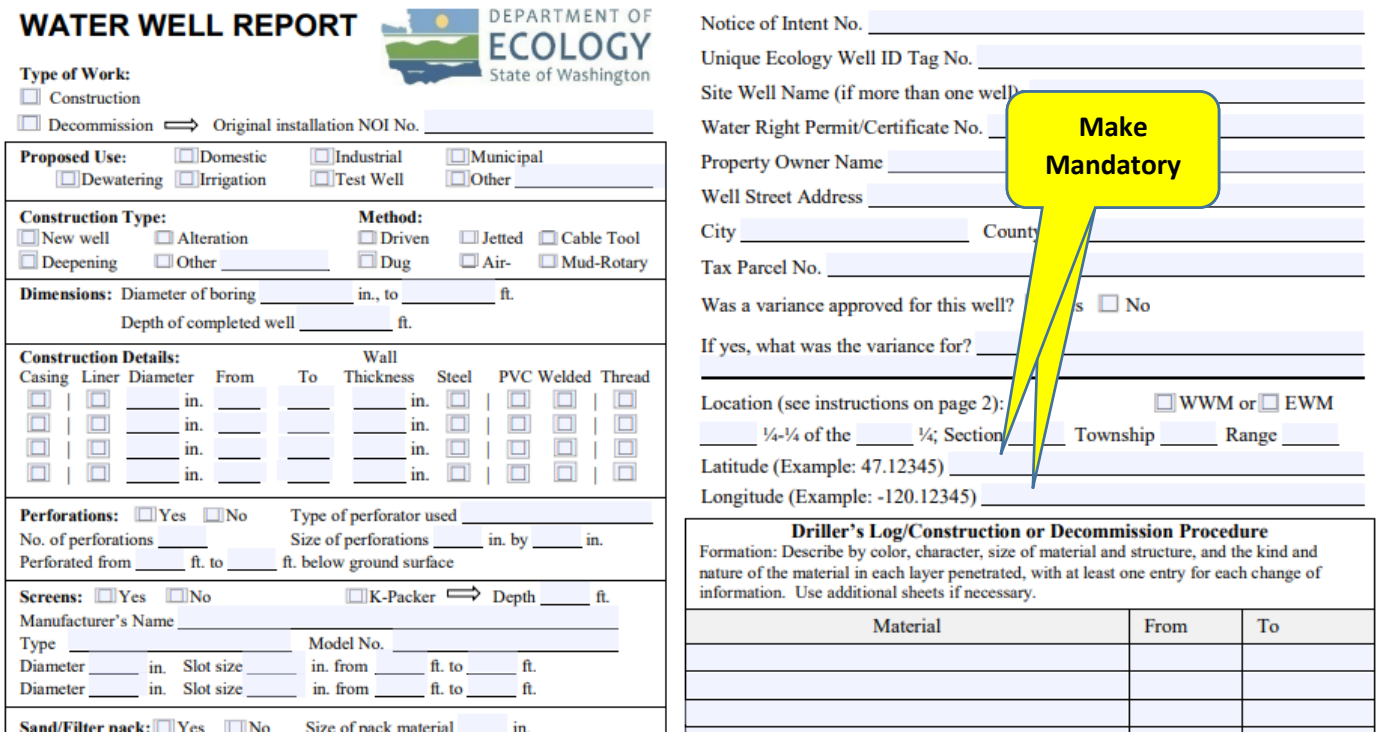
County*

Add interactive map to automatically identify township, range, section, latitude, and longitude

Make Optional

Make Mandatory

https://fortress.wa.gov/ecy/publications/documents/ecy050120.pdf



WATER WELL REPORT

DEPARTMENT OF ECOLOGY
State of Washington

Type of Work:
☐ Construction
☐ Decommission ⟹ Original installation NOI No. _____

Proposed Use: ☐ Domestic ☐ Industrial ☐ Municipal ☐ Dewatering ☐ Irrigation ☐ Test Well ☐ Other _____

Construction Type: ☐ New well ☐ Alteration ☐ Deepening ☐ Other _____

Method: ☐ Driven ☐ Jetted ☐ Cable Tool ☐ Dug ☐ Air- ☐ Mud-Rotary

Dimensions: Diameter of boring _____ in., to _____ ft.
Depth of completed well _____ ft.

Construction Details:

Casing	Liner	Diameter	From	To	Wall Thickness	Steel	PVC	Welded	Thread
☐	☐	_____ in.	_____	_____	_____ in.	☐	☐	☐	☐
☐	☐	_____ in.	_____	_____	_____ in.	☐	☐	☐	☐
☐	☐	_____ in.	_____	_____	_____ in.	☐	☐	☐	☐
☐	☐	_____ in.	_____	_____	_____ in.	☐	☐	☐	☐

Perforations: ☐ Yes ☐ No Type of perforator used _____
No. of perforations _____ Size of perforations _____ in. by _____ in.
Perforated from _____ ft. to _____ ft. below ground surface

Screens: ☐ Yes ☐ No ☐ K-Packer ⟹ Depth _____ ft.
Manufacturer's Name _____
Type _____ Model No. _____
Diameter _____ in. Slot size _____ in. from _____ ft. to _____ ft.
Diameter _____ in. Slot size _____ in. from _____ ft. to _____ ft.

Sand/Filter pack: ☐ Yes ☐ No Size of pack material _____ in.

Notice of Intent No. _____
Unique Ecology Well ID Tag No. _____
Site Well Name (if more than one well) _____
Water Right Permit/Certificate No. _____
Property Owner Name _____
Well Street Address _____
City _____ County _____
Tax Parcel No. _____
Was a variance approved for this well? ☐ Yes ☐ No
If yes, what was the variance for? _____

Make Mandatory

Location (see instructions on page 2): ☐ WWM or ☐ EWM
_____ ¼-¼ of the _____ ¼; Section _____ Township _____ Range _____
Latitude (Example: 47.12345) _____
Longitude (Example: -120.12345) _____

Driller's Log/Construction or Decommission Procedure
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each layer penetrated, with at least one entry for each change of information. Use additional sheets if necessary.

Material	From	To

Add interactive map to automatically identify township, range, section, latitude, and longitude

Change this water well report into a web form.

Policy proposal – WRIA 14 WREC

Name: Water Supply Data for Comprehensive Water Planning

Entity: Squaxin Island Tribe

Type of policy idea (see list below): Monitoring and Research

Description of policy idea (a short abstract)**:**

1. *Identify the potential implementers and other key players.*
    a. Ecology, possibly consultant, support from Counties and WDOH
2. *Describe proposed actions (including current policies or codes, existing programs and their limitations, problems to be corrected, etc.).*
    a. The following language is quoted from RCW 90.94.030:
        i. (b) At a minimum, the plan must include those actions that the committee determines to be necessary to offset potential impacts to instream flows associated with permit-exempt domestic water use.
        ii. (c) Prior to adoption of the watershed restoration and enhancement plan, the department must determine that actions identified in the plan, after accounting for new projected uses of water over the subsequent twenty years, will result in a net ecological benefit to instream resources within the water resource inventory area.
        iii. (d) The watershed restoration and enhancement plan must include an evaluation or estimation of the cost of offsetting new domestic water uses over the subsequent twenty years, including withdrawals exempt from permitting under RCW 90.44.050.
        iv. (e) The watershed restoration and enhancement plan must include estimates of the cumulative consumptive water use impacts over the subsequent twenty years, including withdrawals exempt from permitting under RCW 90.44.050.
    b. To ensure compliance with the law, and consistent with principles of sound water management, the following information needs to be developed:
        i. Past permit exempt domestic water wells and water use
        ii. All projected water use for the next 20 years
            1. Permit exempt wells
            2. Inchoate municipal water rights brought into active use
                a. Mitigated versus unmitigated
            3. New water rights
    c. The following screening level information <u>for the WRIA as a whole</u> will be developed and included in the Plan:
        i. Municipal water supply connections expected in the next 20 years, by subbasin
            1. Can be determined by difference from total growth and future PE wells
        ii. Total number of existing PE wells by county
            1. Can be determined by Counties from planning and permitting information

   d. Within the first five years of Plan implementation, the following information should be developed for each subbasin:
      i. Total existing (2018 and earlier) connections in service using:
         1. unmitigated inchoate water rights
         2. mitigated inchoate water rights
         3. permit-exempt wells
      ii. Total connections expected to be put into service in the next 20 years using:
         1. unmitigated inchoate water rights
         2. mitigated inchoate water rights
         3. new water rights

3. *Identify who the action impacts (if different than primary implementer).*
   a. Workload and financial impacts for participants in developing the information
4. *Describe benefits and challenges/obstacles*.
   a. Benefits: Provides a robust information base for comprehensive water planning. Provides a context for the Plan and its goals.
   b. Challenges/obstacles: Workload and financial requirements needed.

Description of purpose:

1. *How would this recommendation enhance the WRIA 14 plan? Describe the desired result and its purpose in this plan (we want to be clear how this relates to offsetting impacts from PEW OR be explicit that this is a benefit to the watershed even if not directly related to PEW impacts).*
   a. Ensures that the Plan is in compliance with the law
   b. Provides vital information for comprehensive planning by understanding both legacy water use and emerging trends.
   c. Supports the overall goal of the plan to restore streamflow.

Description of concerns:

1. *What, if any, concerns with this policy idea have WRIA 14 members expressed or that you anticipate?*
   a. Time spend on this task takes away from other important tasks
   b. Capacity to do this work is limited
   c. Ecology takes the position that this is not required by law
2. *If you have discussed this with concerned members, what was the result of those discussions?*
   a. It has been discussed in Committee meetings, without result
3. *Are there other potential downsides or objections to the proposal that you anticipate?*
   a. None
4. *In what ways does your proposal address those concerns?*
   a. Split study into initial screening analysis and future more detailed analysis

Cost and funding sources:

1. *What elements of the proposal are likely to require funding?*
   a. Staff time for collecting and analyzing information
2. *Provide a rough cost estimate (if known) and discuss potential funding sources and whether funding is one time or ongoing.*
   a. One time funding, has not been determined

3. *Explain costs to other affected parties besides implementing regulators (for example: costs will increase for well drilling or new requirements on homeowners/home builders).*
    a. No impact on other parties

Policy proposal – WRIA 14 WREC

Name: Waterwise Landscaping **DRAFT**

Entity: Squaxin Island Tribe - No Sponsoring Entity at this time.

Type of policy idea (see list below): Incentives and Compensation

Description of policy idea (a short abstract)**:**

1. *Identify the potential implementers and other key players.*
    a. Mason Conservation District, Mason County, Support from Squaxin Island Tribe
2. *Describe proposed actions (including current policies or codes, existing programs and their limitations, problems to be corrected, etc.).*

    The definition of waterwise landscaping is: a style of landscape design requiring little or no irrigation but some maintenance

    Provide a technical and financial support program for 100 landowners who are developing their property and installing permit-exempt wells to do the following:
    a. Around a newly built home site, create "waterwise" landscaping which includes native plants or retains the native vegetation that is already on the site. Include wildfire-resilient designs that do not increase fire danger around buildings.
    b. After the completion of home landscaping, monitor daily outdoor water consumption for landscaping purposes only for three years after waterwise landscaping project. The first year may require some irrigation for plants to establish.
    c. Total outdoor water use per household will be summarized and reported by Mason Conservation District.
3. *Identify who the action impacts (if different than primary implementer).*
    a. Volunteer homeowners with individual wells.
4. *Describe benefits and challenges/obstacles.*
    a. Benefits: This will be a demonstration of water savings and drought resilience that can be achieved by waterwise landscaping. It provides a safety factor by reducing well water use. Supports drought response and climate change resilience. Non-regulatory approach is widely supported.
    b. Challenges/Obstacles: Cost. Finding participants. Scale of conservation benefits may be small and have a minor benefit as compared to costs. This project should supplement, but not replace, projects that significantly increase recharge, reduce water withdrawals, or adjust water use timing to increase summer flows.

Description of purpose:

1. *How would this recommendation enhance the WRIA 14 plan? Describe the desired result and its purpose in this plan (we want to be clear how this relates to offsetting impacts from PEW OR be explicit that this is a benefit to the watershed even if not directly related to PEW impacts).*
    a. Though not a direct offset to PEW impacts, this project would contribute to a safety factor for well consumptive use. Ideally, it would generate a new model in waterwise and native landscaping that is pleasurable to the eye, good wildlife habitat, and that

decreases water use. Outdoor water use under this project will be quantified and so can be used for planning of future incentives programs.

Description of concerns:

1. *What, if any, concerns with this policy idea have WRIA 14 members expressed or that you anticipate?*
    a. Many express concerns about monitoring water use, but this is a voluntary program with a financial incentive. The incentive is a fully funded landscaping project.
    b. This program will have to be funded.
    c. Tribes are concerned that education not be seen as a panacea and replacement of projects producing significant summer flow improvements.
2. *If you have discussed this with concerned members, what was the result of those discussions?*
    a. Erica Marbet (Squaxin Island Tribe) has discussed this with Evan Bauder (Mason Conservation District) and Larry Boltz (Washington Farm Bureau). Larry provided extensive edits, and Evan made note that Mason CD would have to modify cost estimates if we ever applied for funding for the project.
3. *Are there other potential downsides or objections to the proposal that you anticipate?*
    a.
4. *In what ways does your proposal address those concerns?*
    a. Program is voluntary. The proposal identifies future tasks: the specific program will need to be developed by implementers, and funding will have to secure.

Cost and funding sources:

1. *What elements of the proposal are likely to require funding?*
    a. Mason Conservation District engineering (design) and outreach staff- 1 FTE for five years. $80,000 per year for five years - $400,000
    b. Outdoor hose monitoring devices or other monitoring on small lot outdoor irrigation.
    c. Construction firm to and install water wise landscaping ~$10,000 per parcel, total $1,000,000. However, if landowner leaves some existing native plants, cost comes down substantially.
    d. Rock, soil, and native plants of xeriscape. - ~$5,000 per parcel, total $500,000
    e. Permitting- Landscaping is expected to occur "at grade" on the already prepared home site and should not require additional permitting beyond home construction.

Total cost $1.9 million at an annual cost of $380,000 per year assuming approximately 20 participants per year in a five year program.

2. *Provide a rough cost estimate (if known) and discuss potential funding sources and whether funding is one time or ongoing.*
    a. See #1. Grants or other funding contributions from state or local governments will need to be obtained.
3. *Explain costs to other affected parties besides implementing regulators (for example: costs will increase for well drilling or new requirements on homeowners/home builders).*
    a. Homeowner participants will have to commit to a small amount of annual maintenance and outdoor water use monitoring

*Policy types (not comprehensive list; feel free to add):

- Education: providing information, encouragement and recognition
- Incentives: providing incentives – In this study, the incentive is a fully funded landscaping project.

Forest stand age and flow restoration

Concept paper
Paul J. Pickett
For the Squaxin Island Tribe
January 21, 2021

Background

Technical appendix G of the Nisqually Watershed Plan Addendum (Nisqually Indian Tribe, 2019) provided a detailed technical analysis of a Community forest project designed to manage forest stand age to improve stream flows. Excerpts from that document describe some of the technical background for this project concept:

> *A significant body of field evidence, research and important new modeling indicates that large streamflow benefits can accrue from increasing forest stand age through Managed Forestry:*
>
> - *Perry and Jones (2016) used paired forest stands comparable to those in the Nisqually River watershed to show that after a forest stand age of 40 years, re-growing forests contribute significantly to streamflow.*
> - *Abdelnour et al (2011 and 2013) confirm that the findings of Perry and Jones (2016) can be reproduced using numerical modeling with the VELMA model code.*
> - *McKane et al (2018) has modeled the Mashel River sub-basin using the VELMA model. Preliminary results indicate that streamflows increase substantially when forest stand ages increase.*
> - *Managed Forest practices are already being implemented in the Nisqually Community Forest, which include over 1,900 acres already purchased and under protection. This ongoing program (limited only by funding) indicates the viability of the long-term managed forest concept.*
>
> *The work of Perry and Jones (2016) is critical to the understanding of the streamflow benefits of Managed Forests. Figure 6b is extracted below for reference from their paper, Summer streamflow deficits from regenerating Douglas-fir forest in the Pacific Northwest, USA:*
>
> *In this figure, streamflows are compared between pairs of test basins: one cut and the other uncut. Their streamflows are expressed as the percent difference between the reference (uncut) streamflow and the clear-cut basin streamflow – over a test period of 35 to 45 years.*
>
> - *Initially, streamflows rise rapidly in the cut basin, relative to the uncut partner basin.*
> - *Streamflows then decline rapidly as vegetation re-growth uses more water relative to the uncut partner basin.*
> - *In forests older than 35-40 years, streamflows then stabilize at 50% to 70% lower than in the uncut partner basin.*

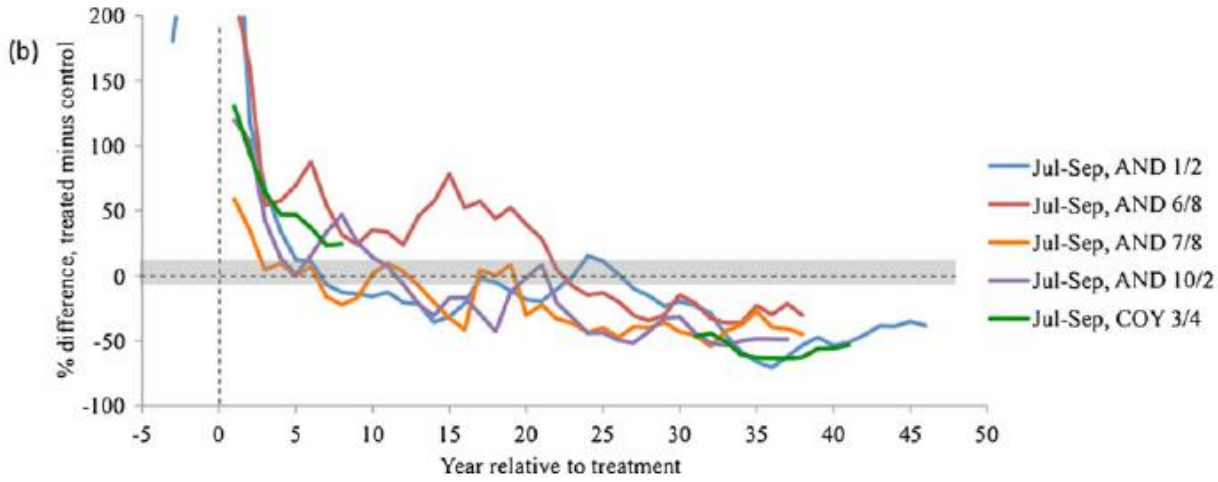


Figure 6b, (excerpted from Perry and Jones (2016).

Computer modeling using the VELMA modeling software (McKane et al) was able to reproduce this sequence – both the hydrology and forest cover changes – for the Mashel River sub-shed (McKane et al, 2018) – at 10 reach locations. Reach 0 at the west end of the model domain represents the simulation of USGS gage 12087000:

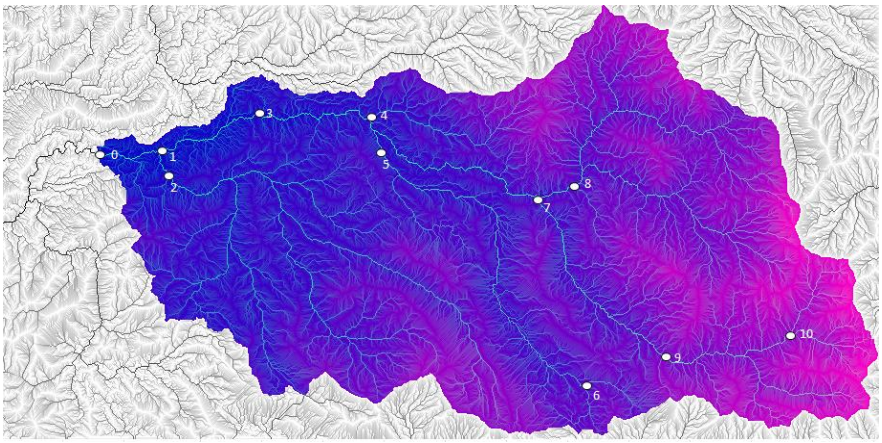


Figure: VELMA model domain for the Mashel Sub-basin showing the stream network, simulated gages at key reaches and boundary view (reproduced from McKane et al, 2018).

The VELMA modeling made a good approximation of the actual discharge in the Mashel River. Three other scenarios were simulated in the modeling: 1 year after clear-cut, 40 years after clear-cut and 240 years after clear-cut. The streamflow from the 240-year old forest stand is reported to be nearly indistinguishable at the streamflow from a 100-year-old forest stand (McKane, 2018; Abdelnour 2011; Abdelnour 2013). Lowest modeled streamflows were found at 40 years after clear-cut, while from 40 to 100 years, streamflows returned, approaching un-cut old-growth streamflows in the 100-year-old stand age modeling.

A recent study by Coble et al. (2020)[1] describes studies of the effect of forest stand age on stream low flows. A summary of effects from Coble et al (2020) and others describes a general pattern observed in response to clearcut:

1. Initial response: increased stream flow compared to pre-harvest (mature forest)
2. Regenerating stands: small, mixed, or variable responses (modern cutting programs may provide some improved recharge compared to historic clearcut methods)
3. Continued growth: decline in low flows
4. Mature forest: low flows return to pre-harvest conditions

The graph in Figure 1 summarizes the results from 19 catchments from a variety of studies. Flow reductions in Hydrologic period 3 were found in 17 of 19 studies.

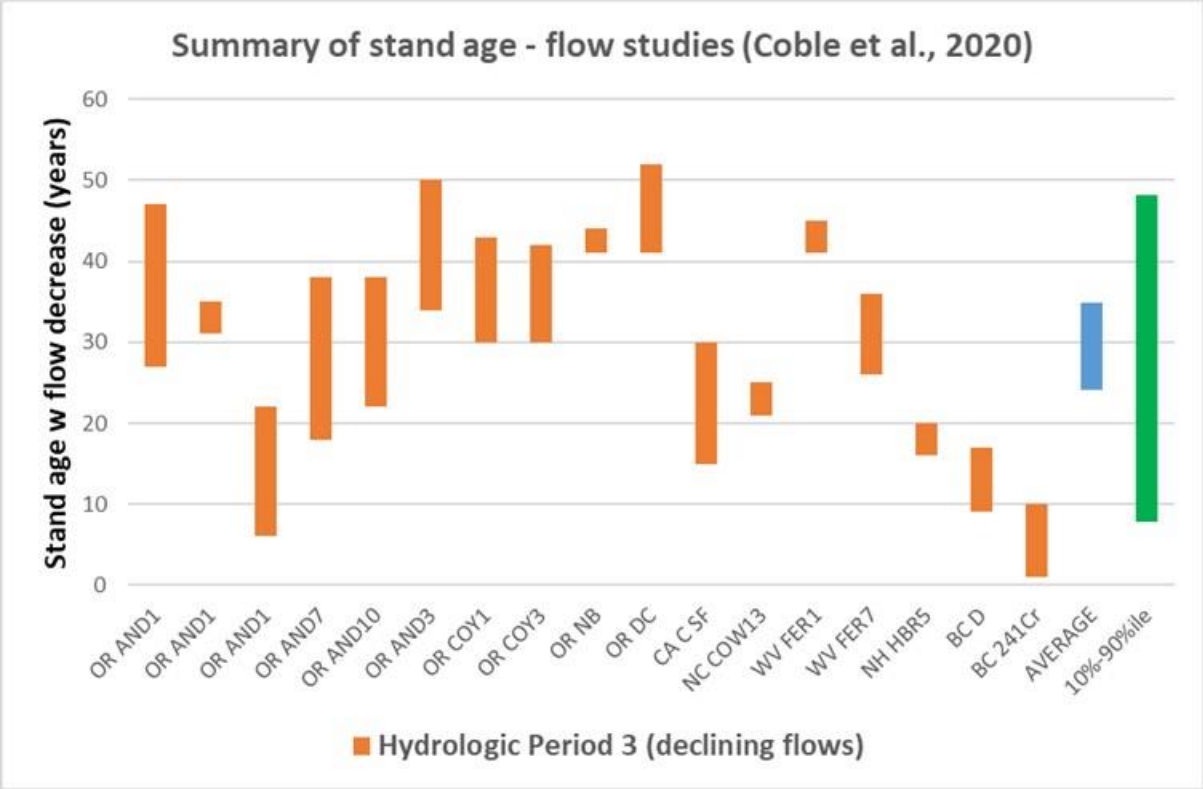


Figure 1. Summary of stand age studies (Coble et al., 2020)

This graph illustrates the effect of stand age. Study results indicate that stream flows decrease with stand ages from 10 to 50 years (10th percentile of onset year to 90th percentile of final year), and on the average between 25 and 35 years (average onset year to average final year). Commercial cut rotations tend to occur between 40 and 60 years.). In most cases, stream flows rebound to pre-harvest conditions at 35 to 50 years.

[1] Long-term hydrological response to forest harvest during seasonal low flow: Potential implications for current forest practices. Science of the Total Environment 730 (2020) 138926

Bob McKane from the EPA Corvallis Laboratory has developed a method to model the flow effects of stand age using the VELMA model. He applied this model to a study of the Nisqually Community Forest.[2] Figure 2 compares streamflows at 40- and 100-year forest stand ages.

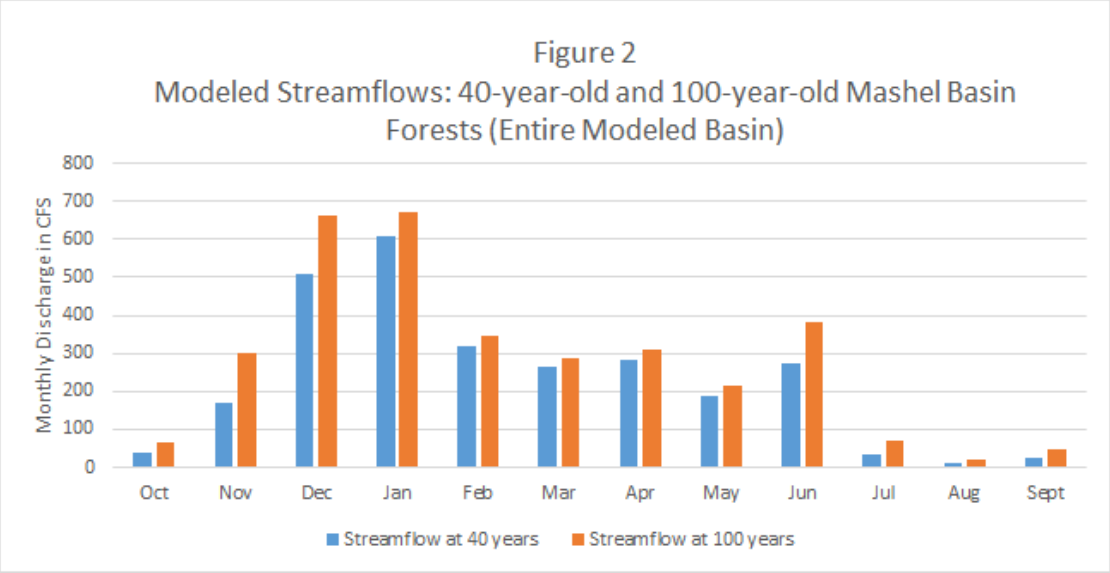


Figure 2. Modeled streamflows in the Mashel River basin (Nisqually Indian Tribe, 2019)

Using these assumptions, differences between monthly flows in the 40-year-old and 100-year-old VELMA simulations can be used to determine a unit acre of per-year streamflow increase that can be reasonably achieved for new Managed Forestry lands added to the potentially protected forest.

The uncertainties in this analysis must be acknowledged. Forest stand age affects hydrology through a complex variety of factors, which include:

- Geophysical and climate factors across any specific watershed, such as: latitude, climate, local weather patterns; watershed elevation, slope, and aspect; soils; and underlying geology.
- Average stand age, tree species composition, and parcel-scale cut patterns across the watershed.
- Patterns of forest harvest, such as the extent of clear-cut, patchy cutting strategies, riparian areas left intact, and management of debris.
- Other factors such as soil compaction and roads.

There are also possible differences between the effects in research study areas and effects in working forests subject to regional regulation, such Washington's Forests & Fish program and Habitat Conservation Plans.

[2] https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=CPHEA&dirEntryId=348155

Project concept

To meet the requirement of a project under RCW 90.94, a project just provide benefits indefinitely. From the research cited above, this suggests that protecting a forest stand so that it either: 1) remains uncut; or 2) is cut in a rotation of 80 years or more, could provide baseflow benefits. EPA's VELMA modeling tool could help to quantify those benefits.

Funding is limited for streamflow restoration, so directly funding fee-simple forest land acquisition is possible, but difficult. However, there may be opportunities to leverage acquisition for multiple purposes using a combination of Streamflow Restoration grants and other funding sources. Note that the focus of this proposal is projects with the voluntary cooperation of a landowner, and is not intended to address legal or regulatory issues.

Several kinds of forest protection projects appear to be viable for this kind of synergy: setting aside an area as conservation or community forest; habitat protection; and carbon sequestration. A project such as these that provides permanent protection for forest lands might meet Ecology criteria for a water offset if the benefits could be quantified. Another window of opportunity could be a project that would protect forest with low timber value, and where a project is on the borderline for water offset – but might be a candidate for funding with habitat or carbon sequestration funding. By adding in Streamflow Restoration grant funding, a project may be realized that would otherwise not reach financial viability.

With this in mind, a forest stand age project might include these elements:

- Project would need to be an area currently managed for timber harvest.
- Stand age management for streamflow protection can be either forest protection (total elimination of harvest), or management to an average stand age of 80 years or more.
- A project could access supplemental Streamflow Restoration funding to support permanent forest protection or stand age management, and also conduct the offset analysis to quantify benefits.
- If a project is funded through other sources and provides permanent forest protection or stand age management, only an offset analysis would be needed to quantify baseflow enhancement benefits.

Several factors would need to be evaluated as part of a feasibility study:

- Whether the project is in a basin with baseflow enhancement needs, including tributaries where perennial flows are threatened.
- Whether the project is large enough to provide significant baseflow enhancement downstream. Specific project areas could be of any size, but the greater the coverage of a tributary watershed, the more the presumed benefits.
- The ability to selectively harvest trees for a longer cut rotation. The literature suggests other methods could enhance streamflow, such as selective patchy cutting.
- Evaluation of the effect of site-specific factors through a spatial and modeling analysis.
- The economic implications for lengthening harvest or taking timber out of production, including reduced employment and local revenues.

- There are corollary environmental and economic benefits from longer cut rotations that could be evaluated and quantified.

Next steps

- Include a categorical project that would allow for future specific projects, or support further research into this type of project to more clearly define the availability, structure, and suitability of potential projects, including assessing the potential social, economic, and environmental positive and negative impacts to the watershed and local communities.
- Identify specific opportunities that could be put forward for a suitable project.

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Abdelnour, A., Stieglitz, M., Pan, F., & McKane, R. (2011). Catchment hydrological responses to forest harvest amount and spatial pattern. Water Resources Research, 47(9).

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Coble, Ashley A., Barnard, H., Du, E., Johnson, S., Jones, J., Keppeler, E., Kwon, H., Link, T., Penaluna, B., Reiter, M., River, M., Puettmann, K., and Wagenbrenner, J. 2020. Long-term hydrological response to forest harvest during seasonal low flow: Potential implications for current forest practices. Science of the Total Environment 730 (2020) 138926 https://doi.org/10.1016/j.scitotenv.2020.138926

McKane, R., Barnhart, B, Brookes, A. Halama, J., Pettus, P., Djang, K., Hall, J., Kane, J., Swedeen, P., Blair, G. Webster, M., Hodgson, S., Ellings, C., Benson, L., and Stonington, D. 2018. Nisqually Community Forest VELMA modeling to evaluate effects of forest management scenarios on streamflow and salmon habitat. U.S. Environmental Protection Agency. Pers. Comm. draft May 31st 2018.

Nisqually Indian Tribe, 2019. Nisqually Watershed Response to the 2018 Streamflow Restoration Act (RCW 90.94) – Addendum Appendices. Prepared for the Nisqually Indian Tribe and Nisqually Watershed Planning Unit, January 16, 2019

Perry, T. D., & Jones, J. A. (2017). Summer streamflow deficits from regenerating Douglas-fir forest in the Pacific Northwest, USA. *Ecohydrology*, *10*(2).

WRIA 14
Analysis of water use under climate change
February 12, 2020
Paul Pickett

Assumption: increased evapotranspiration (ET) is equivalent to increased water use. If yard and landscaping vegetation has higher ET, homeowners will increase water use at a similar rate.

Approach: Regression of average daily ET to average daily temperature, relative humidity, wind speed, and precipitation. Method suggested by Guillaume Mauger UW Climate Impacts group. Direct calculation is possible but is complex and data-intensive.

Data sources

- AgWeatherNet (WSU) Poulsbo.S station http://weather.wsu.edu/index.php?page=station_details&UNIT_ID=355001
- AgWeatherNet (WSU) Tumwater station http://weather.wsu.edu/?p=90150&UNIT_ID=330153
- NWS Sanderson Field, Shelton station (KSHN) https://www.wunderground.com/weather/KSHN

Data selected

- 2018 chosen for analysis – a summer with moderate summer conditions. Multiple years possible but labor-intensive. Single year seemed reasonable for screening-level analysis. April through October – growing season.
- Average of ET from AgWeatherNet Poulsbo and Tumwater stations
- Temperature, percent humidity, wind speed, and precipitation from Shelton NWS station

Initial regression screening

- Relationship to temperature and humidity strong, wind and precipitation weak. (See attached graph.)
- Regressions tested for 4, 3, and 2 parameters. Regressions to temperature and humidity were very similar in strength to regressions including wind or precipitation.

Regression Results: multiple regression of ET to temperature and relative humidity

Regression Statistics	
Multiple R	0.836
R Square	0.699
Adjusted R Square	0.696
Standard Error	0.029
Observations	214
Coefficients	
Intercept	0.06117
Tair	0.00361
AvgRH%	-0.00217

Method to project future climate conditions: assume primary driver is temperature change. Northwest Climate Toolbox provides forecasts of future climate, including daily average temperatures. Relative humidity forecasts are not available, and so are assumed to not change significantly.
https://climatetoolbox.org/tool/Future-Boxplots

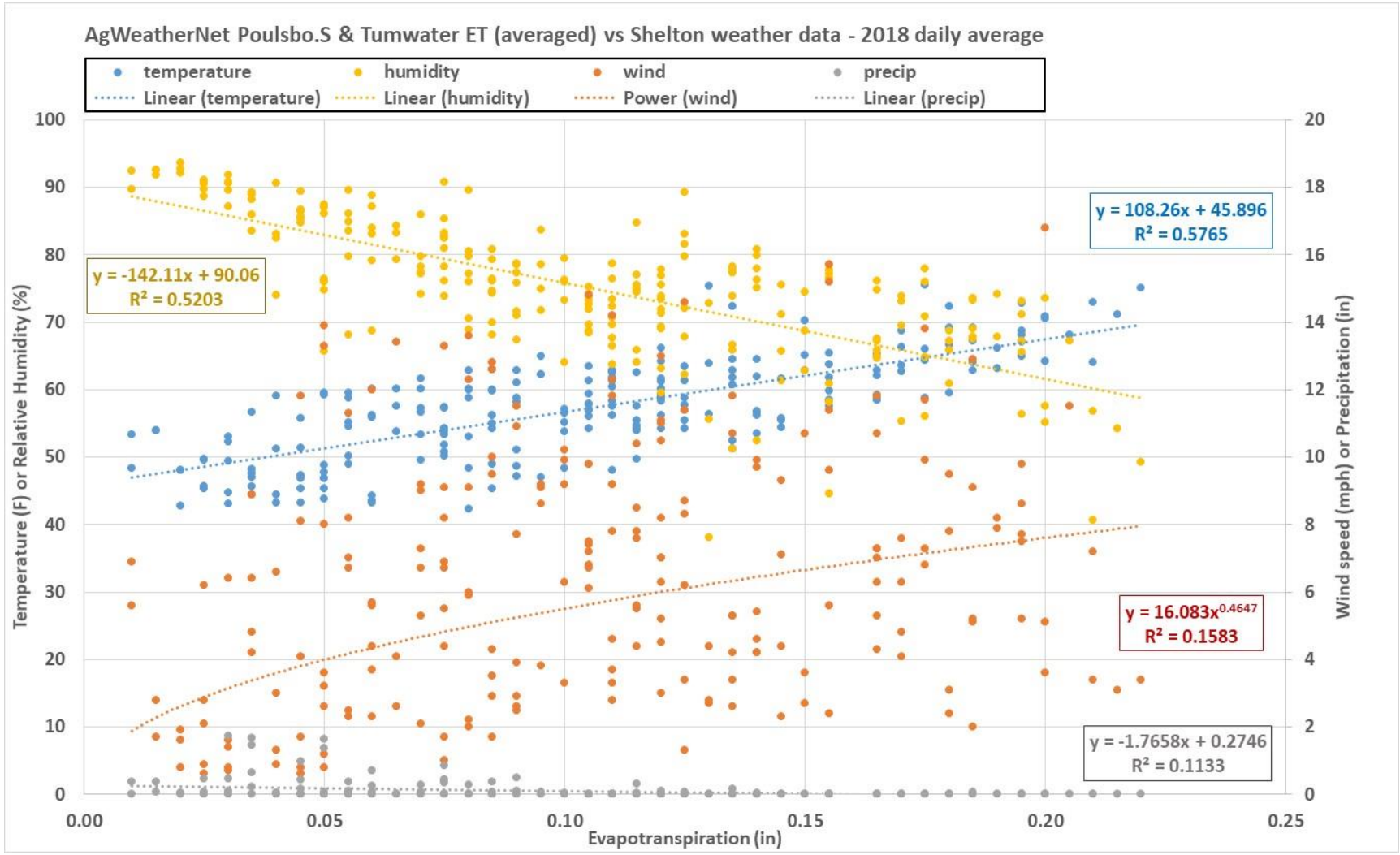
- Select location (same lat/long as Shelton NWS station)
- Select season: spring (March-May), summer (June-August), fall (September-November)
- Select mean temperature
- Select high emissions scenario (current track)
- Box plots show mean of climate model results for seasonal mean temperatures

Climate Toolbox	**Mar-May**	**Jun-Aug**	**Sep-Nov**
1971-2000	49.7	63.2	51.4
2010-2039	51.8	65.5	53.4
Diff	2.1	2.3	2.0

Future ET results: Seasonal difference in temperatures applied to 2018 record. ET calculated with regression. Daily ET summed for a total difference by month and over the growing season.

Month:	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sept**	**Oct**	**Apr-Oct**
2018	2.2	3.3	3.6	4.7	4.3	3.0	1.6	22.7
2040	2.4	3.6	3.9	5.0	4.5	3.0	1.6	24.0
Difference	0.2	0.2	0.3	0.3	0.3	0.0	0.0	**1.2**
percent	10.4%	7.1%	7.0%	5.5%	6.1%	0.0%	0.0%	5.5%

The analysis shows an increase in total growing season evapotranspiration of 1.2 inches by 2040.


AgWeatherNet Poulsbo.S & Tumwater ET (averaged) vs Shelton weather data - 2018 daily average
temperature
humidity
wind
precip
Linear (temperature)
Linear (humidity)
Power (wind)
Linear (precip)
y = 108.26x + 45.896
R² = 0.5765
y = -142.11x + 90.06
R² = 0.5203
y = 16.083x^0.4647
R² = 0.1583
y = -1.7658x + 0.2746
R² = 0.1133
Temperature (F) or Relative Humidity (%)
Wind speed (mph) or Precipitation (in)
Evapotranspiration (in)
0.00
0.05
0.10
0.15
0.20
0.25
0
10
20
30
40
50
60
70
80
90
100
0
2
4
6
8
10
12
14
16
18
20