APPENDIX A

Evaluation of Future Permit-Exempt Well Demand

MEMORANDUM

Project No. 190259

October 1, 2020

To: Angela Hubbard, Okanogan County Office of Planning & Development

From:

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Re: **Evaluation of Future Permit-Exempt Well Demand**
WRIA 49 Chapter 90.94 RCW Streamflow Restoration Plan Addendum

Summary of Findings

The passage of Engrossed Substitute Senate Bill (ESSB) 6091, as codified by Chapter 90.94 Revised Code of Washington (RCW), requires that an update to the existing Watershed Plan for Water Resource Inventory Area (WRIA) 49, the Okanogan River Basin, be approved by the Washington Department of Ecology (Ecology) by February 1, 2021. A forecast of consumptive water use for new permit-exempt wells over a 20-year period involves making three principal estimates:

1. An estimate the total number of *new residences* expected to be supplied by permit-exempt wells over the 20-year planning horizon
2. An estimate of consumptive *indoor water use* for each permit-exempt well
3. An estimate of consumptive *outdoor water use* for each permit-exempt well

An evaluation of future permit-exempt well demand was conducted based on recent Ecology guidance. There are an estimated 12,598 current total dwellings in the evaluated portion of WRIA 49 (not falling on Confederated Tribes of the Colville Reservation (CTCR) lands) and of those dwellings, 5,777 were estimated to be potentially permit-exempt well sources i.e., self-supplied by a domestic water source and not served by a larger water system.

Assuming a 10 percent growth scenario through 2038, the estimated future domestic dwelling growth in WRIA 49 subbasin resulted in 578 new dwellings, which would be domestic permit-

exempt well demand dwellings. This growth scenario resulted in a projected cumulative total consumptive use demand of 203 acre-feet per year in WRIA 49 (estimated through 2038).

Background

The passage of Engrossed Substitute Senate Bill (ESSB) 6091, as codified by Chapter 90.94 RCW, requires that an update to the existing Watershed Plan for Water Resource Inventory Area (WRIA) 49, the Okanogan River Basin, be approved by the Washington Department of Ecology (Ecology) by February 1, 2021. Okanogan County Office of Planning & Development is serving as the lead agency for this process. Aspect Consulting, LLC (Aspect) has been contracted by Okanogan County as technical lead, including attendance of planning unit meetings, conducting supporting technical tasks, and preparation of the Streamflow Restoration Plan Addendum (Plan Addendum).

A key requirement of Chapter 90.94 RCW concerns the identification of water and non-water offset (i.e., Net Ecological Benefit (NEB) contributing) projects to mitigate forecasted impacts on instream flows associated with permit-exempt well[1] consumptive water use[2] over a 20-year planning horizon[3]. To produce this forecast/estimate, Aspect developed growth projections for new domestic permit-exempt well connections within WRIA 49, as well as an estimate for typical/average water use associated with each permit-exempt well connection.

This memorandum summarizes the methods used to estimate consumptive water use associated with the new permit-exempt well connections and provides the corresponding results for the 20-year forecast. The methods presented here are largely based on Ecology guidance document *ESSB 6091 - Recommendations for Water Use Estimates* (publication #18-11-007)[4].

Overview of Methodology

A forecast of consumptive water use for new permit-exempt wells over a 20-year period involves making three principal estimates:

1. An estimate the total number of *new residences* expected to be supplied by permit-exempt wells over the 20-year planning horizon
2. An estimate of consumptive *indoor water use* for each permit-exempt well
3. An estimate of consumptive *outdoor water use* for each permit-exempt well

[1] A permit-exempt well is defined as a well that withdraws less than 5,000 gallons per day of groundwater for small domestic (and other non-commercial) uses such as a single home or small group of homes. Until recent legal challenges such as the Hirst and Swinomish decisions, these small domestic uses had been exempted from obtaining a formal water right permit from the state.
[2] "Consumptive use" refers to water that is removed from the immediate water system/environment, through human consumption, evaporation, transpiration or similar (e.g. water from domestic wells that is not replaced through irrigation return flows, septic systems, etc.)
[3] In its GUID-2094: *Final Guidance for Determining Net Ecological Benefit*, Ecology noted that this 20-year planning horizon begins on January 19, 2018 (the date ESSB 6091 was signed into law). Publication 19-11-079, July 31, 2019.
[4] https://fortress.wa.gov/ecy/publications/SummaryPages/1811007.html

The total amount of water needed for ESSB 6091 offset and mitigation projects in WRIA 49 is the sum of the indoor and outdoor consumptive use estimates per-permit-exempt well connection (residences) times the number of forecasted new residences connected to permit-exempt wells.

Generally, permit-exempt wells are unmetered and the actual volume of water withdrawals are unknown. The portion of water that is or is not returning to the water system for any given well, or any given geographic setting—i.e., the consumptive portion of water use—is variable. Thus, the estimates presented in this memo rely on a number of practical and generally accepted assumptions (per *ESSB 6091 - Recommendations for Water Use Estimates)*, local (WRIA/Okanogan County) trends, and observed patterns.

Additionally, for the purposes of project identification and offset planning, future permit-exempt well consumptive water use estimates are aggregated and totaled for each individual subbasin of WRIA 49.

Geographic Setting: WRIA 49, Subbasins, and Analysis Extent

The boundaries of WRIA 49 as established in WAC 173-500-990 are shown in Figure 1 (attached). WRIA 49 encompasses the portion of the Okanogan River drainage basin falling within the United States including its primary tributary, the Similkameen River, and other numerous perennial and intermittent stream drainages comprising tributaries to the Okanogan. WRIA 49 is completely within the boundaries of Okanagan County and includes the major municipalities of Oroville, Tonasket, Omak, Okanogan, Conconully, and Mallott.

Excluded from the scope of this analysis are the lands of the CTCR, which comprise the eastern portion of WRIA 49 lying east of the Okanogan River and south of Riverside (see Figure 1).

To support watershed planning and offset project identification[5], the Planning Unit divided WRIA 49 into five subbasin areas[6] (as seen in Figure 1):

1. Loup Loup - Swamp (Lower Okanogan)
2. Salmon Creek
3. Bonaparte-Johnson (Middle Okanogan)
4. Antoine- Whitestone (Upper Okanogan)
5. Similkameen

[5] Regarding subbasins, ESSB 6091 - Recommendations for Water Use Estimates states: "*ESSB 6091 is written in the context of Water Resources Inventory Area (WRIA)-wide mitigation, so Ecology interprets the words 'same basin or tributary' to refer to subareas or subbasins as opposed to entire WRIAs. For the purposes of this document, the term 'subbasin' is equivalent to the words 'same basin or tributary' as used in sections 202(4)(b) and 203 (3)(b). Planning groups must delineate subbasins within WRIAs, and these subbasins must be suitably sized to allow meaningful determinations of whether mitigation is in-time and in the same subbasin in the context of highest priority and lower priority projects, without being so small that they are unwieldly (e.g. a WRIA might be divided into eight subbasins). In some instances, subbasins may not correspond exactly with hydrologic basin delineations (i.e. watershed divides).*"

[6] See the corresponding Plan Addendum memorandum: "Summary of Subbasin Assessments and Project Identification"

A sixth subbasin area, Omak Creek, falling completely within CTCR reservation lands, is excluded for the purposes of this memo and the related watershed planning efforts.

20-year Exempt Well Forecast

An estimate of future permit-exempt well connections involves two elements:

1. An estimate of the total number of current permit-exempt well connections (and their location/distribution)

2. Establishing one or more growth rate "scenarios" to extrapolate forward 20 years from the current estimate

Chapter 90.94 RCW requires future consumptive water use estimates at the subbasin scale. This means that estimates that might rely solely on County-wide or WRIA-scale data—while helpful for comparative purposes—would be inadequate for Chapter 90.94 RCW-required planning efforts. Thus, Aspect produced a *parcel-scale* estimate of residential development and water sources to allow for the allotment of permit-exempt well connection estimates to each subbasin in WRIA 49 (or any other spatial analysis unit, as required).

Estimate of Current Permit-Exempt Well Connections

In WRIA 49/Okanogan County, no single database or data set explicitly tracks the domestic water supply source of each parcel. To estimate current permit-exempt well connections, the project team used GIS to cross-reference a combination of data sources, including assessor/parcel data, public water services areas, water rights, and building permits..

Residential Parcels

Based on similar methodology established in developing WRIA 48 Instream Flow Reservation Tracking Database in 2011 (and subsequent update in 2019)[7], and through consultation with County GIS staff, Aspect developed a series of query tools[8] to establish whether a given parcel is developed or undeveloped, whether it is developed as a residence/dwelling, and (in some cases) how many residential units the parcel contains. This analysis uses two key data sources:

1. Okanogan Parcel GIS shapefile with Assessor's Database fields

2. Okanogan County's Building Permit Database[9]

The estimate is based on a combination of each parcel's Washington State Department of Revenue (DOR) land use code(s), assessed improvement values, and building permit records for residential development. Recent wildfire-related property destruction and redevelopment data was also considered in the analysis. Parcels with data suggesting multi-dwelling residential development were reviewed individually using the County's online parcel database[10] to make an estimate of the total number of housing units on each. Additionally, (as part of the lawn-size aerial photo review

[7] Memo available through a link at https://www.methowwatershed.com/library
[8] These tools were built as part of an ArcGIS ModelBuilder/Python Toolbox to allow for repeat/updated analysis
[9] Okanogan County building permits are stored in separate datasets for those predating 1994 and those from 1994 and later. Both were included in this analysis.
[10] http://okanoganwa.taxsifter.com/

discussed later in this memo) a large number of parcels were spot checked to confirm the outputs of this methodology.

In total, this yielded an estimate of 12,598 total dwellings in the portion of WRIA 49 not falling on CTCR reservation lands.

Parcels Served by Public Water Systems

Aspect used GIS to evaluate whether each given parcel is served (or not) by a permitted (water right) source of domestic water such as a Group A or large Group B public water system. Using GIS, public water system service area boundaries were overlaid with parcel areas. A parcel (and its associated housing units) was assumed to be served by a given water system if its centroid falls within the service area boundary of that system. Residential parcels falling outside of permitted water service area boundaries (or domestic water right places-of-use) were then assumed to be self-supplied by a permit-exempt well[11].

Public Water System Service Area Boundaries

Washington State Department of Health (DOH) provides a GIS dataset of public water system service area boundaries. However, this dataset was not comprehensive of all Group A systems in WRIA 49—and did not include any service area delineations of Group B systems.

To establish which water system delineations were missing from the dataset, all active public water systems in WRIA 49 were downloaded from the DOH SENTRY Internet query page[12]. This list was then cross referenced with the initial GIS service area delineations to establish which Group A and larger Group B systems (greater than six connections) did *not* have boundaries in the GIS[13]. Where possible, a variety of data sources were used to delineate water system boundaries missing from the DOH data, including domestic water rights places of use from Ecology's Water Rights Tracking System (WRTS) and Geographic Water Information System (GWIS); city limits: water system plans; and parcel legal descriptions/boundaries. Not all system boundaries were able to be delineated in GIS[14]. The final dataset used for this analysis contains the approximate service area boundaries for 43 systems in WRIA 49[15].

See Table 1 (attached) for details on these water systems.

[11] This is a simplifying assumption. It is possible that residences inside the service area boundaries of a public water system are supplied by permit-exempt wells. However, establishing how many (or which) parcels this applies to was not feasible within the scope of this work.
[12] https://fortress.wa.gov/doh/odwsentry/portal/odw/si/Intro.aspx
[13] Group B systems with six or fewer connections are most often supplied by permit-exempt wells—whereas larger Group B systems with more than six connections usually have a water right permit. Thus, identifying the service area boundaries for larger Group B systems was a relative priority.
[14] See Table 1 (attached). 30 water systems (including 7 Group A and 23 Group B with more than six residential connections) were not located in GIS. These water systems represent approximately 385 residential connections, which is about 5% of the total estimated residential public water system connections in WRIA 49 (based on DOH data).
[15] Only three (of 29 total) Group A community water system service area boundaries in WRIA 49 were unable to be identified (representing 114 residential connections).

After cross referencing parcels with these service areas, there are an estimated 6,641 housing units receiving water from permitted public water systems in WRIA 49[16] (see Table 2 below).

Table 2. Estimated Existing Housing Units Inside and Outside of Public Water System Service Areas in WRIA 49

Subbasin	Estimated Number of Existing Housing Units Inside Public Water System Service Area Boundaries	Estimated Number of Existing Housing Units *Outside* Public Water System Service Area Boundaries (assumed connected to permit-exempt wells)	Total
Antoine-Whitestone (Upper Okanogan)	1,452	**1,730**	3,182
Bonaparte-Johnson (Middle Okanogan) *	3,425	**2,559**	5,984
Loup Loup-Swamp (Lower Okanogan) *	1,345	**1,058**	2,403
Salmon Creek	142	**324**	466
Similkameen	277	**286**	563
Total*	6,641	**5,957**	12,598*

Notes: *excluding areas in CTCR reservation lands.

Figure 2 (attached) shows the geographic distribution of the parcels assumed to be connected to permit-exempt wells in WRIA 49, as well as the location of the delineated public water system service areas.

Growth Projections

Five approaches to establishing a population/housing unit growth rate were considered or reviewed for this permit-exempt well study:

1. Washington State Office of Financial Management's (OFM) low-, medium-, and high-growth population projections for Okanogan County between 2019 and 2038
2. A growth rate from OFM's Small Area Estimates Program (SAEP) data between 2010 and 2019—extrapolated forward
3. A growth rate from OFM "April 1st" estimates for Unincorporated Okanogan County between 2010 and 2019—extrapolated forward
4. Okanogan building permit trends—extrapolated forward
5. Growth rates from OFM SAEP census block group GIS data between 2000 and 2019

A discussion of each of these five approaches/data sources follows.

[16] Excluding CTCR lands

Growth Rate from OFM's Okanogan County 2017 to 2050 Year-over-year Projections

In collaboration with county agencies, OFM periodically publishes county-specific, year-over-year population growth estimates[17]. These estimates, which were last updated and published in 2017, forecast annual population growth out to the year 2050. OFM's estimates are provided in low-, medium-, and high-growth scenarios. For Okanogan County, OFM estimates the following population change percentages between 2019 and 2038:

- Low-growth scenario: -6.0 percent (decrease)
- Medium-growth scenario: 7.2 percent
- High-growth scenario: 29.3 percent

It should be noted that these projections are for population change (not housing units) and for all of Okanogan County.

Growth Rate from OFM SAEP (2010 to 2019 Estimates)

One primary recommendation for estimating future permit-exempt well demand in Ecology's *ESSB 6091 - Recommendations for Water Use Estimates* (Ecology, 2018) is to use basin-specific, year-over-year growth numbers from OFM SAEP to extrapolate forward (based on the previous 10 years of data).

OFM's SAEP estimate for WRIA 49[18] puts the ten-year *population* change (2010 to 2019) at 2.58 percent and the ten-year change in total housing units at 4.7 percent (see Table 3, below). Extrapolated 20 years forward to 2038, this would imply 5.2 percent increase in population and a 9.6 percent increase in total housing units.

Table 3. OFM Population Forecast for WRIA 49 2010-2019

	Total Population	Total Housing Units	Occupied Housing Units
2010	30,037	14,349	11,672
2011	30,051	14,436	11,723
2012	30,168	14,528	11,760
2013	30,209	14,596	11,794
2014	30,312	14,671	11,814
2015	30,463	14,775	11,880
2016	30,324	14,826	11,914
2017	30,505	14,894	11,956
2018	30,700	14,957	11,996
2019	30,811	15,024	12,032
Numeric Change, 2010 to 2019	774	675	360
Percent Change, 2010 to 2019	2.6%	4.7%	3.1%
Extrapolated 20-year change	**5.2%**	**9.6%**	**6.3%**

[17] https://www.ofm.wa.gov/washington-data-research/population-demographics/population-forecasts-and-projections/growth-management-act-county-projections
[18] Updated 9/11/2019. https://www.ofm.wa.gov/washington-data-research/population-demographics/population-estimates/small-area-estimates-program

Growth Rate from OFM "April 1st" Estimates for Unincorporated Okanogan County

Though less specific to WRIA 49, another approach to using OFM projections in the context of future permit-exempt well demand would be to use OFM's more *official* "April 1st" estimates[19] to establish a trend. In these estimates, OFM has "2010 Base Census Estimate of Total Housing Units" in Unincorporated Okanogan County at 14,916 and "2019 Postcensal Estimate of Total Housing Units" in Unincorporated Okanogan County at 15,921—a 6.7 percent increase over 10 years. Extrapolated forward to 2038, this would suggest a 13.9 percent increase in housing units for a 20-year planning horizon.

Building Permit Trends

The Okanogan County Office of Planning and Development conducted a buildout analysis for WRIA 49 in 2019[20]. As part of this analysis, the County looked at building permit trends between 2010 and 2018 and estimated that, over that time span, there was an average of 71 building permits per year for new single-family domestic units (SFDU) in WRIA 49 (2010 to 2018). This rate of growth, they estimated, would translate to 1,420 new SFDUs in a 20-year span.

Assuming a baseline of approximately 13,000 to 15,000 existing housing units in WRIA 49 (see Tables 2 and 3, above), this would equate to a 9.5 to 11 percent growth in housing units over a 20-year span.

Consideration for Variable Growth in Subbasins

OFM's Small Area Estimates Program (SAEP) also provides GIS data at the census block group level[21]. Unlike the WRIA-wide OFM SAEP estimates referenced above, the block group-level GIS data provided by SAEP contains 20 years of data/estimates, from 2000 to 2019. Using GIS, this data can be disaggregated and reapportioned to subbasin areas[22], generating the subbasin-specific estimates in Table 4 (below).

[19] https://www.ofm.wa.gov/washington-data-research/population-demographics/population-estimates/april-1-official-population-estimates

[20] https://www.okanogancounty.org/planning/Docs%20and%20PDFs/WRIA49PlanningUnit/WRIA%2049%20Planning%20Unit%20Buildout%20Analysis.pptx. Other related materials available here: https://www.okanogancounty.org/planning/wria_49_plannng_unit.html

[21] Census block groups are the second smallest geographic unit used by the US Census Bureau—larger than census blocks and smaller than tracts. There are around 30 census block groups completely or partially within WRIA 49.

[22] This process involves clipping block groups to developed areas (per Okanogan County parcel GIS) and calculating the *density* of a given measure (e.g. households per square foot) in a given block group over that developed area. Then, the portions of the given block group that fall withing a particular subbasin are isolated, and the resulting values (e.g. households) are re-summed within the subbasins.

Table 4. Subbasin-specific 20-year Growth Trends from OFM SAEP Block Groups (GIS)

Subbasin	2000 Estimated Population	2019 Estimated Population	Estimated 20-year Percent Change in Population (2000 to 2019)	2000 Estimated Number of Housing Units	2019 Estimated Number of Housing Units	Estimated 20-year Percent Change in Housing Units (2000 to 2019)	2000 Estimated Number of Occupied Housing Units	2019 Estimated Number of Occupied Housing Units	Estimated 20-year Percent Change in Occupied Housing Units (2000 to 2019)
Antoine-Whitestone (Upper Okanogan)	5,188	5,631	**8.5%**	2,636	3,410	**29.4%**	1,999	2,315	**15.8%**
Bonaparte-Johnson (Middle Okanogan)	13,849	14,593	**5.4%**	6,151	7,139	**16.1%**	5,265	5,904	**12.1%**
Loup Loup-Swamp (Lower Okanogan)	6,487	6,972	**7.5%**	2,573	2,836	**10.2%**	2,216	2,431	**9.7%**
Salmon Creek	610	551	**-9.7%**	322	337	**4.6%**	235	243	**3.5%**
Similkameen	1,398	1,361	**-2.6%**	706	779	**10.3%**	551	557	**1.1%**
Total	*27,532*	*29,108*	***5.7%***	*12,388*	*14,501*	***17.1%***	*10,266*	*11,450*	***11.5%***

The values in Table 4 suggest that the subbasin areas of WRIA 49 have experienced variable growth over the prior 20 years—and it is reasonably likely that the variability will continue in the next 20 years. At the same time, the overall WRIA 49 growth estimates are roughly in line with other WRIA-wide growth estimates reviewed as part of this study. It is also notable that the overall range of subbasin-specific growth rates (around 5 to 30 percent) is consistent the overall range of growth scenarios suggested by other data/methods. Because of this, and because permit-exempt well impact quantification/mitigation is happening at the WRIA-scale, growth rates are applied uniformly across the subbasins as "scenarios", rather than applying different growth rates to different subbasins.

Selecting Growth Rates for the Study

The potential growth rates calculated or cited above span a wide range, from -6 percent (OFM low-growth scenario for Okanogan County population) to 29.3 percent (OFM high-growth scenario for Okanogan County population).

For the purposes of estimating potential permit-exempt well growth in this Study, the following growth rates are used:

- **Low-growth scenario: 6 percent**
  This is based on OFM's SAEP estimate for WRIA 49 total population change (5.7 percent) and on the OFM/Okanogan County medium growth scenario for population change for all of Okanogan County from 2019 to 2038 (7.2 percent), rounded to reflect uncertainty.

- **Medium-growth scenario: 10 percent**
  This is based on Okanogan County SFDU building permit trend analysis (10 percent), the 2010 to 2019 OFM SAEP housing unit trends for WRIA 49 (9.6 percent), rounded to reflect uncertainty.
- **High-growth scenario: 30 percent**
  This a notably conservative estimate for planning purposes. It is based on OFM's high growth scenario population projections through 2038 for all of Okanogan County (29.3 percent) as well as the maximum subbasin-level 20-year SAEP block group-based estimate (29.4 percent, for Antoine-Whitestone-Upper Okanogan), rounded to reflect uncertainty.

Figure 3. Summary of Growth Rate Projections from Various Sources and Methods

Source/Method	20-year Rate
Okanogan Co. **OFM 2038 Population** - (**Low**-growth)	-6.0%
Okanogan Co. **OFM 2038 Population** - (**Med**-growth)	7.2%
Okanogan Co. **OFM 2038 Population** - (**High**-growth)	29.3%
WRIA 49 OFM **Block Group Occupied Housing Units (2000 to 2019)**	11.5%
OFM April 1st Est. for Housing Units in Unincorporated Okanogan Co. **(2010 to 2019, carried forward)**	13.9%
WRIA 49 OFM **Block Group Housing (2010 to 2019, carried forward)**	9.6%
WRIA 49 **OFM Block Group Population (2000 to 2019)**	5.7%
Trend from **2010 to 2018 SFDU Building Permits**	10%
OVERALL AVERAGE	10%

This Study:

LOW SCENARIO: 6%

MED SCENARIO: 10%

HIGH SCENARIO: 30%

Table 5. Estimated Number of New Permit-Exempt Well Connections by Growth Scenario

Subbasin	Estimated Current Number of Permit-Exempt Well Connections	6% Growth Scenario: New Permit-Exempt Well Connections by 2038	10% Growth Scenario: New Permit-Exempt Well Connections by 2038	30% Growth Scenario: New Permit-Exempt Well Connections by 2038
Antoine-Whitestone (Upper Okanogan)	1,730	104	173	519
Bonaparte-Johnson (Middle Okanogan)*	2,559	154	256	768
Loup Loup-Swamp (Lower Okanogan)*	1,058	63	106	317
Salmon Creek	324	19	32	97
Similkameen	286	17	29	86
Total*	**5,957**	**357**	**596**	**1,787**

Notes: *excluding areas in CTCR reservation lands.

Buildout Analysis

In the context presented here, a buildout assessment is a parcel-scale quantification of possible future residential development based on zoning-based restrictions (e.g., minimum lot size), existing development on a given parcel, current parcel ownership (e.g., federal), conservation easements, and other practical or physical constraints on future development. It is meant to quantify how many residences *could* reasonably be added in a given area. Buildout is not a prediction or projection—nor should it be used as such. In this Study, buildout potential was considered as a possible limit on the 20-year development projection in each basin.

The results of Aspect's buildout analysis (see Table 6, below) were generally consistent with a similar analysis conducted by The Okanogan County Office of Planning and Development in 2019. The buildout potential of WRIA 49 is orders of magnitude greater than even the high-growth scenario of 30 percent—and is not a constraint on the 20-year forecast(s) in this Study, at the WRIA or subbasin level.

Table 6. High Growth Exempt Well Estimate Compared to Buildout

		Developable Lands Outside of Existing Public Water Service Areas	
Subbasin	**2038 High-growth Projection for New Exempt Well Parcels**	**Number of Existing Undeveloped Developable Parcels**	**Buildout Lots (subdivision on presently undeveloped lots)**
Antoine-Whitestone (Upper Okanogan)	519	3,396	29,106
Bonaparte-Johnson (Middle Okanogan)*	768	3,909	56,985
Loup Loup-Swamp (Lower Okanogan)*	317	1,938	47,768
Salmon Creek	97	394	5,096
Similkameen	86	744	16,693
Total*	**1,787**	**10,381**	**155,648**

Notes: *excluding areas in CTCR lands.

Outdoor Water Use Estimates

Outdoor water use (namely, lawn and garden irrigation) typically accounts for the majority of *consumptive* use at single-family domestic residence. Per *ESSB 6091 - Recommendations for Water Use Estimates*, the calculation for Household Consumptive Outdoor Water Use is found by:

1. Using the Washington Irrigation Guide (WAIG) to find the Net Irrigation Water Requirement for pasture/turf (IWRnet) for a nearby, representative station. **The Omak station was used in this analysis, with a Net Irrigation Water Requirement of 26.89 inches per year for pasture/turf.**

2. Multiplying this value for IWRnet (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:

$$\frac{IWR_{net}\ (26.89\frac{in}{yr})\ \times Irrigated\ Area}{Application\ Efficiency\ (75\%)} = Total\ Outdoor\ Water\ Use$$

and:

$$Total\ Outdoor\ Water\ Use \times \%\ Consumptive\ (80\%) = Outdoor\ Consumptive\ Water\ Use$$

Average Lawn Size/Irrigated Area Analysis

Using GIS, Aspect conducted an aerial photo-based analysis on 508 parcels across all WRIA 49 subbasins. These 508 parcels represented 18 percent of the total set of "indicator parcels" in WRIA 49, which were defined as parcels meeting the following criteria:

- Parcels with residential development (per assessor and building permit databases, as described previously in this memo)

- Parcels falling outside the boundary of public water system service areas

- Parcels not in the fee rolls/service areas of irrigation districts

- Parcels not covered by irrigation water right places of use (from Ecology's GWIS database)

"Indicator parcels" were defined as residential parcels that are likely receiving water from permit-exempt wells *that do not have a separate source of irrigation water*. There were total 2,874 parcels in WRIA 49 meeting these criteria[23].

After identifying the total sample set of indicator parcels matching the above criteria in WRIA 49, 18 percent of these parcels[24] were selected at random[25] *from within each* of the twelve 12th-digit United States Geological Survey (USGS) Hydrologic Unit Codes (HUCs) in the WRIA[26]. This selection method was used to ensure an even geographical distribution of parcels for review. The location of these parcels can be seen in Figure 4 (attached).

Each of the selected parcels was reviewed visually using GIS software, inspecting and comparing aerial images from the National Agriculture Imagery Program (NAIP) for the years 2011, 2013, 2015, and 2017. Areas that showed clear, visible signs of irrigation (chiefly, bright green areas set apart from dry, brown, grassy areas) were delineated. All clearly indefinable larger-scale agricultural activity was excluded, as was any unmaintained pasture or field areas and native landscape/forest. Homes with no visible or obvious irrigated footprint were tracked as such, with a value of zero irrigated acres counting towards the overall average.

Figure 5 (below) show a selection of the irrigated area delineations. The identified irrigated acreage is outlined in yellow and the parcel boundaries are shown as white lines.

Figure 5. Example Irrigated Area Delineations

[23] 2,874 is just under half of the total number of estimated exempt well-connected parcels in WRIA 49, suggesting that about half of all exempt well parcels in the WRIA have separate sources of irrigation water.
[24] This yields a 95% confidence level with less than 4% margin of error.
[25] Using the "random selection within subsets" algorithm in QGIS
[26] At the time this analysis was conducted, the WRIA 49 Planning Unit had not yet divided the WRIA into six subbasins used for the purposes of the Plan Update.

The results of the analysis are shown in Table 7 (below). **The overall average outdoor irrigation footprint of the 508 parcels was 0.14 acres**. The deviation between the subbasins from this overall average is modest (ranging from 0.10 acres for Salmon Creek to 0.16 acres for Loup Loup-Swamp). Thus, the overall average was used in the calculation of outdoor water use estimates for new permit-exempt well in all subbasins[27].

Table 7. Average Outdoor Irrigation Acreage Estimates by Subbasin

	Average Estimated Irrigated Area (acres)	Number of Parcels Reviewed
Antoine-Whitestone (Upper Okanogan)	0.12	170
Bonaparte-Johnson (Middle Okanogan)	0.15	219
Loup Loup-Swamp (Lower Okanogan)	0.16	91
Salmon Creek	0.10	17
Similkameen	0.12	11
Overall	**0.14**	**508**

Total and Consumptive Outdoor Water Use

Using the values presented above (0.14 acres irrigated per residence, 26.89 inches per year net irrigation water requirement for pasture/turf, 75% application efficiency, 80% consumptive use), Aspect calculated a **per-permit-exempt well connection outdoor consumptive water use of 299 gallons per day (gpd)/0.34 acre-feet per year (afy)** and a total outdoor water use of 373 gpd/0.42 afy.

Indoor Water Use Estimates

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) was taken directly *from ESSB 6091 - Recommendations for Water Use Estimates*[28]. Using the US Census Bureau's estimate of 2.55 persons per household (2014-2018) for Washington State[29], this equates to 153 gallons per day of total indoor water use (0.17 afy).

Based on the assumption that homes with permit-exempt wells are also on septic systems (as opposed to sewer), Ecology guidance suggests that indoor water use is 10 percent consumptive (90 percent return to the ground via septic systems). Therefore, **the consumptive indoor water use estimate per-exempt well connection (residence) is 15 gpd (or 0.017 afy).**

[27] Aspect also looked at whether there was a statistically significant relationship between parcel characteristics (e.g., lot size and land and/or improvement values) and outdoor irrigation and no meaningful correlation seems to exist. Additionally, Aspect calculated the average irrigated areas for parcels falling withing either areas of unconsolidated (alluvial aquifer) or consolidated (bedrock aquifer) surficial geology. Homes in the low-lying alluvium/valley floors had larger irrigated areas, at about 0.16 acres, while homes at higher elevations (bedrock) had smaller areas, with about 0.10 acres irrigated. This difference is not easily applied to future permit-exempt well consumptive use estimates, since those estimates are not segregated by surficial geology.
[28] This guidance document itself cites a 2016 study by the Water Research Foundation (DeOreo, et al., 2016)
[29] https://www.census.gov/quickfacts/WA

Total Consumptive Use Estimates for New Permit-Exempt Well Connections by Subbasin

The outdoor and indoor water use estimates outlined above suggest a *total* water use for each permit-exempt well connection of 0.59 afy (526 gpd) **with 0.35 afy (314 gpd) of that being consumptive water use**.

These numbers can be multiplied by the estimated number of new permit-exempt wells in a given growth scenario/subbasin to establish the total amount of water needed for water and non-water offset (i.e., NEB contributing) projects in WRIA 49, by subbasin.

Exclusion of Duck Lake Aquifer Groundwater Area

Parcels within the Duck Lake Groundwater Management Subarea (as defined in WAC 173-132-010)[30], which falls completely within the Bonaparte-Johnson (Middle Okanogan) subbasin, north of Omak (see Figure 1, attached), were excluded from the final tally and 20-year forecast of permit-exempt wells. This area has been the subject of a previous water right adjudication. Mitigation is currently available through the Okanogan Irrigation District. As such, future self-supplied parcels in this area are not counted for the purpose of mitigation planning in the Plan Update.

Based on a comparison between the Okanogan County parcel GIS and a shapefile (provided by the County) there are 303 total parcels in the Duck Lake Groundwater Management Subarea, 180 of which are developed as residences (and likely self-supplied with permit-exempt wells).

Results

Table 8 (below) shows the estimated consumptive use impacts in each WRIA 49 subbasin for the three selected growth scenarios over the 20-year planning horizon (through 2038). The range of estimated impacts is between 122 afy (0.168 cubic feet per second (cfs)) and 607 afy (0.837 cfs) additional consumptive water use from new permit-exempt well connections in WRIA 49 (excluding the Duck Lake Aquifer Groundwater Subarea and CTCR lands).

[30] https://apps.leg.wa.gov/WAC/default.aspx?cite=173-132

Table 8. Total Consumptive Water Use Impact by Growth Scenario

Subbasin	Estimated Current Number of Permit-Exempt Well Connections *(not on CTCR lands)*	*6% Growth (Low Scenario)*		*10% Growth (Medium Scenario)*		*30% Growth (High Scenario)*	
		New Permit-Exempt Well Connections	Consumptive Water Use Impact (afy)[1]	New Permit-Exempt Well Connections	Consumptive Water Use Impact (afy)[1]	New Permit-Exempt Well Connections	Consumptive Water Use Impact (afy)[1]
Loup Loup-Swamp (Lower Okanogan)	1,058	63	**22.2**	106	**37.3**	317	**111.6**
Omak Creek	0	0	**NA**	NA	**NA**	NA	**NA**
Salmon Creek	324	19	**6.7**	32	**11.2**	97	**34.1**
Bonaparte-Johnson (Middle Okanogan)[2]	2,379	143	**50.3**	238	**83.7**	714	**251.3**
Antoine-Whitestone (Upper Okanogan)	1,730	104	**36.6**	173	**60.9**	519	**182.7**
Similkameen	286	17	**6.0**	29	**10.2**	86	**30.3**
TOTAL	**5,777**	346	**122**	578	**203**	1,733	**607**

[1]Based on a per-permit exempt well connection consumptive water use estimate of 0.017 afy indoor and 0.335 afy outdoor
[2]Excludes the Duck Lake Aquifer Area

Table 9 (attached) includes additional breakdowns of estimated indoor and outdoor water use impacts (both total and consumptive use) for the three growth scenarios.

For the purposes of quantifying forecasted impacts on instream flows associated with permit-exempt well growth and the identification of water and non-water offset projects for Chapter 90.94 RCW offset, **Aspect recommends adopting the Medium-growth scenario as the most likely (203 afy consumptive impact)**.

The Medium-growth scenario rate of 10 percent is consistent with the overall average of all growth rates reviewed in this study (see Figure 3, above). Additionally, it is consistent with the growth rate derived from Okanogan County Planning and Development's analysis of building permit trends in WRIA 49. Since offset planning/quantification is happening at the WRIA-scale, the overall average for Medium-growth is the most defensible planning number considering the relatively narrow range of results using the five approaches detailed above.

Figure 6 (attached) displays the estimated consumptive use impacts by subbasin for the Medium-growth scenario.

Notable Sources of Uncertainty and Conservatism in Estimates

Different components of the estimates in this study incorporate varying degrees of uncertainty. Where possible, this Study has conservatively (over-) estimated future consumptive use demand from permit-exempt wells. These considerations have been noted in prior sections of this report—but key sources of uncertainty and the effect on the overall estimates are summarized below.

- **Occupied housing units vs. total housing units:** OFM data indicate (see Table 3) that there is a notable difference in the number of total housing units in WRIA 49 (15,024) vs. the number of housing units that are occupied full-time (12,032)—an occupancy rate of about 80 percent. The lower number is more in line with the parcel-based estimate of current housing units developed for this Study (12,598), but that may have more to do with the exclusion of CTCR lands than dwelling occupancy.

  For the purposes of estimating current and future water use, all residences/housing units/dwellings have been assumed to be occupied full-time. However, this is almost certainly not the case. Adjusting for estimated occupied residences would reduce the overall demand estimate. Additionally, given that it is suggested in the data that there is a housing surplus in WRIA 49, it could be assumed that some portion of future population growth will be into *existing* residences (which have already been accounted for), rather than into new development.

- **County-wide growth vs. rural growth**: The high growth scenario rate (30 percent) is based on an Okanogan County-wide estimate (inclusive of urban areas and WRIA 48). However, a high rate of growth in Okanogan County is likely to be driven by urban growth (almost all of which would be covered by water system service areas)—with rural growth making up a smaller portion/percent. Again, this suggests that a 30 percent increase is likely to be a highly conservative overestimate for rural growth and, by extension, permit-exempt well growth.

- **Not all domestic water right permits accounted for**: The public water system service area boundaries used to identify parcels that are supplied by permitted sources (chiefly, Group A and larger Group B water systems) is not inclusive of every domestic water right permit in WRIA 49. It is reasonable to assume that some number of parcels outside these service area boundaries have domestic water supplies tied to water rights. Thus, the estimate of current (and by extension) and future parcels served by permit-exempt wells in WRIA 49 could be a slight overestimate.

- **High percentage of homes in WRIA 49 have separate sources of irrigation water**: The consumptive use forecast presented in the memo assumes that all new permit-exempt well connections will be used for water both indoors and outdoors. However, based on a GIS overlay analysis, perhaps as many as half of the total permit-exempt well residences/parcels in Okanogan County are within irrigation water right places of use and/or irrigation district services areas. Presuming that some number of future permit-exempt wells will also receive irrigation water from permitted sources would reduce the overall demand estimate.

- **Equal growth rate assumed in all subbasins**: The analysis of OFM SAEP census block group GIS data between 2000 and 2019 shows that the past 20 years have seen inconsistent population/well growth rates across the subbasin areas of WRIA 49 (See Table 4). While it

seems most likely that the overall WRIA 49 growth rate will track closely with the Medium-growth scenario, the Low-growth (6 percent) and High-growth (30 percent) rates appear to be reasonable upper and lower estimates on the increase of permit-exempt well connection in any given subbasin through 2038. This uncertainty could be addressed with improved tracking of new permit-exempt wells in WRIA 49/Okanogan County coupled with adaptive management approaches in the Watershed Plan Update.

Limitations

Work for this project was performed for Okanogan County (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.

All reports prepared by Aspect Consulting for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect Consulting. Aspect Consulting's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

Attachments: Table 1 – WRIA 49 Public Water Systems
Table 9 – Water Use Impacts (Detail) by Growth Scenario
Figure 1 – WRIA 49 Subbasins
Figure 2 – Public Water System Service Areas and Distribution of Current Exempt Well Parcels
Figure 4 – Distribution of Parcels Reviewed for Outdoor Irrigation Analysis
Figure 6 - Estimated Consumptive Use Impacts by Subbasin

V:\190259 WRIA 49 Watershed Planning Support\Deliverables\Watershed Plan Addendum\Final\Appendix A\App A_Future Exempt Well Demand_Final.docx

TABLES

Table 1. WRIA 49 Public Water Systems - Group A and Large Group B (with greater than 6 connections)

Evaluation of Future Exempt Well Demand - WRIA 49 RCW 90.94 Streamflow Restoration Plan Addendum (190259)

Water System Name	Water System ID	System Group	System Type	GIS Service Area Boundary Source	Residential Connections	Full-time Residential Population	Maximum Total Population	Total System Connections	Number of Active Sources
OMAK CITY OF	63750	A	Comm	DOH GIS	2,159	4,925	4,925	2,471	7
OROVILLE CITY OF	64400	A	Comm	DOH GIS	1,447	2,384	3,327	1,663	5
OKANOGAN WATER DEPARTMENT CITY OF	63200	A	Comm	Water System Plan	1,012	2,571	3,072	1,224	4
BREWSTER CITY OF	08300	A	Comm	DOH GIS	688	2,354	3,235	903	4
TONASKET WATER SYSTEM	88700	A	Comm	DOH GIS	474	1,110	2,392	602	8
BREWSTER FLAT DOMESTIC WATER ASSN	08290	A	Comm	WR POU (GWIS)	189	514	542	190	5
DUCK LAKE WATER ASSOCIATION	20200	A	Comm	DOH GIS	130	262	272	131	4
SUNCREST PLAT WATER SYSTEM	85207	A	Comm	DOH GIS	113	253	253	113	3
RIVERSIDE TOWN OF	72850	A	Comm	City Limits	111	349	349	116	2
SANDFLAT WATER ASSOCIATION	09064	A	Comm	WR POU (GWIS)	104	260	260	104	2
JAW FARMS INC	08246	A	Comm	WR POU (GWIS)	96	124	330	96	2
COLEMAN BUTTE WATER ASSN	13940	A	Comm	--	96	250	250	96	3
LOOMIS WATER USERS ASSN INC	48200	A	Comm	City Limits	82	200	225	93	3
PROGRESSIVE FLAT WATER ASSN	69650	A	Comm	DOH GIS	72	150	249	73	1
ASTON ESTATES	09066	A	Comm	DOH GIS	59	141	141	59	5
RIVER ROAD MOBILE HOME PARK	17631	A	Comm	WR POU (GWIS)	55	150	150	55	2
PINECREST SUBDIVISON OWNERS	13909	A	Comm	WR POU (GWIS)	47	63	63	47	1
CRUMBACHER ESTATES WATER SYSTEM	13916	A	Comm	WR POU (GWIS)	44	100	101	44	3
M J TRAILER RANCH	49515	A	Comm	WR POU (GWIS)	44	100	100	44	4
HOMESTEAD MOBILE HOME PARK	01576	A	Comm	DOH GIS	43	150	150	43	2
OLD ORCHARD ESTATES WATER SYSTEM	07748	A	Comm	WR POU (GWIS)	27	56	66	29	3
EASTLAKE WATER ASSOCIATION	26707	A	Comm	WR POU (GWIS)	27	35	65	27	3
JOHNSON CREEK WATER USERS ASSN	39411	A	Comm	WR POU (GWIS)	27	48	48	27	3
VISTA VUE WATER USERS ASSN	20226	A	Comm	WR POU (supporting docs)	21	60	60	22	1
P AND G ORCHARDS CAMP 2	07870	A	Comm	DOH GIS	21	116	489	21	2
EMANUEL HEIGHTS WATER SYSTEM	26916	A	Comm	DOH GIS	21	60	60	21	1
MANY LAKES MOBILE HOME PARK	04670	A	Comm	--	14	37	37	14	1
Valley View Estates Water System	06321	A	Comm	Parcel boundaries	11	28	28	11	1
Buckingham Water System	AD637	A	Comm	--	4	32	32	4	1
PINE CREEK HOUSING	07319	A	NTNC	--	3	10	64	4	3
MOLSON WATER USERS	55630	A	TNC	City Limits	22	12	13	22	1
ORO BEACH RV RESORT	06475	A	TNC	Parcel boundaries	21	0	13	34	1
Gold Digger Orchards (North Co.) #2	AA387	A	TNC	--	18	6	66	19	1
Lazy Daze Water Association	86273	A	TNC	--	16	8	29	17	1
P AND G ORCHARDS CAMP 3	07871	A	TNC	--	16	18	152	16	1
CUSTOM ORCHARD 1	07993	A	TNC	--	8	18	42	8	1
Monse-Riggan Camp	AC141	A	TNC	--	8	2	943	8	3
SONORA POINT RESORT	70792	A	TNC	--	6	1	5	55	1
PALMER LAKE LAND COMPANY	08259	A	TNC	--	6	14	54	8	1
SUN COVE WATER SYSTEM	85125	A	TNC	DOH GIS	4	6	49	41	2
BONAPARTE LAKE RESORT	07634	A	TNC	--	2	1	104	7	1
NCSB	FS665	A	TNC	--	2	3	71	5	2
SPECTACLE LAKE RESORT	82935	A	TNC	--	1	4	37	55	2
LIARS COVE	47095	A	TNC	--	1	2	73	40	1
CONCONULLY STATE PARK	SP170	A	TNC	--	1	2	1,004	36	2
SHADY PINES RESORT	77775	A	TNC	--	1	0	62	31	1
OROVILLE CONG.OF JEHOVAHS WITNESSES	02479	A	TNC	--	1	0	51	2	1
OROVILLE GOLF CLUB	27691	A	TNC	DOH GIS	1	1	201	2	1
SIT N BULL SALOON	38740	A	TNC	--	1	2	76	2	1
OUR LADY OF VALLEY CATHOLIC CHURCH	41522	A	TNC	--	1	1	60	2	1
APPLEWAY MOBILE HOME PARK	00603	B	GRPB	DOH GIS	14	24	24	14	1
OK RANCH INC	07358	B	GRPB	DOH GIS	14	1	13	14	1
Sunrise Acres Mobile Home Park	30891	B	GRPB	--	14	20	20	14	1
BJS MOBILE HOME COURT WATER SYSTEM	41703	B	GRPB	--	14	21	21	14	1
TWIN PINES MOBILE HOME PARK	31790	B	GRPB	--	13	20	20	13	1
DON S MOBILE HOME COURT	47840	B	GRPB	--	12	24	24	12	2
Overlook at Silver Spur	AC758	B	GRPB	WR POU (GWIS)	11	1	1	11	1
COPPLE ROAD WATER SYSTEM	03921	B	GRPB	--	9	10	11	12	1
FAIRWAY ACRES 3RD ADDITION	00157	B	GRPB	--	9	23	23	9	1
SUMMER WIND WATER SYSTEM	03473	B	GRPB	--	9	23	23	9	1
WESTVUE RANCHETTES #1	04506	B	GRPB	--	9	17	17	9	1
WESTVUE RANCHETTES #2	17624	B	GRPB	--	9	13	13	9	1
KING-BOND WATER USERS	30236	B	GRPB	--	9	23	23	9	1
PEONY CREEK WATER USERS	34193	B	GRPB	--	9	23	23	9	1
Mt Gardner Heights	AC554	B	GRPB	--	9	1	1	9	1
CHESAW WATER ASSN #1	08379	B	GRPB	--	8	18	53	9	1
CHESAW WATER ASSN #2	08380	B	GRPB	--	8	18	24	9	1
FOGGY RIVER WATER SYSTEM	08438	B	GRPB	--	8	24	24	8	1
SUNRISE HEIGHTS WATER SYSTEM	51881	B	GRPB	--	8	20	20	8	1
Horizon Estates II	AB262	B	GRPB	--	8	1	1	8	1
Drunkin Rooster Water Assn	AB501	B	GRPB	--	8	1	1	8	1
Duck Lake Properties	AC586	B	GRPB	--	8	1	1	8	1
WESTVUE RANCHETTES #3	05524	B	GRPB	--	7	18	18	7	1
DUNCKEL TRAILER PARK #1	20461	B	GRPB	--	7	18	18	7	1
Vista View Homeowners Assn	AB845	B	GRPB	--	7	7	7	7	1
Columbia River Vista Estates LLC	AC682	B	GRPB	--	7	1	1	7	1
BIRCH SPRING WATER USERS	07100	B	GRPB	WR POU (GWIS)	6	15	15	6	1
KINCAID WATER SYSTEM	01337	B	GRPB	WR POU	4	14	14	4	1
HIDDEN HILLS GUEST RANCH	34522	B	GRPB	WR POU (GWIS)	2	3	8	12	1
MUNCE WATER SYSTEM	51799	B	GRPB	WR POU (GWIS)	2	5	5	2	1
				Totals:	***7,640***	***17,401***	***24,907***	***9,034***	***146***

Table 9. Water Use Impacts (Detail) by Growth Scenario

Evaluation of Future Exempt Well Demand - WRIA 49 RCW 90.94 Streamflow Restoration Plan Addendum (190259)

		6% Growth (Low Scenario)					
		Total Water Use (afy)			*Consumptive Water Use (afy)*		
Subbasin	**New Permit-Exempt Well Connections**	Indoor *(0.17 afy per dwelling)*	Outdoor *(0.42 afy per dwelling)*	**Total**	Indoor *(0.017 afy per dwelling)*	Outdoor *(0.335 afy per dwelling)*	**Total**
Loup Loup-Swamp (Lower Okanogan)*	63	10.7	26.5	37.2	1.1	21.1	22.2
Salmon Creek	19	3.2	8.0	11.2	0.3	6.4	6.7
Bonaparte-Johnson (Middle Okanogan)*	143	24.3	60.1	84.4	2.4	47.9	50.3
Antoine-Whitestone (Upper Okanogan)	104	17.7	43.7	61.4	1.8	34.8	36.6
Similkameen	17	2.9	7.1	10.0	0.3	5.7	6.0
TOTAL	**346**	**59**	**145**	**204**	**6**	**116**	**122**

		10% Growth (Medium Scenario)					
		Total Water Use (afy)			*Consumptive Water Use (afy)*		
Subbasin	**New Permit-Exempt Well Connections**	Indoor *(0.17 afy per dwelling)*	Outdoor *(0.42 afy per dwelling)*	**Total**	Indoor *(0.017 afy per dwelling)*	Outdoor *(0.335 afy per dwelling)*	**Total**
Loup Loup-Swamp (Lower Okanogan)*	106	18.0	44.5	62.5	1.8	35.5	37.3
Salmon Creek	32	5.4	13.4	18.8	0.5	10.7	11.2
Bonaparte-Johnson (Middle Okanogan)*	238	40.5	100.0	140.5	4.0	79.7	83.7
Antoine-Whitestone (Upper Okanogan)	173	29.4	72.7	102.1	2.9	58.0	60.9
Similkameen	29	4.9	12.2	17.1	0.5	9.7	10.2
TOTAL	**578**	**98**	**243**	**341**	**10**	**194**	**203**

		30% Growth (High Scenario)					
		Total Water Use (afy)			*Consumptive Water Use (afy)*		
Subbasin	**New Permit-Exempt Well Connections**	Indoor *(0.17 afy per dwelling)*	Outdoor *(0.42 afy per dwelling)*	**Total**	Indoor *(0.017 afy per dwelling)*	Outdoor *(0.335 afy per dwelling)*	**Total**
Loup Loup-Swamp (Lower Okanogan)*	317	53.9	133.1	187.0	5.4	106.2	111.6
Salmon Creek	97	16.5	40.7	57.2	1.6	32.5	34.1
Bonaparte-Johnson (Middle Okanogan)*	714	121.4	299.9	421.3	12.1	239.2	251.3
Antoine-Whitestone (Upper Okanogan)	519	88.2	218.0	306.2	8.8	173.9	182.7
Similkameen	86	14.6	36.1	50.7	1.5	28.8	30.3
TOTAL	**1,733**	**295**	**728**	**1,022**	**29**	**581**	**610**

Excludes the Duck Lake Aquifer Area and CTCR lands

FIGURES

WRIA 49 Subbasins

WRIA 49 RCW 90.94 Streamflow Restoration Plan Addendum
Okanogan County, WA

Aspect CONSULTING	JUL-2020	BY: PPW	FIGURE NO. 1
	PROJECT NO. 190259	REVISED BY: ---/---	

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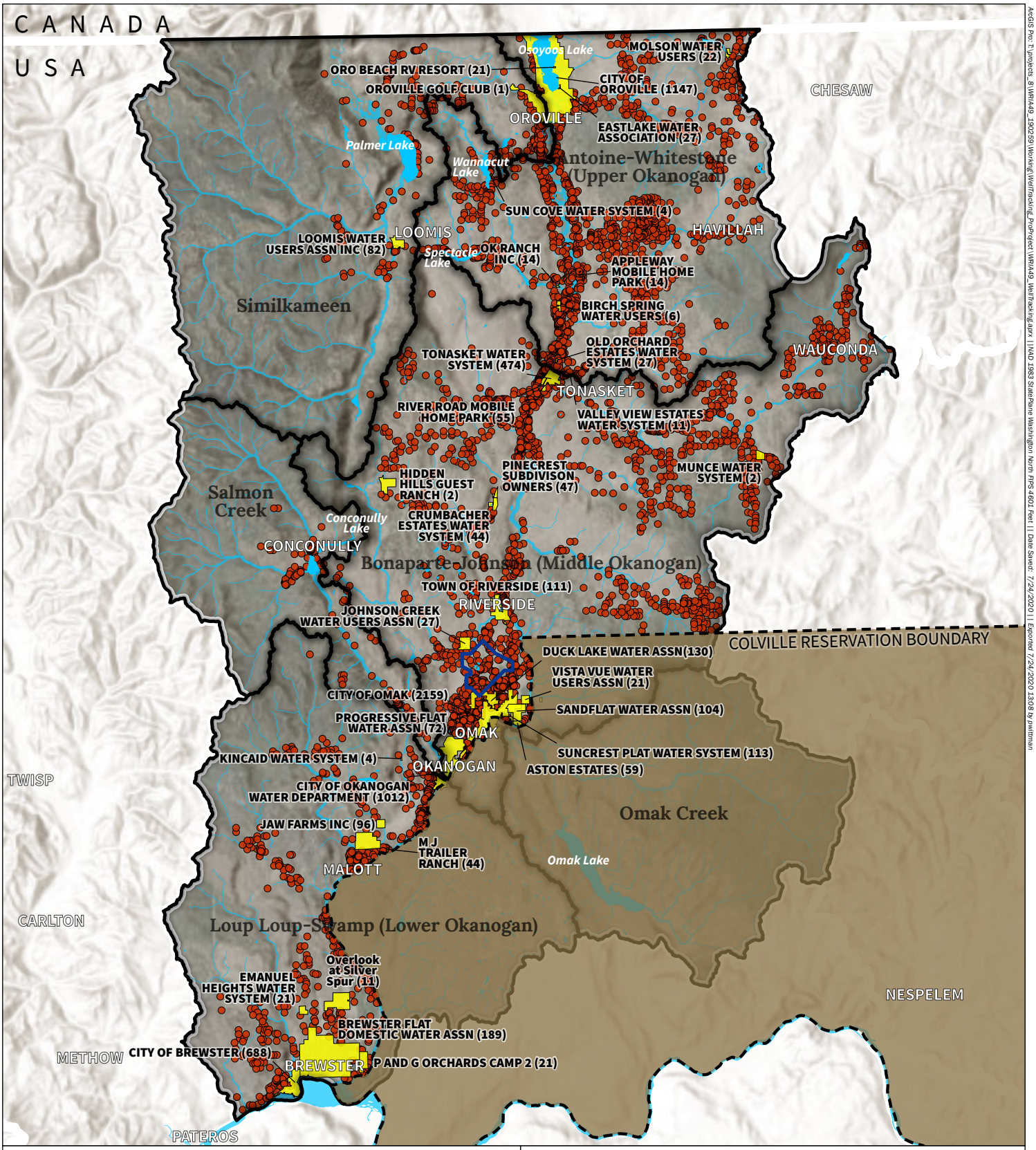

Estimated Permit-Exempt Well Parcel (centroid)

Public Water Service Area Boundary*

Duck Lake Aquifer Area

Colville Reservation

WRIA 49 Subbasins

N

0 20,000 40,000 Feet

1:500,000
(1 inch equals 41,667 feet)

***Note:** Only water systems with one or more residential connection are shown. Not all service area boundaries have been delineated (see Table 1).*

Public Water System Service Areas and Distribution of Current Exempt Well Parcels in WRIA 49

WRIA 49 RCW 90.94 Streamflow Restoration Plan Addendum
Okanogan County, WA

Aspect CONSULTING	JUL-2020	BY: PPW	FIGURE NO. 2
	PROJECT NO. 190259	REVISED BY: ---/---	

Data source credits: None | | Basemap Service Layer Credits: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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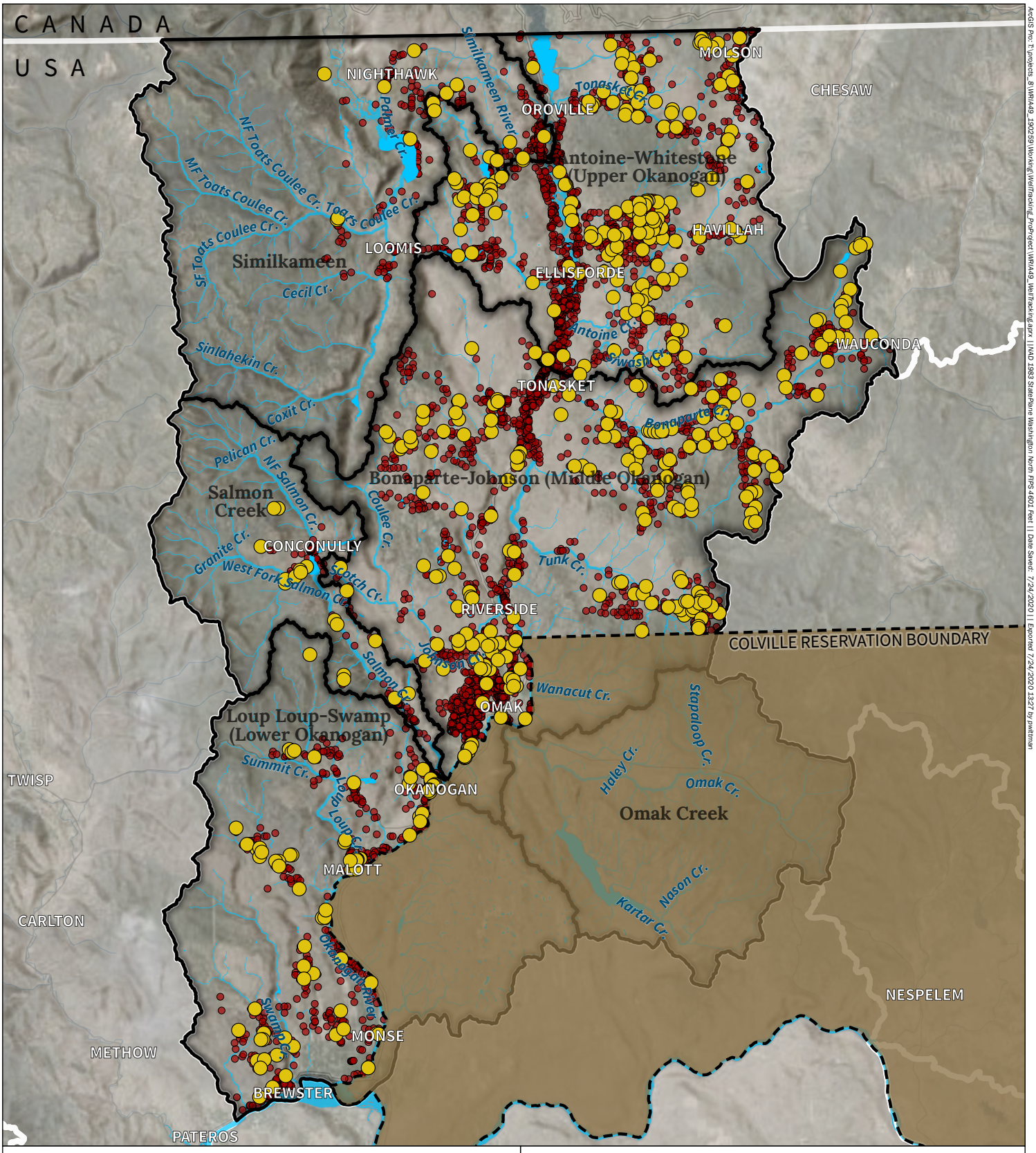

Estimated Permit-Exempt Well Parcel (centroid)

Location of Parcel Reviewed in Outdoor Irrigation Analysis

Colville Reservation

WRIA 49 Subbasins

N

0 20,000 40,000 Feet

1:500,000
(1 inch equals 41,667 feet)

Distribution of Parcels Reviewed for Outdoor Irrigation Analysis

WRIA 49 RCW 90.94 Streamflow Restoration Plan Addendum
Okanogan County, WA

Aspect CONSULTING	JUL-2020	BY: PPW	FIGURE NO. 4
	PROJECT NO. 190259	REVISED BY: ---/---	

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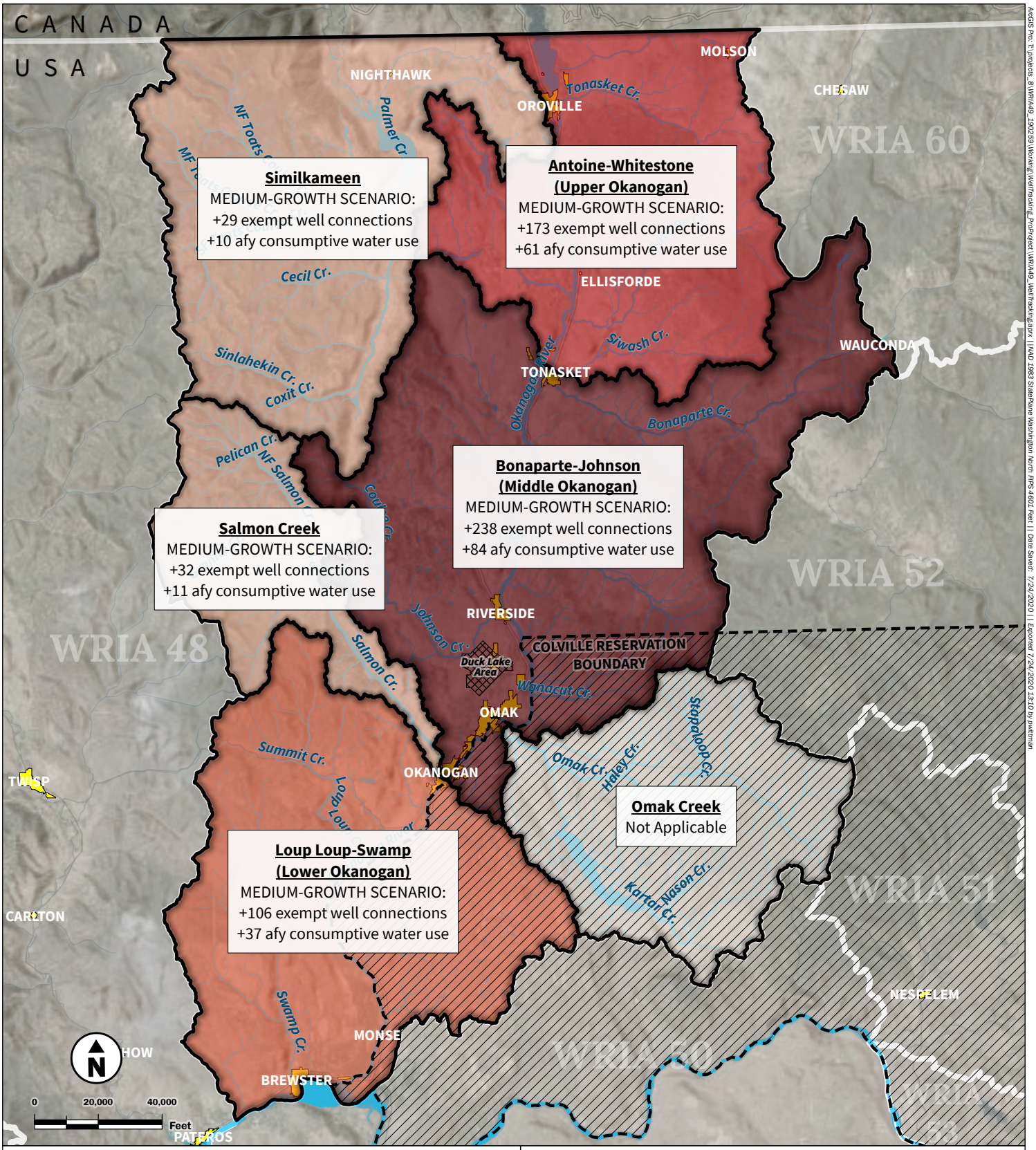

20-year Forecasted Consumptive Use Demand from New Permit-Exempt Well Connections (medium-growth scenario)

- 0 (NA/Reservation)
- ≤11 afy (Salmon and Similkameen)
- ≤37 afy (Lower)
- ≤61 afy (Upper)
- ≤90 afy (Middle)

- Duck Lake Aquifer Area
- WRIA49 Subbasins
- Towns
- Colville Reservation

Estimated Consumptive Use Impacts by Subbasin

WRIA 49 RCW 90.94 Streamflow Restoration Plan Addendum
Okanogan County, WA

Aspect Consulting	JUL-2020	BY: PPW	FIGURE NO. 6
	PROJECT NO. 190259	REVISED BY: ---/---	

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APPENDIX B

Technical Memo on

Identified Projects and

Basins

MEMORANDUM

Project No. 190259

October 1, 2020

To: Angela Hubbard, Okanogan County Office of Planning & Development

From:

Tyson D. Carlson, LHG, CWRE
Senior Associate Hydrogeologist
tcarlson@aspectconsulting.com

Re: **Summary of Subbasin Assessments and Project Identification**
WRIA 49 Chapter 90.94 RCW Streamflow Restoration Plan Addendum

Introduction

The passage of Engrossed Substitute Senate Bill (ESSB) 6091, as codified by Chapter90.94 Revised Code of Washington (RCW), requires that an update to the existing Watershed Plan for Water Resource Inventory Area (WRIA) 49, the Okanogan River Basin, be approved by the Washington Department of Ecology (Ecology) by February 1, 2021. Okanogan County Office of Planning & Development (Okanogan County) is serving as the lead agency for this process. The WRIA 49 Initiating Governments for the watershed planning process are Okanogan County, the City of Omak, and the Oroville-Tonasket Irrigation District. The process is supported by convening the WRIA 49 Planning Unit to review technical tasks and memorandums, policy decisions, and the pending watershed plan update. Aspect Consulting, LLC (Aspect) has been contracted by Okanogan County as technical lead, including attendance of planning unit meetings, conducting supporting technical tasks, and preparation of the Streamflow Restoration Plan Addendum.

Chapter 90.94 RCW require projects be identified to offset potential impacts to instream flows associated with estimated permit-exempt well use over a 20-year horizon.[1]

RCW 90.94.020(b) defines offset project priorities:

- At a minimum, include actions that the planning units determine to be necessary to offset potential impacts to instream flows associated with permit-exempt domestic water use.

[1] In its GUID-2094:*Final Guidance for Determining Net Ecological Benefit*, Ecology noted that this 20-year planning horizon begins on January 19, 2018 (the date ESSB 6091 was signed into law). Publication 19-11-079, July 31, 2019.

- The highest priority recommendations include replacing the quantity of consumptive water use during the same time as the impact and in the same basin or tributary.
- Lower priority projects include projects not in the same basin or tributary and projects that replace consumptive water supply impacts only during critical flow periods.
- Non-water offset projects include projects such as aquatic habitat, fish passage, and water quality improvements that serve to supplement water-offset projects such that the overall plan meets the Net Ecological Benefit (NEB) standard required by Chapter 90.94 RCW.

Evaluation Process

Ecology is required to determine that actions identified in the watershed plan, after accounting for new projected uses of water over the subsequent 20 years, will result in a NEB[2] to instream resources within the WRIA.

In order to meet the requirements of RCW 90.94.020(b), the Planning Unit followed a streamlined five-step evaluation process, including the following:

1. Defining the 20-year permit-exempt well consumptive use impacts
2. Defining water-for-water projects at the watershed scale
3. Defining offset gaps in time and space at the subbasin scale
4. Define a list of NEB projects
5. Determine NEB, consensus recommendations on watershed plan update and Initiating Governments' approval

This memorandum is intended to serve the following purposes:

- To document the rationale for WRIA 49 subbasin delineation, including considerations of tributary restoration potential.
- To provide results of subbasin assessments completed to identify and evaluate potentially viable projects in WRIA 49, including both water and non-water offset projects that contribute to NEB.
- To provide descriptions of identified water and non-water offset projects to the WRIA 49 Planning Unit for review.
- To document WRIA 49 Planning Unit review of and concurrence with the proposed project list, prior to incorporating the selected projects into the addendum.

In evaluating NEB, the Planning Unit elected to use the Ecosystem Diagnosis and Treatment (EDT) Model previously developed for anadromous reaches of the mainstem and tributaries to the

[2]Ecology GUID-2094 defines NEB as: *"the outcome that is anticipated to occur through implementation of projects in a plan to yield offsets that exceed impacts within: a) the planning horizon; and, b) the relevant WRIA boundary."*

Okanogan River as a primary method to evaluate impacts of water offset restoration projects contributing to NEB. While EDT is not the sole method the Planning Unit used to evaluate NEB, it provides an important quantitative means to compare impacts of projected permit-exempt well use against proposals for restoration projects at the subbasin (and reach) scale. Results of EDT modeling are documented in the *Summary of NEB Analysis Methods and Results used for WRIA 49 Watershed Planning Memorandum* (Confluence, 2020)

Subbasin Delineation

Ecology's GUID-2094 stipulates minimum Chapter 90.94 RCW planning requirements, including delineation of subbasins. The guidance states:

> *"Planning groups must divide the WRIA into suitably-sized subbasins to allow meaningful analysis of the relationship between new consumptive use and offsets. Subbasins will help the planning groups understand and describe location and timing of projected new consumptive water use, location and timing of impacts to instream resources, and the necessary scope, scale, and anticipated benefits of projects. Planning at the subbasin scale will also allow planning groups to consider specific reaches in terms of documented presence (e.g., spawning and rearing) of salmonid species listed under the federal Endangered Species Act."*

To begin, the Planning Unit used the scheme employed by the U.S. Geological Survey (USGS) to classify the nation's watersheds into successively smaller units and catalog them by a unique identifier known as a Hydrologic Unit Code (HUC). HUCs consist of from two to eight digits identifying the hydrologic unit of interest and the greater watersheds or region that the hydrologic unit lies within. Smaller hydrologic units contain more digits in their HUC than larger ones because more detail is required to describe their hydrologic hierarchy. HUC boundaries are typically drawn based on topographic divides; however, larger hydrologic units can be subdivided by river reach.

Three HUC levels are important in WRIA 49: HUC-8 units include the entire Okanogan and Similkameen drainages located within Washington State, HUC-10 units include larger named tributaries to these two rivers, and HUC-12 units generally include subwatersheds of these tributaries that are often comprised of unnamed tributaries and intermittent streams.

Using the HUC delineation, the Planning Unit considered the following information when selecting planning subbasins:

- **Previous subbasins in 2006 Watershed Plan:** The five subbasins identified in the 2006 Watershed Plan were not grouped to consider water offset in tributaries of significance for ESA-listed salmonids. The Watershed Plan subbasins consisted of combinations of various HUC level hydrologic units covering the entire WRIA 49 area.
- **Suitability of using topographic divides for subbasin delineation:** During the December Planning Unit meeting and the TAG workshop, Aspect displayed the HUC scheme as it relates to WRIA 49 and also discussed the concept that groundwater flow does not always observe topographic divides in areas having thick unconsolidated sediments such as the Okanogan valley floor. This could affect how permit-exempt well withdrawals are debited among subbasins. While the Planning Unit acknowledged this, it concluded sufficient

information was not available to consider groundwater divides when delineating subbasins, and the Planning Unit decided to use HUC boundaries for planning subbasins.

- **Habitat potential and EDT modeling considerations:** The mainstem Okanogan and Similkameen rivers and several key tributaries comprise water bodies of significance to ESA-listed salmonids in WRIA 49. The EDT model generates an array of results useful for describing habitat potential for salmon and steelhead and identifying protection and restoration priorities. For the NEB analysis, the Planning Unit is evaluating a single EDT reporting metric, equilibrium abundance, also referred to as Neq. Neq is the theoretical population size that a given quantity and quality of habitat can support over time.
- **EDT Neq results** provides a useful means for evaluating the relative restoration potential of the different subwatersheds in WRIA 49. EDT characterizes restoration potential by comparing the performance for two different types of habitat scenarios, the template, or restoration ideal, and the patient, or current conditions. Subwatersheds with the largest template Neq for the target species have the greatest habitat potential. The larger the difference between the template and the patient Neq the greater the potential restoration gain. For example, Salmon Creek has an adult steelhead Neq of 321 under the Okanogan EDT template scenario and 117 under the most current patient scenario, translating to a potential restoration gain of 204 adult steelhead. Note, Omak Creek was not considered because the entire watershed is located on reservation lands of the Colville Confederated Tribes (CCT).

The Planning Unit used the EDT estimated restoration potential by HUC12 subwatershed to guide the definition of planning subbasins used in the WRIA 49 plan addendum. Each analysis subbasin includes at least one tributary or mainstem subwatershed with a potential restoration gain of 10 or more adult steelhead. Subbasin definition also considered the anticipated distribution of future domestic water demand and proposed streamflow restoration projects in WRIA 49.

WRIA 49 Planning Update Subbasins

Based on the above considerations, the Planning Unit identified the following planning subbasins for use in the Plan Addendum as shown in Figure 1:

- **Loup - Swamp (Lower Okanogan) –** This subbasin consists of two adjacent HUC-10 watersheds: Loup Loup Creek and Swamp Creek. These watersheds contain smaller creeks draining the region west of the mouth of the Okanogan River and south of the City of Okanogan.
- **Salmon Creek –** This subbasin consists of the HUC-10 Salmon Creek watershed, a tributary to the Okanogan River that drains the region west of the City of Okanogan and Omak. Salmon Creek discharges to the Okanogan River at Okanogan.
- **Bonaparte-Johnson (Middle Okanogan) –** This subbasin consists three HUC-10 watersheds including the Okanogan River and several steelhead-bearing tributary streams located on opposite sides of the mainstem. Bonaparte Creek drains the region east of Tonasket and discharges to the Okanogan River at Tonasket. Tunk Creek drains the region east of the Okanogan River and north of Riverside and the Omak Creek drainage. Tunk Creek discharges to the Okanogan River north of Riverside. Johnson Creek drains the

region east of Salmon Creek and west of the Okanogan River. Johnson Creek discharges to the Okanogan River at Riverside.

- **Antoine-Whitestone (Upper Okanogan) –** This subbasin consists of three HUC-10 watersheds that include the mainstem Okanogan River and several steelhead bearing tributaries located on opposite sides of the river. Antoine and Siwash creeks drain the region east of the Okanogan River and north of Tonasket and discharge to the river north of Tonasket. Tonasket Creek and Ninemile Creek drain the region east of the Okanogan River at Lake Osoyoos and discharges to the lake at and near Oroville, respectively. Whitestone and Aeneas creeks drain to the west side of the Okanogan River to the north and south of the City of Tonasket, respectively.
- **Similkameen –** This subbasin consists of the HUC-8 Similkameen River that originates in Canada and drains the Sinlahekin Creek region located north of the Salmon Creek drainage and west of the Whitestone drainage. The Similkameen discharges to the Okanogan River at Oroville.

By proximity, the mainstem Okanogan River is included by reference in each of the adjacent subbasins as noted above (i.e., lower, middle, upper), from the confluence with the Columbia River to the Canadian Border. Figure 2 also shows the anadromous fish zone and EDT model domain.

Subbasin Assessments and Background Information

To identify and evaluate potentially viable projects in WRIA 49, individual subbasin assessments were completed. The purpose of these assessments was to evaluate how much water is available for various types of water right acquisitions.

The assessment began with downloading the most recent version of Ecology's Geographic Water Information System (GWIS). Information contained in the database includes water right priority and location, and also major attributes including both instantiations and annual quantities, purpose of use, and place of use. Based on the delineation of subbasins (as described above), water rights were screened to identify the location and quantity of valid water rights that may be available to help offset future permit-exempt well consumptive use.

An ArcGIS project was developed to organize and cross-reference the water right database with the following data sources:

- HUCs (USGS)
- Okanogan County Tax Parcels (Okanogan County Assessor's Office)
- Aerial Imagery (USDA NAIP 2011, 2013, 2015, 2017)
- Publicly Owned Lands (Washington Recreation and Conservation Office [RCO] Lands Inventory)
- Public Utility District Boundaries (Ecology GWIS database)
- Group A Municipal service areas (Washington Department of Health)
- Irrigation District Boundaries (individual Irrigation Districts and Okanogan County)
- Surficial Geology (Washington Department of Natural Resources)

- Soil Types (USDA SSURGO Database)
- Stream reaches that are subject to closures under WAC 173-549
- Total Maximum Daily Loads (TMDL) listings (Ecology)
- Stream conditions and fish presence in the Columbia River Instream Atlas (Ecology, 2016)

The ArcGIS project containing the above data and water rights database was uploaded to the WRIA49 Subbasin Assessment Webmap.[3] Within the webmap, a query tool allows the user to export a table of the water right database filtered by subbasin, priority date, and/or purpose of use codes. The additional data for cross reference can be toggled on and off by the user for ease of comparison. Together with the aerial photos and other data provided on the webmap, the query tool provides the user a real-time basis of analysis to identify how much water associated with valid water rights is available in the subbasin for different types of offset projects.

The subbasin assessment was later refined with the rationale for subbasin delineation and the restoration potential of each tributary to identify potential water offset projects as described in the sections below. The online tool also provided the basis for ongoing Planning Unit discussion of project locations and type, included relative effectiveness whether it was a water offset project and/or a project contributing toward NEB.

Data and shapefiles included in the WRIA49 Subbasin Assessment Webmap are also included as an electronic attachment (i.e., thumb drive) to this document.

Solicitation of Project Proposals

At the December 5, 2019, Planning Unit meeting, Aspect presented the range of permit-exempt-well consumptive use estimates for the 20-year planning horizon, discussed potential alternatives for delineating subbasins, and solicited input from the Planning Unit for water and non-water offset (NEB contributing) projects. Confluence Environmental (Confluence) introduced the EDT model and discussed how it will be used to evaluate restoration projects for NEB. Following the meeting, Aspect provided email and hard copy Preliminary Project Proposal templates to Planning Unit members. The project templates prompted project sponsors to provide the following information about potential projects:

- General Project Description
- Water source for water offset projects (existing water right, groundwater, surface water)
- Quantity, timing, and location (tributary and mainstem reaches benefited)
- Factors contributing to NEB (instream flow benefit, fish habitat enhancement; channel, floodplain, or riparian restoration, etc.)
- Data gaps to identify unknowns about project benefits or implementation feasibility
- Cost estimates, if any are known, for study/design, construction, and operations/maintenance

[3] At the time of publication, the WRIA49 Subbasin Assessment Webmap is maintained at the following link: https://maps.aspectconsulting.com/wria_49/index.html

- Existing or potential sources of funding
- Mitigation requirements (i.e., is any portion of the project overlapping state or federal mitigation requirements)
- Potential barriers to project implementation (e.g., access to private property, permitting requirements, legal issues, operations and maintenance costs)
- Estimated time frame to completion

The initial deadline to return offset project templates was January 3, 2020, to allow most project proposals to be available for discussion at the Technical Advisory Group (TAG) workshop held on January 9-10, 2020. The TAG is a working group under the Planning Unit.

The two-day TAG workshop was an open meeting for members of the TAG and Planning Unit. The group was attended by a broad range of interests, including representatives from the County, Ecology, Non-Governmental Organizations (NGOs), Irrigation Districts, Landowners, and non-profit groups, such as the Farm Bureau.

Key elements of the workshop included discussion of project proposals received to date, solicitation and discussion of any new proposals, breakout discussion of project data gaps, preliminary slating of projects into Tier 1 and 2 projects (described below), and preliminary delineation of WRIA 49 planning subbasins. Tier 1 projects were designated based on meeting all three criteria:

1. Projects were proposed, contracted, or funded for construction after January 2018; the effective date of Chapter 90.94 RCW.
2. Projects are likely to result in measurable benefits to aquatic habitat in anadromous fish zones of WRIA 49 that can be measured or estimated accurately.
3. Project descriptions and supporting information are sufficient to enable evaluation of benefits using EDT

Tier 1 projects consisting of water and non-water offset projects were nominated for evaluation to quantify NEB using EDT modeling. Projects not meeting all three Tier 1 criteria above were designated as Tier 2. Tier 2 projects consist primarily of non-water offset projects (for example, riparian plantings), projects having no clear benefit to specific anadromous zones, and projects lacking sufficient detail to enable evaluation using EDT. While Tier 2 projects are likely to contribute to overall NEB, the benefit of these projects are evaluated by means other than using EDT.

Recommendations from the TAG workshop were presented to the Planning Unit at the January 16, 2020 meeting and again at the February 6, 2020 meeting. Additional project proposals were submitted by sponsors in January and February, and later ahead of the May Planning Unit meeting. While no final determination was made by the Planning Unit regarding the suite of projects for inclusion in the plan update, the Planning Unit indicated concurrence with the proposed subbasin delineation and with conducting EDT modeling to evaluate benefits of identified Tier 1 projects. Preliminary EDT results were presented at the April 22, 2020, Planning Unit meeting, and following review and comment, final EDT modeling results and supporting NEB analysis were presented at the May 7, 2020, Planning Unit meeting.

Considerations for Implementing Proposed Offset Projects

Ecology's GUID-2094 suggests planning groups consider the following factors:

- Cost of implementation
- Technical feasibility of implementation
- Operations and maintenance needs and costs
- Parties identified to undertake specified project or action
- Political support (i.e., local and stakeholder support)
- The role of uncertainty, including projected trends, in the offset estimates and project or action benefits
- The duration of project or action compared to the duration of the new consumptive water use
- Connections to existing projects and actions, such as land use regulations
- The role of adaptive management in plan implementation

Additional scoring metrics used in similar project evaluations were also presented to the TAG. These included the criteria used by the Upper Columbia Regional Technical Team (UCRTT) on evaluation of fish barrier removal projects in anadromous streams, including several projects located in WRIA 49, and criteria used by the Upper Columbia Salmon Recovery Board to evaluate project proposals. Project implementation feasibility was evaluated based on landowner willingness, design effort, construction effort, site access, site management, regulatory requirements/permitting, risk and uncertainty, and value.

To the extent possible at this stage of offset project proposals and development, these factors are considered in the offset project descriptions presented in this memorandum.

Summary of Proposed Projects

A total of 20 restoration projects were identified by sponsors for consideration by the WRIA 49 Planning Unit. Water and non-water offset projects contributing to NEB were designated as Tier 1 (8) and Tier 2 (12) based on discussion and criteria presented at the January TAG workshop and later Planning Unit meeting(s). Each project, along with a broad characterization of whether the project provides offset and/or contribution NEB, is described briefly below. Projects identified by the Planning Unit for inclusion in the Plan Addendum are summarized in Table 1. Locations of the projects are shown on Figure 2. Copies of project proposals received from sponsors containing detailed descriptions as submitted are included as Appendix A.

Additional project background and detailed narrative specific to how the projects were conceptualized as contributing to NEB and parameterized for the purposes of EDT modeling is provided in Appendix C (Confluence, 2020) of the Plan Addendum. In addition, Appendix C provides the clear and systematic rationale how each project provides water offset or contributes toward NEB.

Tier 1 Projects

The following section presents the Tier 1 water and non-water offset projects evaluated by the Planning Unit. The projects include the following:

Antoine Valley Ranch (AVR) – Land and water acquisition to purchase approximately 2,500 acres of land, including water rights totaling approximately 1,160 acre-feet of consumptive use offset benefiting flows and temperature in Antoine Creek. The project provides up to 1,160 acre-feet of consumptive use offset in the Antoine-Whitestone subbasin and contributes to NEB in Antoine Creek and the Okanogan River.

Project Cost: Purchase price for the ranch is pending private negotiation, but is estimated to be $7 to $7.5 million. Post-acquisition restoration and land and vegetation management is estimated to be about $150,000 to $200,000 per year for the first few years.

Conservancy Island Side Channel Reactivation – The construction of the Highway 20 to Highway 97 connecting road in the late 1950s and the subsequent construction of the Island Avenue SW leading to the City of Okanogan WWTP resulted in disconnection of an historic side channel and/or split flow channel. The CMP culvert under the Highway 20 connector was designed to pass a small amount of water to the side channel during initial construction. The culvert has failed and is blocked with cobbles and debris. The relict channel retains a down-water connection that allows limited access during higher flow events. However, the loss of flushing flows has resulted in transformation of the site from a perennial side channel to a backwater slough with stagnant warm water during the summer months. The Island Avenue SW culvert was designed to match the flow capacity of the Highway 20 connector culvert and is vulnerable to similar failure. Both culverts need to be replaced to reliably restore side channel connectivity and reactivate this important Chinook salmon spawning and rearing habitat.

The City of Okanogan and the CCT have partnered to improve off-channel flow conditions within the relict channel to expand off-channel rearing habitat for salmonids. The project has achieved limited successes at improving water quality and reducing width depth ratios in the channel. Re-establishing the upstream connection to the Okanogan River would increase the volume and duration of flow activation in the relict channel, flushing accumulated fine sediments, improving substrate suitability for salmonid spawning and incubation, and provide more favorable water temperature conditions.

Restoring flows to the relict channel would require the simultaneous replacement of the Highway 20 and the City-owned Island Avenue SW culverts. Ideally, both would be replaced with bottomless box or arch culvert designs that allow for full side channel activation under a wide range of mainstem flow conditions. This project would contribute to NEB in the mainstem Okanogan River, mainly benefiting summer/fall Chinook salmon. The proposed project seeks funding for replacement of the City-owned Island Avenue SW culvert, under the assumption that WSDOT is responsible for replacement of the SR-20 connector culvert.

Project Cost: Preferred alternative development, design, permitting, and public engagement is estimated at $150,000; project construction at $700,000, including removal and replacement of the culvert and associated road repairs.

Johnson Creek Fish Passage – In August 2018, Trout Unlimited signed a funding contract with the Washington Recreation & Conservation Office to remove a fish passage barrier near the mouth of Johnson Creek underneath Cooper Street in the Town of Riverside. Later in August 2019, Trout Unlimited signed additional contracts to remove three additional fish passage barriers on Johnson Creek: 1) an undersized culvert beneath Highway 97 and associated trash rack, 2) a perched and undersized culvert below Green Acres Road, and 3) an undersized culvert and associated headcut below State Street in the Town of Riverside.

These four fish passage improvement projects build upon a multi-year, multi-phase effort that has been ongoing since 2015 to replace eight barriers currently blocking fish passage in the lower mile of Johnson Creek. Once these four barriers are removed, this effort will have replaced five undersized barrier culverts with appropriately sized box culverts, and removed three other in-channel barriers. Completion of these projects will reconnect the lower section of Johnson Creek with high quality habitat above Green Acres Road, restoring over nine miles of prime spawning and rearing habitat. In addition to increasing access to ideal habitat for summer steelhead and chinook, this effort is providing appropriately sized, low-maintenance infrastructure for the Town of Riverside, and reducing flood risk to local property owners.

Specific to Streamflow Restoration, and based Ecology's technical assistance provided (and described in the Plan Addendum), three of the culvert projects are eligible to be counted as a project under Chapter 90.94 RCW. The Johnson Creek culvert under Highway 97 and associated trash rack immediately upstream are required by other mitigation requirements, and therefore not available to be included toward NEB.

Project Cost: These projects are currently fully funded at a combined cost of $2.7 million.

Loup Loup Creek Diversion Improvements – The proposed project will target improvements to a specific diversion on Loup Loup Creek This project could include a variety of operational changes, distribution system improvements, and increased water delivery efficiency. The proponents have identified that a major upstream diverter has existing facilities, such as a storage reservoir, which could play a part in adjusting the timing of flows to benefit habitat and instream flow in lower Loup Loup Creek. Enhanced conveyance efficiency could further optimize delivery into the storage reservoir where storage is owned by the diverter. WWT has support from CCT fisheries staff for pursuing efficiency projects with water users along Loup Loup Creek to enhance flows which would benefit summer steelhead, spring Chinook salmon, and coho salmon, all of which have inhabited Loup Loup Creek.

A preliminary estimate indicates that potential water savings could increase stream flow in Loup Loup Creek by approximately 5 to 10 cfs throughout the year, providing water offset at the subbasin scale (see footnote above) and contributing toward NEB in Loup Loup Creek. It is expected that the full extent of the irrigation efficiencies water (i.e., leakage) will be placed in the State's Trust Water Right Program and not available for future out-of-stream uses. However, Ecology may choose to manage the water instream at a reduced rate to account for in-basin return flows and to ensure impairment of senior water rights does not occur. In addition, additional consumptive use associated with reduction of evapotranspiration of vegetation along with current ditch alignment was not quantified under this evaluation. It is expected that additional consumptive use offset will be available as determined by additional study and permitting investigations.

Project Cost: Feasibility and pre- and final design is estimated at about $175,000; construction is estimated at $1.5 million.

Okanogan-Tonasket Irrigation District (OTID) Flow Supplementation – The goal of this project to develop a long-term flow supplementation program that will increase streamflows and decrease temperatures in target fish bearing tributaries in the Okanogan Basin. Using existing infrastructure and with minor modifications, OTID has the ability to supplement flows in select tributaries including the following:

- Bonaparte Creek - 75 gpm, located 2,095 feet from the mouth of the creek the source of the water would come from the Bonaparte Station.
- Siwash Creek - 75 gpm, located 500 feet from the mouth of the creek water would come from the Tonasket Station.
- White Stone Creek - 75 gpm, located 650 ft and 3,100 feet from the mouth of the creek for a total of 150 gpm water would come from the Ellisforde Station.
- Nine Mile Creek - 75 gpm, located 1,740 feet from the mouth of the creek water would come from the Osoyoos Station.
- Antoine Creek - 100 gpm, at 2,324 ft and 50 gpm at 940 feet from the mouth of the creek water would come from the Ellisforde station.

Over the long term, this project will benefit ESA-listed Upper Columbia River Steelhead as well as native fish and aquatic species of concern that inhabit six tributaries in the northern part of the Okanogan Basin. The project would provide tributary water offset at the subbasin scale and contribute to NEB.

Project Cost: The scope of work for 1) a pilot spring supplementation effort in Antoine Creek; 2) a system-wide assessment of Okanogan Tonasket Irrigation District (OTID) infrastructure modifications that will enable streamflow supplementation spring through fall; and 3) a study of Managed Aquifer Recharge (MAR) opportunities that can be pursued as part of developing a streamflow supplementation program in partnership with OTID is estimated at $404,079.

Pine Creek Water Right Acquisition – Water Right purchase of the Pine Creek water right, currently held in the State's Trust Water Right Program by Ecology's Office of Columbia River (OCR). Based on OCR's water right mitigation suitability analysis, the Pine Creek Trust Water Right (CG4-23992(A)C), has 625.7 acre-feet of consumptive use available for mitigation downstream of Janis Rapids (RM 51) on the mainstem Okanogan River, of which 225.7 acre-feet are only available for mitigation near the mainstem Okanogan River within Okanogan County. The remaining 400 acre-feet of consumptive use may be used further downstream out of the WRIA. This project provides water offset in the mainstem Okanogan River. In addition, because it does not affect tributary flows, it is assumed to not significantly contribute to NEB.

Project Cost: Cost for the water right purchase is $1,300 per acre-foot (CU). Because the water is currently in the TWRP, no additional permitting or O&M cost will be incurred.

Salmon Creek Source Substitution – The City of Okanogan has a municipal water right claim to divert waters from Salmon Creek for municipal uses. The claim has a 1908 priority date. The City maintains a collections system, reservoir, and delivery pipeline for the use of the right. The City has maintained the water source as a future source to meet municipal needs.

The City is proposing to transfer the water right from Salmon Creek to an existing or new groundwater well in continuity with the Okanogan River. The project would need to provide funding to mitigate any existing facilities on Salmon Creek that would impact habitat projects and would need to provide adequate funding to improve the new or existing groundwater well to meet state requirements. The project would benefit in-stream flows in Salmon Creek by eliminating the diversion right to 300 gpm (about 484 acre-feet), providing water offset at the subbasin scale[4] and contributes to NEB.

Ecology recently published a focus sheet on the implications of Foster v. Ecology State Supreme Court's decision on water rights permitting, including evaluation of Streamflow Restoration projects. The ruling significantly limits Ecology's ability to approve change application that do not perfectly match the season, timing, and place of use between the existing water right and a proposed change. Specific to the Salmon Creek source substitution project, the year-round diversion is proposed to be replaced by a well in continuity with the mainstem Okanogan River. Final well siting has not been completed, and the City has several locations that are both downstream from the Salmon Creek confluence and in high continuity with the Okanogan River. Because the project is water budget neutral and the water right authorizes a year-round season of use, seasonal pumping lag effects are not anticipated to impair instream flows, and final well siting will limit pumping impacts to the mainstem Okanogan River downgradient of the Salmon Creek confluence. Therefore, Foster implications are not expected to negatively impact implementation of this project.

Project Cost: Project development and design is estimated at approximately $50,000, project construction of a new municipal water supply well is estimated at $200,000, and annual O&M is approximately $10,000.

Salmon Lake Storage – Increase storage for retiming of up to 1,000 acre-feet of water benefitting instream flows in Salmon Creek. A draft Environmental Impact Statement (DEIS) was developed to restore perennial flow in Salmon Creek. One alternative identified in the DEIS that was considered but not pursued was raising the height of Salmon Lake Dam. Due to the number of existing cabins and associated septic systems, this alternative was eliminated (though if the cabin leases were eliminated, this alternative could be reevaluated).

Recent information indicates that the project will be beneficial for increasing storage without changing the height of the dam. This would require structures and infrastructure to be relocated to prevent their inundation. According to the DEIS, twelve cabins would need to be relocated. Also, approximately 2,000 feet of septic pipe and eight septic tanks would need to be moved.

[4] This project provides water offset in the subbasin level by shifting total and/or consumptive use impacts to the mainstem Okanagan River. However, this offset will not be counted toward required water offset at the WRIA scale.

The additional volume as a product of the implementation of this project would contribute to the 3,600 ac-ft. dedicated to providing perennial flow downstream of the Okanogan Irrigation District diversion dam. This additional volume would augment or extend the duration of elevated flow during migration or augment winter-time flow to increase over-winter survival. This project provides water offset and contributes to NEB in the Salmon Creek subbasin and mainstem Okanogan River.

Project Cost: The estimated cost to replace 2,000 feet of septic pipe is about $100,000. Relocation of the eight cabins is approximately $18,000 each/and $144,000 total; new foundation for each cabin is estimate at $20,000 each/$160,000 total; and to relocate septic systems is about $12,000 each or $96,000. The total estimate construction cost of the project is $652,000. No long-term costs related to ongoing O&M are expected to occur.

Whitestone Creek Flow and Temperature Augmentation - This project proposes a phased project to construct additional storage and/or conveyance to improve irrigation efficiency, both increasing flow and benefiting water quality in lower Whitestone Creek. The project would provide for water offset at the subbasin scale and contribute to NEB. Additional technical details on project conceptualization and parameterization is provided in Appendix C (Confluence, 2020) of the Plan Addendum.

Project Cost: Cost estimate pending additional refinement of project alternatives.

Tier 2 Projects

The following section presents the Tier 2 water and non-water offset projects evaluated by the Planning Unit. The projects include the following:

Aeneas Lake Irrigation District Efficiencies – Aeneas Lake Irrigation District (ALID) is in the process of developing a plan to improve energy and water efficiency from a pumping station on the Okanogan River. ALID diverts up to 15.6 cubic feet per second (cfs) from the Okanogan River to irrigate 1,425 acres of agriculture land using high-capacity pumps. The pumps operate at full capacity during the irrigation season, even when less water is required. Currently ALID pumps excess water back to the river and they also have a permit that allows them to pump water into Aeneas Lake (about 1,200 acre/ft). This project would reduce the amount of excess water pumped from the river. This would reduce the over-pumping and dumping back to the river, which is expected to reduce turbidity in that location.

Project Costs: Project development and design is estimated to be $30,000. Project construction costs have not yet been determined.

Conconully Dam Replacement – Due to Dam Safety concern, the project includes mandatory replacement of the lower dam. Replacement or improvement of the dam could include additional storage capacity or fish passage. If implemented, the project benefits would include water offset and contribute to NEB in the Salmon Creek subbasin. Detailed project alternative analysis is pending an Appraisal Study by the U.S. Bureau of Reclamation (Reclamation), due to be available later in 2020.

Project Cost: Replacement alternative cost estimates pending Reclamation Appraisal Study.

Highlands Springs Protection and Enhancement – Protecting springs, seeps, and water resources enhances multiple use of public and private lands. The Okanogan Highlands Alliance (OHA) is committed to monitoring and improving infrastructure that protects and restores water resources and the habitats that rely on these water resources. OHA's objectives are to partner with range lessees, landowners, and the U.S. Forest Service (USFS) to assess the condition of water resources, repair spring protection infrastructure, and install fencing and troughs to protect undeveloped springs. The project will contribute to NEB.

Project Cost: Estimated cost for project development and design is about $20,000 to develop and pilot systems of monitoring and repair work. Project construction depends on repair needs at specific sites. USFS provides materials for repairs done on USFS land, with costs in staff/contractor labor. Project annual O&M to monitor, repair and install new infrastructure, estimated cost: $5,000-10,000, depending on sites selected and identified needs

Irrigation Efficiency Projects – Complete on-farm irrigation efficiency projects throughout WRIA 49 reducing overall irrigation water demand. On-farm Irrigation Efficiency Projects are opportunistic in nature and will be completed over the 20-year planning horizon when willing landowners (and funding) are identified. These projects historically have been funded under Washington State's Irrigation Efficiencies Grant Program (IEGP). Two on-farm projects are currently identified in the Loup Loup – Swamp Subbasin (not to be confused with the Loup Loup Creek Diversion Improvement project above). Depending on location, irrigation efficiency projects would provide both water offset and NEB in adjacent tributaries. Final project-specific offset values will be determined during permitting, as water savings will be dedicated to instream flows.

Project Cost: Funding requirements will be dependent on required upgrades and size (i.e., number of acres). For example, a replacement of wheel line (at 65 percent efficiency) with center pivot (90 percent efficient) for 45 acres of irrigation, conveyance piping, and diversion pump, is estimated to cost $4,800 (design), $56,000 (construction), and $1,100 (annual power costs).

Loup Loup Creek Channel and Riparian Improvements – The Okanogan Conservation District is working with a landowner to improve instream habitat and riparian condition along 600 feet of Loup Loup Creek. The location is near the town of Malott. The project will improve spawning habitat for ESA-listed steelhead. Redds are documented by CCT on adjacent properties; however, this property was not surveyed due to previous accessibility issues. Riparian buffers will be increased from 10 feet to 30-100 feet. The project would contribute to NEB in the Loup Loup subbasin.

Project Costs: Cost estimate pending additional study and identification of appropriate funding sources.

Methow Beaver Project – The Methow Beaver Project (MBP) proposes to restore streamflow in degraded and structure-deficient low order stream channels impacted by fire and anthropogenic activities using process-based restoration (PBR) strategies in eight sub-basins of the Methow (5) and Okanogan (3) River watersheds. MBP believes that restoration actions can be developed and implemented within a three-year period in stream segments above the anadromous zone. These actions are to the intended benefit of groundwater recharge, extended streamflow, downstream

salmonid habitat, and human communities through the restoration of natural processes and water quality improvement.

The goal of the project is to increase late season streamflow by restoring channel structure and floodplain connection with process-based restoration strategies that evolve with the environment over time and restore natural watershed functions and resilience to disturbance. Reconnecting streams to their floodplains seasonally by adding structure to stream channels and repairing wetland habitat is a restoration strategy recommended in all current Methow watershed reach assessments as well as the Okanogan Watershed Plan. Process based restoration strategies, made up of a variety of potential actions, results in longer water residency time in upper watersheds leading to moderated annual flows, increased late season flows, significant riparian and aquatic habitat and water quality improvements, and increased channel complexity. The project will contribute toward NEB.

Project Cost: Estimate budget to complete the project includes $550,000 for a 3-year project including completion of project development, planning, restoration designs, permitting, pre-project monitoring, action implementation, construction, adaptive management, post-project monitoring, assessment, reporting, and recommended applications to future projects.

Okanogan Highlands Water Riparian Restoration – Riparian areas along creeks and wetlands are vital to the health of ecosystems both in and near the waterways. Protecting and improving the health of riparian areas will impact water quality and quantity from the highlands to the valley, will support native plant and animal species, and will increase the diversity of habitat throughout WRIA 49. This project has the possibility of taking place at various locations throughout the Okanogan Highlands on public and private lands. Restoration techniques will vary by site, depending on geomorphology, land use, streamflow, instream structure and roughness, etc. OHA will utilize restoration techniques that support and enhance natural processes, which will reduce infrastructure requirements and may benefit from ongoing adaptive management.

Project objectives:

1. Identify areas adjacent to waterways and drainages that have water storage potential (e.g. current or historical wetlands) and make structural adjustments to allow spring meltwater and stormwater to flow into and be stored in these areas until later in the year. Increasing the residence time of water on the landscape will create the conditions needed for healthy riparian plant communities to thrive and contribute a tangible ecological benefit, in addition to supporting late-season flows.
2. Plant native species to provide shade to creeks, reduce water temperatures, reduce erosion, filter water, and increase species and habitat diversity.
3. Install/upgrade livestock management infrastructure where needed to protect degraded riparian areas, while allowing cattle and other wildlife access to clean, safe water.

The project will contribute to NEB.

Project Cost: Cost for project development and design is site dependent, but estimated $5,000-$15,000 per site; project construction is also site dependent, but estimated $5,000 to $50,000 per site; and project annual O&M is estimated $1,000 to $15,000 per year per site.

Okanogan River Riparian Enhancement – This project would maintain four previously planted acres on the 2-mile long stretch of property (WQC-2015-OkanCD-0009). This will include replacement of dead plants, adaptive management for weed control, and irrigation. Weed management will occur on the previously planted four acres and six additional acres. The goal of this activity is to improve surface water quality through ensuring successful riparian planting. Proper monitoring and adaptive management increase successful establishment of effective riparian cover, increase the diversity of habitat for the aquatic ecosystem (particularly to increase woody debris recruitment), and—especially important in this reach of the Okanogan River—erosion control, to reduce sedimentation in the mainstem Okanogan River. The project will contribute to NEB.

Project Cost: Project construction is estimate at $54,116 and annual O&M at $1,500.

Pine Creek Riparian Restoration – This project is part of BMPs for a Riparian Restoration project designed to protect riparian and wetland areas from water quality impacts from livestock using downed 'jackstraw' logs. These scattered logs mimic natural barriers to browsing and protect natural regeneration of riparian plants and new plantings. Monitoring will track effectiveness on livestock exclusion and vegetation. In addition, the program will maintain four completed projects, develop three restoration plans, and provide community outreach.

The Pine Creek location will construct jackstraw barriers to protect 1.7 acres of riparian wetland and 662 feet of ephemeral stream from livestock with a 35-foot minimum buffer; install off-site water development, submitting a design to the Ecology Project Manager for review and approval prior to installation; implement weed management for Canada thistle across 0.25 acres; install 65 riparian plants within the pockets of jackstraw. The project will contribute to NEB.

Project Cost: Project development and design is estimated at $27,295; construction at $92,455, and project annual O&M at $2,000 for a total of all three jackstraw projects.

Salmon Creek Streambank Stabilization Projects – The objective of two Conservation Reserve Enhancement Program (CREP) project is to restore and enhance riparian vegetation by planting woody shrub and tree species for the purpose of providing woody debris recruitment into Salmon Creek as a means of creating habitat for invertebrates, which will enhance food sources for threatened and endangered fish species. This CREP project can only be installed after the eroding stream bank is stabilized. This project will maintain the stabilized stream bank and provide additional food for fish whose survival is enhanced by the addition of saved water from a nearby OCD Irrigation Efficiencies project.

The combined streambank stabilization/CREP project will help reduce sedimentation, contribute to stream complexity and fish habitat enhancement, and maintain cooler stream temperatures. Noxious weeds will also be removed and controlled, possibly being replaced by pollinator plants. The project will contribute to NEB is in the Salmon Creek subbasin.

Project Cost: Design and construction of the streambank stabilization is estimated to be $11,000 and $16,000, respectively, followed by maintenance at $3,000 for 3 years. CREP costs

include $2,200 for design, $10,500 for construction, and an average of $900 maintenance for the first 5 years, then none thereafter.

Sinlahekin Wildlife Area Improvement Project – This project proposes to improve a number of existing water impoundments within the Sinlahekin Wildlife Area. Improvements would address deficiencies related to water control structures and water diversion infrastructure related to the following water bodies:

- Blue Lake (183 Acres) – Increase water capacity by addressing diversion on Sinlahekin Creek and control structure(s) at outflow back into Sinlahekin Creek.
- Conners Lake (35 Acres) – Increase water capacity by modernizing control structure and address any issues related to the earthen impoundment.
- Forde Lake (37 Acres) – Improve capacity management by updating water control structure.
- Reflection Pond (3.5 Acres) – Increase water capacity by renovating control structure and address any issues related to the earthen impoundment.
- Fish Lake (100 Acres) – Better regulate capacity by updating water control structure.

By increasing capacity at each location, available water within Sinlahekin Creek would increase or be maintained and available later in the year, benefiting downstream irrigators, agriculture, and native fish species such as the Westslope Cutthroat Trout, Pygmy Whitefish, and Kokanee. This project would provide water offset and contribute to NEB in the Similkameen subbasin. Instream flows benefits will be protected by dedicating a portion of the water to the State's Trust Water Right Program.

Project Cost – Project development and design is estimated to be $250,000; project construction at $500,000; and annual O&M would be covered with WDFW's existing staffing and budget.

Tunk Valley Dry Forest Restoration – The objective of this 1,100-acre project is to create long-term habitat quality and ecological integrity by moving stands back towards more dispersed, larger diameter trees at a much-reduced density. The ultimate goal would be a forest maintained by periodic, low intensity prescribed burns (and mechanical treatments). Basic configuration of the various habitats will be maintained (i.e., forest stays forest, meadow stays meadow). The largest trees will be retained as will large-diameter dead wood wherever it occurs. To get there thinning is needed on many acres of the property. Small diameter regeneration will be thinned, keeping all of the largest trees in the overstory. For species diversity, anything not ponderosa pine (Douglas fir/Larch/Grand fir), will be retained. Most of the material thinned will need to be chipped, burned in piles, or broadcast burned in prescribed burns after the fuel loading is low enough to ensure survival of overstory trees. Increased infiltration of precipitation will result from thinning, thus allowing more groundwater recharge. All of these activities will occur the next 10 to 20 years will general maintenance over the long-term. The project will contribute to NEB.

Project Costs: Cost estimate pending additional study and identification of appropriate funding sources.

Projects Not Advanced for Evaluation

Several projects were not selected to be included in the plan addendum. These projects and their fatal flaw(s) from further consideration under Streamflow Restoration included the following:

OTID Water Right Purchase – OTID would make available up to 100 acre-feet (consumptive use) for purchase to offset future impacts from permit-exempt wells. The senior water right (CS4-ADJ01P2@13) is currently held in the State's Trust Water Right Program (TWRP) under a Trust Water Agreement with Ecology. The price is set at $10,000 per acre-foot (CU), which is considered a high unit price, and the Planning Unit has alternative more cost-effective water off-set projects available.

Okanogan Irrigation District (OID) Diversion Improvements – The project would increase fish passage through a major irrigation diversion on Salmon Creek. In addition, the project would contribute toward perennial year-round flow in the Salmon Creek, which is identified as a limited factor in restoration potential. However, this project is regarded as being completed under other mitigation requirements, and therefore not eligible under the Chapter 90.94 RCW requirements.

Shankers Bend Storage – The project including constructing a new dam impounding up to 1.3 million acre-feet on the Similkameen River benefitting flows in the mainstem Similkameen and Okanogan Rivers. This project has been the subject of several studies, including the most recent Similkameen River Appraisal Level Study (Okanogan County PUD, 2009) which concluded the probable construction costs between $289 million to over $1 billion dollars. The scope of the project was considered too great to be reliably completed under the Chapter 90.94 RCW planning horizon.

Palmer Lake – The project would increase storage in Palmer Lake by constructing a dike at the north end of the lake to raise lake levels and protect against flooding from the Similkameen River. Stored water would be retimed to benefit the mainstem Similkameen and Okanogan Rivers. However, inundation of viable farmland and private property would likely occur. At this time, the Planning Unit did not want to pursue this project under Streamflow Restoration.

Kermal Drainage – The project included the feasibility of diverting drainage water to benefit instream flows in lower Salmon Creek. The project was not included due to a number of data gaps that would not be filled by the planning deadline.

Sourdough Creek Riparian Restoration – This project is part of a Livestock BMPs for Riparian Restoration project designed to protect riparian and wetland areas from water quality impacts by livestock using downed jackstraw logs. However, the project location is just outside the WRIA 49 boundary and therefore not advanced for consideration.

Limitations

Work for this project was performed for Okanogan County (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.

All reports prepared by Aspect Consulting for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect Consulting. Aspect Consulting's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

Attachments: Figure 1 – WRIA 49 Subbasin Map
Figure 2 – Tier 1 and 2 Project Locations
Table 1 – Summary of Proposed WRIA 49 Offset Projects
Appendix A – Restoration Project Proposals Received from Sponsors

V:\190259 WRIA 49 Watershed Planning Support\Deliverables\Watershed Plan Addendum\Final\Appendix B\App B_WRIA 49 Project Identification and Subbasin Memo.docx

TABLES

Table 1. Summary of Proposed WRIA 49 Offset Projects

WRIA 49 RCW 90.94 Streamflow Restoration Plan Addendum (190259)

Project	WRIA 49 Subbasin/Stream	Tier Ranking	Sponsor	Project Type[1]	Description	Consumptive Use Offset	Instream Flow Benefit	Affected Stream Length (mi)[2]	Estimated Cost	Requires O&M?
Antoine Valley Ranch (AVR)[3]	Antoine-Whitestone/ Antoine Creek	Tier 1	Washington Water Trust, CTCR, Trout Unlimited	O&NEB	Conservation acquisition of 2,524-acre Antoine Valley Ranch (AVR) and senior water rights totaling 1,294 af. Includes ownership of Fanchers Dam with its related storage 500 AF capacity. Project will provide flow augmentation and retiming for summer baseflow and thermal benefits, and support future habitat restoration in a valuable spawning tributary.	Up to 1,294 afy	1.8 cfs (average)	5.4 (flow restoration may support restoring access to additional ~12 miles of habitat between AVR and Fanchers Dam)	$7.9-$8.5 million	Yes
Conservancy Island Side Channel Reactivation	Bonaparte-Johnson/ Okanogan River	Tier 1	City of Okanogan	NEB	Restore Conservancy Island side channel connectivity with Okanogan River, providing access to historical Chinook salmon and steelhead spawning and rearing habitat.	--	--	0.9	$850,000	Yes
Johnson Creek Fish Passage	Bonaparte-Johnson/ Johnson Creek	Tier 1	Trout Unlimited	NEB	Package of 3 90.94-eligible fish passage restoration projects funded by the Brian Abbot (Washington State) Fish Barrier Removal Board. Provides access from mouth upstream to Duck Lake diversion.	--	--	4	$2.7 million	No
Loup Loup Creek Diversion Improvements[3]	Swamp-Loup Loup/ Loup Loup Creek	Tier 1	CTCR, Washington Water Trust	NEB&LO (O pending additional study)	Replace unlined diversion ditch with pipe to eliminate leakage and evaporation losses. Water savings will be dedicated to instream flows.	TBD	0.38 cfs (average), ~275 afy	2.17	$1.7 million	Yes
OTID Tributary Supplementation[3]	Johnson-Bonaparte/ Bonaparte Creek Antoine-Whitestone/ Siwash Creek, Antoine Creek, Whitestone Creek, Ninemile Creek	Tier 1	Oroville-Tonasket Irrigation District	NEB&LO	Use existing diversion infrastructure to provide flow augmentation in lower reaches of select Okanogan tributary streams from April 1 to October 15.	460-525 afy	1.2-1.3 cfs (Apr-Oct)	5.7	$10,500	Yes
Pine Creek Water Right Acquisition[3]	Bonaparte-Johnson (Middle Okanogan)	Tier 1	Okanogan County / OCD	O	Purchase the Pine Creek Trust Water Right (CG4-23992(A)C) from Ecology for consumptive use offset.	625.7 afy	0.86 cfs	51	$1,300 per af	No
Salmon Creek Source Substitution	Salmon Creek	Tier 1	City of Okanogan	NEB&LO	Transfer 300 gpm municipal surface water diversion right from Salmon Creek to an existing or new groundwater well in continuity with Okanogan River.	485 afy	0.67 cfs	3.7	$250,000, +$10,000 annual O&M	Yes
Salmon Lake Storage	Salmon Creek	Tier 1	Bureau of Reclamation, CTCR, Okanogan Irrigation District	O&NEB	Residential infrastructure purchase or improvements to allow for full use of Salmon Lake reservoir pool. Provides increased storage for flow retiming.	~1,000 afy	2.1 cfs (average)	18.8	$175,000 to $652,000 depending on management option	Yes
Whitestone Creek Flow and Temperature Augmentation	Antoine-Whitestone/ Whitestone Creek	Tier 1	Whitestone Irrigation District	NEB	Improve conveyance system to increase irrigation system efficiency and reduce maintenance. Provide 1 to 1.5 cfs additional instream flow in Whitestone Creek from Apr-Oct to for flow and temperature augmentation.	425-485 afy	1-1.5 cfs inflow (Apr-Oct) at 5-7 degrees C below ambient surface water temperature	3.3	In development	Yes
Aeneas Lake Irrigation District Efficiencies	Bonaparte-Johnson (Middle Okanogan)	Tier 2	OCD	NEB	Reduce the amount of excess water pumped from the mainstem Okanogan River. This would reduce the over-pumping and return flow to the river, which is expected to reduce turbidity in that location.	--	--	TBD	$30,000	Yes
Conconully Dam Replacement	Salmon Creek	Tier 2	Bureau of Reclamation, Okanogan Irrigation District	O&NEB	Proposed dam replacement, with potential to increase available storage and provide fish passage to historically accessible headwaters of Salmon Creek.	Unspecified	Unspecified	TBD	Unspecified	Yes
Highlands Springs Protection and Enhancement	Bonaparte-Johnson (Middle Okanogan)	Tier 2	Okanogan Highlands Alliance	NEB	Partner with range lessees, landowners, and the U.S. Forest Service (USFS) to assess the condition of water resources, repair spring protection infrastructure, and install fencing and troughs to protect undeveloped springs.	--	--	TBD	$20,000 + $5,000-$10,000 annual O&M	Yes
Irrigation Efficiency Projects	Multiple	Tier 2	OCD	O&NEB	Opportunistic irrigation efficiency projects throughout WRIA 49 reducing overall water demand. Water savings will be dedicated to instream flows.	TBD	Unspecified	TBD	Unspecified	Yes
Loup Loup Creek Channel and Riparian Improvements	Swamp-Loup Loup/ Loup Loup Creek	Tier 2	OCD	NEB	Improve instream habitat and riparian conditions along 600 feet of Loup Loup Creek, improving spawning habitat for ESA-listed steelhead. Riparian buffers will be increased from 10 feet to 30-100 feet.	--	--	0.11	Unspecified	No
Methow Beaver Project[3]	Antoine-Whitestone/ Whitestone Creek, Swamp-Loup Loup, Bonaparte-Johnson	Tier 2	Methow Beaver Project	NEB	Increase late season streamflow by adding and improving channel structure and floodplain connection to restore natural watershed functions.	--	--	TBD	$550,000	No
Okanogan Highlands Water Riparian Restoration	Antoine-Whitestone/ Whitestone Creek	Tier 2	Okanogan Highlands Alliance	NEB	Restoration techniques will vary by site, depending on geomorphology, land use, streamflow, instream structure and roughness, etc., but will include structural adjustments to improve flow and storage, plant native species, and install/upgrade	--	--	TBD	$10,000-$65,000 + $1,000-$15,000 annual O&M	Yes
Okanogan River Riparian Enhancement	Antoine-Whitestone/ Whitestone Creek	Tier 2	OCD	NEB	Maintain four previously planted acres on the 2-mile long stretch of property. This will include replacement of dead plants, adaptive management for weed control, and irrigation.	--	--	2	$55,000 + $1,500 annual O&M	Yes

Table 1. Summary of Proposed WRIA 49 Offset Projects

WRIA 49 RCW 90.94 Streamflow Restoration Plan Addendum (190259)

Pine Creek Riparian Restoration	Bonaparte-Johnson (Middle Okanogan)	Tier 2	OCD	NEB	Protect riparian and wetland areas from water quality impacts from livestock using downed 'jackstraw' logs. These scattered logs mimic natural barriers to browsing and protect natural regeneration of riparian plants and new plantings.	--	--	0.13	12,000 + $2,000 annual O&M	Yes
Salmon Creek Streambank Stabilization Projects	Salmon Creek	Tier 2	OCD	NEB	Restore and enhance riparian vegetation by planting woody shrub and tree species for the purpose of providing woody debris recruitment into Salmon Creek as a means of creating habitat for invertebrates, which will enhance food sources for threatened	--	--	TBD	$16,000 + $900 annual O&M (5 years)	Yes
Sinlahekin Wildlife Area Improvement Project	Similkameen	Tier 2	Oroville-Tonasket Irrigation District, Washington Department of Fish and Wildlife	O&NEB	Impoundment and diversion system improvements to support instream flows in Sinlahekin Creek. A portion of water savings will be dedicated to instream flows.	Unspecified	Unspecified	42	$750,000	Yes
Tunk Valley Dry Forest Restoration	Bonaparte-Johnson (Middle Okanogan)	Tier 2	OCD, DNR	NEB	1,100-acre project to create long-term habitat quality and ecological integrity by moving stands back towards more dispersed, larger diameter trees at a much-reduced density.	--	--	--	Unspecified	Yes

1 O&NEB = consumptive use offset project with or without additional habitat restoration that contributes to NEB; NEB = streamflow and/or habitat restoration project that contributes to NEB; LO = Local Tributary Offset

2 The approximate length of tributary or mainstem reach measurably affected by the proposed non-water offset project. For the Highway 20 culvert replacement project the affected length covers the Conservancy Island side channel from its historical upstream and downstream connection points with the mainstem Okanogan River.

3 Indicates project applied for 2020 Streamflow Restoration Grant funding.

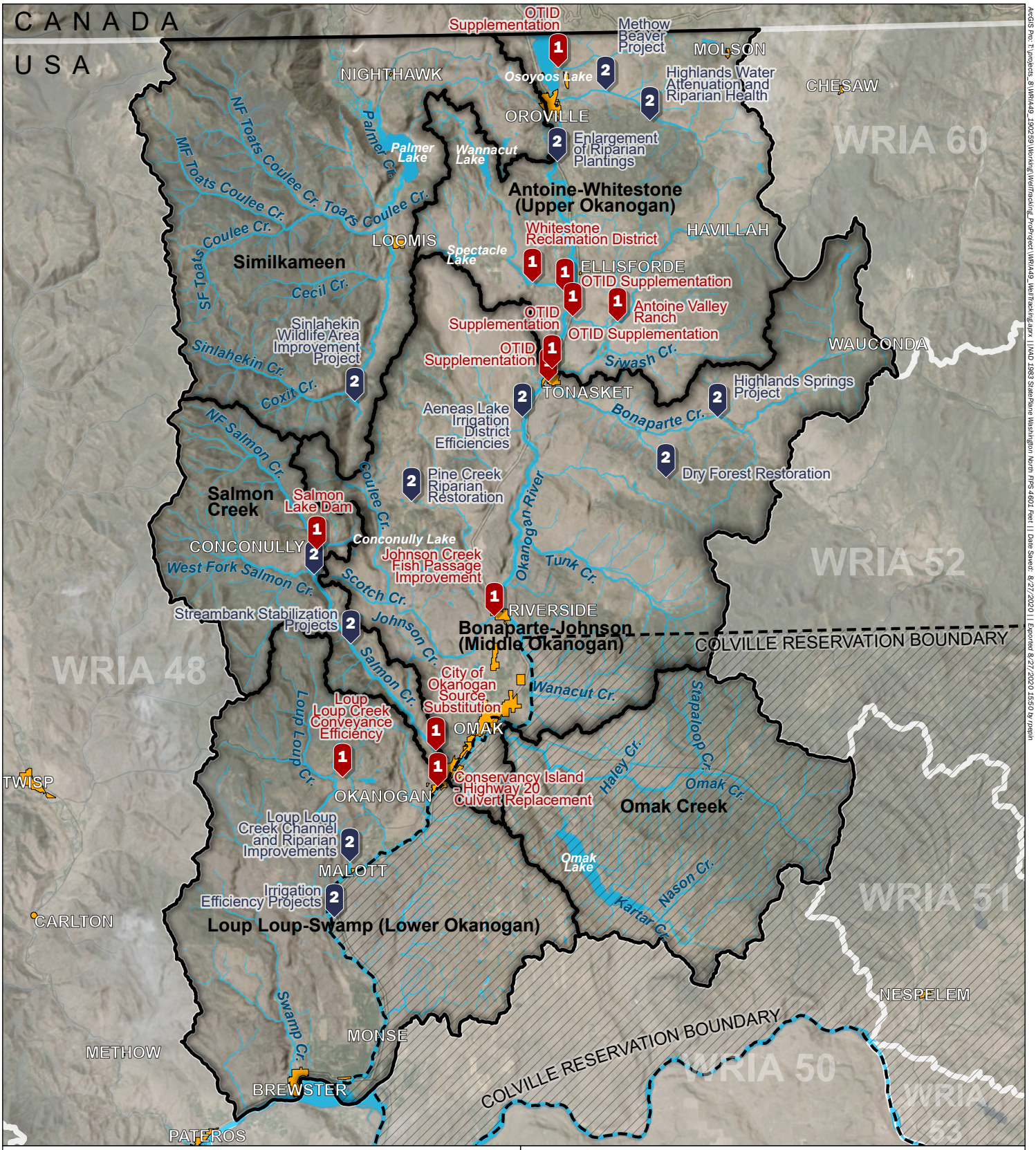
FIGURES

WRIA 49 Subbasins

WRIA 49 RCW 90.94 Streamflow Restoration Plan Addendum
Okanogan County, WA

Aspect CONSULTING	JUL-2020	BY: PPW	FIGURE NO. 1
	PROJECT NO. 190259	REVISED BY: ---/---	

ArcGIS Pro: T:\projects_8\WRIA49_190259\Working\WaitTracking_ProProject\WRIA49_WaitTracking.aprx | | No Projected Coordinate System | | Date Saved: 7/23/2020 | | Exported 7/23/2020 15:05 by pwittman



Tier 1 and 2 Project Locations

WRIA 49 RCW 90.94 Streamflow Restoration Plan Addendum
Okanogan County, WA

Aspect Consulting	AUG-2020	BY: PPW	FIGURE NO. 2
	PROJECT NO. 190259	REVISED BY: TDC / RAP	

Data source credits: None | | Basemap Service Layer Credits: Esri, CGIAR, USGS, WA State Parks GIS, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

APPENDIX A

- Tier 1 Project Proposals

- Tier 2 Project Proposals

- Projects Not Advanced

Tier 1 Projects

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING
PRELIMINARY PROJECT PROPOSAL TEMPLATE

The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use for evaluation under RCW 90.94. When complete, please submit to Bill Sullivan (bsullivan@aspectconsulting.com) by January 3, 2020

1. Title:	**2. Proposal Preparer(s):**
Antoine Valley Ranch Land and Water Acquisition	**Colville Tribes Fish and Wildlife Program**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

Acquire fee title to the Antoine Valley Ranch (AVR), real property comprised of 2524.34 acres, more or less, located between Tonasket and Havillah with a physical street address of 245-B Fancher Road, Tonasket, Washington 98855.

Colville Tribes would take fee title subject of AVR and propose to manage it for fish and wildlife conservation purposes as described in a resource management plan to be developed. The primary purpose of the acquisition is to acquire AVR's appurtenant water rights to restore instream flow in Antoine Creek for the benefit of ESA-listed summer steelhead. AVR's water rights are described in the attached 2017 trust water rights memo from Aspect Consulting.

Although the Colville Tribes would propose to convey title to AVR's appurtenant water rights to the Trust Water Rights Program after acquisition it would also work with the Department of Ecology to change the season of use/release schedule of the Fancher Reservoir storage and release rights to optimize steelhead habitat/passage, production and survival (see attached Rancher Reservoir Management Proposal).

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

■ a. Existing Water Right □ b. Groundwater ■ c. Surface Water □ d. Other
See attached trust water rights memo from Aspect Consulting dated September 13, 2017 (Aspect memo).

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:
Approximately 1,160 a/f of consumptive use associated with beneficial use attributable to irrigation water rights and claims. *See* Aspect memo.

b. Timeframe(s) or Season of Use:
Subject to change to optimize steelhead passage, production, and survival.

c. Tributary (name) or Mainstem Okanogan River and Location(s):
Antoine Creek.

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

Restores UCR summer steelhead habitat quantity (wetted usable area) and quality; improves passage conditions at mouth of Antoine Creek/confluence with the Okanogan River during the adult steelhead migration period.

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

None expected, although transferable quantity (instantaneous quantity and annual volume) of appurtenant water that can be transferred and protected instream is subject to a tentative determination of the extent and validity of AVR's water rights by the Department of Ecology resulting in a report of Examination and Record of Decision.

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design: N/A

b. Project Construction: Land and water acquisition ~ $7 to $7.5 million dollars

c. Project Annual O&M: Post-acquisition restoration and land and vegetation management ~ $150 - $200K/year

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

BPA, SRFB, PRCC, HCP Trib, etc. could provide cost-share or match to Ecology streamflow restoration grant funding.

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

Depending on availability and source of cost-share the AVR project could meet other (FCRPS BiOp – BPA, FERC license – Mid-C PUD) mitigation requirements.

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

AVR acquisition could facilitate habitat quality improvement/habitat complexity projects on the Ranch and/or provide opportunities and a location for managed aquifer recharge projects in addition to habitat protection and streamflow restoration.

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

Landowner willingness to sell, agreed-upon sale price, secure source of post-acquisition maintenance funding, Fancher Dam and Reservoir operation, maintenance, and liability.

12. Estimated Time Frame to Implement Project?

Could be implemented immediately or within six to twelve months based on sources of funding for acquisition and related requirements (appraisals, deed restrictions, etc.).

Conservancy Island Side Channel Reactivation

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING
PRELIMINARY PROJECT PROPOSAL TEMPLATE

The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use for evaluation under RCW 90.94. When complete, please submit to Bill Sullivan (bsullivan@aspectconsulting.com) by January 3, 2020

1. Title:	**2. Proposal Preparer(s):**
Highway 20 Culvert Replacement	**Chris Johnson, City of Okanogan**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

Construction of the WSDOT connecting bridge across the Okanogan River from Highway 20 to SR 97 at the southern end of the City of Okanogan in the late 1950's resulted in disconnection of an historic side channel / split flow channel (See Exhibit). The relict channel retains a down-water connection that allows limited access during higher flow events. However, the loss of flushing flows has resulted in transformation of the site from a perennial side channel to a backwater slough with stagnant warm water during the summer months. A CMP culvert was placed under the constructed roadway to pass a small amount of water to the side channel during initial construction. That culvert has failed and is blocked with cobbles and debris. A second set of culverts were placed by the city to gain access across the side channel to provide access to the waste water treatment facility. The culverts were sized to accommodate flows that could be expected based on the sizing of the DOT culvert. If the DOT culvert is substantially up-sized, the City owned culverts would also need to be up-sized.

The City and the Colville Tribes have partnered to improve off-channel flow conditions within the relict channel to expand off-channel rearing habitat for salmonids. The project has achieved limited successes at improving water quality and reducing width depth ratios in the channel. Re-establishing an upstream connection to the Okanogan River would extend the period of river connection to the relict channel, aid in flushing of sediment to improve the suitability of bed habitat and help address temperature issues.

Restoring flows to the relict channel would require replacement of the Highway 20 culvert and the second set of culverts under the City's access road to the waste water treatment facility. Ideally, the culverts would need to be replaced with bottomless box culvert, or bottomless arched culverts.

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

□ a. Existing Water Right □ b. Groundwater □ c. Surface Water □ d. Other

N/A

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:

N/A

b. Timeframe(s) or Season of Use:

c. Tributary (name) or Mainstem Okanogan River and Location(s):

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

This project would contribute to fish passage restoration (upstream access to existing isolated habitat); channel condition (sediment and temperature), and floodplain restoration.

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

The Colville Tribes are currently conducting a study of fish usage within the relict channel. The project is actively supported by the City of Okanogan. Expansion of the study would likely be needed to evaluate potential benefits from additional flows to water quality (sediment and temperature) and water quantity (increased flows).

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design: $150K - Preferred alternatives development, permitting and public engagement

b. Project Construction: $700K +/-Removal and replacement of culverts, road repairs, etc.

c. Project Annual O&M: TBD

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

TBD

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

In addition to habitat objectives, the project may increase flood resiliency at the highway crossing and at the access road to the sewage treatment plant

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

As with any project bordering private lands, some degree of landowner engagement would be needed. The City of Okanogan holds clear title to the majority of the 4800 +/- l.f. relict channel and the surrounding 56 +/- acre floodplain lands. Coordination with WA State Department of Transportation will also be required. No unusual permitting issues are anticipated.

12. Estimated Time Frame to Implement Project?

The project would be expected to be completed in several phases – The first phase would be feasibility analysis and could be initiated as soon as funding were made available. Construction design and implementation could be completed prior to 2024, pending completion of feasibility.

Wetlands

- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deepwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

DOT Culvert Location

Location of City Culverts

Johnson Creek Fish Passage

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING PRELIMINARY PROJECT PROPOSAL TEMPLATE	
The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use for evaluation under RCW 90.94. When complete, please submit to Bill Sullivan (bsullivan@aspectconsulting.com) by January 3, 2020	
1. Title: **Johnson Creek Fish Passage Improvement**	**2. Proposal Preparer(s):** **Jacquelyn Wallace, Trout Unlimited**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

In August 2018, Trout Unlimited signed a funding contract with the WA Recreation & Conservation Office to remove a fish passage barrier near the mouth of Johnson Creek underneath Cooper Street in the Town of Riverside.

In August 2019, Trout Unlimited signed funding contracts with the WA Recreation & Conservation Office to remove three additional significant fish passage barriers on Johnson Creek: 1) an undersized culvert beneath State Highway 97 and associated trash rack, 2) a perched and undersized culvert below Green Acres Road, and 3) an undersized culvert and associated headcut beloq State Street in the Town of Riverside.

These four fish passage improvement projects build upon a multi-year, multi-phase effort that has been ongoing since 2015 to replace eight barriers currently blocking fish passage in the lower mile of Johnson Creek. Once these four barriers are removed, this effort will have replaced five undersized barrier culverts with appropriately sized box culverts, and removed three other in-channel barriers.

Completion of these projects will reconnect the lower section of Johnson Creek with high quality habitat above Green Acres Rad, restoring over nine miles of prime spawning and rearing habitat.

In addition to increasing access to ideal habitat for summer steelhead and chinook, this effort is providing appropriately sized, low-maintenance infrastructure for the Town of Riverside, and reducing flood risk to local property owners.

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

□ a. Existing Water Right □ b. Groundwater □ c. Surface Water □ d. Other

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:

b. Timeframe(s) or Season of Use:

c. Tributary (name) or Mainstem Okanogan River and Location(s):
Johnson Creek

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

In 2012, monitoring efforts detected ESA listed summer steelhead adults and redds in Johnson Creek, demonstrating this tributary's importance to salmon recovery goals in the Okanogan Basin. This same year, an intrinsic potential model for fish habitat restoration revealed that Johnson Creek has the third largest area of potential summer steelhead habitat in the entire United States portion of the Okanogan River basin. Removing these fish passage barriers will restore this tributary to its full potential.

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design: see below

b. Project Construction:

c. Project Annual O&M:

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

These projects are fully funded. Total project cost for removing these three barriers is $2.7 million.

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

12. Estimated Time Frame to Implement Project?
These barriers are slated to be removed by December 2021.

Loop Loop Creek Diversion Improvements

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING
PRELIMINARY PROJECT PROPOSAL TEMPLATE

The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use for evaluation under RCW 90.94. When complete, please submit to Bill Sullivan (bsullivan@aspectconsulting.com) by January 31, 2020

1. Title:	**2. Proposal Preparer(s):**
Loop Loop Creek 2 - Conveyance Efficiencies Feasibility Study	**Kevin Haydon and Greg McLaughlin, Washington Water Trust**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

The Confederated Tribes of the Colville Reservation (CCT) and Washington Water Trust (WWT) are working to identify projects to enhance instream flows on Loup Loup Creek. The proposed project will target improved efficiency of water use for upstream water diversions. This could include a variety of operational changes, distribution system improvements, and increased water delivery efficiency. The proponents have identified that a major upstream water user has existing facilities, such as a storage reservoir, which could play a part in adjusting the timing of flows to benefit habitat and instream flow in lower Loup Loup Creek. Enhanced conveyance efficiency could further optimize delivery into the storage reservoir where storage is owned by the water user. We have support from CCT fisheries staff for pursuing efficiency projects with water users along Loup Loup Creek to enhance flows which would benefit summer steelhead, spring Chinook salmon, and coho salmon, all of which have inhabited Loup Loup Creek.

The project we would like to pursue builds on previous assessments that suggest significant water savings potential exists within the drainage, with over 1,000 irrigated acres presently farmed, much of which is supplied from Loup Loup Creek. These prior assessments indicate the potential benefit would be a substantial increase in flow throughout the year, particularly during natural low-flow periods.

This funding request would verify the accuracy of prior assessment estimates for the combined annual water production from creeks feeding the existing out-of-stream uses, and provide an independent engineering estimate of construction costs and infrastructure needs within the drainage. This would provide an estimated quantity of water made available from the efficiency upgrades or source switch projects to satisfy irrigation needs. Results of the feasibility study will be an important precursor to securing the permission of landowners to participate in future project phases. If the amount of water made available by efficiency improvements allows the water user to retain existing agricultural production, this lays the framework for agreements on future project development and implementation phases.

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

X a. Existing Water Right □ b. Groundwater X c. Surface Water □ d. Other
Water Rights:
Various water rights are known to exist, full research to be completed as part of initial feasibility work.

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:
A preliminary estimate indicates that potential water savings could increase stream flow in Loup Loup Creek by approximately 5 to 10 cfs throughout the year. This increase in streamflow would be realized

in future phases of the project (not in Phase I) once agreements between the parties regarding water source and implementation of the project are reached.

b. Timeframe(s) or Season of Use:
All waters of Loup Loup Creek and its tributaries within the time periods allowed by existing water rights. There is potential for year-round flow improvements.

c. Tributary (name) or Mainstem Okanogan River and Location(s):
Loup Loup Creek and its tributaries (Sweat and Little Loup Loup Creeks)
Little Loup Loup Creek and Sweat Creek (tributaries to Loup Loup Creek)

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

This project is occurring in close coordination with biological recommendations for Loup Loup Creek, with the goal of providing adequate flows for Upper Columbia Steelhead spawning and rearing, as well as potential cool water refugia at its confluence with the Okanogan River. Loup Loup Creek is listed as a priority tributary by the Upper Columbia Steelhead ESU Recovery Plan, and this proposed project would enhance an existing project WWT and CCT completed on Loup Loup Creek in 2010, which adds 3.21 cfs and 665 acre-feet of annual flows through 2030.

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

This project proposal encompasses the confirmation of previous analysis of water production from sub-watersheds. If these sub-watersheds provide a sufficient amount of water for existing agricultural production, this project will direct efforts towards design and implementation of irrigation delivery efficiencies upgrades for the long-term. As part of the project development Phase I, WWT would contract an independent engineering and hydrologic assessment of efficiency impacts and hydrological conditions to determine feasibility of the project.

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design: Phase I: Feasibility and Pre-design: $50,000, *Phase II: Design: $125,000.*

b. Project Construction: Phase $1.5 Million.

c. Project Annual O&M: To be determined by feasibility and pre-design study. (italics indicated future phases)

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

This project is not tied to mandated mitigation requirements. It would be a voluntary agreement. However, the impacts of the project would address recovery actions identified in the BiOp.

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

The proposed project would address flow and temperature limiting factors in Loup Loup Creek, which are specifically identified in regional recovery plans.
11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*
Protecting irrigator's water right, such as is the case in Loup Loup Creek and optimizing their delivery system for current agricultural production is an important value to be met by future projects. We will also need to establish potential costs and benefits for the project to ensure the environmental benefits can be achieved in a cost-effective manner.
12. Estimated Time Frame to Implement Project?
Phase 1 would be completed by December 2020, with design and construction, pending project agreement, occurring between 2021 and 2023.

OTID Tributary Supplementation

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING
PRELIMINARY PROJECT PROPOSAL TEMPLATE

The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use for evaluation under RCW 90.94. When complete, please submit to Bill Sullivan (bsullivan@aspectconsulting.com) by January 3, 2020

1. Title:	**2. Proposal Preparer(s):**
Oroville-Tonasket Irrigation District (OTID) – Tributary Supplementation	**Jay O'Brien**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

Using existing infrastructure and with minor modifications, OTID has the ability to supplement flows in select tributaries to the Okanogan River. Supplementation will help increase flow and reduce temperatures in the following tributaries.

1. Bonaparte Creek - 75 GPM located 2095 ft from the mouth of the creek the source of the water would come from the Bonaparte Station.
2. Siwash Creek - 75 GPM located 500 ft from the mouth of the creek water would come from the Tonasket Station.
3. White Stone Creek - 75 GPM located 650 ft and 3100ft from the mouth of the creek for a total of 150 GPM water would come from the Ellisforde Station.
4. Nine Mile Creek - 75 GPM located 1740 ft from the mouth of the creek water would come from the Osoyoos Station.
5. Antoine Creek - 100 GPM at 2324 ft and 50 GPM at 940 ft from the mouth of the creek water would come from the Ellisforde station.

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

X a. Existing Water Right □ b. Groundwater X c. Surface Water □ d. Other

Water Right No. CS4-ADJ01P2@13 or new non-consumptive water right from Ecology.

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:
See above.

b. Timeframe(s) or Season of Use:
April 1 through October 15

c. Tributary (name) or Mainstem Okanogan River and Location(s):
see above.

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

Increase in flow and a reduction of temperature in select tributaries to allow for a longer time period before streamflow temperature reach lethal levels.

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

OTID and the Colville Tribe completed a small-scale pilot test in 2019. Data and applicability to other reaches is pending analysis and reporting of the results.

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design: Install each site would not exceed $1500, for a total of $10,500.

b. Project Construction: 2020

c. Project Annual O&M: N/A

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

TBD.

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No.

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

Water-for-water in the lower reaches of select tributaries to the Okanogan Rivers.

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

Pending analysis of results from the 2019 pilot study.

12. Estimated Time Frame to Implement Project?

Infrastructure can be installed in 2020.

Pine Creek Water Right Acquisition

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING PRELIMINARY PROJECT PROPOSAL TEMPLATE	
The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use for evaluation under RCW 90.94. When complete, please submit to Bill Sullivan (bsullivan@aspectconsulting.com) by January 3, 2020	
1. Title: **Pine Creek Water Right Purchase**	**2. Proposal Preparer(s):** **Tyson Carlson**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

Water Right purchase of the Pine Creek water right, currently held in the State's Trust Water Right Program by Washington State Department of Ecology, Office of Columbia River (OCR).

Email correspondence with Tyler Roberts indicates:

The Pine Creek Trust Water Right (CG4-23992(A)C), has 625.7 acre-feet of consumptive use available for mitigation downstream of Janis Rapids (RM 51), of which 225.7 acre-feet are only available for mitigation near the mainstem Okanogan River within Okanogan County. The remaining 400 acre-feet of consumptive use may be used further downstream out of the County, but I've not been informed of any other OCR commitments to this mitigation bucket. As such, if the County wants to start with the 625.7 number as an upper limit I think that is reasonable.

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

X a. Existing Water Right □ b. Groundwater X c. Surface Water □ d. Other

See above.

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:
Up to 625.7 acre-feet (CU)

b. Timeframe(s) or Season of Use:
April 1 to October 1

c. Tributary (name) or Mainstem Okanogan River and Location(s):
Pine Creek and Okanogan River

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

N/A

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design: N/A

b. Project Construction: N/A

c. Project Annual O&M: N/A

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

Water-for-water offset.

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

Water is currently available in the State's TWRP

12. Estimated Time Frame to Implement Project?

2020

Salmon Creek Source Substitution

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING PRELIMINARY PROJECT PROPOSAL TEMPLATE	
The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use for evaluation under RCW 90.94. When complete, please submit to Bill Sullivan (bsullivan@aspectconsulting.com) by January 3, 2020	
1. Title: Salmon Creek – City of Okanogan Water right claim transfer	**2. Proposal Preparer(s):** **Chris Johnson _ City of Okanogan**
3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*	
The City of Okanogan has a municipal water right claim to divert waters from Salmon Creek for municipal uses. The claim has a 1908 priority date. The City maintains a collections system, reservoir and delivery pipeline for the use of the right. The City has maintained the water source as a future untended source to meet municipal needs. The City is proposing to transfer the water right from Salmon Creek to an existing or new groundwater well in continuity with the Okanogan River. The project would need to provide funding to mitigate any existing facilities on Salmon Creek that would impact habitat projects and would need to provide adequate funding to improve the new or existing groundwater well to meet state requirements. The project would benefit in-stream flows in Salmon Creek by eliminating the diversion right to 300 gpm.	
4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*	
X a. Existing Water Right □ b. Groundwater X c. Surface Water □ d. Other	
5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*	
a. Acre-feet and/or Cubic-feet-per-second: 484 acre feet/year, 300 gpm	
b. Timeframe(s) or Season of Use: Continuous	
c. Tributary (name) or Mainstem Okanogan River and Location(s): Salmon Creek is a tributary to the Okanogan River	
6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*	

Restoration of stream flow within the lower 4.0 miles
Removal of upland improvements impacting riparian function

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

None known

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design: - $50,000 estimate from city engineers

b. Project Construction: $200,000 – Assumes 100-foot depth drilled to municipal standards

c. Project Annual O&M: $5,000 - $10,000

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

None identified

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

City of Okanogan is preparing to submit an application to consolidate our water rights for the benefits of system operation. Transferring the water right from a surface source to a groundwater source would improve health/safety of the drinking water sources by eliminating the risk posed by surface water sources.

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

None, other than cost

12. Estimated Time Frame to Implement Project?

Project could be initiated as soon as water right approvals are received.

Salmon Lake Storage

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING PRELIMINARY PROJECT PROPOSAL TEMPLATE	
The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use for evaluation under RCW 90.94. When complete, please submit to Bill Sullivan (bsullivan@aspectconsulting.com) by January 3, 2020	
1. Title: **Relocate or change septic systems at residences surrounding Salmon Lake allowing increased storage**	**2. Proposal Preparer(s):** **Bureau of Reclamation**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

During 2004 a draft Environmental Impact Statement (DEIS) was developed to restore perennial flow in Salmon Creek. One alternative identified in the DEIS that was considered but not pursued was raising the height of Salmon Lake Dam. Due to the number of cabins and associated septic systems this alternative was eliminated though if the leases of cabins were eliminated this alternative could be reevaluated.

Recent information suggests that it wouldn't be necessary to alter the height of the dam to increase water storage but structures and infrastructure would need to be relocated to prevent inundation. According to the DEIS, twelve cabins would need to be relocated. Also, approximately 2,000 feet of septic pipe and 8 septic tanks would need to be moved.

There may be an opportunity, if cabin lease agreements have expired and the Bureau of Reclamation would be willing to dismantle or demolish the cabins, not to relocate but remove the cabins completely. The option to remove the infrastructure rather than relocate would be less expensive.

The additional volume as a product of the implementation of this project would contribute to the 3,600 ac-ft. dedicated to provide perennial flow downstream of the Okanogan Irrigation District diversion dam. This additional volume would augment or extend the duration of elevated flow during migration or augment winter-time flow to increase over-winter survival. Since this project would result in a long-term (life of Salmon Lake dam), reliable (dependent upon snowpack) source of water to benefit summer steelhead in the most productive tributary in the Okanogan River subbasin, the cost for this project, for either option (see below: relocation, removal) seem worthy of serious consideration.

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4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

□ a. Existing Water Right □ b. Groundwater □ c. Surface Water □ d. Other

This water could be captured during snow melt and spring run-off when stream flow conditions are robust and could be released downstream when stream flow conditions are minima, during the summer or over-winter. This would result in an increased production of steelhead in Salmon Creek.

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:
Approximately 1,000 acre-feet

b. Timeframe(s) or Season of Use:

This additional volume would benefit conditions during spring for migration and emigration as well as during over-winter flows.

c. Tributary (name) or Mainstem Okanogan River and Location(s):

Salmon Creek

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

In stream flow increase provided by the new storage capacity would increase the amount of habitat and duration of stream flow during critical periods, such as adult migration, juvenile emigration and over-winter, to benefit anadromous fish while keeping irrigated lands fully functional for growers

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

Actual number of residences and associated infrastructure in the proposed inundation area. Also, the material in which structures are constructed to accommodate moving or demolishing and removal.

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design:

Undetermined or unknown at this time.

b. Project Construction: Estimates to relocate infrastructure and cabins, as identified in the 2004 Draft Environmental Impact Statement, originate from a local construction contractor.

The ESTIMATED cost to relocate each structure type is as follows:

2,000 feet of septic pipe: $100,000
Each cabin relocated 50 ft. from current location: $18,000 each; 8 cabins, $144,000
New foundation for each cabin: $20,000 each; 8 cabins, $160,000
Relocate septic systems; $12,000 each; 8 cabins, $96,000
ESTIMATED TOTAL: $652,000

If the cabins in question were to be demolished and removed the estimated cost is as follows:

Inspection for asbestos or toxic material: $14,000 each; 8 cabins, $112,000
Dump fee: $8,000 each; 8 cabins, $64,000
ESTIMATED TOTAL: $176,000

c. Project Annual O&M:

Not applicable.

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

Unknown at this time.

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No. This proposed project would contribute to water flow that has been reestablished from contributions by Bonneville Power Administration and Bureau of Reclamation.

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

The implementation of this project would benefit the local economy by providing a construction project for local contractors. This water would contribute water to Salmon Creek for the recovery of summer steelhead. Worth noting Salmon Creek currently produces 2/3 of the total smolt production of all tributaries in the U.S. portion of the Okanogan River basin.

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

Not knowing the disposition of lakeside residents, it is unpredictable to gage support. One benefit there is expected to be increased waterfront, but consequently each landowner may lose some available land due to the increased inundation.

Naturally permits would be required to construct this project. It is anticipated that review process may be less complicated since this proposed project is in a closed system, with no federally-listed species. However, the outcome of the project would benefit listed species. However, local jurisdiction (Town of Conconully, Okanogan County Shoreline, etc.) may cause delay depending upon public feedback.

12. Estimated Time Frame to Implement Project?

Once agreements are established between landowners, Bureau of Reclamation and others, as well as required permits are secured. The proposed project could be completed during one summer/fall. The increased water elevation/storage would be realized the following year.

Whitestone Creek Flow and Temperature Augmentation

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING PRELIMINARY PROJECT PROPOSAL TEMPLATE	
The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use for evaluation under RCW 90.94. When complete, please submit to Bill Sullivan (bsullivan@aspectconsulting.com) by January 3, 2020	
1. Title: **Whitestone Reclamation District Aquafer Recharge Timing and Water Loss Project**	**2. Proposal Preparer(s):** **Rob Inlow, WRD Director**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

1. Investigate the ability to refurbish a 100-year-old 5000AF reservoir (T36 R26 S16).
2. Construct a drain in the reservoir for off-timed discharge of storage water.
3. Replace 7.9 miles of open ditch with PVC pipe.
4. Install "Y" structure and install 1.5 miles of pipe to fill reservoir.
5. Remove silts from Whitestone Lake, and possibly Spectacle Lake to use in the sealing of 100-year-old reservoir.
6. Refurbish an assortment of turnouts, air vents, and screen room to allow for winter time operation.

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

☒ a. Existing Water Right ☐ b. Groundwater ☐ c. Surface Water ☐ d. Other

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second: 6-10 CFS of water is available typically during winter runoff. This water could be used to fill the reservoir during winter months. Our existing system is capable of 70-80 CFS when in operation during irrigation season. If the full volume is not needed during the spring, part of this water could also be sent to the reservoir.

b. Timeframe(s) or Season of Use: Reservoir to be filled in winter when recovery is not needed in Spectacle Lake.

c. Tributary (name) or Mainstem Okanogan River and Location(s): Toats Coulee Creek (T39 R25 S34) west of Loomis.

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

Improved river flow, decreased water temperatures, and the new reservoir would create new habitat areas in a location that is currently limited. This could also effect or improve water volume in Whitestone Creek if desired.

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

Ability to use reservoir (state land), continuity of reservoir with surrounding likes, cost of pipe project, winter time use of pipeline from Toats Coulee diversion, and related costs to ensure safe operation.

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design: There are numerous avenues to explore that can create multiple effects on the Upper Okanogan River Basin.

b. Project Construction: These improvements would need to be engineered and then priced accordingly.

c. Project Annual O&M: Minimal due to the fact that this system would be able to operate off of gravity.

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

Possible USBR funding for piping of canals

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No known requirements.

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

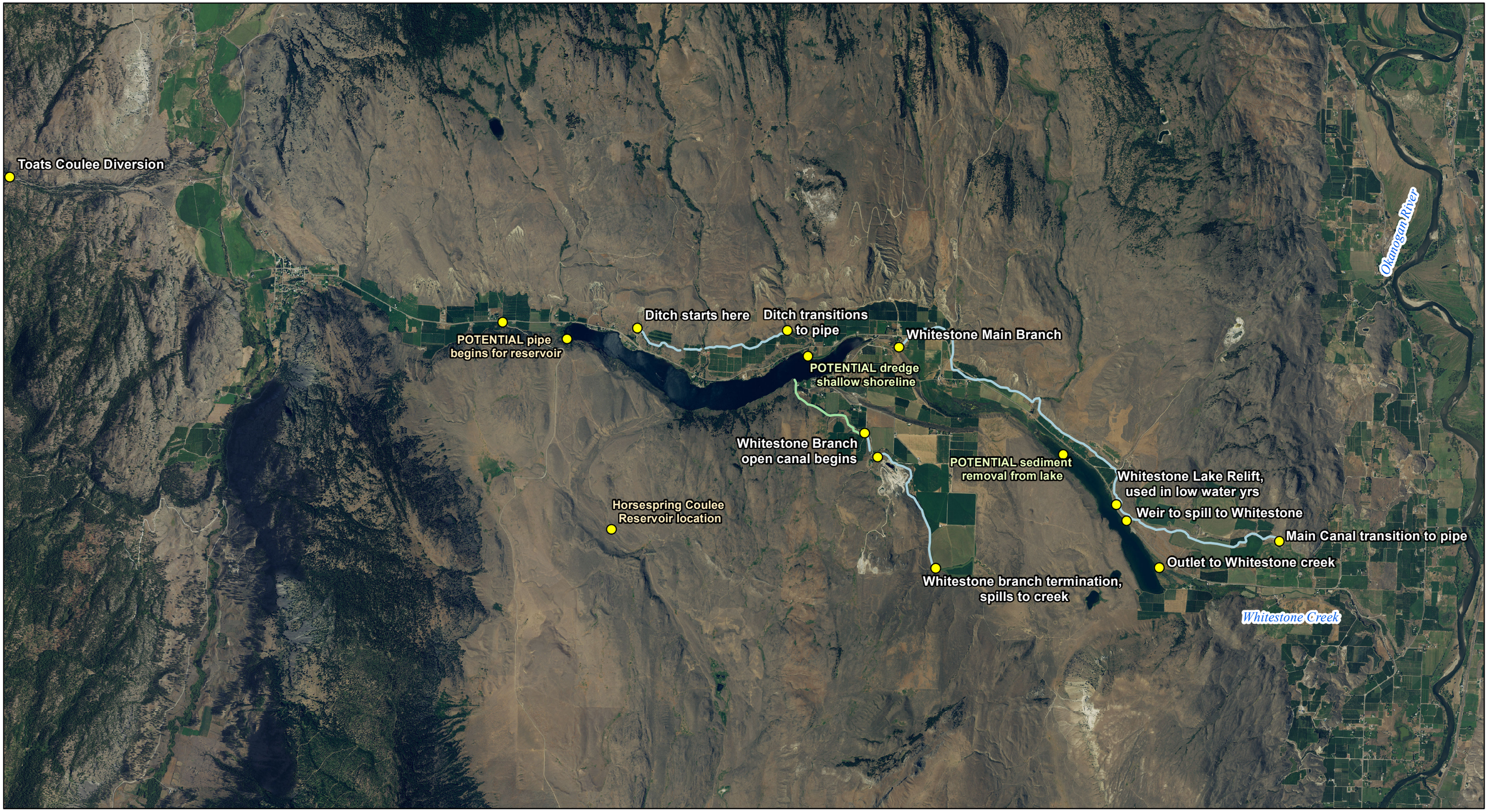
Reduced water loss through canal leakage, ability to change pumps to VFD, a percentage of farmer pumps could be removed, water would be maintained in a cleaner environment, thus improving food safety. Wildlife would have an easier movement in the valley and less death loss due to being barricaded by canals, and a resurrection of the new reservoir would make a new riparian and habitat area, and an open wasteland of sagebrush.
Dredging of the lakes, and enclosing of canals will decrease water temperature, thus lowing lake discharge temperatures, which should result in a positive effect in Whitestone Creek, and the Okanogan River, not to mention the numerous leaks, water loss, and evaporation associated with open ditches.

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

State holdups on land use, pipeline easement, weather rising existing pipeline structures.

12. Estimated Time Frame to Implement Project?

Best guess: 3-5 years, depending on scope of project.



Canal

Pipe

Whitestone Reclamation District WRIA 49 Proposal

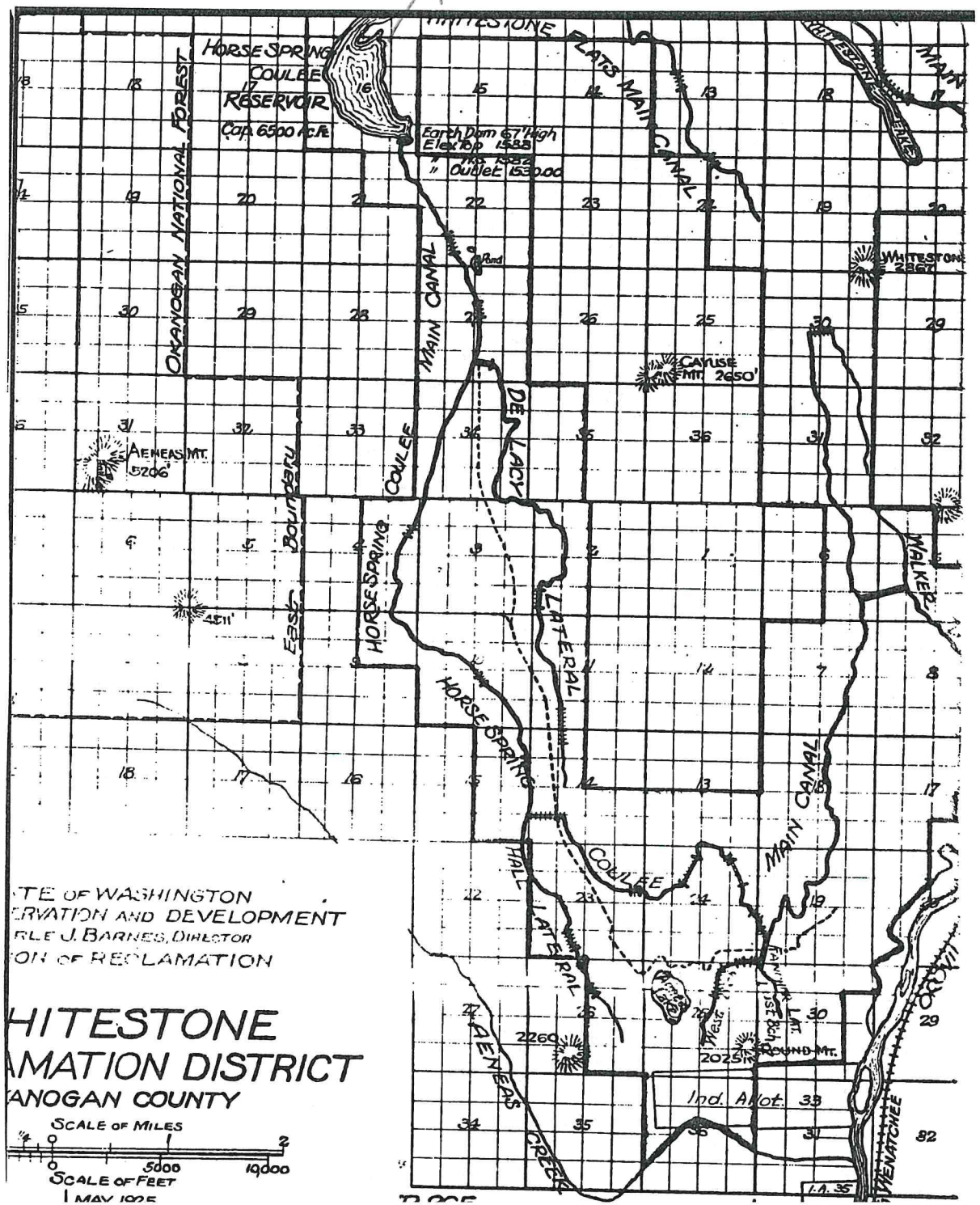
Locations for potential water management projects with the Whitestone Reclamation District.
Opportunities include converting nearly 8 miles of open canals to pipeline, dredging parts of Whitestone and Spectacle Lakes to increase reservoir capacity, or rehabilitating an old (failed) reservoir, Horsespring Coulee Reservoir.
Not all piped sections are mapped.

0 0.75 1.5 3 Miles

Conceptual projects are proposed for inclusion in the WRIA 49 Planning process.
January 3, 2020

Map prepared by Amy Martin, Okanogan Conservation District

also an option for Groundwater Recharge



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construction financed and ma
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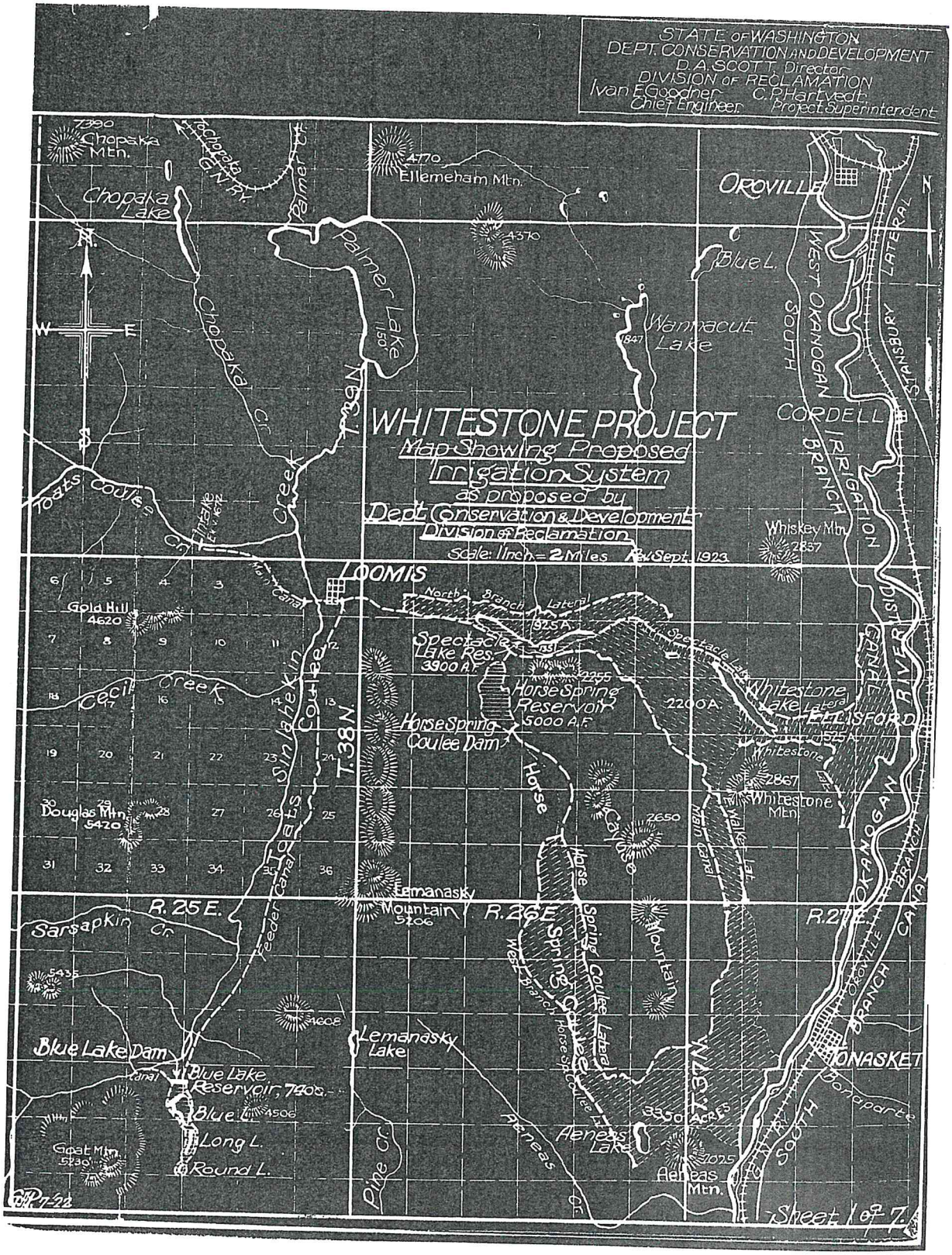


Tier 2 Projects

Tier 2

Project Proposals

Aeneas Lake Irrigation District Efficiencies

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING PRELIMINARY PROJECT PROPOSAL TEMPLATE	
The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use for evaluation under RCW 90.94. When complete, please submit to Bill Sullivan (bsullivan@aspectconsulting.com) by January 3, 2020	
1. Title: **Aeneas Lake Irrigation District Efficiencies**	**2. Proposal Preparer(s):** **Okanogan Conservation District**
3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*	
Aeneas Lake Irrigation District (ALID) is in the process of developing a plan to improve energy and water efficiency from a pumping station on the Okanogan River. ALID diverts up to 15.6 cubic feet per second (cfs) from the Okanogan River to irrigate 1425 acres of agriculture land. They have 2 – 600 hp turbine pumps with 1 – 50 hp supplemental centrifugal pump. The pumps operate at full capacity during the irrigation season, even when water is required less the pumps operate at max capacity. Currently they pump excess water back to the river and they also have a permit that allows them to pump water into Aeneas Lake, about 1200 acre/ft. This project would reduce the amount of excess water pumped from the River, but the amount has not been determined. Potentially reducing the over-pumping and dumping back to the river will reduce turbidity in that location. EDT Reach 16-31 Okanogan River, north of Rolling Hills Drive Summer Chinook and steelhead redds (2014) have been documented in this part of the Okanogan River.	
4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*	
X a. Existing Water Right □ b. Groundwater **X c. Surface Water** □ d. Other	
5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*	
a. Acre-feet and/or Cubic-feet-per-second: TBD	
b. Timeframe(s) or Season of Use: April-October	
c. Tributary (name) or Mainstem Okanogan River and Location(s): Mainstem Okanogan	

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

Unknown.

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

ALID & Okanogan CD are in the process of selecting efficiency improvements. Likely an engineer will be hired to assess/complete the plan.

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design: $30,000

b. Project Construction: Uncertain.

c. Project Annual O&M:

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

Okanogan CD and ALID will pursue grants from the Bureau of Reclamation and other sources.

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

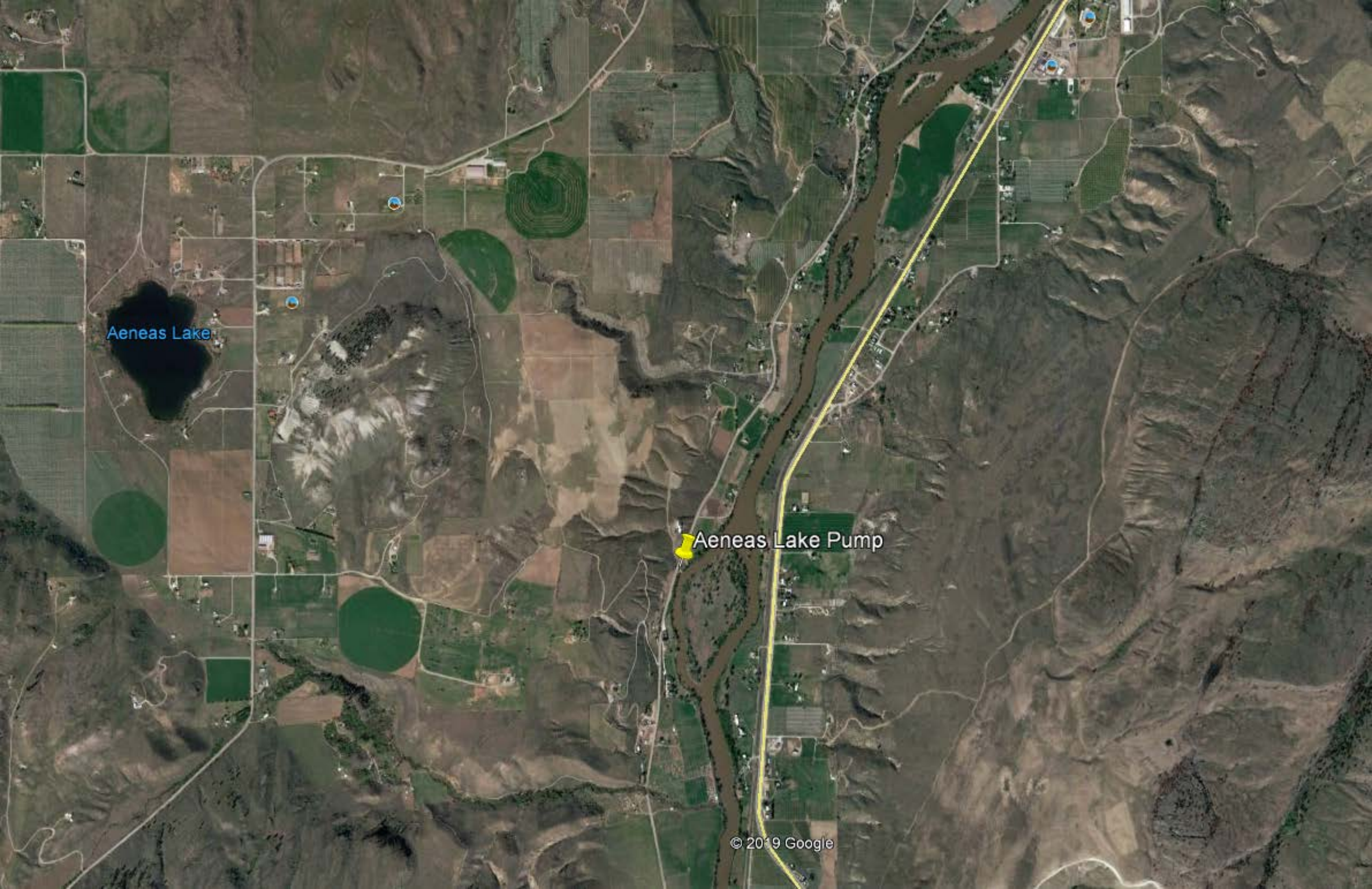
This project would benefit ALID by reducing power costs from pumping and avoid pumping water when it's unneeded.

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

Potentially funding is a barrier.

12. Estimated Time Frame to Implement Project?

Planning and implementation- 4-6 years.


Aeneas Lake
Aeneas Lake Pump
© 2019 Google

Conconully Dam Replacement

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING PRELIMINARY PROJECT PROPOSAL TEMPLATE	
The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use for evaluation under RCW 90.94. When complete, please submit to Bill Sullivan (bsullivan@aspectconsulting.com) by January 3, 2020	
1. Title: **Lower Conconully Reservoir dam replacement**	**2. Proposal Preparer(s):** **Bureau of Reclamation**
3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*	
The lower Conconully Dam needs to be upgraded to withstand a certain earthquake impact. In light of the desire to improve Salmon Creek for an anadromous fish habitat and the fact that flows necessary for improving that habitat would impact the Okanogan Irrigation District user a new site for the dam is being proposed south of the dam and west of Andrew Lake that would double reservoir capacity. The cost for either option are similar enough to make the project a worthwhile consideration. Complete description of proposal and the willingness to commit to it will be investigated by Dan Newhouse's representative.	
4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*	
□ a. Existing Water Right □ b. Groundwater □ c. Surface Water □ d. Other One contribution is it could be a water for water project once the water left Salmon Creek	
5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*	
a. Acre-feet and/or Cubic-feet-per-second: No specific AF provided at this time	
b. Timeframe(s) or Season of Use: Benefit would occur during spring runoff through September/October low instream flows	
c. Tributary (name) or Mainstem Okanogan River and Location(s): Salmon Creek	

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

In stream flow increase provided by the new storage capacity would meet needed habitat benefit for anadromous fish while keeping irrigated lands fully functional for growers

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

Actual site location and engineering associated with the site.

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design:
No figures given at this time

b. Project Construction:

c. Project Annual O&M:
Not provided.

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

BOR is already engaged in the Conconully Reservoir project design phase which appears to be funded

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

Assessment of any impacts on local land owners

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

Maintains viable agriculture with sufficient irrigation water while providing needed habitat for anadromous fish and water off sets down stream of habitat needs

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

None practically envisioned other than traditional government slowness.

12. Estimated Time Frame to Implement Project?

Initial project goal was initiating dam replacement within two years

Highlands Springs Protection and Enhancement

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING PRELIMINARY PROJECT PROPOSAL TEMPLATE	
The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use for evaluation under RCW 90.94. When complete, please submit to Bill Sullivan (bsullivan@aspectconsulting.com) by January 3, 2020	
1. Title: **Highland Springs Project**	**2. Proposal Preparer(s):** **Okanogan Highlands Alliance (OHA)** **Contact: Jen Weddle** **jen@okanoganhighlands.org** **509-429-4399**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

Protecting springs, seeps and water resources enhances multiple use of public and private lands. OHA is committed to monitoring and improving infrastructure that protects and restores water resources and the habitats that rely on these water resources. Our geographic area is the Okanogan Highlands in the north end of WRIA 49. Partners at the US Forest Service have confirmed the need for spring protection throughout the Tonasket Ranger District in the Okanogan Highlands, and are supportive of this project. In future years spring protection and monitoring will take place on both National Forest and private land. Our objectives are to partner with range lessees, landowners, and the US Forest Service to: assess the condition of water resources, repair spring protection infrastructure, and install fencing, troughs, etc. to protect undeveloped springs.

Infrastructure requirements are low - the Forest Service will provide supplies and materials to do spring protection work on National Forest land.

In 2020, OHA is planning to establish a system of monitoring, evaluating and repairing spring infrastructure on a portion of the Tonasket Ranger District. In future years OHA will expand the project to include more sections of National Forest as well as private land.

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

□ a. Existing Water Right □ b. Groundwater □ c. Surface Water □ d. Other

N/A

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:

N/A

b. Timeframe(s) or Season of Use:

N/A

c. Tributary (name) or Mainstem Okanogan River and Location(s):

Upper reaches of: Mill Creek, Siwash Creek, Antoine Creek (2020).
Future years will also include: Upper reaches of Bonaparte Creek, Tonasket Creek

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

In the Okanogan Highlands cattle grazing is ubiquitous. Cattle and other animals drink from natural water sources including creeks, developed springs (those with troughs or other infrastructure), and undeveloped springs. When headwaters are not adequately protected, they are frequently trampled as they emerge from the ground, polluting the water with sediment and feces, limiting recreational enjoyment, and destroying critical habitat. All of the creeks in the project area are vulnerable to headwater degradation.

This proposal will result in:

- Repair and protection of degraded springs, seeps or other water resources.
- Protection of sensitive soils, native species, and ecosystems at springs, which support a multitude of life.
- Inventory and assessment of the condition of springs, seeps and water resources.
- Development of a system of annual spring assessment and repair that can be expanded for use throughout the Okanogan Highlands to ensure long-term protection of water resources.

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

- NEPA to newly develop unprotected water resources on public lands (NEPA is not needed for repairs to developed springs);
- Development of agreements/contracts with landowners and range lessees
- Inventory of water resources on National Forest land and private land

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design: in 2020, OHA estimates $20,000 to develop and pilot systems of monitoring and repair work

b. Project Construction: Depends on repair needs at specific sites. USFS provides materials for repairs done on FS land, so costs are in staff/contractor labor.

c. Project Annual O&M: annual cost to monitor, repair and install new infrastructure, estimated cost: $5,000-10,000, depending on sites selected and identified needs

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

Potential: National Forest Foundation (applied for 1 year grant support, with the requirement of matching funds). Total project ~$20,000.

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No. National Forest lessees are required to protect springs; OHA will be helping with this effort.

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

The project has the potential to:

1. Unite diverse stakeholders around the shared goal of ensuring that water resources are clean and sustainable.

2. Provide volunteer opportunities to: access areas of public lands they might not otherwise experience, steward our land, and get some exercise.
3. Increase the health and productivity of cattle.
4. Provide educational opportunities to students and the general public.
5. Add to our community's knowledge base, enabling us to better steward water resources in the Okanogan Highlands.

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

1. Permitting requirements for developing new springs.

12. Estimated Time Frame to Implement Project?

Annual, as needed.

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING
PRELIMINARY PROJECT PROPOSAL TEMPLATE

The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use for evaluation under RCW 90.94. When complete, please submit to Bill Sullivan (bsullivan@aspectconsulting.com) by January 3, 2020

1. Title:	2. Proposal Preparer(s):
Irrigation Efficiencies Project **Loup Loup-Swamp Sub-basin** **approximately, RM 19.1** **Okanogan River**	**Okanogan Conservation District**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

Objective: To reduce water and electrical use
Infrastructure Requirements: Replace leaking wheel lines (55% efficient) with center pivot (90% efficient).
Connection to other projects: Save Water-Save Energy to reduce electrical use. Also, landowner has expressed a desire to have a pump intake screen with a lifting boom. The screen could potentially reduce mortality of small fish.
Other stakeholders: Colville Confederated Tribes Fisheries, NRCS
Funding: Federal Farm Bill – NRCS; CCT Fisheries Columbia River BiOp; WSCC Irrigation Efficiencies Program
Maintenance Requirements: Landowner is required to maintain installed conservation practices for their projected lifetime (NRCS standards)

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

□ a. Existing Water Right □ b. Groundwater **X** c. Surface Water □ d. Other

Okanogan River

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:
unknown, but likely minimal

b. Timeframe(s) or Season of Use:
May through September

c. Tributary (name) or Mainstem Okanogan River and Location(s):
Mainstem Okanogan River at approximately river mile 19.1

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

Retention of water in river to augment river flow
Reduced runoff and aquifer infiltration of fertilizers and pesticides

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

Calculation of water use savings

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design:
$3,000
b. Project Construction:
$32,000
c. Project Annual O&M:
$750 (includes power costs)

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

Washington State Conservation Commission Irrigation Efficiencies Program funding
Save Water-Save Energy program

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

Reduced water use
Reduced O&M costs, greater crop production, reduced labor costs, reduced water quality impacts from more appropriate quantities of water applied to crops

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

Minimal water use savings do not qualify this project for the IEP.

12. Estimated Time Frame to Implement Project?

1 year

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING
PRELIMINARY PROJECT PROPOSAL TEMPLATE

The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use for evaluation under RCW 90.94. When complete, please submit to Bill Sullivan (bsullivan@aspectconsulting.com) by January 3, 2020

1. **Title:**	2. **Proposal Preparer(s):**
Pivot and Pump upgrades Loup Loup-Swamp (Lower Okanogan) Sub-basin approximately, RM 33 Okanogan River	**Okanogan Conservation District**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

Objective: To reduce water and electrical use to irrigate 44.89 acres
Infrastructure Requirements: Replace wheel lines (at best, 65% efficient) with center pivot (90% efficient); replace aging, leaking pump.
Connection to other projects: Save Water-Save Energy to reduce electrical use.
Other stakeholders: Colville Confederated Tribes Fisheries, NRCS
Funding: Federal Farm Bill – NRCS; CCT Fisheries Columbia River BiOp; WSCC Irrigation Efficiencies Program
Maintenance Requirements: Landowner is required to maintain installed conservation practices for their projected lifetime (NRCS standards)

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

□ a. Existing Water Right **X** b. Groundwater □ c. Surface Water □ d. Other
Okanogan River

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:
unknown, but likely minimal

b. Timeframe(s) or Season of Use:
May through September (typical irrigation season)

c. Tributary (name) or Mainstem Okanogan River and Location(s):
Mainstem Okanogan River at approximately river mile 33

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

- **Retention of water in river to augment river flow**
- **Reduced runoff and aquifer infiltration of fertilizers and pesticides**

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

Calculation of water use savings

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design:
$4,800
b. Project Construction:
$56,000
c. Project Annual O&M:
$1100 (includes power costs)

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

Washington State Conservation Commission Irrigation Efficiencies Program funding
Save Water-Save Energy program
NRCS EQIP
Colville Confederated Tribes Fisheries

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

- **Reduced water use**
- **Reduced O&M costs, greater crop production, reduced labor costs, reduced water quality impacts from more appropriate quantities of water applied to crops**

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

- **Minimal water use savings do not qualify this project for the IEP**
- **Permitting requirements**

12. Estimated Time Frame to Implement Project?

2 years

Loup Loup Creek Channel and Riparian Improvements

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING
PRELIMINARY PROJECT PROPOSAL TEMPLATE

The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use for evaluation under RCW 90.94. When complete, please submit to Bill Sullivan (bsullivan@aspectconsulting.com) by January 3, 2020

1. Title:	**2. Proposal Preparer(s):**
Loup Loup Creek Channel and Riparian Improvements	**Okanogan CD**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements,* v*arious sizing or phasing, etc.).*

Okanogan CD is working with a landowner to improve instream habitat and riparian condition along 600 feet of Loup Loup Creek. The location is near the town of Malott. The project will improve spawning habitat for ESA steelhead. Redds are documented by Colville Tribes F&W on adjacent properties, however this property was not surveyed due to previous accessibility issues. Riparian buffers will be increased from 10 feet to 30-100 feet.

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

□ a. Existing Water Right □ b. Groundwater □ c. Surface Water □ d. Other

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:

b. Timeframe(s) or Season of Use:

c. Tributary (name) or Mainstem Okanogan River and Location(s):

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

This project will improve spawning and rearing habitat for ESA steelhead, including channel improvements and installing a riparian buffer.

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

None

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design:

b. Project Construction:

c. Project Annual O&M:

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

Two grant applications in review (Ecology, BIA), pursuing multiple options.

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

None. Landowner is interested in the project and it's a high priority area for many funding sources. Permitting requirements for the project are straight-forward.

12. Estimated Time Frame to Implement Project?

Within 4 years, 2024.

Loup Loup Creek is a tributary to the Okanogan River, supporting anadromous steelhead for approximately 2.5 miles, ending at a natural waterfall barrier. The proposed project area is located within the natural anadromy segment of Loup Loup Creek.

Okanogan Conservation District

0.25 0.125 0 0.25 Miles

N

1:13,034

10/15/2019

Prepared by: HannahCoe

Document Path: K:\ProjectData\WaterQuality\Lassila\Lassila_projectmap1.mxd

The project area includes 1.4 acres of riparian planting and planning for approximately 600 feet of in-stream salmon habitat.
This project will improve water quality and increase in-stream habitat complexity to benefit ESA-listed summer steelhead in Loup Loup Creek.

Okanogan Conservation District

0 30 60 120 180
Feet

N

1:1,308

10/10/2019
Prepared by: HannahCoe

Document Path: K:\ProjectData\WaterQuality\Lassila\Lassila_projectmap.mxd

Methow Beaver Project

WDOE – Streamflow Restoration Grant Project Summary

Objective**:** Methow Beaver Project is preparing to submit an application to the WA Department of Ecology's (WDOE) Streamflow Restoration Competitive Grant Program. We are proposing to scale up effective and critically needed process-based restoration efforts in low order streams of the upper Methow and Okanogan watersheds. These actions would expedite the rebuilding of resilience and sustainability into ecosystem processes and services required for our watersheds and communities to function well. To assist WDOE in ranking our application, we are seeking letters of support from project partners that demonstrate the collaborative aspect of this effort.

Project Title: Restoring Streamflow and Water Quality Through Process Based Restoration of Wildfire and Human Impacted Streams in the Okanogan and Methow Watersheds of North Central Washington

Project Management: Methow Beaver Project, a project of Methow Salmon Recovery Foundation

Project Partners: Collaboration is key!!

Washington Department of Fish and Wildlife
(Methow & Scotch Creek Wildlife Areas)
Washington Department of Natural Resources
United States Forest Service
Okanogan Highlands Alliance
Chiliwist Creek Private Lands Partners

Project Timeline: Fall 2020 – Fall 2023

Proposal:

The Methow Beaver Project (MBP) proposes to restore streamflow in degraded and structure deficient low order stream channels impacted by fire and anthropogenic activities using process-based restoration (PBR) strategies in eight sub-basins of the Methow (5) and Okanogan (3) River watersheds (Figure 1). MBP believes that restoration actions can be developed and implemented within a three-year period in stream segments above the anadromous zone. These actions are to the intended benefit of groundwater recharge, extended streamflow, downstream salmonid habitat, and human communities through the restoration of natural processes and water quality improvement. Project development, planning, design and implementation would occur in Year one and two of the project timeline. Construction actions and monitoring would be implemented in Years one, two and three. Adaptive management would occur in Years two and three.

The goal of our project is to increase late season streamflow by restoring channel structure and floodplain connection with process-based restoration strategies that evolve with the environment over time and restore natural watershed functions and resilience to disturbance (Wheaton et al 2019). Reconnecting streams to their floodplains seasonally by adding structure to stream channels and repairing wetland habitat is a restoration strategy recommended in all current Methow watershed reach assessments as well as the Okanogan Watershed Plan. Process based restoration strategies, made up of a variety of potential actions, results in longer water residency time in upper watersheds leading to moderated annual flows, increased late season flows, significant riparian and aquatic habitat and water quality improvements, and increased channel complexity (Cluer & Thorne 2014, Wheaton et al. 2019).

Stream structure and floodplain reconnection would reduce excessive nutrient and sediment transport from wildfire and anthropogenic impacted streams to the sensitive and critical anadromous zones downstream (Whipple 2019), while improving essential reciprocal subsidies between the terrestrial and aquatic environments (Nakano & Murakami 2001). Restoring natural processes to dysfunctional watersheds would increase resilience to disturbance and reduce downstream catastrophic flooding and continued habitat degradation that are a common result of severely incised, fire impacted stream channels (Figure 2).

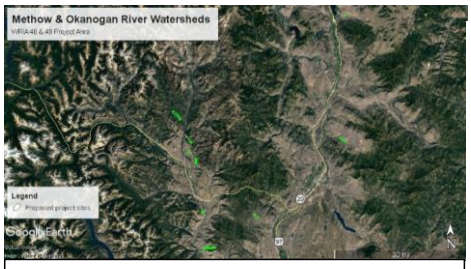


Figure 1. Project map of proposed restoration sites in WRIA 48 (Methow) & 49 (Okanogan).

Figure 2. Severely incised stream channels after wildfire in Okanogan County (Methow Beaver Project).

The PBR strategies or tools we will choose from to reconnect degraded streams to their floodplains and improve floodplain habitat and function include: **1**. installation of redundant beaver dam analogs (BDA's) (Figure 3), post assisted log structures (PALS)(Figure 4), post reinforcement and repair of derelict beaver dams (Figure 5), **2**. large wood recruitment (Figure 6), **3**. riparian planting, and **4**. beaver translocation when conditions have improved substantially to support colony establishment (Figure 7).

Figure 3. Severe incision with subsequent process-based restoration in Myers Creek, Chesaw, WA (Okanogan Highlands Alliance).

Figure 4. Examples of bank-anchored and mid-channel PALS from Asotin, WA (Wheaton et al 2019).

The Methow Beaver Project and Methow Salmon Recovery Foundation are well provisioned to accomplish this process-based restoration proposal with our broad partnerships and collaborative approach to restoration, as well as our combined knowledge and experience in restoring degraded landscapes with low tech strategies (beaver translocation (Figure 8), BDA and PALS installation, and wood recruitment, as well as with engineered approaches.

Figure 5. Example of low-tech beaver dam repair in unoccupied historic beaver complex, photos 1-3 taken August 23, 2019, photo 4 taken October 13, 2019 (Methow Beaver Project).

Figure 6. Example of 2014 post-fire/flood channel incision and October 2019 local wood recruitment treatment (Methow Beaver Project).

Figure 7. Beavers move into BDA complex within days of installation on Myers Creek, Chesaw (Okanogan Highlands Alliance).

Figure 8. Beaver translocation in the Methow Watershed 2016 (Methow Beaver Project).

Project Need:

WRIA 48 (Methow River Watershed) and WRIA 49 (Okanogan River Watershed) have experienced severe wildfire impacts in the last 20 years (Figure 9). Large scale, uncontrolled fire followed by climate intensified precipitation events has led to widespread sediment transport, channel scouring debris flows and severe channel incision and disconnection from floodplains (Figure 2). These events are compounded by the legacy of institutional fire suppression and anthropogenic resource extraction in both watersheds including beaver trapping, mining, timber harvest, water abstraction, road infrastructure, wood and riparian vegetation removal, and livestock grazing. In sum, human activities and climate intensified events have severely compromised natural ecosystem processes. Historically, and in a properly functioning ecosystem, natural processes such as wood recruitment and beaver dam building would ensure that streams were connected to their riparian zones when seasonal or disturbance induced high flows topped channel banks and inundated adjacent floodplains. Floodplains naturally spread high stream flows or excess water onto the landscape, decreasing stream power, and

Commented [CIJ1]: May want a statement here about wood recruitment

increasing water residence time. This natural process gradually filters water through riparian soils, broadening groundwater influence on riparian vegetation and ultimately contributes to greener, wetter landscapes and supports effective stream base flows throughout the annual water cycle through extended, slow release. As an additional and critical benefit, increased floodplain connection, riparian wetting, and beaver establishment also contribute to wildfire abatement and recovery in our arid watersheds (Figure 10, from Wheaton et al 2019) (Whipple 2019, Fairfax 2020).

Commented [CIJ2]: Vague word choice - are you trying to say that the process "supports or maintains" late season base flows?

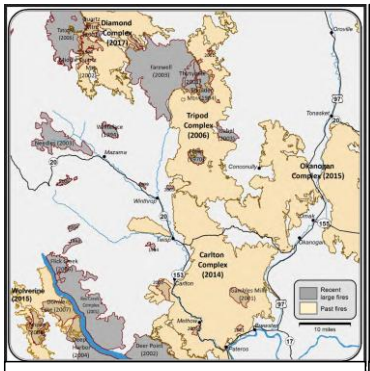


Figure 9. Upper Columbia watersheds wildfire history 2000-2017 (Fire Management Today).

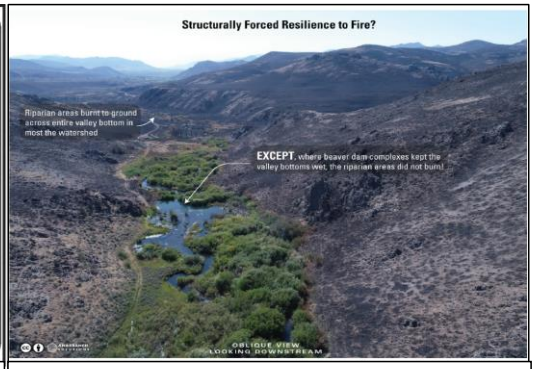


Figure 10. Beaver complex on Baugh Creek, ID showing wildfire resistance compared to burned riparian area without beavers (Wheaton et al 2019).

Estimated Budget and Funding Request:

$550,000 for a three-year project including completion of project development, planning, restoration designs, permitting, pre-project monitoring, action implementation, construction, adaptive management, post-project monitoring, assessment, reporting, and recommended applications to future projects.

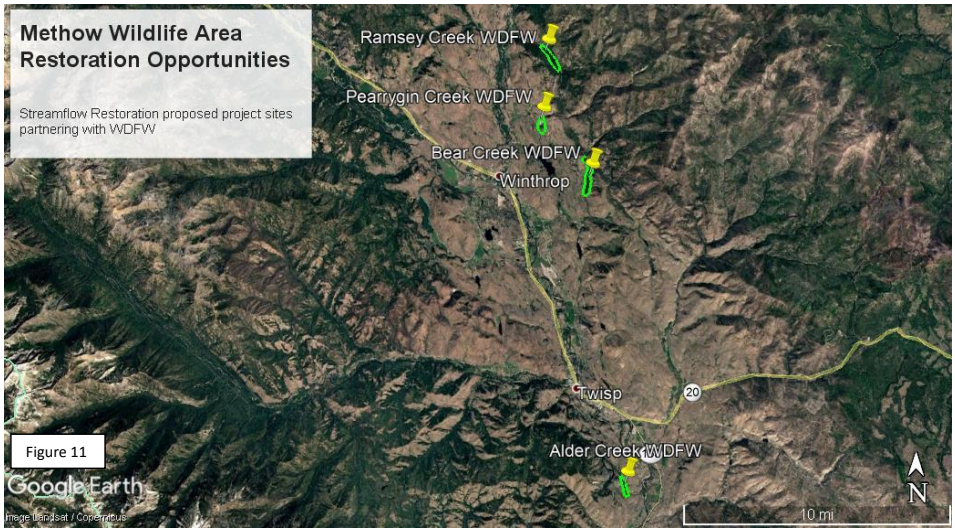
Proposed Project Areas and Landownership:

The following project areas in both the Methow and Okanogan watersheds have been identified as prime candidates for process-based restoration due to degraded condition, appropriate valley form for process based restoration, current impacts on downstream anadromous zones, and the confirmed cooperation and collaboration with all relevant public and private landowners. We have proposed restoration in eight project areas over three years, however we have included four additional sites as potential alternatives if needed, three in the Methow and one in the Okanogan watershed.

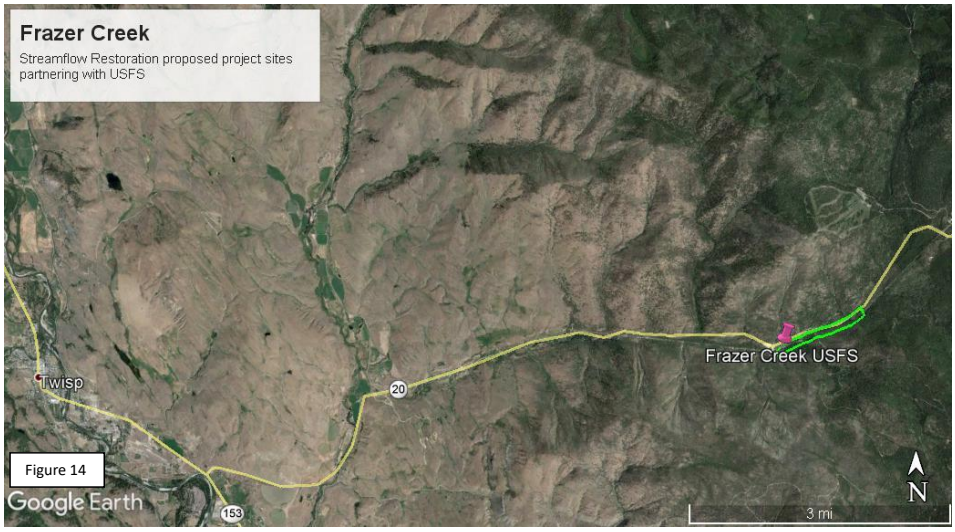
Methow Watershed

1. Ramsey Creek (WDFW) (Figure 11)
2. Pearrygin Creek (WDFW) (Figure 11)
3. Bear Creek (WDFW) (Figure 11)
4. Alder Creek (WDFW) (Figure 11)
5. Eightmile Creek (USFS) (Figure 12)
6. Benson Creek (USFS) (Figure 13)

7. Frazer Creek (USFS) (Figure 14)
8. Cow Creek (WDNR & Private) (Figure 15)




Benson Creek
Streamflow Restoration proposed project sites partnering with USFS
153
Benson Creek USFS
Figure 13
Google Earth
2 mi
N


Frazer Creek
Streamflow Restoration proposed project sites partnering with USFS
Frazer Creek USFS
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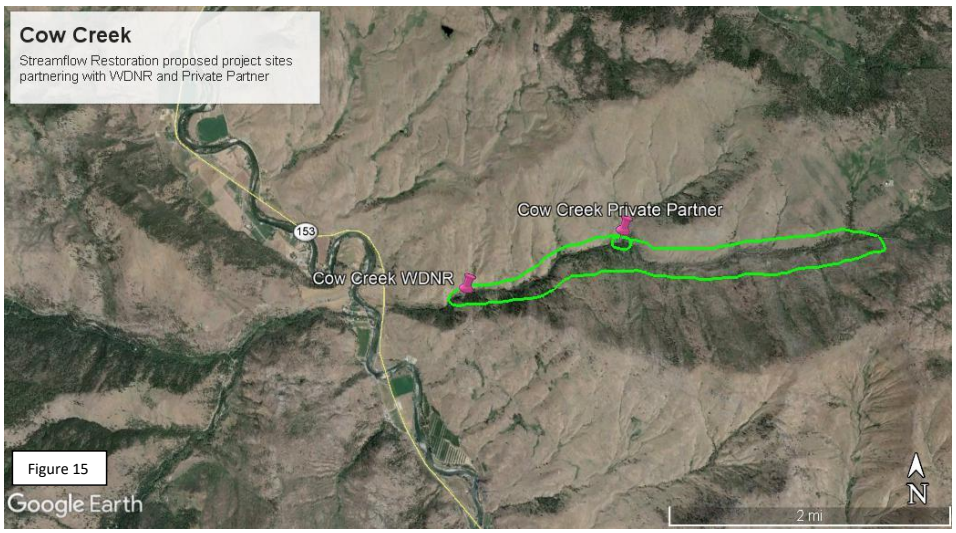


Okanogan Watershed

1. Tunk Creek (WDFW) (Figure 16)
2. Loup Loup Creek (WDNR) (Figure 17)
3. Tonasket Creek (WDFW & Private) (Figure 18)
4. Chiliwist Creek (Private) (Figure 19)

Figure 17

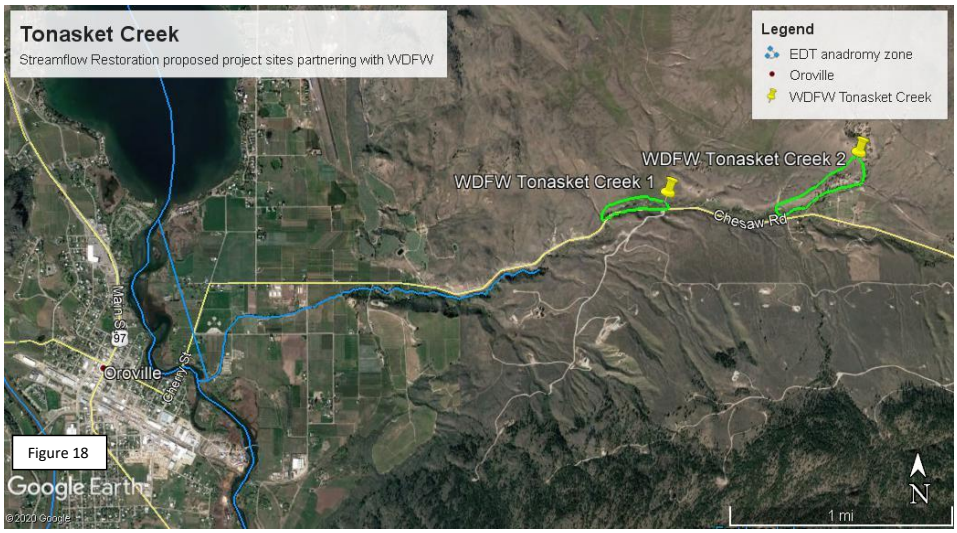
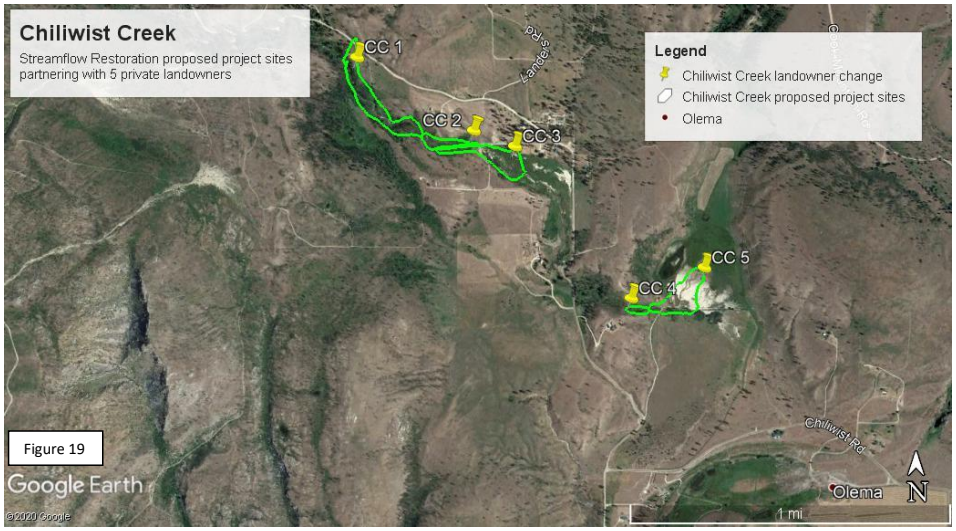


Figure 18


Chiliwist Creek
Streamflow Restoration proposed project sites
partnering with 5 private landowners
CC 1
CC 2
CC 3
CC 4
CC 5
Legend
Chiliwist Creek landowner change
Chiliwist Creek proposed project sites
Olema
Chiliwist Rd
Olema
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Google Earth
©2020 Google

Figure 19

Okanogan Highlands Water Riparian Restoration

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING
PRELIMINARY PROJECT PROPOSAL TEMPLATE

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1. Title:	**2. Proposal Preparer(s):**
Highlands Water Attenuation and Riparian Health	**Okanogan Highlands Alliance** **Contact: Jen Weddle** **509-429-4399**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements,* v*arious sizing or phasing, etc.).*

Riparian areas along creeks and wetlands are vital to the health of ecosystems both in and near the waterways. Protecting and improving the health of riparian areas will impact water quality and quantity from the highlands to the valley, will support native plant and animal species, and will increase the diversity of habitat throughout WRIA 49. This project has the possibility of taking place at various locations throughout the Okanogan Highlands on public and private lands. Restoration techniques will vary by site, depending on geomorphology, land use, stream flow, instream structure and roughness, etc. OHA will utilize restoration techniques that support and enhance natural processes, which will reduce infrastructure requirements and may benefit from ongoing adaptive management.

Project objectives:

1. Identify areas adjacent to waterways and drainages that have water storage potential (e.g. current or historical wetlands) and make structural adjustments to allow spring meltwater and stormwater to flow into and be stored in these areas until later in the year. Increasing the residence time of water on the landscape will create the conditions needed for healthy riparian plant communities to thrive and contribute a tangible ecological benefit, in addition to supporting late-season flows.
2. Plant native species to provide shade to creeks, reduce water temperatures, reduce erosion, filter water, and increase species and habitat diversity.
3. Install/upgrade livestock management infrastructure where needed to protect degraded riparian areas, while allowing cattle and other wildlife access to clean, safe water.

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

□ a. Existing Water Right □ b. Groundwater □ c. Surface Water □ d. Other
NA

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:
NA

b. Timeframe(s) or Season of Use:

Spring meltwater to be slowed down/captured high in the watershed, stored and naturally released slowly throughout the spring/summer/fall, while supporting healthy plant communities throughout the growing season.

c. Tributary (name) or Mainstem Okanogan River and Location(s):
Upper reaches of: Bonaparte Creek, Siwash Creek, Antoine Creek, Tonasket Creek

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

- Riparian habitat restoration and protection
- Floodplain restoration and protection
- Instream habitat restoration and protection
- Water quality improvements
- Water quantity improvements
- Re-timing of water in creeks to increase later-season flow
- Erosion reduction

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

- Feasibility of re-routing drainages, stormwater/meltwater ditches, to be assessed on a site-by-site basis
- Analysis of sites to determine best practices, restoration techniques

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design: Site dependent, estimated $5,000-$15,000 per site

b. Project Construction: Site dependent, estimated $5,000-50,000 per site

c. Project Annual O&M: Site dependent, estimated $1,000-$15,000 per year per site.

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

Potential: DOE's streamflow restoration funding.

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No.

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

- Maximize the benefit of natural flooding and reduce damage to infrastructure during spring melt and storms.
- Reduce fire danger by increasing surface water storage and wetland vegetation high in the watershed.
- Potentially benefit junior water right holders by increasing water available instream later in the season.

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

- Landowner willingness and site access
- Permitting requirements if on public lands, depending on timing and coordination with other projects

12. Estimated Time Frame to Implement Project?

Overall, this project will be implemented over the next 10+ years. Individual site timeframes will vary from,1-3 years for planning, permitting, and initial restoration, with possible ongoing adaptive management (O&M).

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

No none data gaps. No studies need to be completed.

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design:

b. Project Construction: **$54,116**

c. Project Annual O&M: **$1,500**

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

Washington State Department of Ecology

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

Stabilization of floodplain areas

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

No known barriers

12. Estimated Time Frame to Implement Project?

10/01/2019 – 9/30/2024

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1. Title:	**2. Proposal Preparer(s):**
Restoration and Maintenance and enlargement of previous riparian planting, Upper Okanogan River	**Okanogan Conservation District**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

Maintain four previously planted acres on the two-mile long stretch of property (WQC-2015-OkanCD-0009). This will include replacement of dead plants, adaptive management for weed control, and irrigation. Manage weeds on the previously planted four acres and six additional acres. The goal of this activity is to improve surface water quality through ensuring successful riparian planting. Proper monitoring and adaptive management increase successful establishment of effective riparian cover, increase the diversity of habitat for the aquatic ecosystem (particularly to increase woody debris recruitment), and, especially important in this reach of the Okanogan River, erosion control, to reduce sedimentation in the mainstem Okanogan River.

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

□ a. Existing Water Right □ b. Groundwater □ c. Surface Water □ d. Other
N.A.

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:

b. Timeframe(s) or Season of Use:

c. Tributary (name) or Mainstem Okanogan River and Location(s):
Antoine-Whitestone (Upper Okanogan) sub-basin

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

- **floodplain restoration and/or protection**
- **increased woody debris recruitment**
- **decreased sedimentation in the Okanogan River**
- **more diverse wildlife habitat**

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

No none data gaps. No studies need to be completed.

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design:

b. Project Construction: **$54,116**

c. Project Annual O&M: **$1,500**

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

Washington State Department of Ecology

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

Stabilization of floodplain areas

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

No known barriers

12. Estimated Time Frame to Implement Project?

10/01/2019 – 9/30/2024

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING
PRELIMINARY PROJECT PROPOSAL TEMPLATE

The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use for evaluation under RCW 90.94. When complete, please submit to Bill Sullivan (bsullivan@aspectconsulting.com) by January 3, 2020

1. Title:	**2. Proposal Preparer(s):**
Pine Creek **Livestock Exclusion with jackstraw timber barriers, plus Revegetation**	**Okanogan Conservation District (OCD)**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

This project is part of a Livestock BMPs for Riparian Restoration project designed to protect riparian and wetland areas from water quality impacts by livestock using downed 'jackstraw' logs. These scattered logs mimic natural barriers to browsing and protect natural regeneration of riparian plants and new plantings. Monitoring will track effectiveness on livestock exclusion and vegetation. In addition, the program will maintain four completed projects, develop three restoration plans, and provide community outreach.

The Pine Creek location will construct jackstraw barriers to protect **1.7 acres of riparian wetland and 662 feet of ephemeral stream from livestock with a 35-foot minimum buffer**; install off-site water development, submitting a design to the Ecology Project Manager for review and approval prior to installation; implement **weed management** for Canada thistle across 0.25 acres; **install 65 riparian plants** within the pockets of jackstraw.

The OCD will monitor and maintain plantings utilizing the methodology outlined an Ecology-approved Riparian Planting and Maintenance Plan to fully establish the plantings and meet planting goals. Irrigation must utilize legally available water. The OCD will utilize adaptive management to adjust maintenance as necessary. The OCD will report the final plant survival in a closeout report.

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

□ a. Existing Water Right □ b. Groundwater □ c. Surface Water □ d. Other

To be determined if water use is necessary.

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:

Unknown, but likely minimal

b. Timeframe(s) or Season of Use:

If used, mid- to late-summer

c. Tributary (name) or Mainstem Okanogan River and Location(s):

Pine Creek, an ephemeral tributary to the Okanogan River
Within the Bonaparte-Johnson (Middle Okanogan) sub-basin

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

Channel and riparian restoration and protection will reduce water quality impacts. Weed control will increase native plant diversity.

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

This project is part of a study to determine the effectiveness of jackstraw barriers as an alternative to traditional livestock exclusion fencing for use in remote locations.

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design: **$27,295 (total of all 3 jackstraw projects)**

b. Project Construction: **$92,455 (total of all 3 jackstraw projects)**

c. Project Annual O&M: **$2,000 (total of all 3 jackstraw projects)**

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

Washington State Department of Ecology, Landowners (cost share)
Final project cost is subject to final implementation costs.

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

This project, in conjunction with two other sites (to have an adequate sample of variety), will determine the effectiveness of jackstraw barriers as an alternative to traditional livestock exclusion fencing for use in remote locations.

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

No perceived project barriers

12. Estimated Time Frame to Implement Project?

10/01/2019 – 9/30/2023

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1. Title:	**2. Proposal Preparer(s):**
Streambank Stabilization & CREP – Salmon Creek, mid-watershed, #2	**Okanogan Conservation District**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

Project Extent: approximately 500 linear feet of stream front, 100 feet wide = 1.15 acres
Objective: The objective of this potential Conservation Reserve Enhancement Program (CREP) project is to restore and enhance riparian vegetation by planting woody shrub and tree species for the purpose of providing woody debris recruitment into Salmon Creek as a means of creating habitat for invertebrates, which will enhance food sources for threatened and endangered fish species.
Infrastructure Requirements: Fencing will be required to exclude livestock.
Connection to other projects: This CREP project can only be installed after the eroding stream bank is stabilized. This project will maintain the stabilized stream bank and provide additional food for fish whose survival is enhanced by the addition of saved water from a nearby OCD Irrigation Efficiencies project.
Other Stakeholders: USDA Farm Service Agency, USDA NRCS, Colville Tribal Fisheries, WDFW
Funding: Federal Farm Bill (soil rental, partial funding of initial installation, and partial funding of maintenance costs) Washington State CREP targeted funds (partial funding of initial installation and maintenance costs)
Maintenance Requirements: As per the requirements of the CREP, the riparian buffer will be required to be maintained through total exclusion of livestock and replanting installed plants that do not survive for the minimum of 10 or 15 years, whichever contract period is chosen by the landowner. Weed control is also required. The landowner has the option to reenroll their buffer land in the program and continue to receive soil rental payments.

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

□ a. Existing Water Right □ b. Groundwater □ c. Surface Water □ d. Other

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:
N.A.

b. Timeframe(s) or Season of Use:
N.A.

c. Tributary (name) or Mainstem Okanogan River and Location(s): **Salmon Creek, mid-drainage**

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

The combined streambank stabilization/CREP project will help reduce sedimentation, contribute to stream complexity and fish habitat enhancement, and maintain cooler stream temperatures. Noxious weeds will also be removed and controlled, possibly being replaced by pollinator plants.

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

Design of streambank stabilization will lead to accurate cost estimates. CREP plans will delineate project costs.

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design: **Streambank stabilization - $ 11,500; CREP - $2,200**

b. Project Construction: **Streambank stabilization - $16,000; CREP - $10,500**

c. Project Annual O&M: **Streambank stabilization - $3,000 for 3 years; CREP - $900/year average for first five years, none thereafter**

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

Streambank Stabilization

Colville Tribal Fisheries (through BPA Columbia River BiOp) $19,250

CREP

Installation: FSA $10,800 (90% - 50% cost share & 40% practice incentive payment); Washington State Conservation Commission (WSCC) - $1,200 (10% cost share)

O & M: FSA annual soil rental payments (unknown, but minimal); WSCC - $3,750 (first 5 years)

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No. Landowner generated voluntary project, funding for streambank stabilization

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

Reduced stream sedimentation, enhancement of endangered fish species habitat

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

Landowner willingness

12. Estimated Time Frame to Implement Project?

4 years: allow 2-1/2 years for development of design, implementation, and verification of establishment of streambank protection features plus 1-1/2 years for installation and establishment of CREP vegetative features and installation of fence

Salmon Creek Streambank Stabilization Projects (2)

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING
PRELIMINARY PROJECT PROPOSAL TEMPLATE

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1. **Title:** **Streambank Stabilization & CREP – Salmon Creek, mid-watershed**	2. **Proposal Preparer(s):** **Okanogan Conservation District**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

Project Extent: approximately 400 linear feet of stream front, 100 feet wide = 0.92 acres
Objective: The objective of this potential Conservation Reserve Enhancement Program (CREP) project is to restore and enhance riparian vegetation by planting woody shrub and tree species for the purpose of providing woody debris recruitment into Salmon Creek as a means of creating habitat for invertebrates, which will enhance food sources for threatened and endangered fish species.
Infrastructure Requirements: Fencing will be required to exclude livestock.
Connection to other projects: This CREP project can only be installed after the eroding stream bank is stabilized. This project will maintain the stabilized stream bank and provide additional food for fish whose survival is enhanced by the addition of saved water from an OCD Irrigation Efficiencies project.
Other Stakeholders: USDA Farm Service Agency, USDA NRCS, Colville Tribal Fisheries, WDFW
Funding: Federal Farm Bill (soil rental, partial funding of initial installation, and partial funding of maintenance costs) Washington State CREP targeted funds (partial funding of initial installation and maintenance costs)
Maintenance Requirements: As per the requirements of the CREP, the riparian buffer will be required to be maintained through total exclusion of livestock and replanting installed plants that do not survive for the minimum of 10 or 15 years, whichever contract period is chosen by the landowner. Weed control is also required. The landowner has the option to reenroll their buffer land in the program and continue to receive soil rental payments.

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

□ a. Existing Water Right □ b. Groundwater □ c. Surface Water □ d. Other

N.A.

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:

b. Timeframe(s) or Season of Use:

c. Tributary (name) or Mainstem Okanogan River and Location(s): **Salmon Creek, mid-drainage**

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

The combined streambank stabilization/CREP project will help reduce sedimentation, contribute to stream complexity and fish habitat enhancement, and maintain cooler stream temperatures.

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

Design of streambank stabilization will lead to accurate cost estimates. CREP plans will delineate project costs.

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design: **Streambank stabilization - $ 9,500; CREP - $1,600**

b. Project Construction: **Streambank stabilization - $12,000; CREP - $8,500**

c. Project Annual O&M: **Streambank stabilization - $2,000 for 3 years; CREP - $750/year average for first five years, none thereafte**r

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

Streambank Stabilization

Colville Tribal Fisheries (through BPA Columbia River BiOp) $19,250

CREP

Installation: FSA $10,800 (90% - 50% cost share & 40% practice incentive payment); Washington State Conservation Commission (WSCC) - $1,200 (10% cost share)

O & M: FSA annual soil rental payments (unknown, but minimal); WSCC - $3,750 (first 5 years)

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No. Landowner generated voluntary project, funding for streambank stabilization

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

Reduced stream sedimentation, enhancement of endangered fish species habitat

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

Landowner willingness

12. Estimated Time Frame to Implement Project?

4 years: allow 2-1/2 years for development of design, implementation, and verification of establishment of streambank protection features plus 1-1/2 years for installation and establishment of CREP vegetative features and installation of fence

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING
PRELIMINARY PROJECT PROPOSAL TEMPLATE

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1. Title:	**2. Proposal Preparer(s):**
Sinlahekin Wildlife Area Impoundments Improvement Project	**Oroville-Tonasket Irrigation District & Washington Department of Fish and Wildlife**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

This project proposes to improve a number of water impoundments within the Sinlahekin Wildlife Area. Improvements would address deficiencies related to water control structures and water diversion infrastructure related to the following water bodies:

- Blue Lake (183 Acres) – Increase water capacity by addressing diversion on Sinlahekin Creek and control structure(s) at outflow back into Sinlahekin Creek.
- Conners Lake (35 Acres) – Increase water capacity by modernizing control structure and address any issues related to the earthen impoundment.
- Forde Lake (37 Acres) – Better control capacity by updating water control structure
- Reflection Pond (3.5 Acres) - Increase water capacity by renovating control structure and address any issues related to the earthen impoundment.
- Fish Lake (100 Acres) - Better regulate capacity by updating water control structure

By increasing capacity at each location, available water within Sinlahekin Creek would increase or be maintained later in the year, benefiting downstream irrigators, ag producers and a fish such as the Westslope Cutthroat Trout, Pygmy Whitefish and Kokanee.

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

■ a. Existing Water Right □ b. Groundwater □ c. Surface Water □ d. Other
S4-38016JWRIS – Sinlahekin Creek
S4-38030AKTJWRIS – Sinlahekin Creek

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:
Water right allows storage in excess of allowed 7400-acre ft if available in excess of what's required downstream

b. Timeframe(s) or Season of Use:
Between April 15th and Oct. 1st

c. Tributary (name) or Mainstem Okanogan River and Location(s):
Sinlahekin Creek

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

Increase stream flow later in the year with decreased water temperatures benefitting fish species (kokanee, rainbow trout, redband trout).
Improve fish passage with updating water control structures at each impoundment
Reduced sedimentation into Sinlahekin Creek due to annual road damage and erosion as a result of diversion.

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

Capacity limits and risk assessment on each of the impoundments. DOE may have some info already.

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design: $250,000

b. Project Construction: $500,000

c. Project Annual O&M: None. Existing DFW O&M used to manage water.

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

Some Capital Funds may be available for this project. $250,000 asked for in 2018.
Potential funding partners: Western Native Trout Initiative, in-kind donations from private interests.

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

Improvements to control structures will decrease staff time needed to raise/lower water levels throughout the valley. Safety concerns will also be addressed by modernizing these structures. County road maintenance costs could be significantly reduced.

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

Coordination between state, federal and private entities may provide some challenges. Closely working with existing water right holders and DOE will be paramount.

12. Estimated Time Frame to Implement Project?

Fall 2022

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING
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1. Title:	**2. Proposal Preparer(s):**
Tunk Valley Dry Forest Restoration	**Okanogan Conservation District** **WA Department of Natural Resources**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

The objectives of this 1100-acre project are to create long-term habitat quality and ecological integrity by moving stands back towards more dispersed, larger diameter trees at a much-reduced density. The ultimate goal would be a forest maintained by periodic, low intensity prescribed burns (and mechanical treatments). Basic configuration of the various habitats will be maintained; i.e. forest stays forest, meadow stays meadow. Largest trees will be retained as will large diameter dead wood wherever it occurs. To get there thinning is needed on many acres of the property. Small diameter regeneration will be thinned, keeping all of the largest trees in the overstory. For species diversity, anything not ponderosa pine (Douglas fir/Larch/Grand fir), will be retained. Most of the material thinned will need to be chipped, burned in piles, or broadcast burned in prescribed burns after the fuel loading is low enough to ensure survival of overstory trees.

For wildlife habitat diversity, thinning with "skips" will be included. These will be dense patches left at approximately 300 to 500-foot intervals, spaced to break the sight distance across areas of forest to provide security cover for large animals (deer, bear), and places for shrub/dense cover birds and small mammals to rest and breed. These patches should be at least 30 feet across, and 50 feet in length.

"Gaps" are also valuable habitat features; i.e., areas where the canopy is opened up down to grass/shrub, perhaps removing all trees. These should be between 100-300 feet in diameter.

Increased infiltration of precipitation will result from thinning, thus allowing more ground water recharge. All of these activities will occur the next 10 to 20 years will general maintenance over the long-term.

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

□ a. Existing Water Right □ b. Groundwater □ c. Surface Water □ d. Other

N.A.

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:

b. Timeframe(s) or Season of Use:

c. Tributary (name) or Mainstem Okanogan River and Location(s):

Tunk Creek, a tributary of the Okanogan River within the Bonaparte-Johnson (Middle Okanogan) sub-basin.

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

- **Timber stand thinning**
- **Snag creation**
- **Creation of forest stands with skips and/or gaps (explained above)**
- **Fuels reduction**
- **Pruning**
- **Habitat pile creation from slash**
- **Installation of nest boxes**
- **Grazing management (if the new landowner continues leasing the area for livestock grazing)**

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

Adaptive management will be utilized to assess effectiveness of various treatments and to change timber stand management activities as appropriate.

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design: **Unknown**

b. Project Construction: **Unknown**

c. Project Annual O&M: **Unknown**

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

WA DNR Small Forest Landowners

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

- **Reduced wildland fire potential, thereby greatly reducing fire suppression costs**
- **Reduced management cost in the long-term**
- **More open canopy will allow snow to reach the ground thereby lessening water lost to sublimation**

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

- **Permitting requirements (especially when regarding prescribed burning)**
- **Short to mid-term implementation costs**
- **Liability insurance for prescribed burning**

12. Estimated Time Frame to Implement Project?

Major activities will be conducted over the next 10 to 20 years beyond which low level maintenance activities will be required.

Projects Not Advanced

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING
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1. Title:	**2. Proposal Preparer(s):**
Kermel Drainage	**Todd McDaniel** **City of Omak**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

The area just west of Omak's incorporated limits has numerous areas of springs and intermittent surface water. These were diverted in the late 1800's for irrigation and potable source along the adjacent properties and piped to the lower reaches of the valley. It provided water to Omak Townsite prior to the city's incorporation. Over the years land uses have changed as well as the methods of water conveyance. The original diversions have gone unmaintained, underutilized, or unutilized. This has caused unintended flooding and ground saturations that affect existing structures and unpredictable run off.

This project would consolidate and place the surface water produced by the springs into s predictable channel that would interact better with current land use activities. Produce a stream bed that could support fish habitat. Improve water quality by directing, limiting and protecting the water sources from contact with polluted areas.

Existing water right holders are aware of the need to solve the condition that exist. There ae over 50 water rights or certificates associated with the springs and surface waters in this area. It appears these rights may be over allocated and underutilized. This project would identify the actual need of the water right/certificate holders. Once this is established rights'/certificates would be retired, bought, or exchanged for project value.

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

X a. Existing Water Right X b. Groundwater X c. Surface Water □ d. Other

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:

Lots

b. Timeframe(s) or Season of Use:
Annual

c. Tributary (name) or Mainstem Okanogan River and Location(s):
Jasmine Drainage to Okanogan River

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

Water quality would be increased by providing a predictable route for flows. Existing channels and riparian areas would benefit from the increased flows. New channels and impoundments would be engineered to maximize habitat.

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

Identify Water right Owners
Owner outreach
Evaluate water right use
Design and Scope
Construction Easements, Easements, land Acquisition

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design:
$900,000
b. Project Construction:
$3,00,000
c. Project Annual O&M:
$15,000

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

City, County, Department of Ecology, Landowners, Sale of water rights, local service clubs

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

Unknown

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

Corrects flooding issue due to unpredictable spring flows. Provide recreational opportunities. Improve Storm water management for the City of Omak and Okanogan County. Provide for greater use of adjacent lands.

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

Landowner unwillingness, funding, government barriers.

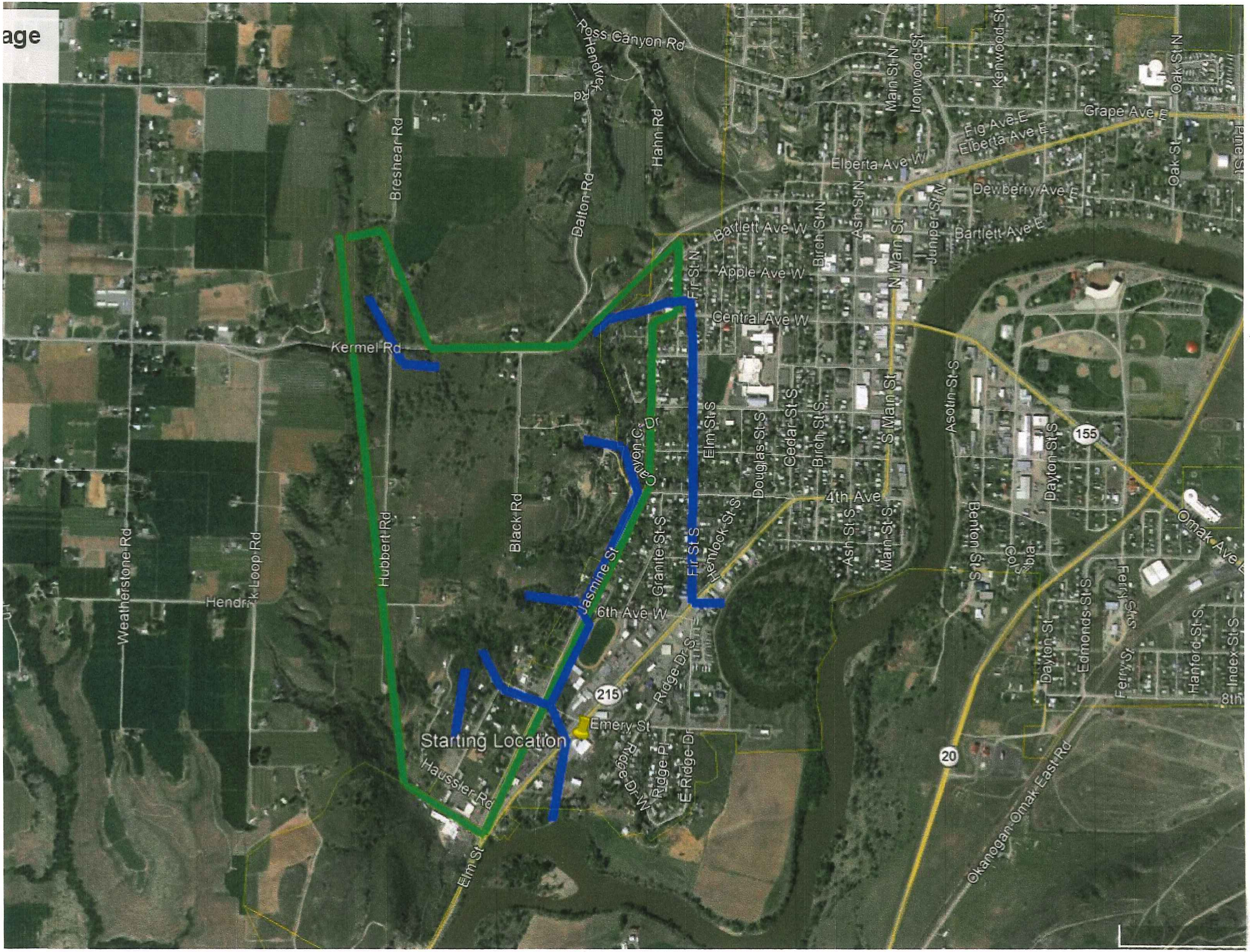
12. Estimated Time Frame to Implement Project?
? Funding 1-year research and planning study 1-year water right/land acquisition 6 month -design 6 month construction

Requested Documents Report
Department of Ecology
Water Right Map Search Result
Report Generated on 1/13/2020

Report ran by: IUSR
Disclaimer: This data may not be complete or accurate. Validity of water rights documented by statements of claims can only be determined in Superior Court. Ecology cannot guarantee the validity of the water rights documented by Permits and Certificate.

Record / Document No.	WR Doc ID	Person or Organization	Priority Date	Status	Images	Metered	Low Flow Provision	Application No.	Permit No.	Certificate No.	Phase	Qi	Qa	TRS	QQ	Q
S4-200119CL	2038696	Jacobsen Victor F,	01/01/1902	Active	N	N	N				Claim	0.0600 CFS	10.0000	T34.0N/R26.0E/26		
S4-200127CL	2038699	Payne Earl F,	04/01/1902	Active	N	N	N				Claim	0.0400 CFS	5.3300	T34.0N/R26.0E/26		
S4-200128CL	2038700	Bevier Roger A,	01/01/1902	Active	N	N	N				Claim	0.0260 CFS	5.2000	T34.0N/R26.0E/26		
G4-151347CL	2041408	O Neil, Larry	01/01/1954	Active	N	N	N				Claim	10.0000 GPM	2.0000	T34.0N/R26.0E/26		
S4-151910CL	2041585	Payne, Earl F	01/01/1906	Active	N	N	N				Claim	10.0000 CFS	2.0000	T34.0N/R26.0E/26	NW	NE
G4-151912CL	2041587	Payne, Earl F	09/01/1972	Active	N	N	N				Claim	25.0000 GPM	4.0000	T34.0N/R26.0E/26		
S4-137481CL	2044963	Hayner, Fred A	06/01/1906	Active	N	N	N				Claim	1.0000 CFS	4.0000	T34.0N/R26.0E/26		
G4-136176CL	2045529	Freel, Kenneth E	06/01/1969	Active	N	N	N				Claim	20.5000 GPM	4.0000	T34.0N/R26.0E/26		
G4-134275CL	2045770	Stagge, John E	06/01/1952	Active	N	N	N				Claim	20.0000 GPM	2.0000	T34.0N/R26.0E/26		
G4-129462CL	2047007	General Recording Corp,	07/01/1963	Active	N	N	N				Claim	10.0000 GPM	2.0000	T34.0N/R26.0E/26		
S4-127855CL	2047516	Keeling, Martin M	01/01/1906	Active	N	N	N				Claim	10.0000 CFS	2.0000	T34.0N/R26.0E/26		
S4-127856CL	2047517	Keeling, Martin M	01/01/1906	Active	N	N	N				Claim	10.0000 CFS	2.0000	T34.0N/R26.0E/26		
G4-125824CL	2047605	Lucas, Beatrice E	05/01/1955	Active	N	N	N				Claim	10.0000 GPM	2.0000	T34.0N/R26.0E/26		
S4-118498CL	2049956	Kermel, Frances Estate	01/01/1908	Active	N	N	N				Claim	10.0000 CFS	4.0000	T34.0N/R26.0E/26		
S4-118499CL	2049957	Kermel, Frances Estate	01/01/1908	Active	N	N	N				Claim	10.0000 CFS	4.0000	T34.0N/R26.0E/26		
G4-112376CL	2051446	Ferguson, Darrell	05/01/1956	Active	N	N	N				Claim	10.0000 GPM	2.0000	T34.0N/R26.0E/26		
G4-104848CL	2053259	Partridge, Duane E	06/01/1958	Active	N	N	N				Claim	10.0000 GPM	2.0000	T34.0N/R26.0E/26		
G4-103226CL	2053762	Chiles, Robert W	03/01/1953	Active	N	N	N				Claim	15.0000 GPM		T34.0N/R26.0E/26		
S4-098605CL	2054594	Mc Intosh, James G	01/01/1910	Active	N	N	N				Claim	0.0200 CFS	4.0000	T34.0N/R26.0E/26		
S4-098606CL	2054595	Mc Intosh, James G	01/01/1910	Active	N	N	N				Claim	3.0000 CFS	2.0000	T34.0N/R26.0E/26		
G4-096472CL	2054922	Hutchins, Earl H	08/01/1973	Active	N	N	N				Claim	15.0000 GPM	2.0000	T34.0N/R26.0E/26		
G4-096473CL	2054923	Hutchins, Earl H	05/01/1952	Active	N	N	N				Claim	30.0000 GPM	5.0000	T34.0N/R26.0E/26		
G4-096352CL	2055271	Freel, Kenneth E	08/01/1972	Active	N	N	N				Claim	20.5000 GPM	6.0000	T34.0N/R26.0E/26		
S4-094391CL	2055883	Erwin, Harold W	05/01/1952	Active	N	N	N				Claim	0.0750 CFS	10.0000	T34.0N/R26.0E/26		
S4-094506CL	2055928	Boyd, Treca L	03/01/1964	Active	N	N	N				Claim	0.0600 CFS	6.5000	T34.0N/R26.0E/26		
G4-094507CL	2055929	Boyd, Treca L	06/01/1968	Active	N	N	N				Claim	10.0000 GPM	2.0000	T34.0N/R26.0E/26		
S4-094056CL	2056188	Kermel, John R	05/01/1908	Active	N	N	N				Claim	120.0000 CFS	48.0000	T34.0N/R26.0E/26		
S4-091983CL	2056543	Jacobsen, Victor F	01/01/1900	Active	N	N	N				Claim	20.0000 CFS	8.0000	T34.0N/R26.0E/26		
S4-090089CL	2056680	Danielson, Harold L	04/01/1964	Active	N	N	N				Claim	10.0000 CFS	2.0000	T34.0N/R26.0E/26		
G4-089971CL	2057108	Weak, Robert A	07/01/1956	Active	N	N	N				Claim	10.0000 GPM	0.5000	T34.0N/R26.0E/26		
G4-084395CL	2058026	Moses, Robert D	06/01/1926	Active	N	N	N				Claim	10.0000 GPM	2.0000	T34.0N/R26.0E/26		
G4-082537CL	2058688	Precht, Henry F	01/01/1944	Active	N	N	N				Claim	40.0000 GPM	1.5000	T34.0N/R26.0E/26		
G4-075432CL	2060153	Taylor, Emma S	08/01/1962	Active	N	N	N				Claim	13.0000 GPM	1.0000	T34.0N/R26.0E/26		
G4-069442CL	2061528	Nansen, Earl K	01/01/1906	Active	N	N	N				Claim	10.0000 GPM	2.0000	T34.0N/R26.0E/26		
G4-069443CL	2061529	Nansen, Earl K	01/01/1906	Active	N	N	N				Claim	30.0000 GPM	12.0000	T34.0N/R26.0E/26		
G4-066747CL	2061628	Haussler, J D		Active	N	N	N				Claim			T34.0N/R26.0E/26		
G4-066748CL	2061629	Haussler, J D		Active	N	N	N				Claim			T34.0N/R26.0E/26		
G4-066105CL	2061921	Davis, Jack W	08/01/1959	Active	N	N	N				Claim	10.0000 GPM	4.0000	T34.0N/R26.0E/26		
G4-062310CL	2063037	Wenham, Lauren L	06/01/1961	Active	N	N	N				Claim	1.0000 GPM	2.0000	T34.0N/R26.0E/26		
G4-059053CL	2063713	Suder, George	06/01/1960	Active	N	N	N				Claim	35.0000 GPM	17.0000	T34.0N/R26.0E/26		
G4-042696CL	2066781	Weak, Robert A		Active	N	N	N				Claim			T34.0N/R26.0E/26		
G4-041209CL	2067016	Raney, B Arley	06/01/1957	Active	N	N	N				Claim	10.0000 GPM	2.0000	T34.0N/R26.0E/26		
S4-032595CL	2068591	Michelsen, Don E	12/01/1908	Active	N	N	N				Claim	10.0000 CFS	2.0000	T34.0N/R26.0E/26		
G4-016087CL	2071868	Wilson, Kenneth A	07/20/1972	Active	N	N	N				Claim	10.0000 GPM	2.0000	T34.0N/R26.0E/26		
G4-004356CL	2074092	Botchek, Gerald	01/01/1930	Active	N	N	N				Claim	225.0000 GPM	112.0000	T34.0N/R26.0E/26		
G4-002462CL	2074846	Whitehall, Ed	11/01/1970	Active	N	N	N				Claim	10.0000 GPM	2.0000	T34.0N/R26.0E/26		
G4-001227CL	2075030	Hallam, Earnest Everette	07/30/1970	Active	N	N	N				Claim	40.0000 GPM	5.0000	T34.0N/R26.0E/26		
S4-27918GWRIS	2076351	Bevier Roger,	05/04/1982	Active	Y	Y	Y			S4-27918 G	Certificate	0.0300 CFS	5.2000	T34.0N/R26.0E/26	SE	NE
S4-25681GWRIS	2077079	Payne Earl F,	01/03/1978	Active	Y	N	Y			S4-25681 G	Certificate	0.0400 CFS	5.3300	T34.0N/R26.0E/26	NE	SE
S4-25703GWRIS	2077080	Jacobsen Victor Etux,	01/03/1978	Active	Y	N	Y			S4-25703 G	Certificate	0.0600 CFS	8.6600	T34.0N/R26.0E/26	E2	E2
S4-25737CWRIS	2077084	Keeling Martin M,	01/10/1978	Active	Y	N	N			S4-25737 C	Certificate	0.0200 CFS	2.0000	T34.0N/R26.0E/26	SE	NE
S4-23670CWRIS	2077158	Jacobsen Victor F,	05/10/1974	Active	Y	N	Y			S4-23670 C	Certificate	0.0600 CFS	10.0000	T34.0N/R26.0E/26	SE	NE
S4-*09657CWRIS	2078975	Wa Fish & Wildlife Dept - Cro,	06/03/1950	Active	Y	Y	N	09657	07082	03996	Certificate	2.5000 CFS		T34.0N/R26.0E/26	NW	SE
S4-*11396CWRIS	2079026	Schrock R L / E L,	05/27/1952	Active	Y	N	N	11396	08495	05871	Certificate	0.0750 CFS		T34.0N/R26.0E/26		
G4-01310GWRIS	2082914	Siltman Alfred C,	03/23/1971	Active	Y	N	N	11720		G4-01310 G	Certificate	90.0000 GPM	36.0000	T34.0N/R26.0E/26	SW	NE
G4-*07522CWRIS	2083301	Black R B,	03/10/1965	Active	Y	N	N	07522	07097	05211	Certificate	40.0000 GPM	20.0000	T34.0N/R26.0E/26	NE	NE
G4-*00953SWRIS	2084047	Kermel A,	07/01/1928	Active	Y	N	N	00953		00732	Certificate	200.0000 GPM	60.0000	T34.0N/R26.0E/26	NW	NE
G4-*00954SWRIS	2084048	Kermel J,	06/01/1920	Active	Y	N	N	00954		00749	Certificate	200.0000 GPM	60.0000	T34.0N/R26.0E/26	SE	NW
G4-*01533CWRIS	2084165	Lane A J,	06/06/1950	Active	Y	N	N	01533	01451	02194	Certificate	80.0000 GPM	12.0000	T34.0N/R26.0E/26	E2	NE
G4-32096	2086300	Wa Fish & Widlife Dept - Olympia*,	07/05/1994	Active	Y	N	N				New Application	500.0000 GPM		T34.0N/R26.0E/26		
S4-300014CL	2087907	George, Robert	01/01/1907	Active	N	N	N				Claim	0.0400 CFS	1.5000	T34.0N/R26.0E/26		
S3-+20053CWRIS	2133051	Greening Benoni M,	03/17/1972	Active	Y	N	N			S3+20053 C	Certificate	0.0300 CFS	2.0000	T34.0N/R26.0E/26	NW	SE
G3-+21800CWRIS	2139864	Woodard Ross Et Ux,	09/21/1973	Active	Y	N	N			G3+21800 C	Certificate	20.0000 GPM	2.0000	T34.0N/R26.0E/26	NW	SE
G3-+00640CWRIS	2140346	Botchek Gerald J,	05/20/1971	Active	Y	N	N	11912		G3+00640 C	Certificate	110.0000 GPM	35.4000	T34.0N/R26.0E/26	SW	NE
G3-+00718CWRIS	2140362	Reinke Walter A,	08/20/1971	Active	Y	N	N	12119		G3+00718 C	Certificate	50.0000 GPM	22.5000	T34.0N/R26.0E/26	E2	NE
S4-CV1P54	4158282	Weatherstone C E,	01/01/1901	Active	N	N	N				Certificate of Change	0.2500 CFS		T34.0N/R26.0E/26		

TOTAL RECORDS: 66


Ross Canyon Rd
Breshear Rd
Dalton Rd
Hahn Rd
Kermel Rd
Hubbert Rd
Black Rd
Weatherstone Rd
Hendrick Loop Rd
Jasmine St
Granite St S
Fir St S
Hemlock St S
Elm St S
Douglas St S
Cedar St S
Birch St S
Ash St S
Main St S
S Main St
N Main St
Ash St N
Birch St N
Juniper St N
Fir St N
Ironwood St
Kenwood St
Oak St N
Oak St
Pine St
Grape Ave E
Fig Ave E
Elberta Ave E
Elberta Ave W
Dewberry Ave E
Bartlett Ave W
Bartlett Ave E
Apple Ave W
Central Ave W
4th Ave
6th Ave W
Asotin St S
Dayton St S
Omak Ave
Benton St S
Columbia
Edmonds St S
Ferry St S
Hanford St S
Index St S
8th
Dayton St
Ridge Dr S
E Ridge Dr
Ridge Pl
Ridge Dr
Emery St
Starting Location
Haussler Rd
Elm St
Okanogan-Omak East Rd
155
215
20

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING
PRELIMINARY PROJECT PROPOSAL TEMPLATE

The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use for evaluation under RCW 90.94. When complete, please submit to Bill Sullivan (bsullivan@aspectconsulting.com) by January 3, 2020

1. Title:	**2. Proposal Preparer(s):**
Oroville-Tonasket Irrigation District (OTID) Water Right Purchase	**Jay O'Brien**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

OTID will make available 100 acre-feet (consumptive use) for purchase to offset future consumptive use impacts from permit exempt wells. The senior water right (CS4-ADJ01P2@13) is currently held in the State's Trust Water Right Program (TWRP) under a Trust Water Agreement with the Washington State Department of Ecology. The price is set at $10,000 per acre-foot (CU).

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

X a. Existing Water Right □ b. Groundwater X c. Surface Water □ d. Other

Water Right No. CS4-ADJ01P2@13

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:
100 acre-feet (CU)

b. Timeframe(s) or Season of Use:
April 1 through October 15

c. Tributary (name) or Mainstem Okanogan River and Location(s):
Authorized diversion from the Similkameen and Okanogan Rivers.

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

N/A

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

The water right is currently in the TWRP

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design: N/A

b. Project Construction: N/A

c. Project Annual O&M: N/A

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

N/A

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

No.

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

Water-for-water project in the mainstem Similkameen and Okanogan Rivers.

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

Permitting complete.

12. Estimated Time Frame to Implement Project?

Immediately.

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING
PRELIMINARY PROJECT PROPOSAL TEMPLATE

The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use for evaluation under RCW 90.94. When complete, please submit to Bill Sullivan (bsullivan@aspectconsulting.com) by January 3, 2020

1. Title:	**2. Proposal Preparer(s):**
Palmer Lake Storage Project	**CH2 Hill, 1990 Palmer Lake Environmental Assessment**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements, various sizing or phasing, etc.).*

Palmer Lake is a natural water body located approximately two miles south of the confluence of Palmer Creek and the Similkameen River. The lake floods during spring runoff raising the level of the lake an average of 12 feet to an elevation of 1156 feet. During the severe flood of 1972 the lake reached an elevation of 1165 feet. Average summer minimum pool elevation is 1144 feet. A 1955 Plan of Development issued by the International Columbia River Engineering Board considered a low earth-filled dam raising the level of the lake by 15 feet. A 1972 evaluation by Ecology concluded that the same amount of storage could be obtained by raising the lake 12 feet using an 18 foot dike. Also a 30 foot dike would have protected against the 46500 cfs flood stage reached in 1972 on the Similkameen.

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

□ a. Existing Water Right □ b. Groundwater □ c. Surface Water □ d. Other
Water created by storage

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

Acre-feet and/or Cubic-feet-per-second:
10,500 to 30,000-acre feet of storage depending on dike height

b. Timeframe(s) or Season of Use:
Could be variable depending on operation priorities

c. Tributary (name) or Mainstem Okanogan River and Location(s):
Similkameen

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

Water for water off-set for Okanogan basin. This could be important as most economic development and municipal use in Okanogan county would occur along highway 97. Could also provide water temperature and flow benefits that are not maintained due to lower summer flows from Lake Osoyoos.

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

There may be engineering estimates by CH2M Hill or the Columbia River Engineering Board

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design:
None provided
b. Project Construction:
None provided
c. Project Annual O&M: None provided Not known

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

No research available on this question but Army Corp of Engineers or Bureau of Reclamation may be a source as well as Office of the Columbia River.

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

None discussed

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

Creates "new" water which can be appropriated for out of stream uses as well as exempt uses. Could also provide water temperature and flow benefits that are not maintained due to lower summer flows from Lake Osoyoos.

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

Project is reported as having very little impact as it would often operate within natural flood stage occurrences which also means private land ownership has already adjusted to fluctuating lake levels.

12. Estimated Time Frame to Implement Project?
This would be considered as a long term project most likely completed sometime after the 20 year horizon and associated with assessed need. It should be kept in the inventory of projects to

DRAFT WRIA 49 STREAMFLOW RESTORATION PLANNING
PRELIMINARY PROJECT PROPOSAL TEMPLATE

The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use for evaluation under RCW 90.94. When complete, please submit to Bill Sullivan (bsullivan@aspectconsulting.com) by January 3, 2020

1. Title:	**2. Proposal Preparer(s):**
Shanker's Bend	**US Army Corps of Engineers**

3. General Description of Proposal: *Briefly explain the proposed project (project objective, infrastructure requirements, connection to other new, ongoing or past projects and/or funding, other stakeholders, maintenance requirements,* v*arious sizing or phasing, etc.).*

This site was studied first in 1948 in a study of major storage and hydro projects on the Columbia River and it tributaries. Proposed dam heights range from 90 feet to 260 feet. The higher dam height would provide international benefits to Canada while lower dam heights would not back up water into Canada but just to Nighthawk. The project could be regional in nature and provide appropriable water as well as 84 MW of power and needed flood control.

4. Water-for-Water Source (if applicable): *Mark all applicable and identify (water right number, stream name, source aquifer).*

□ a. Existing Water Right □ b. Groundwater □ c. Surface Water □ d. Other

5. Quantity/Timing/Location of Water Instream: *Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?*

a. Acre-feet and/or Cubic-feet-per-second:
1.3M acre-feet of storage with a minimum glow of 1000 cfs

b. Timeframe(s) or Season of Use:
Spring through late fall/early winter

c. Tributary (name) or Mainstem Okanogan River and Location(s):
Similkameen

6. Net Ecological Benefit: *Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)*

Water off-sets in Okanogan County but could also provide based on Ecology estimate that the project would provide ample water to mitigate thermal blocks for anadromous fish in the lower Okanogan, dilute effluent from sewage treatment plants and cover spawning areas.

7. Data Gaps: *Describe major unknowns or studies that would need to be completed.*

Final determination on how to ultimately use this sight and

8. Cost Estimates: *Provide known and estimated costs to develop and implement the project.*

a. Project Development and Design:
$37M but an antiquated estimate for final design and construction
b. Project Construction:

c. Project Annual O&M:
Not provided.

8. Existing or Potential Funding: *List sources and approximate amounts if known.*

9. Mitigation Requirements: I*s any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?*

Depending on scope of project, there would need to be allocation of flow interests, an agreed means of sharing costs, agreements on sharing benefits of storage and a clear disposition of the inundated lands.

10. Project Advantages: *In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)*

Growth is the leading concern for both Canada and US/Okanogan County The project would solve the water availability issues that are foreseen by both countries. Flood control for the Okanogan basin

11. Potential Project Barriers: *Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)*

Political and local will, but future necessity may eventually prevail.

12. Estimated Time Frame to Implement Project?

APPENDIX C

Summary NEB

Analysis Tech

Memo

CONFLUENCE
ENVIRONMENTAL COMPANY

To: Angela Hubbard, Okanogan County Office of Planning and Development
cc: Tyson Carlson, Aspect Consulting

From: Eric Doyle, Confluence Environmental Company

Date: July 20, 2020

Re: FINAL DRAFT - Summary of NEB analysis methods and results used for WRIA 49 watershed planning

Enclosures:

This memorandum describes the application of the Okanogan Ecosystem Diagnosis and Treatment (EDT) model to support watershed planning in Water Resource Inventory Area 49 (WRIA 49) under the Streamflow Restoration Act of 2018 (RCW 90.94). It provides an overview of EDT and how the platform was used to conduct the *net ecological benefit* (NEB) analysis for the WRIA 49 watershed plan.

1.0 BACKGROUND

EDT is a habitat-based life history model that synthesizes data and information about fish habitat conditions into quantitative metrics that describe habitat potential. Access to the Okanogan EDT model is being provided by the Confederated Tribes of the Colville Reservation (CTCR) Okanogan Basin Monitoring and Evaluation Program (OBMEP). OBMEP developed the Okanogan EDT model to support long-term habitat status and trends monitoring and restoration planning under the Columbia Basin Fish Accords. The Accords provide federal funding to state and tribal governments to promote the conservation and recovery of salmon and steelhead populations listed under the Endangered Species Act (ESA).

Per RCW 90.94.020.4(b) and 4(c), a watershed plan must include actions sufficient to offset projected future water demand and provide habitat benefits sufficient to result in NEB. Ecology (2019) has established policy guidance for conducting NEB determinations. The NEB analysis should consider the impacts of projected future water demand, identify projects and actions that provide additional benefits to instream resources above and beyond those provided by consumptive use offsets, and present a clear statement of findings that the proposed actions will or will not achieve NEB.

The Ecology (2019) guidance further stipulates that the NEB evaluation must consider the extent of aquatic habitat affected; the presence, distribution, and life stage requirements of important fish species; and ecosystem structure, function, and composition. The guidance places emphasis on improving conditions for Pacific salmonid populations listed under the ESA, followed by other native anadromous and resident fish species. Elements of the NEB analysis may be conducted at the individual subbasin level, but the final determination is made based on the net effect of all proposed actions at the WRIA scale.

The Okanogan EDT model is an ideal tool for conducting the WRIA 49 NEB analysis because:

- EDT is a life cycle-based habitat model with a spatial and temporal dispersal component that represents the full range life history expression for the target species;
- The Okanogan model includes over 180 miles of stream reaches in WRIA 49, covering all currently accessible anadromous habitat and nearly all tributaries likely to be affected by future consumptive use demand;
- It characterizes the environment using over 40 environmental attributes with unique values assigned to each reach in the model network, and;
- It is based on over 15 years of habitat data collected by OBMEP for long-term salmon habitat status and trends monitoring.

Okanogan EDT currently includes model populations for summer steelhead and summer-fall Chinook salmon. The Planning Unit selected Okanogan steelhead as the primary indicator species for the WRIA 49 NEB analysis because this summer run population is ESA-listed, and its distribution includes most of tributary streams likely to be affected by future water demand. We used Chinook salmon to evaluate the benefits of NEB project proposals on the Okanogan mainstem. While not ESA-listed, Okanogan Chinook salmon are an important anadromous species in WRIA 49 that rely on mainstem Okanogan river habitats.

The EDT model generates an array of results useful for describing habitat potential for salmon and steelhead and identifying protection and restoration priorities. For the NEB analysis we are relying on a single reporting metric, equilibrium abundance, also referred to as *Neq*. Neq is the theoretical population size that a given quantity and quality of habitat can support over time. We are evaluating NEB using the projected effect of proposed actions on adult and juvenile Neq. These metrics usefully represent the effect of our water use and NEB scenarios on habitat performance. Consistent with NEB guidance (Ecology 2019), we evaluated the projected impacts of future water demand on adult and juvenile Neq combined with the effects of Tier 1 non-water offset (i.e. NEB-contributing) projects that were advanced for consideration by the WRIA 49 Watershed Planning Unit. The EDT scenario used to conduct the impact analysis is described in Section 3. The parameters used in the NEB analysis scenario are described in

Section 3. The results of the water use impact and NEB scenario analyses are summarized in Section 4.

2.0 BASE SCENARIO

The baseline condition (BASE scenario) used for the Okanogan EDT model analysis is the OBMEP 2017 habitat status and trends monitoring scenario. This scenario is based on habitat monitoring data collected by OMBEP from 2014 through 2017 and provides a useful representation of average habitat conditions over a recent four-year period. Where appropriate, we modified BASE scenario conditions in specific tributaries to reflect habitat actions that occurred after 2017 but are 90.94 ineligible. All BASE scenario modifications are described in Section 4 under the respective tributary streams where those actions occurred.

3.0 SENSITIVITY AND IMPACT ANALYSIS

Confluence and Aspect used a sensitivity analysis approach to evaluate the potential effects of projected future water demand on aquatic resources. We developed a hypothetical scenario that assumed future water demand would decrease wetted channel width by 0.5% in low flow months, which typically extend from July through September and December through February. We applied the baseflow width reduction to all tributary streams within the accessible anadromous zone in WRIA 49 and modeled the effect on steelhead habitat potential using EDT. We did not modify baseflow widths in the mainstem Okanogan River because the projected changes in flow would have negligible effects on baseflow channel width in large mainstem reaches.

The sensitivity analysis is intended to provide a conservative overestimate of the likely effect of future water demand on streamflow and wetted channel width. This is demonstrated by a case study comparison of the estimated streamflow reduction required to produce a 0.5% loss in channel width to the anticipated demand effect in the Loup Loup Creek watershed, an important steelhead-bearing tributary stream (Aspect 2020a). Under the medium growth development scenario, the projected increase in consumptive use in the Loup Loup Creek watershed equates to continuous streamflow reduction of 0.0044 cubic feet per second (cfs). As shown in Table 3-1, the reduction in streamflow required to decrease baseflow channel width by 0.5% ranges from 43 to 127 times the projected consumptive use effect throughout the watershed, varying by month. When modeled in EDT, the 0.5% sensitivity scenario results in no change in adult Neq and a net loss of three juvenile steelhead in Loup Loup Creek.

At the request of the Department of Ecology, Confluence expanded the sensitivity analysis in Loup Loup Creek to compare the projected demand effect to the reduction in streamflow

required to produce a 1%, 2.5%, and 5% reduction in baseflow channel width. The result of the extended Loup Loup Creek analysis are presented in Table 3-1. As shown, the streamflow reduction required to produce these width effects range from tens to hundreds of times the projected demand effect at the watershed level. When modeled in EDT, the 5% sensitivity scenario reduces adult steelhead Neq by 1 and juvenile steelhead Neq by 32 (Table 3-1).

Table 3-1. Comparison of EDT sensitivity analysis assumptions to projected future water demand effects on streamflow in the Loup Loup Creek watershed.

Month/Neq Parameter	Change in cfs Required to Achieve Stated % Reduction in Wetted Channel Width (multiple of -0.0044 cfs demand effect)			
	0.5%	1%	2.5%	5%
Jan	-0.23 (52 X)	-0.48 (109 X)	-1.1 (250 X)	-1.8 (409 X)
Feb	-0.43 (98 X)	-0.76 (173 X)	-1.65 (375 X)	-2.68 (609 X)
Mar	0	0	0	0
Apr	0	0	0	0
May	0	0	0	0
June	-0.56 (127 X)	-1.13 (257 X)	-2.66 (605 X)	-4.73 (1,075 X)
July	-0.4 (91 X)	-0.69 (157 X)	-1.51 (343 X)	-2.48 (564 X)
Aug	-0.25 (57 X)	-0.32 (73 X)	-0.91 (207 X)	-1.48 (336 X)
Sept	-0.19 (43 X)	-0.38 (86 X)	-0.83 (189 X)	-1.42 (323 X)
Oct	-0.22 (50 X)	-0.41 (93 X)	-0.92 (209 X)	-1.51 (343 X)
Nov	-0.38 (86 X)	-0.69 (157 X)	-1.48 (336 X)	-2.45 (557 X)
Dec	-0.37 (84 X)	-0.69 (157 X)	-1.48 (336 X)	-2.45 (557 X)
Change in Adult Neq	0	0	n/a	-1
Change in Juvenile Neq	-3	-6	n/a	-32

The progressive increase in effect on steelhead Neq across these scenarios demonstrate that 1) the EDT model captures the effect of small changes in streamflow on habitat potential, and; 2) the effects of future water demand on steelhead habitat are likely to be small under typical water year conditions.

Following review of the original draft of this memorandum, the Department of Ecology requested that Confluence confirm the validity of the 0.5% sensitivity assumptions in other WRIA 49 tributary watersheds. Confluence and Aspect selected a representative set of channel cross sections in four tributary streams with suitable gage data and compared the calculated change in streamflow required to reduce wetted channel width by 0.5% to the projected demand effect on streamflow during the July to October low flow period. As shown in Table 3.2, the 0.5% sensitivity analysis scenario overestimates projected demand effects on streamflow in each of these four tributary streams by an estimated 4 to 491 times during the critical summer baseflow period. These findings demonstrate that the 0.5% sensitivity analysis scenario conservatively overestimates the effects of future water demand on streamflows in Okanogan River tributary streams.

Table 3-2. Comparison of EDT sensitivity analysis assumptions to projected future water demand effects on streamflow in selected Okanogan River tributary watersheds.

Tributary Watershed	Projected Demand Effect (cfs)	Change in cfs Required to Achieve 0.5% Reduction in Wetted Channel Width (multiple of demand effect)			
		July	August	September	October
Salmon Creek	-0.016	-2.9 (181 X)	-2.7 (168 X)	-7.8 (491 X)	-0.7 (43 X)
Bonaparte Creek	-0.022	-0.40 (18 X)	-0.18 (8 X)	-0.26 (12 X)	-0.68 (31 X)
Antoine Creek	-0.018	-0.23 (13 X)	-0.06 (4 X)	-0.06 (4 X)	-0.15 (8 X)
Ninemile Creek	-0.0024	-0.16 (66 X)	-0.13 (53 X)	-0.09 (39 X)	-0.27 (111 X)

Based on these findings, we applied the 0.5% reduction in baseflow channel width to all anadromous tributaries to represent the effects of future water demand on anadromous habitat potential in our EDT modeling scenarios. We maintained these impact levels in all tributary streams where no streamflow offsets in the form of water-for-water or Tier 1 NEB-contributing projects are proposed. Where streamflow offsets are proposed, we assumed BASE scenario channel widths as a starting point (i.e. we assumed that the offsets will "zero out" future demand effects).

This approach conservatively overestimates the probable negative effects of future water demand on steelhead habitat. Overestimating the probable impacts provides an additional factor of safety for the final NEB determination.

4.0 NEB ANALYSIS SCENARIO

We developed the NEB analysis scenario for EDT modeling from the suite of proposed streamflow and habitat restoration projects advanced by the WRIA 49 Planning Unit and stakeholders for consideration in the watershed plan. NEB-contributing project proposals were designated as Tier 1 or Tier 2 based on the following criteria:

1. The projects are 90.94 eligible, meaning they were proposed, contracted, and/or funded for construction after January 2018;
2. The project is likely to result in a measurable effect on aquatic habitat conditions within the WRIA 49 anadromous zone, and;
3. The project description and available supporting information are sufficient to characterize the potential effect of the proposed action using Okanogan EDT model environmental input parameters

Projects designated Tier 1 project meet all three of these criteria and were evaluated using the advanced for EDT modeling. Tier 1 NEB-contributing projects and the ecological parameters used to model these projects in EDT are described by tributary watershed in the following sections.

Several of the submitted NEB-contributing project proposals meet condition 1 (i.e. they are 90.94 eligible) but do not meet conditions 2 or 3 and are therefore designated as Tier 2. These projects are likely to contribute to positive NEB but insufficient information is available to quantify their effect on the environment. EDT modeling clearly demonstrates that the proposed Tier 1 projects will achieve NEB. The Tier 2 projects provide additional ecological benefits that build on the Tier 1 NEB determination and provide a factor of safety in case a Tier 1 project cannot be implemented as planned.

All modeled Tier 1 projects are described below, ordered by the geographic position of the affected tributary stream or mainstem reach within WRIA 49.

4.1 Loup Loup Creek

Loup Loup Creek Irrigation Efficiency - One Tier 1 project in the Loup Loup-Swamp Creek subbasin, Loup Loup Creek Irrigation Efficiency, was advanced for consideration in the NEB analysis.

The CTCR Okanogan Subbasin Habitat Implementation Program (OSHIP) and Washington Water Trust (WWT) are proposing an irrigation conveyance system efficiency improvement

project to enhance instream flows on Loup Loup Creek. The project proposal requests funding for additional feasibility assessments and design development. A preliminary water savings investigation developed by OSHIP (Kistler et al. 2015) was used to estimate potential instream flow restoration benefits for the purpose of EDT modeling. OSHIP measured streamflow diversion rates into and losses from the Loup Loup irrigation canal system between points of diversion and Leader Lake on four dates in 2015 (March 3, April 16, June 24, and October 27). Diversion rates and streamflow losses are summarized in Table 4-1. As shown, the canal system loses a significant amount of diverted water to leakage and evaporation, ranging from 38 to over 50% total flow during each month of operation.

The proposed irrigation system improvement project would eliminate this flow loss by replacing the existing open ditch network with a piped system. The water savings would be placed into trust by the project proponents as a condition of funding. For the NEB analysis, we evaluated two scenarios. The first assumes that these improvements would allow 100% of estimated flow losses to remain instream, the second assumes that only 23% of flow losses would return to Loup Loup Creek. The latter scenario assumes that all canal leakage returns to surface waters, meaning that the water savings returned to Loup Loup Creek would be gained from the 23% of canal length in the Talant Creek drainage. The 100% scenario produces 3 additional adult and 168 additional juvenile steelhead. The 23% scenario produces 2 additional adult and 118 additional juvenile steelhead. The 23% scenario results are used in the NEB evaluation.

Talant Creek drains Leader Lake and is used primarily as an irrigation water conveyance ditch supplying the Pleasant Valley Water Users Association. This drainage was historically intermittent and likely non-fish bearing based on its small drainage area. The stream is currently classified as fish-bearing and likely supports yellow perch and hatchery origin rainbow trout ouplants from Leader Lake. Talant Creek routinely runs dry or nearly dry when operational releases are halted, so its potential to support viable populations of native fish species is negligible (R. Klett, personal communication, August 18, 2020). Therefore any loss of leakage-related flows is this system would have a negligible effect on habitat potential for native resident fish species in WRIA 49.

The potential gain in average monthly stream flow in Loup Loup Creek losses were estimated by linear interpolation of daily flow losses measured between the March 3 and October 27 (Table 4-1). Diversion rates between late October and early March were not measured and are unknown. To interpolate daily flow estimates for this period, we assumed a minimum loss rate of 1.5 cfs on January 1. Average monthly flows in Loup Loup Creek for the 2014 to 2017 base period, the estimated increase in average monthly flows resulting from the Loup Loup Creek

Irrigation Conveyance Efficiency project, and the total estimated flows used for the NEB analysis are shown in Table 4-2.

Aspect estimated the monthly average channel widths in EDT model reaches Loup Loup 16-1 and 16-2 under existing and proposed flow conditions using a customized hydraulic modeling tool (Aspect 2020b). These results were used to calculate the proportional change in average monthly channel width resulting from the proposed NEB-contributing project. We used EDT BASE scenario channel widths and these proportional multipliers to develop the NEB scenario dimensions used in the EDT model analysis (Table 4-3).

Initial test runs using the modified channel widths shown in Table 4-3 produced a minimal beneficial effect on steelhead equilibrium abundance. The lack of effect is attributable to degraded habitat conditions, specifically reduced habitat complexity and increased substrate fines, resulting from repeated high intensity fires in the headwaters. For the NEB analysis we assumed that habitat conditions would recover to OBMEP 2013 scenario conditions within the 20-year 90.94 implementation period through natural sediment transport processes supported by additional habitat restoration. The 2017 scenario habitat attribute ratings in Loup Loup Creek (i.e. sediment conditions, habitat composition, large woody debris density, etc.) were replaced with 2013 scenario conditions to reflect this assumption for NEB modeling purposes.

Table 4-1. Loup Loup Creek Diversion Rates and Estimated Streamflow Losses in 2015 (Source: Kistler et al. 2015).

Measurement Location	Units	Diversion Rate and Flow Losses by Date			
		3/3/2015	4/16/2015	6/24/2015	10/27/2015
Sweat Creek diversion	cfs	2.09	4.91	2.02	2.41
Little Loup Creek diversion	cfs	1.56	3.12	0.8	0.13
Loup Loup Creek diversion	cfs	16.92	8.97	0	0.81
Total withdrawals into canal	cfs	20.56	16.99	2.82	3.35
Canal discharge into Leader Lake	cfs	9.85	8.52	1.28	2.05
Estimated streamflow loss from canal leakage	**cfs**	**10.71**	**8.47**	**1.54**	**1.29**
	acre ft/day	**21.25**	**16.8**	**3.06**	**2.57**
	% of diverted flow	**52.10%**	**49.80%**	**54.60%**	**38.70%**

Table 4-2. Existing average monthly flows, estimated flow gain, and proposed NEB flow conditions Loup Loup Creek

Month	2014-17 Average Flow (cfs)[1]	100% Flow Return Scenario		23% Flow Return Scenario	
		Estimated Average Flow Gain (cfs)	NEB Average Flow (cfs)	Estimated Average Flow Gain (cfs)	NEB Average Flow (cfs)
Jan	5.49	3.76	9.25	0.87	6.36
Feb	7.47	8.22	15.68	1.90	9.36
Mar	24.48	10.03	34.51	2.32	26.80
Apr	70.90	8.32	79.22	1.92	72.82
May	34.70	5.46	40.15	1.26	35.96
Jun	13.12	2.46	15.58	0.57	13.68
Jul	6.93	1.50	8.43	0.35	7.28
Aug	4.44	1.43	5.88	0.33	4.77
Sep	4.26	1.37	5.63	0.32	4.57
Oct	4.54	1.31	5.85	0.30	4.84
Nov	6.90	1.35	8.25	0.31	7.21
Dec	6.90	1.45	8.35	0.34	7.23

[1] USGS 12447285 Loup Loup Creek at Malott, WA

Table 4-3. Estimated change in average monthly wetted channel width in Loup Loup Creek under current and proposed NEB flow conditions.

EDT Reach	Month	Existing Wetted Width (meters)	100% Flow Return Scenario		23% Flow Return Scenario	
			Proposed Wetted Width (meters)	Proportional Change	Proposed Wetted Width (meters)	Proportional Change
Loup Loup 16-1	Jan	1.89	2.08	+10%	1.93	+2%
	Feb	1.98	2.28	+15%	2.07	+4%
	Mar	2.53	2.68	+6%	2.57	+2%
	Apr	4.05	4.09	+1%	4.06	+0%
	May	2.87	2.94	+3%	2.88	+0%
	Jun	2.16	2.23	+3%	2.18	+1%
	Jul	1.96	2.02	+3%	1.97	+1%
	Aug	1.88	1.98	+5%	1.91	+1%
	Sep	1.87	1.97	+6%	1.91	+2%
	Oct	1.88	1.96	+4%	1.90	+1%
	Nov	1.95	2.01	+3%	1.97	+1%
	Dec	1.98	2.05	+3%	2.00	+1%
Loup Loup 16-2	Jan	3.65	4.21	+15%	3.79	+4%
	Feb	3.72	4.47	+20%	3.93	+5%
	Mar	4.17	4.49	+8%	4.25	+2%
	Apr	5.41	5.50	+2%	5.43	+0%
	May	4.45	4.57	+3%	4.47	+0%
	Jun	3.87	4.03	+4%	3.91	+1%
	Jul	3.70	3.92	+6%	3.77	+2%
	Aug	3.64	3.91	+7%	3.71	+2%
	Sep	3.63	3.90	+7%	3.70	+2%
	Oct	3.64	3.88	+7%	3.70	+2%
	Nov	3.70	3.90	+5%	3.76	+2%
	Dec	3.72	3.94	+6%	3.79	+2%
Loup Loup 16-3	Jan	2.49	2.74	+10%	2.54	+2%
	Feb	2.52	2.90	+15%	2.63	+4%
	Mar	2.71	2.88	+6%	2.76	+2%
	Apr	3.25	3.29	+1%	3.26	+0%
	May	2.83	2.91	+3%	2.85	+1%
	Jun	2.58	2.66	+3%	2.60	+1%
	Jul	2.51	2.60	+3%	2.53	+1%
	Aug	2.48	2.62	+5%	2.52	+2%
	Sep	2.48	2.62	+6%	2.53	+2%
	Oct	2.48	2.59	+4%	2.51	+1%
	Nov	2.51	2.59	+3%	2.53	+1%
	Dec	2.52	2.60	+3%	2.54	+1%

4.2 Salmon Creek

Two Tier 1 projects in Salmon Creek were advanced for consideration in the NEB analysis.

Okanogan Source Substitution - The City of Okanogan Water Right Claim Transfer would replace a 484-acre feet/year surface diversion in Salmon Creek with a groundwater well. This project would restore 0.668 cfs (300 gpm) of continuous surface flows to EDT reaches Salmon 16-1 and 16-2. The groundwater well would be sited at a location in continuity with the mainstem Okanogan River and would not affect surface flows in Salmon Creek or other tributary streams.[1]

Salmon Lake Storage – The Salmon Lake Storage project would improve and/or relocate septic systems on shoreline properties around Salmon Lake, allowing for the reservoir to operate at full pool. This would create an additional 1,000 acre feet per year (afy) of available storage for NEB flow augmentation in Salmon Creek. We allocated the available flows to specific periods of the year when flows in Salmon Creek fell below specific thresholds.

- April (steelhead spawning migration): Graduated augmentation from 1 to 15 cfs when estimated flows at the mouth of Salmon Creek fall below 18 cfs to improve passage during the adult spawning migration period.
- Remainder of year: Graduated augmentation from 1 to 7 cfs when flows at USGS gage 12446995 fall below 10 cfs to improve juvenile rearing conditions.

The proposed flow allocation schedule was developed collaboratively with OBMEP staff based on over fifteen years of monitoring experience in Salmon Creek. We developed a synthetic streamflow record for the NEB scenario by applying the proposed flow augmentation schedule to observed daily flows in Salmon Creek for 2015-2019 (USGS 2020; OID 2020). The proposed schedule used an average of 78% of the available 1,000 afy over the five-year period (see Table 4-4).

Flow augmentation is expected to improve passage conditions for adult and juvenile steelhead downstream of the OID diversion on lower Salmon Creek. Specifically, the lowermost segment of Salmon Creek (EDT reach Salmon 16-1) loses an estimated 2 to 3 cfs to subsurface flow. Under low flow conditions this can present a partial to nearly complete barrier to adult and juvenile fish passage. The proposed streamflow augmentation schedule is designed to improve passage conditions. We revised the EDT fish passage ratings using a count of days/month that estimated flows in Salmon 16-1 exceeded 15 cfs for adults and 4 cfs for juveniles. EDT passage ratings for the revised BASE and NEB scenarios are shown in Table 4-5.

[1] The Foster Decision implications of the Okanogan Source Substitution Project are discussed in Appendix B.

NEB scenario reach widths in Salmon Creek were estimated from the geometric mean of monthly synthetic streamflows using the transect-based inundation model developed by Aspect (2020b). NEB scenario channel widths and change relative to the BASE scenario are shown by EDT reach and month in Table 4-6.

Table 4-4. Annual Salmon Creek flow augmentation under the NEB scenario.

Year	Allocated Use (af)	Balance (af)	Proportion of Available Flow
2015	1546	-546	155%
2016	849	151	85%
2017	212	788	21%
2018	352	648	35%
2019	944	56	94%
Average	**781**	**219**	**78%**

Table 4-5. Average proportion of days under fish passage flow thresholds in lower Salmon Creek and revised EDT fish passage ratings under the BASE and NEB scenarios.

Month	BASE Scenario				NEB Scenario			
	Days <15 cfs	Days <4 cfs	Adult Passage Rating	Juvenile Passage Rating	Days <15 cfs	Days <4 cfs	Adult Passage Rating[1]	Juvenile Passage Rating[1]
1	94%	94%	0.06	0.06	94%	54%	0.06	**0.46**
2	82%	71%	0.18	0.29	82%	35%	0.18	**0.65**
3	50%	14%	0.50	0.86	50%	13%	0.50	**0.87**
4	27%	0%	0.73	1.00	3%	0%	**0.97**	1.00
5	35%	0%	0.65	1.00	35%	0%	0.65	1.00
6	59%	37%	0.41	0.63	59%	37%	0.41	0.63
7	99%	72%	0.01	0.28	99%	72%	0.01	0.28
8	98%	75%	0.02	0.25	98%	75%	0.02	0.25
9	99%	73%	0.01	0.27	99%	65%	0.01	0.35
10	91%	73%	0.09	0.27	91%	41%	0.09	**0.59**
11	86%	79%	0.14	0.21	86%	52%	0.14	**0.48**
12	100%	99%	0.00	0.01	100%	51%	0.00	**0.49**

[1] Improved ratings relative to BASE scenario highlighted in **bold**.

Table 4-6. NEB scenario channel widths and change relative to BASE scenario (meters) by Salmon Creek EDT reach and month.

Reach	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Salmon 16-1	7.9 (+7.8)	8.5 (+8.4)	9.2 (--)	9.6 (--)	9.8 (--)	8.7 (--)	6.3 (--)	6 (--)	6.4 (+0.1)	8.3 (+8.2)	8.3 (+8.2)	7.8 (+7.7)
Salmon 16-2	4.2 (+1.8)	5 (+4.9)	6 (--)	6.6 (--)	6.8 (--)	5.6 (--)	3.1 (--)	3 (--)	3.1 (+0.1)	5 (+4.9)	5 (+4.9)	4.2 (+4.1)
Salmon 16-3	4 (+0.3)	4 (+0.2)	4.4 (--)	5.1 (--)	5.3 (--)	4.3 (--)	3.8 (--)	3.8 (--)	3.8 (--)	4 (+0.2)	4 (+0.2)	3.9 (+0.7)
Salmon 16-4	4.8 (+1)	5.2 (+0.6)	6.4 (+0.1)	8 (+0.1)	9.4 (+0)	8.5 (+0)	7.9 (+0)	7.9 (+0)	7.1 (+0.1)	5.1 (+1.2)	5.1 (+1.1)	4.8 (+1.5)
Salmon 16-5	2 (+0.4)	2.2 (+0.3)	3.2 (+0.1)	4.6 (+0.1)	5.7 (--)	4.8 (--)	4.4 (--)	4.4 (--)	3.9 (+0.1)	2.1 (+0.5)	2.1 (+0.4)	2 (+0.6)
Salmon 16-6	2.2 (+0.4)	2.4 (+0.3)	3.5 (+0.1)	5 (+0.1)	6.3 (--)	5.2 (--)	4.9 (--)	4.8 (--)	4.3 (+0.1)	2.3 (+0.5)	2.4 (+0.4)	2.2 (+0.7)
Salmon 16-7	4 (+0.6)	4.3 (+0.6)	5.5 (+0.1)	6.7 (+0.1)	7.8 (--)	7.2 (--)	6.7 (--)	6.7 (--)	6.2 (+0.1)	4.2 (+0.7)	4.2 (+0.6)	3.9 (+0.8)
Salmon 16-8	4.4 (+1)	4.6 (+0.7)	5.7 (+0.1)	8.3 (+0.1)	10.4 (--)	8.6 (--)	7.8 (--)	7.7 (--)	6.8 (+0.1)	4.5 (+0.9)	4.6 (+0.8)	4 (+1.2)
Salmon 16-9	3.5 (+0.5)	3.7 (+0.5)	4.8 (+0.1)	5.7 (+0.1)	6.5 (--)	6.1 (--)	5.8 (--)	5.8 (--)	5.4 (+0.1)	3.7 (+0.6)	3.7 (+0.5)	3.4 (+0.7)
Salmon 16-10	5.6 (+1.3)	5.8 (+0.8)	7 (+0.1)	8.7 (+0.1)	9.6 (--)	9 (--)	8.7 (--)	8.6 (--)	8 (+0.1)	5.8 (+1.2)	5.8 (+1.1)	5.2 (+1.6)
Salmon 16-11	4.5 (+1.1)	4.7 (+0.7)	5.6 (+0.1)	6.5 (+0.1)	6.7 (--)	6.7 (--)	6.6 (--)	6.6 (--)	6.3 (+0.1)	4.7 (+1)	4.7 (+0.9)	4.2 (+1.3)
Salmon 16-12	3.9 (+1.2)	4.3 (+0.8)	5.7 (+0.1)	7.2 (+0.2)	8.3 (--)	7.6 (--)	7.2 (--)	7.1 (--)	6.6 (+0.1)	4.3 (+1.5)	4.3 (+0.9)	3.9 (+1.8)
Salmon 16-13	6.1 (+0.9)	6.5 (+0.9)	8.3 (+0.1)	9.6 (+0.1)	10.4 (--)	10.1 (--)	9.8 (--)	9.8 (--)	9.2 (+0.1)	6.4 (+1)	6.4 (+0.9)	6 (+1.3)

4.3 Okanogan River

Conservancy Island Side Channel - One Tier 1 project in the mainstem Okanogan River was advanced for NEB modeling. The City of Okanogan is proposing to replace a culvert under Island Avenue SW and make additional improvements to restore hydraulic connectivity between the mainstem Okanogan River and a relict side channel that encircles Conservancy Island, also known as Roundup Park. The proposed NEB-contributing project would reactivate the side channel, providing flushing flows that would both improve fish access and habitat conditions. This project would primarily benefit Chinook salmon, specifically by increasing the amount of low-velocity off-channel habitat available for spawning and fry recruitment. This project would necessarily be paired with the replacement of a Washington State Department of Transportation (WSDOT) owned culvert under the State Route (SR-) 20 connector road between SR-215 and SR-97. Responsibility for the latter project falls to WSDOT. The projected benefits of this project assume that both projects are implemented with the same design objectives.

The NEB scenario for this project was developed using side channel width and depth measurements collected by the Okanogan Subbasin Habitat Implementation Plan (OSHIP) and their partners (OSHIP 2020). These measurements were used to estimate the dimensions of the reactivated side channel. The proposed habitat improvements are assigned to mainstem EDT reach Okanogan 16-14. Current and revised channel widths and the proportional contribution of the reactivated side channel to reach-level habitat composition are summarized in Table 4-7. We estimated rating conditions for the EDT Riparian Function and Woody Debris attributes from features visible in aerial imagery, including Google Earth™ and National Agricultural Imagery Program (USDA 2016). Woody debris and riparian function attributes were rated following the EDT Attribute Rating Guidelines (Lestelle 2005).

Table 4-7. Conservancy Island side channel NEB-contributing project effect on monthly reach width and habitat composition in EDT reach Okanogan 16-14 (bolded parameter values used in EDT).

Parameter	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Existing Reach Width (M)	94.0	94.5	94.8	97.4	102.5	99.4	95.2	93.9	93.5	93.7	94.3	94.4
Existing Reach Area (M^2)	214,709	215,743	216,569	222,435	234,054	227,023	217,513	214,500	213,604	214,025	215,487	215,655
Estimated Side Channel Area (M^2)	18,235	22,134	24,294	33,958	42,771	37,868	26,855	18,321	13,534	18,823	21,376	19,460
Reach + Side Channel Area (M^2)	232,944	237,877	240,863	256,392	276,825	264,891	244,368	232,821	227,138	232,848	236,863	235,114
Revised Reach Width (M)	**102.0**	**104.1**	**105.5**	**112.3**	**121.2**	**116.0**	**107.0**	**101.9**	**99.4**	**101.9**	**103.7**	**102.9**
Side channel proportion of reach area	**0.078**	**0.093**	**0.101**	**0.132**	**0.155**	**0.143**	**0.110**	**0.079**	**0.060**	**0.081**	**0.090**	**0.083**

4.4 Johnson Creek

Johnson Creek Fish Passage - One Tier 1 suite of projects was advanced in Johnson Creek. Trout Unlimited is working with funding from the Brian Abbot Fish Barrier Removal Board, administered by the Washington Recreation and Conservation Office, to address several existing fish passage obstructions. This package of projects is collectively referred to as the Johnson Creek Fish Passage project. Three of these barrier removal projects were proposed and/or funded after January 2018 and are therefore 90.94 eligible. The eligible fish passage barrier projects are identified below by their reach designations in the Okanogan EDT model:

- Johnson 16-1.1 (culvert): Culvert under Cooper St., funded for removal in 2018, removed 2019
- Johnson 16-1.3 (culvert): Culvert under State St., funded for removal in 2019, to be removed in 2020
- Johnson 16-3.1 (culvert): Culvert under Greenacres Rd., funded for removal in 2019, to be removed in 2020

The steelhead passage ratings for these obstructions were updated to 100 percent passable in the NEB analysis scenario. BASE scenario obstruction ratings were updated for two passage projects that were completed prior to January 2018. Monthly EDT passage ratings by life stage for the BASE scenario are shown in Table 4-8. The ratings represent the estimated proportional passage success for fish of each life stage by month. A rating of 1 = 100% passable, while a rating of 0.01 = 1% passage, or effectively impassable. Under the NEB scenario, these life stage ratings are all increased to a value of 1 across all months.

An additional Johnson Creek fish passage project was advanced for consideration but was ultimately determined to be 90.94 ineligible. The Johnson Creek culvert under SR-97 and associated trash rack immediately upstream, represented by EDT reach Johnson 16-2.1 (culvert), are being replaced with a bridge in 2020. However, this project is 90.94 ineligible because it is being implemented by the Washington State Department of Transportation under separate legal requirement. EDT obstruction ratings for these features were updated to 100 percent passable in both the BASE and the NEB analysis scenarios.

Table 4-8. EDT BASE scenario upstream passage ratings for 90.94 eligible fish passage projects in Johnson Creek (all ratings increased to 1, or 100% passable, under the NEB scenario).

EDT Obstruction Reach	Steelhead Life Stage	Proportional Upstream Passage Rating by Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Johnson 16-1.1 (culvert)	0-age resident rearing	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	0-age inactive	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	1-age resident rearing	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	1-age inactive	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	2+-age resident rearing	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	2+-age inactive	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Migrant prespawner	0.85	0.8	1	0.97	0.92	0.93	0.75	0.15	0.5	0.65	0.8	1
	Holding prespawner	0.85	0.8	1	0.97	0.92	0.93	0.75	0.15	0.5	0.65	0.8	1
Johnson 16-1.3 (culvert)	0-age resident rearing	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	0-age inactive	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	1-age resident rearing	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	1-age inactive	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	2+-age resident rearing	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.05	0.01	0.01	0.01
	2+-age inactive	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.05	0.01	0.01	0.01
	Migrant prespawner	0.9	0.8	1	0.97	0.92	0.95	0.8	0.25	0.6	0.75	0.8	1
	Holding prespawner	0.9	0.8	1	0.97	0.92	0.95	0.8	0.25	0.6	0.75	0.8	1
Johnson 16-3.1 (culvert)	0-age resident rearing	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	0-age inactive	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	1-age resident rearing	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	1-age inactive	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	2+-age resident rearing	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	2+-age inactive	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Migrant prespawner	0.8	0.8	0.9	0.9	0.9	0.9	0.8	0.4	0.5	0.6	0.6	0.6
	Holding prespawner	0.8	0.8	0.9	0.9	0.9	0.9	0.8	0.4	0.5	0.6	0.6	0.6

4.5 Whitestone Creek

Two Tier 1 projects in Whitestone Creek were advanced for the NEB analysis.

Okanogan-Tonasket Irrigation District (OTID) Flow Augmentation – OTID has proposed to augment streamflows in selected Okanogan River tributaries using releases from their irrigation water distribution system. The OTID proposal for Whitestone Creek would provide up to 150 gpm (0.5 cfs) of flow augmentation from April 1 through October 15, with the release points located between 650 and 3,100 feet upstream from the confluence with the Okanogan River.

Whitestone Reclamation District (WID) Flow and Temperature Augmentation – WID has proposed to augment instream flows in Whitestone Creek to provide thermal benefits as part of a larger irrigation system storage and conveyance improvement project.[2] The proposal includes piping an existing 7.9 miles of open ditch, extending the conveyance pipe network to improve the service area and support instream flow augmentation, and Spectacle and Whitestone Lake improvements. Current canal losses leak directly to the lakes and is used for irrigation. The proposed project would provide sufficient flow efficiencies to support 1 to 1.5 cfs of direct flow augmentation in all anadromous-accessible reaches of Whitestone Creek from April through October in addition to any leakage benefit.

The project scenario for Whitestone Creek considers increasing the instream flow in EDT reaches Whitestone 16-1, 16-2 and 16-3 by 1.5 cfs from April 1 through May 30 to support steelhead spawning and incubation, and by 1 cfs from June 1 through October 30 for juvenile steelhead emigration. OTID supplementation provides an additional 0.5 cfs of flow augmentation in EDT reach Whitestone 16-1. The primary intent of the WID flow augmentation is to provide cool water inflow to reduce water temperatures during April and May. OBMEP has observed steelhead spawning in Whitestone Creek but has concluded that incubation success is likely to be low due to elevated water temperatures during these critical months. We estimated the effect of the proposed flow augmentation on Whitestone Creek temperatures using a volumetric mixing equation and on wetted channel width using the methods described previously (Aspect 2020b). The following sources of information were used in this analysis:

- OBMEP water temperature data for Whitestone Creek, October 2015 through December 2017[3]
- OBMEP channel cross section measurements in Whitestone 16-1[4]

[2] Future project phases may include improving an abandoned historical reservoir site to provide up to 5,000 acre feet of storage for irrigation water from the Toats Coulee diversion.
[3] Hourly measurements collected at monitoring location OBMEP-1704.
[4] Transect cross section measurements collected in 2008 at monitoring location OBMEP-055.

- Average monthly soil temperature estimated from daily air temperatures in Tonasket, WA from January 2014 through December 2017[5]

No current flow data are available for Whitestone Creek. For this analysis, we assumed a BASE scenario flow rate of 3 cfs from April through October. This estimate is consistent with historical flows measured at USGS gage 12444100 circa 1958-1972 and spot measurements collected by OBMEP during monitoring of an experimental managed aquifer recharge project (Ryan Klett, personal communication, March 24, 2020).

We assumed that augmentation flow temperature would be equal to soil temperature based on 7.9 miles of underground conveyance at a minimum burial depth of 4 feet. We estimated soil temperatures based on the average annual minimum air temperature and the two-month running average of monthly air temperatures to account for thermal lag effect. The effect of flow augmentation on surface water temperatures was estimated using the following equation (Mellina et al. 2002; Mellina 2006):

$$\Delta T = T_{US} - T_{DS} = \frac{Q_{DS} - Q_{US}}{Q_{DS}}(T_{US} - T_{GW})$$

Where:

ΔT = Change in receiving body temperature (°C)
T_{US} = Temperature upstream of discharge (°C)
T_{DS} = Temperature downstream of discharge (°C)
Q_{US} = Flow rate upstream of discharge
Q_{DS} = Flow rate downstream of discharge
T_{GW} = Groundwater (discharge) temperature (°C)

As stated, we assumed Q_{US} and Q_{DS} values of 3 cfs and 4 to 4.5 cfs, respectively, based on available information. We estimated the project effect on daily stream temperatures for the 2015 to 2017 period of record and used the existing and modified temperatures to develop new BASE and NEB scenario temperature ratings for the EDT model. A summary of equation parameters and estimated NEB temperature scenario results are shown in Table 4-9, averaged by month.

We determined that the available channel dimension data are not sufficient to estimate the effect of flow augmentation on Whitestone Creek wetted channel width in all months, except

[5] Weather station USW00094197 data obtained from the National Climatic Data Center (https://www.ncdc.noaa.gov/)

for August and September. The BASE scenario uses a width assumption of effectively zero during those months, used in the EDT model to represent the population sink effect of Whitestone Creek on steelhead habitat. Aspect (2020b) estimated the effect of flow augmentation on baseflow width during those months using available transect data for Whitestone 16-1. BASE and NEB scenario widths are shown in Table 4-10.

Table 4-9. Monthly average of estimated BASE and NEB scenario temperature inputs for Whitestone Creek.

Month	Average Whitestone Creek Temperature TUS (°C)	Average Augmentation Flow Temperature TGW (°C)	Average of ΔT	Average of NEB Scenario Temperature TDS (°C)
1	1.66	--	--	1.66
2	3.13	--	--	3.13
3	6.46	--	--	6.46
4	12.23	6.97	-1.75	10.48
5	17.08	10.20	-2.29	14.79
6	20.09	13.31	-1.69	18.39
7	22.93	16.07	-1.71	21.22
8	21.61	17.30	-1.08	20.53
9	17.18	14.92	-0.56	16.61
10	10.45	10.62	0.04	10.49
11	5.73	--	--	5.73
12	1.42	--	--	1.42
Temperature data for Antoine Creek were obtained from two sources, OBMEP 2015-2017 temperature monitoring data for location OBMEP-1704, and data collected over 4 days during an August 2019 flow augmentation experiment conducted by OBMEP and OTID.				

Table 4-10. Estimated BASE and Modeled NEB scenario widths in Whitestone Creek, changed widths in bold (values in meters).

Month	Whitestone 16-1		Whitestone 16-2		Whitestone 16-3	
	BASE	NEB	BASE	NEB	BASE	NEB
1	2.76	2.76	2.76	2.76	2.76	2.76
2	2.75	2.75	2.75	2.75	2.75	2.75
3	2.83	2.83	2.83	2.83	2.83	2.83
4	2.48	2.47	2.48	2.47	2.48	2.47
5	2.88	2.88	2.88	2.88	2.88	2.88
6	3.08	3.08	3.08	3.08	3.08	3.08
7	3.12	3.12	3.12	3.12	3.12	3.12
8	0.01	**1.88**	0.01	**1.88**	0.01	**1.88**
9	0.01	**1.88**	0.01	**1.88**	0.01	**1.88**
10	2.61	2.61	2.61	2.61	2.61	2.61
11	2.55	2.54	2.55	2.54	2.55	2.54
12	2.74	2.74	2.74	2.74	2.74	2.74

4.6 Antoine Creek

Two Tier 1 projects in Antoine Creek were advanced for the NEB analysis.

Okanogan-Tonasket Irrigation District (OTID) Flow Augmentation – OTID has proposed to augment streamflows in selected Okanogan River tributaries using releases from their irrigation water distribution system. The OTID proposal for Antoine Creek would provide up to 225 gpm (0.5 cfs) of flow augmentation in lower Antoine Creek from April 1 through October 15, with the release points located between 940 and 2,324 feet upstream from the confluence with the Okanogan River. For NEB modeling, we added an additional 0.5 cfs of instream flows to EDT reach Antoine 16-1 from April through mid-October.

Antoine Valley Ranch (AVR) Project - The AVR project is the proposed purchase of an historical ranching property and 1,294 acre feet of appurtenant water rights for instream flow and habitat restoration. The CTCR are working with the Washington Water Trust to acquire the property and associated water rights. The property includes Fanchers Reservoir, a dammed natural impoundment with an outlet control structure, in the headwaters of the watershed. The proposed project may include retiming reservoir releases to provide instream flow and temperature benefits during the summer low flow period. A revised BASE scenario and two project scenarios were considered for the NEB analysis:

- BASE scenario: Monthly stream width pattern based on estimated annual water budget of 1,493 acre feet (2,787 total acre feet minus 1,294 acre feet for irrigation and related uses)

- AVR @203 scenario: Monthly stream width based on an estimated annual water budget of 1,696 acre feet (2,787 total acre feet minus 1,091 acre feet for irrigation and related uses, 203 acre feet dedicated to instream flows)
- AVR @1,294 scenario: Monthly stream width based on an estimated annual water budget of 2,787 acre feet (total available water budget dedicated to instream flows)

We used the observed hydrologic pattern in Antoine Creek for the period from 2014 to 2017, recorded at USGS flow gage 12444290 Antoine Creek at SR 97, to estimate the average daily flow in Antoine Creek based on the available water budget. The AVR @203 and AVR @1294 scenarios considered storage and retiming of a portion of the available annual water budget to increase summer baseflows and provide a thermal benefit following guidance provided by OBMEP (2020). The daily flow hydrograph for the BASE scenario is displayed in Figure 4-1. NEB scenario hydrographs for the AVR @203 and AVR @1,294 are displayed in Figures 4-2 and 4-3, respectively. The latter two figures display projected streamflows with and without the proposed flow retiming.

Combined Tier 1 project effect in Antoine Creek - Monthly reach widths in Antoine Creek under the BASE and NEB scenarios were estimated by calculating the geometric mean of daily synthetic streamflows and entering those values in the transect-based inundation model developed by Aspect (2020b). Modeled streamflows in Antoine 16-1 include an additional 0.5 cfs from April 1 through October 15 representing OTID supplementation. Estimated channel widths by month for the BASE and NEB scenarios are shown by EDT reach in Table 4-11. Monthly widths were modeled based on transect dimensions measured by OBMEP in reaches Antoine 16-1, 16-2, 16-4, and 16-5. Monthly widths in reaches Antoine 16-3 and 16-6 were extrapolated from geomorphically similar neighboring reaches.

The proposed streamflow augmentation and flow retiming under the AVR and OTID supplementation projects would measurably increase streamflows during the summer baseflow period extending from July 1 through October 30. Increased flows are expected to beneficially reduce peak temperatures. We estimated the projected change in peak daily temperatures using a mass-based energy balance equation to generate a monthly average reduction in peak daily temperature, or ΔT during critical months. The ΔT values shown in Table 4-12 were subtracted from the hourly peak temperature records in the available temperature data set for Antoine Creek and used to develop revised EDT Temperature: Daily Maximum attribute ratings for the NEB effects analysis.

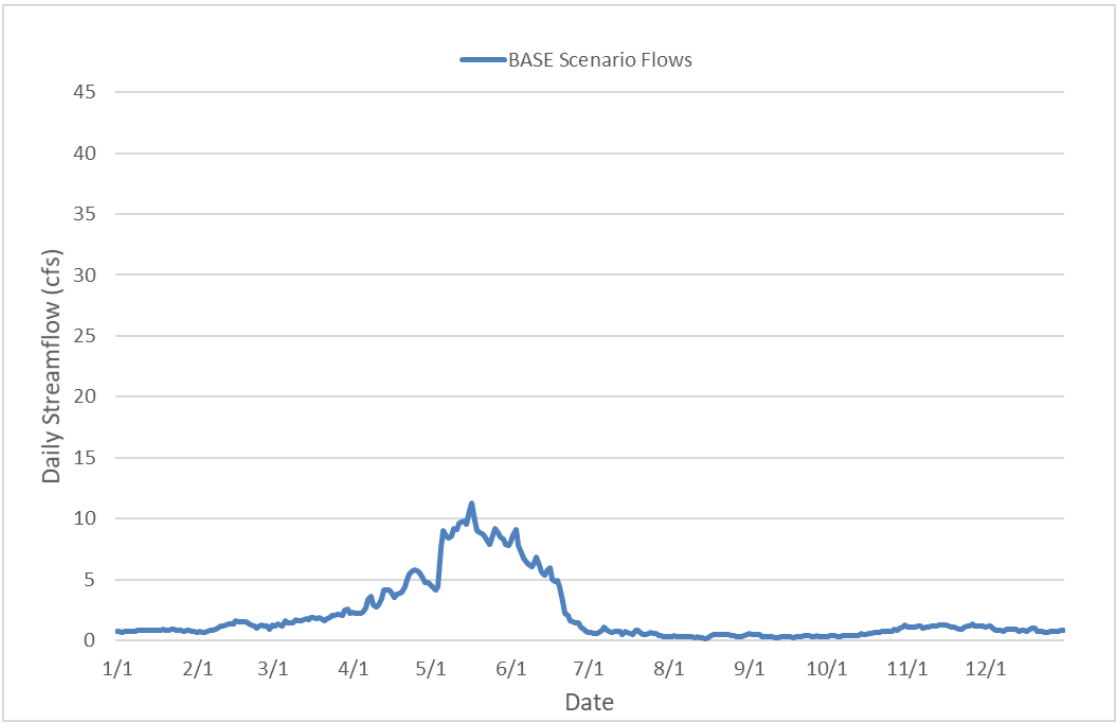


Figure 4-1. Projected daily flows in Antoine Creek under the BASE scenario, assuming 1,493 acre feet/year available for instream flows.

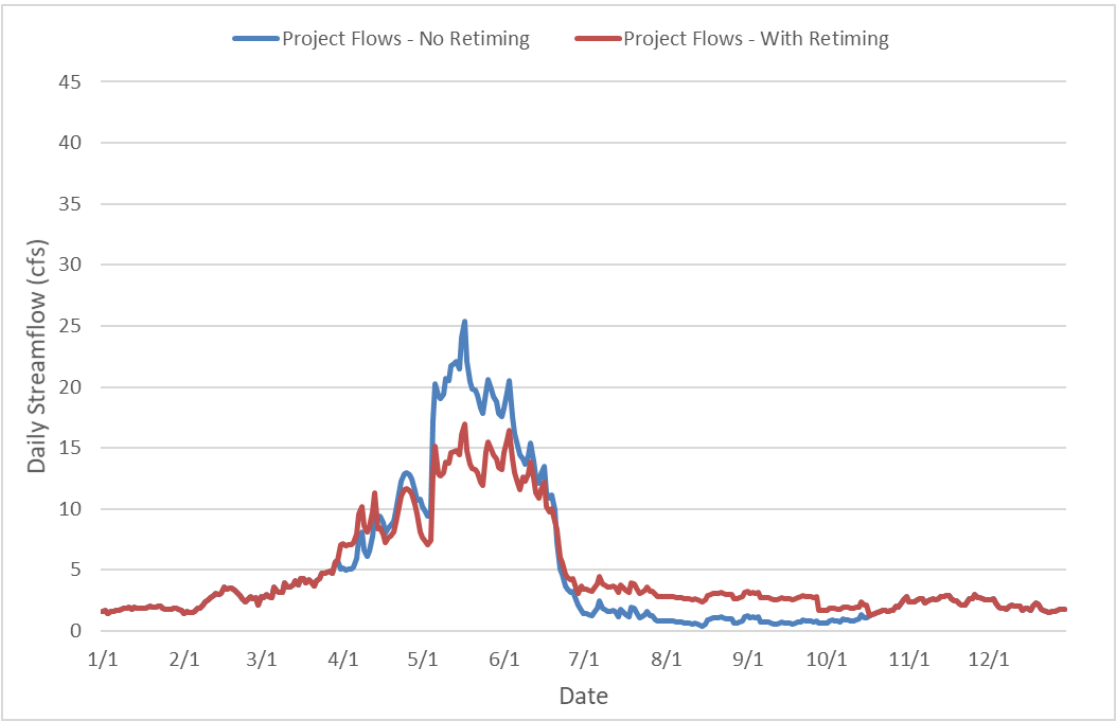


Figure 4-2. Projected daily flows in Antoine Creek under the AVR @203 scenario, assuming 1,693 acre feet/year available for instream flow with proposed flow retiming.

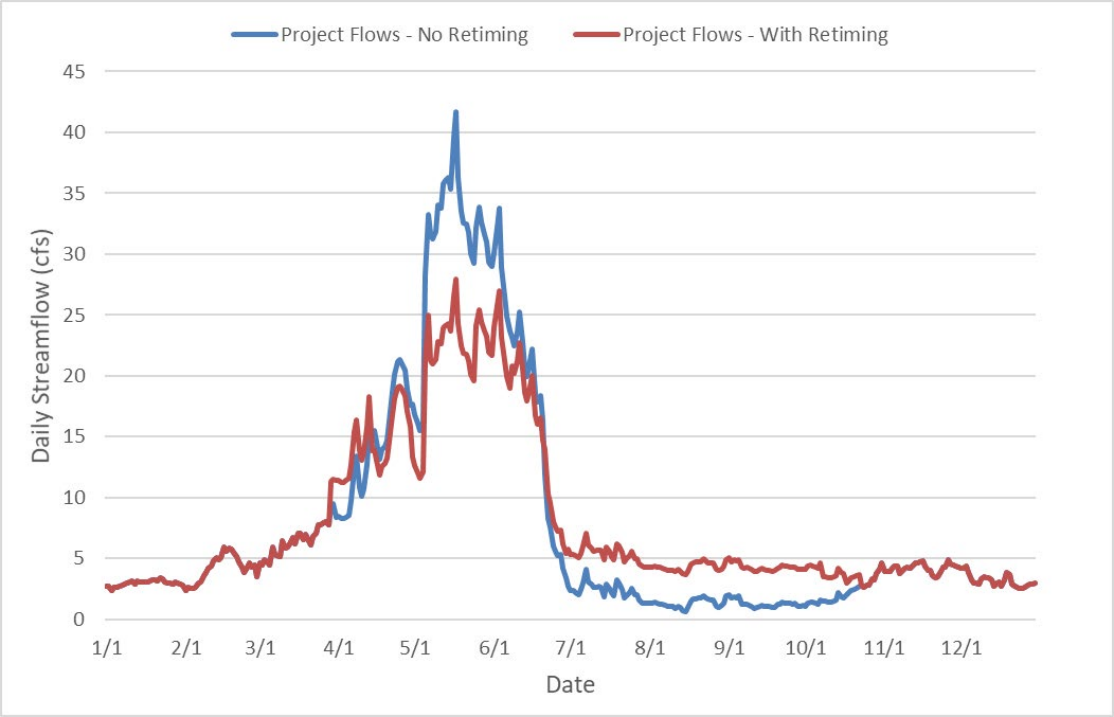


Figure 4-3. Projected daily flows in Antoine Creek under the AVR @1,294 scenario, assuming 2,784 acre feet/year available for instream flow with proposed flow retiming.

Table 4-11. Modeled wetted channel widths by month in Antoine Creek under the BASE, AVR @203 and AVR @1,294 Scenarios (values in meters).

Month	Antoine 16-1			Antoine 16-2			Antoine 16-4			Antoine 16-5		
	BASE	AVR @203	AVR @1,294	BASE	AVR @203	AVR @1,294	BASE	AVR @203	AVR @1,294	BASE	AVR @203	AVR @1,294
1	1.45	1.59	1.75	1.48	1.61	1.99	1.24	1.27	1.66	1.09	1.18	1.44
2	1.53	1.68	1.87	1.88	1.94	2.14	1.40	1.57	1.86	1.35	1.40	1.63
3	1.66	1.82	1.99	2.01	2.08	2.38	1.76	1.81	1.94	1.55	1.60	1.91
4	1.97	2.04	2.09	2.39	2.42	2.64	1.96	1.99	2.09	1.95	2.00	2.13
5	2.10	2.08	2.14	2.66	2.63	2.69	2.11	2.08	2.14	2.17	2.08	2.37
6	2.02	2.04	2.10	2.41	2.49	2.65	1.98	2.00	2.10	1.99	2.01	2.16
7	1.37	1.77	1.94	1.30	2.01	2.36	1.06	1.76	1.92	0.99	1.55	1.77
8	1.09	1.70	1.90	0.98	1.96	2.22	0.82	1.60	1.87	0.81	1.42	1.64
9	1.09	1.70	1.90	0.98	1.96	2.22	0.82	1.60	1.87	0.81	1.42	1.64
10	1.32	1.59	1.81	1.23	1.61	2.02	0.98	1.27	1.80	0.93	1.18	1.57
11	1.53	1.68	1.87	1.88	1.94	2.14	1.40	1.57	1.86	1.35	1.40	1.63
12	1.48	1.63	1.76	1.61	1.84	2.00	1.27	1.33	1.70	1.18	1.32	1.48

Table 4-12. Modeled change in daily maximum water temperature (ΔT) used to develop NEB scenarios in EDT.

Month	ΔT in Peak Daily Temperature (°C)	
	AVR @203	AVR @1,294
7	-0.41	-2.45
8	-0.35	-2.10
9	-0.28	-1.67
10	-0.19	-1.12

5.0 NEB SCENARIO RESULTS

Okanogan EDT model results for the NEB analysis are presented in the following tables:

- Table 5-1: Projected consumptive water use estimates (Aspect 2020a) and EDT model results demonstrating the effect of the 0.5% sensitivity analysis scenario on adult and juvenile steelhead Neq by analysis subbasin
- Table 5-2: EDT model results for the revised BASE and NEB-contributing project scenarios by analysis subbasin, and net effect of Tier 1 NEB-contributing projects on adult and juvenile steelhead and Chinook salmon Neq at the WRIA 49 level
- Table 5-3: NEB analysis results summary, including water-for-water ledger balance and estimated beneficial effect of Tier 1 streamflow and habitat restoration projects on salmon and steelhead resources in WRIA 49

As shown in Tables 4-2 and 4-3, the proposed Tier 1 ledger offset and streamflow and habitat restoration projects are capable of achieving NEB at the WRIA level with a wide factor of safety. This demonstrates that these proposed plan elements provide sufficient adaptive management capacity for the WRIA 49 planning unit to flexibly accommodate future water demand. The WRIA 49 Plan Addendum will detail the adaptive management decision matrix that will be used to achieve 90.94 compliance.

Table 5-1. Projected consumptive water use and EDT sensitivity analysis results by WRIA 49 analysis subbasin.

NEB Subbasin	Consumptive Use Impact			
	Acre feet/yr (afy)	Cubic feet/sec (cfs)	Adult Steelhead Neq*	Juvenile Steelhead Neq*
Loup Loup-Swamp (Lower Okanogan)	37.3	-0.052	19 (0)	1,069 (-3)
Salmon Creek	11.3	-0.016	120 (-1)	8,941 (-39)
Bonaparte-Johnson (Middle Okanogan)	83.8	-0.116	32 (0)	1,909 (-4)
Antoine-Whitestone (Upper Okanogan)	60.9	-0.084	62 (0)	3,756 (-8)
Similkameen	10.2	-0.014	51 (0)	2,058 (+2)
WRIA 49 Total	**203**	**-0.281**	**304 (-1)**	**18,874 (-53)**

* Impact results for -0.5% sensitivity scenario, overestimates actual effect of reduced baseflow by 4-10x

Table 5-2. EDT analysis results for the BASE and NEB scenarios, with projected change in steelhead and Chinook salmon abundance at the analysis subbasin and WRIA levels.

Analysis Subbasin	Species	Current Condition		With NEB-Contributing Projects		Change	
		Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Loup Loup - Swamp (Lower Okanogan)*	Steelhead	19	2,133	21	2,251	+2	+118
Salmon Creek	Steelhead	125	18,587	236	24,126	+111	+5,539
Omak Creek	Steelhead	20	2,222	20	2,222	0	0
Bonaparte-Johnson (Middle Okanogan)	Steelhead	32	3,807	36	3,890	+4	+83
Antoine-Whitestone (Upper Okanogan) #	Steelhead	62	7,491	64	7,601	+2	+110
Similkameen	Steelhead	51	2,052	51	2,056	0	0
WRIA 49 Total	**Steelhead‡**	**309**	**19,244**	**433**	**25,094**	**+119**	**+5,850**
	Chinook§	**12,977**	**1,464,798**	**12,996**	**1,468,550**	**+19**	**+3,752**

* Loup Loup results reflect assumption that 23% of irrigation canal losses used for instream flow augmentation in Loup Loup Creek, and post-fire recovery to 2013 habitat conditions

Subbasin (Antoine Creek), upper and lower row NEB results for AVR project alternatives. Results in parentheses are project effect within Antoine Creek.

§ Chinook NEB effect from Conservancy Island side channel project, Okanogan Mainstem

‡ Totals include steelhead production in the 90.94-exempt Omak Creek Subbasin

Table 5-3. WRIA 49 water ledger and NEB analysis results for proposed water-for-water offset and Tier 1 streamflow restoration projects.

NEB Subbasin	Water-for-Water Offset		Tributary Offset		Net Ecological Benefit			
	Net change (afy)	Net change (cfs) ‡	Net change (afy)	Net change (cfs)‡	Adult Steelhead Neq	Juvenile Steelhead Neq	Adult Chinook Neq§	Juvenile Chinook Neq§
Loup Loup-Swamp (Lower Okanogan)	-- (-37)	-0.51	+275 (approx)	+0.38	+2	+118	+2	+2,357
Salmon Creek	1,000 (+988)	+1.36	+1,499	+2.07	+111	+5,539	--	--
Omak Creek	--	--			--	--	--	--
Bonaparte-Johnson (Middle Okanogan)	626 (+626) #	+0.86	+123	+0.17	+4	+83	+14	+1,999
Antoine-Whitestone (Upper Okanogan)	1,160 (+1,099)	+1.52	+2,371	+3.28	+2	+110	+1	+305
Similkameen	-- (-10)	-0.01	-	-	0	0	+1	+166
WRIA 49 Total	**2,786 (+2,666)**	**+3.22**	**+6,753**	**+5.9**	**+119**	**+5,850**	**+18**	**+4,826**

‡ Net change (cfs) values are average over 1 year. All non-water offset projects provide flow augmentation during specific periods (e.g. April through October) to optimize habitat benefits for steelhead.
# Pine Creek, offset applies in mainstem Okanogan only (no measurable NEB effect)
§ Chinook benefits are mainstem only, Highway 20 Culvert Replacement (Conservancy Island side channel) project

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APPENDIX D

EDT Modeling Hydraulics and Hydrology Inputs Memo

MEMORANDUM

Project No. 190259-01

October 1, 2020

To: Angela Hubbard, Okanogan County Office of Planning and Development

From:

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Re: **Summary of Habitat Parameter Quantification**
WRIA 49 Chapter 90.94 RCW Streamflow Restoration Plan Addendum

The passage of Engrossed Substitute Senate Bill (ESSB) 6091, as codified by Chapter 90.94 Revised Code of Washington (RCW), requires that an update to the existing Watershed Plan for Water Resource Inventory Area (WRIA) 49, the Okanogan River Basin, be approved by the Washington Department of Ecology (Ecology) by February 1, 2021. Okanogan County Office of Planning & Development is serving as the lead agency for this process. The WRIA 49 Initiating Governments for the watershed planning process are Okanogan County, the City of Omak, and the Oroville-Tonasket Irrigation District. The process is supported by convening the WRIA 49 Planning Unit to review technical tasks and memorandums, policy decisions, and the pending watershed plan update. Aspect Consulting, LLC (Aspect), together with Confluence Environmental Company (Confluence) and ICF International (ICF), have been contracted by Okanogan County as technical lead, including attendance of planning unit meetings, conducting supporting technical tasks, and preparation of the Streamflow Restoration Plan Addendum.

The purpose of this memorandum is to provide: (a) a description of available habitat monitoring and other project-related data obtained and reviewed; (b) an overview of the approach and methodology used to quantify the effects of proposed Net Ecological Benefit (NEB) project restoration actions on specific habitat parameters, specifically baseflow wetted width; and (c) a summary of the habitat

parameter assessment (wetted width) results for use in modifying the existing Okanogan Ecosystem Diagnosis and Treatment (EDT) model input attributes in support of NEB scenario analyses.

Data and Information Reviewed

Various sources of data and information were obtained and reviewed to help gain a better understanding of the project and for developing an approach and methodology to quantify the effects of proposed project restoration actions on specific habitat parameters.

Available data was reviewed from the following sources:

- Okanogan Basin Monitoring and Evaluation Program (OBMEP) stream reach habitat monitoring data. Includes channel transect, thalweg data, and other relevant data for survey transect groups within EDT study reaches.
- Streamflow data from USGS surface water gaging stations in the project area.
- OBMEP proposed Fancher Reservoir management proposal, including synthetic low-flow condition hydrograph for Antoine Creek under existing and proposed management scenarios (Klett, 2020).
- Salmon Creek long-term water lease program and proposed water release schedule for 2020 (Fisher, 2020).
- LiDAR, 2015 Oregon LiDAR Consortium (OLC) Okanogan FEMA (3-ft horizontal resolution). Completed by Quantum Spatial for the Department of Geology and Mineral Industries. Refer to LiDAR metadata report referenced at the end of this document for additional information.
- LiDAR, 2017 NE Washington LiDAR Production (3-ft horizontal resolution). Completed by GeoTerra for the Washington Department of Natural Resources. Refer to LiDAR metadata report referenced at the end of this document for additional information.
- National Elevation Dataset (USGS 10-meter Digital Elevation Model).
- Available photographs depicting stream and habitat conditions at select stream transects.

Stream Reach Habitat Monitoring Data

Stream reach habitat monitoring data was collected by OMBEP from 2014 through 2017 and provides a useful representation of average habitat conditions over a recent four-year period. The project streams have been broken up into one or more EDT study reaches as shown in Table 1. Habitat monitoring data was collected at a total of 21 equally spaced transects (or cross sections) within each EDT study reach over a total length of 150 meters. The collection of transects is referred to in this memo as a survey transect group. Discrete transects within a survey transect group are assigned a unique identifier (A, A1, B, B1, …, K). Relevant transect data collected by OBMEP field staff included station interval, station (water) depth, and bankfull height, with a total of 10 stations common to each transect. In addition, bankfull height above the water surface was recorded for each transect.

Channel thalweg data was also collected by OBMEP field staff including thalweg depth and corresponding habitat descriptions (e.g., glide, pool, riffle, etc.). Thalweg data was collected at four equally spaced stations (1.5-meter interval) between transects.

Table 1 – Summary of Project Streams and EDT Study Reaches

Stream	Study Reach	Site	Year
Antoine	Antoine 16-1	OBMEP-551	2015
			2016
	Antoine 16-2	OBMEP-592	2014
	Antoine 16-4	OBMEP-1601	2017
	Antoine 16-5	OBMEP-1608	2017
Bonaparte	Bonaparte 16-1	OBMEP-388	2014
			2015
			2016
			2017
Loup Loup	Loup Loup 16-1	OBMEP-421	2014
			2015
			2016
			2017
	Loup Loup 16-2	OBMEP-1222	2017
Ninemile	Ninemile 16-1	OBMEP-1205	2014
			2015
			2016
			2017
	Ninemile 16-5	OBMEP-121	2017
Salmon	Salmon 16-1	OBMEP-517	2016
	Salmon 16-2	OBMEP-090	2016
	Salmon 16-3	OBMEP-488	2014
		OBMEP-1215	2016
	Salmon 16-4	OBMEP-424	2017
	Salmon 16-7	OBMEP-297	2014
			2015
			2016
			2017
	Salmon 16-10	OBMEP-312	2017
	Salmon 16-12	OBMEP-552	2014
			2015
			2016
			2017
Whitestone	Whitestone 16-1	OBMEP-055	2008

Stream Discharge Data

The USGS operates and maintains a number of stream gaging stations on streams tributary to the Okanogan River. Station information for streams in the current study is provided in Table 2. Daily stream discharge data, as well as daily and monthly statistics, were obtained for the period of record for each stream station.

Mean monthly discharge values for the period of 2014 through 2017 were generally used to represent baseline flow conditions for streams, with the exception of Antoine Creek and Salmon Creek, which relied on proposed flow allocation schedules developed in coordination with OBMEP staff. Changes in baseline flow conditions resulting from implementation of proposed NEB project restoration actions were estimated and used to estimate monthly flows under the proposed condition scenario. The net change in streamflow from the baseline to proposed condition was used to quantify the effects of proposed project restoration actions on specific habitat parameters, specifically channel wetted width.

Table 2 – Summary of Select USGS Stream Stations within Study Area

USGS Station	Station Name	Period of Record
12444290	Antoine Cr at US HWY 97 Near Ellisforde, WA	10-24-2013 to Present
12444550	Bonaparte Cr at Tonasket, WA	04-14-2016 to Present
12438905	Ninemile Cr at Eastlake Rd Near Oroville, WA	10-17-2010 to Present
12446995	Salmon Cr Above Diversion Near Okanogan, WA	10-19-2012 to Present
12447285	Loup Loup Cr at Mallot, WA	10-01-2012 to Present

Stream and Habitat Condition Photographs

Available stream and habitat condition photographs were reviewed and used as a guide for assigning stream channel (Manning's *n*) roughness coefficients for each survey transect group within an EDT study reach. Channel roughness coefficients were derived from tabulated values based on a range of channel types and conditions (Sturm, 2001; based on Chow, 1959). Roughness coefficients for the project streams generally fall within the following categories:

- Natural Streams – Minor Streams – Mountain Streams, No Vegetation in Channel, Banks Usually Steep, Trees and Brush along Banks, Submerged at High Stages – Bottom: Gravels, Cobbles, and Few Boulders
- Natural Streams – Minor Streams – Mountain Streams, No Vegetation in Channel, Banks Usually Steep, Trees and Brush along Banks, Submerged at High Stages – Bottom: Cobbles with Large Boulders

Channel roughness coefficients for these types of streams range from a minimum of 0.030 to a maximum of 0.050. Professional judgment was used in assignment of roughness coefficients for each survey transect group. Roughness coefficients were used in the calculation of wetted width as described below.

Topographic/LiDAR Information

Available LiDAR and topographic information were used to estimate a channel gradient value for each survey transect group. Channel gradient estimates were used in the calculation of wetted width as described below. The following provide a summary of the methodology developed.

Data sources

Based on review of the Washington DNR LiDAR Data Portal, the most current LiDAR data coverages for the project vicinity were acquired between June and July 2015 as part of the OLC Okanogan FEMA study (Quantum Spatial, 2016) and in July and October 2017 as part of the NE Washington LiDAR Production (GeoTerra, 2018). The 2015 LiDAR includes coverage of the mainstem Okanogan River and the Methow River, while the 2017 LiDAR includes coverage for the lower reaches of many of the tributaries to the Okanogan River. For stream reaches that were not completely covered by LiDAR data (Salmon 16-2 and Ninemile 16-12), the National Elevation Dataset (USGS 10-meter) Digital Elevation Model (NED DEM) was used as a surrogate, acquired through the ArcGIS Living Atlas Data Portal. Table 3 provides a summary of available topographic/LiDAR available for each stream reach.

Table 3 – Summary of Topographic/LiDAR Data by Stream Reach

Stream/Reach	Elevation Data Source(s)
Antoine (all reaches)	LiDAR: NE WA 2017
Bonaparte (16-1)	LiDAR: Okanogan FEMA 2015 or NE WA 2017
Loup-Loup (all reaches)	LiDAR: Okanogan FEMA 2015
Ninemile 16-1	LiDAR: Okanogan FEMA 2015
Ninemile 16-2	NED DEM
Salmon 16-1 through 16-10	LiDAR: Okanogan FEMA 2015
Salmon 16-12 (F & downstream of F)	LiDAR: Okanogan FEMA 2015
Salmon 16-12 (Upstream of F)	NED DEM
Whitestone (16-1)	LiDAR: Okanogan FEMA 2015 or NE WA 2017

Processing/analysis steps:

Available LiDAR elevation data was downloaded from Washington DNR LiDAR Data Portal. For the two stream reaches that were not completely covered by LiDAR data (Salmon 16-2 and Ninemile 16-12), the National Elevation Dataset (USGS 10-meter) Digital Elevation Model (NED DEM) was used as a surrogate.

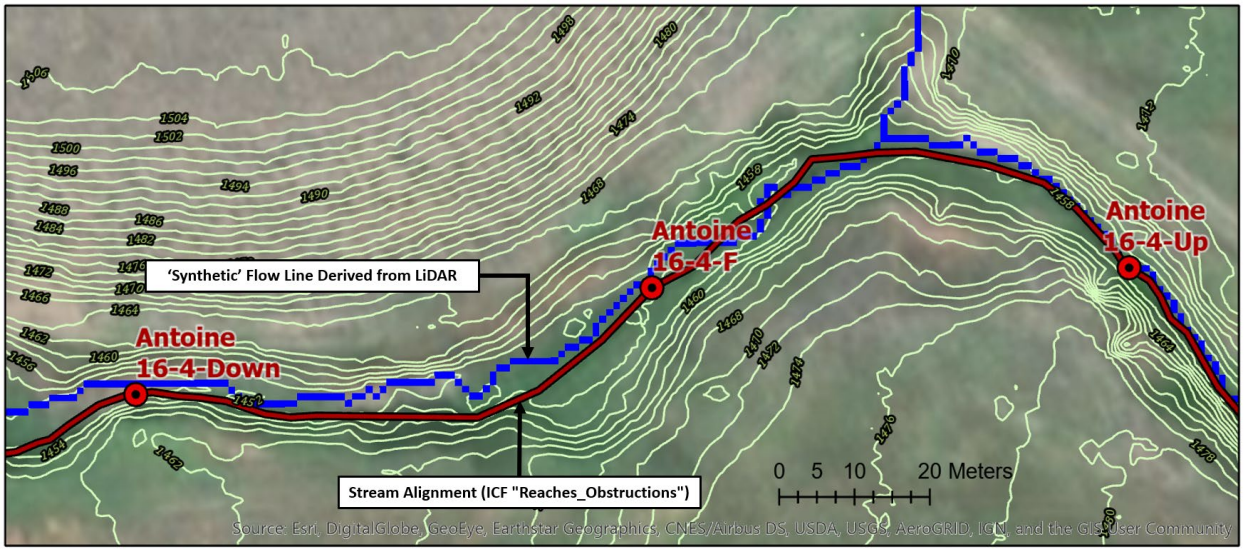
The goal of the analysis was to measure the stream channel elevation at three points along each study reach to calculate the stream slope: (1) at the mid-point of each reach (referred to as the F-transect); (2) 75 meters upstream of the F-transect; and (3) 75 meters downstream of the F-transect.

F-transect locations and stream alignments were provided as GIS data by Confluence ("F-transects" and "Reaches_Obstructions"). GIS was used to measure/identify points falling along each stream alignment (Reaches_Obstructions) exactly 75 meters upstream and downstream of each F-transect.

It is not the case that the stream features (and thus, the transect points) are exactly aligned with the elevation data. That is, a given transect point may fall errantly on a valley wall or bank and not precisely aligned with the local low point (stream centerline). Thus, programmatically measuring/extracting point elevations automatically from the LiDAR or NED data was not advisable, as it might inaccurately represent the actual stream elevation at the given location.

To account for this predictable discrepancy/misalignment, the elevation data (LiDAR/DEM) were processed in GIS to derive and illuminate the "synthetic" stream alignment—essentially the path along which the elevation model suggests water will flow, as shown in Figure 1 below. In most cases, and at a wide scale, the Reaches_Obstructions (GPS-derived) stream alignment agreed reasonably well with the DEM-derived synthetic alignment, but the many small discrepancies confirm the need adjust exactly where each elevation is measured—to confirm it's location in the stream channel as suggested by the elevation data.

Figure 1 – Comparison of stream alignment vs synthetic flow line derived from LiDAR



With visual reference from LiDAR-derived elevation contours and the LiDAR-derived stream channel, elevations for each F-transect and corresponding 75 meter upstream and downstream points were manually measured in GIS at the nearest possible location to each point, corresponding to the local low point (stream channel) in the elevation data. Elevation values are rounded to the nearest foot in keeping with the accuracy of the LiDAR data used in conjunction with the horizontal accuracy of the stream channel and transects. Elevation values are given in units of feet in the NAVD88 vertical datum, as shown in Table 4.

Table 4 – Summary of Elevation Values and Estimated Channel Slope by Stream Reach

Stream	Reach	Elevation (ft, NAVD88)				Notes
		Downstream (75 m)	F-Transect	Upstream (75 m)	Channel Slope (ft/ft)	
Antoine	16-1	921	924	932	0.0224	
	16-2	1090	1100	1110	0.0406	
	16-4	1451	1455	1458	0.0142	
	16-5	1560	1563	1566	0.0122	
Bonaparte	16-1	941	951	954	0.0264	
Loup Loup	16-1	831	836	840	0.0183	
	16-2	877	881	884	0.0142	
Ninemile	16-1	971	978	984	0.0264	
	16-5	2013	2041	2064	0.1036	NED
Salmon	16-1	929	937	942	0.0264	
	16-2	1176	1183	1192	0.0325	
	16-3	1323	1325	1326	0.0061	OBMEP-488
	16-3	1344	1345	1346	0.0041	OBMEP-1215
	16-4	1387	1388	1389	0.0041	
	16-7	1489	1491	1493	0.0081	
	16-10	1754	1756	1759	0.0102	
	16-12	1901	1914	1926	0.0508	NED
	16-12	1906	1914	1926	0.0406	LiDAR
Whitestone	16-1	955	959	968	0.0264	

Channel gradient was obtained by dividing the difference in estimated elevation (upstream minus downstream elevation) by the survey transect length for each reach (150 meters). The resulting channel gradient values were used in the calculation of wetted width as described below.

Wetted Width Estimation Model

Aspect developed a Microsoft Excel-based wetted width estimation model that incorporates available OBMEP stream reach habitat monitoring data, estimates of channel gradient and roughness, and mean monthly stream discharge data to estimate the change in wetted width between existing and proposed conditions in each EDT study reach. The model uses a Manning's-based formula to estimate normal depth and wetted width calculations based on the user input parameter. The advantage of this modeling approach is that it allows for quick iteration of stream flows (and resulting wetted width) to evaluate reach-specific sensitivity to maximize each project's efficacy and contribution to NEB.

The components of the wetted width estimation model and the approach and methodology followed is described below.

Transect Information

Station interval, station (water) depth, and bankfull height data for each transect (in a transect survey group) are entered by the user. These input parameters are used to calculate relative elevation at each station interval along the transect based on setting the channel thalweg to elevation zero. A plot of station interval versus relative elevation is generated for each transect. The resulting channel cross section is then used as the basis for the wetted width calculations.

Additional input parameters for each transect include channel slope and channel roughness. See relevant sections above for methodology use to estimate these additional input parameters.

An example of the transect information user input component of the wetted width estimation model is shown in Figure 2. Note that cells highlighted blue are user inputs.

Figure 2 – Transect information input component to wetted width estimation model

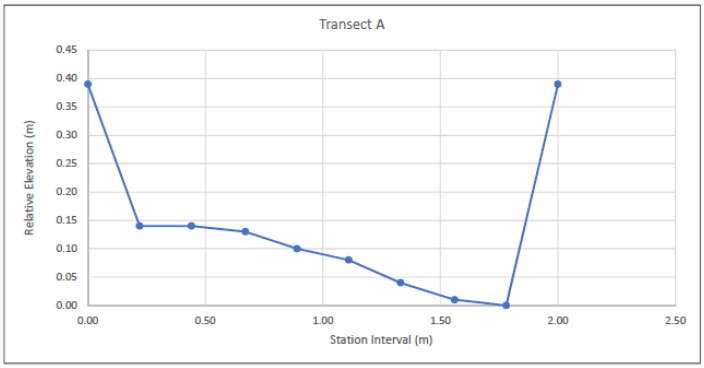
Stream: Antoine Creek
Reach Name: Antoine 16-1
Site: OBMEP-551
Year: 2015
Sample Date: 7/15/15
Transect ID: 3012
Transect: A

Transect Information

Transect Geometry

Station Interval (m)	Station Depth (m)	Relative Elevation (m)	Station Interval (ft)	Relative Elevation (ft)
0.00	0.00	0.39	0.00	1.28
0.22	0.00	0.14	0.72	0.46
0.44	0.00	0.14	1.44	0.46
0.67	0.01	0.13	2.20	0.43
0.89	0.04	0.10	2.92	0.33
1.11	0.06	0.08	3.64	0.26
1.33	0.10	0.04	4.36	0.13
1.56	0.13	0.01	5.12	0.03
1.78	0.14	0.00	5.84	0.00
2.00	0.00	0.39	6.56	1.28

Bankfull Height (m)	0.25
Channel Slope (ft/ft)	0.022
Channel Roughness (n)	0.040



Wetted Width Calculations

Utilizing the channel cross section and user input of the mean monthly flow values for both the existing and proposed condition, wetted width estimates are obtained utilizing the following approach. First, normal depth is calculated using Manning's equation for uniform flow to determine the depth of water in the channel assuming that uniform flow conditions exist (i.e., the slope of the water surface and channel bottom are the same). Second, the wetted top width of the channel is calculated for the resulting normal depth of water in the channel.

Normal depth and wetted width calculations for an irregular channel are performed using custom Microsoft Excel scripts. Note that the results were verified independently using Bentley FlowMaster (Version 8i) for irregular channels.

As a check, the maximum normal depth is compared to the channel cross section to confirm that the peak monthly flow is contained within the bankfull channel. If a calculation reveals that the normal depth to be greater than the available channel cross section geometry, then LiDAR data for the channel overbanks is required to supplement the cross-section geometry.

The normalized change in wetted width between the existing and proposed condition is provided for each transect on a monthly basis.

An example of the streamflow input component of wetted width estimation model is shown in Figure 3. Note that cells highlighted blue are user inputs of mean monthly streamflow for the existing and proposed condition scenarios.

Figure 3 – Existing/proposed streamflow input component to wetted width estimation model for estimation of normalized change in monthly wetted width

Analysis of Mean Monthly Discharge and Wetted Width Under Existing and Proposed Conditions

Month	Existing Condition					Proposed Condition					Normalized Change in Wetted Width
	Existing Cond Avg Flow (cfs)	Normal Depth (ft)	Normal Depth (m)	Wetted Width (ft)	Wetted Width (m)	Proposed Cond Average Flow (cfs)	Normal Depth (ft)	Normal Depth (m)	Wetted Width (ft)	Wetted Width (m)	
Jan	0.82	0.31	0.09	2.85	0.87	0.82	0.31	0.09	2.85	0.87	1.00
Feb	0.79	0.30	0.09	2.79	0.85	0.79	0.30	0.09	2.79	0.85	1.00
Mar	1.35	0.38	0.12	3.51	1.07	1.35	0.38	0.12	3.51	1.07	1.00
Apr	3.32	0.54	0.17	5.50	1.68	3.58	0.55	0.17	5.52	1.68	1.00
May	9.45	0.79	0.24	5.86	1.78	6.58	0.69	0.21	5.71	1.74	0.97
June	4.99	0.62	0.19	5.61	1.71	4.46	0.60	0.18	5.58	1.70	0.99
July	0.65	0.27	0.08	2.48	0.75	1.66	0.41	0.13	3.76	1.15	1.52
Aug	0.42	0.22	0.07	2.12	0.65	1.43	0.39	0.12	3.58	1.09	1.69
Sept	0.46	0.23	0.07	2.17	0.66	1.47	0.39	0.12	3.61	1.10	1.66
Oct	0.75	0.29	0.09	2.71	0.83	0.99	0.33	0.10	3.15	0.96	1.16
Nov	1.07	0.34	0.10	3.23	0.99	1.07	0.34	0.10	3.23	0.99	1.00
Dec	0.77	0.30	0.09	2.76	0.84	0.77	0.30	0.09	2.76	0.84	1.00

Max Flow Existing/Proposed (cfs)	9.45
Max Normal Depth Existing/Proposed (m)	0.24
Normal Depth within Bankfull Channel?	Yes

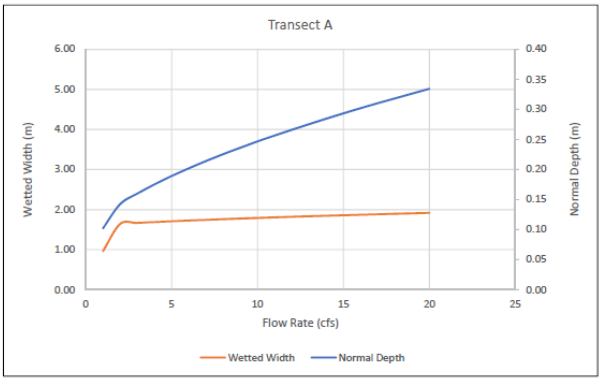
Influence of Stream Discharge on Wetted Width

Normal depth and wetted width are estimated for a range of stream flows to better understand the cumulative percent increase in wetted width for each channel cross section as a function of flow rate. A plot of normal depth versus streamflow and wetted width versus streamflow is included as a visual aid, as shown in Figure 4.

Figure 4 – Influence of streamflow on wetted width and normal depth for a range of anticipated flows in each study reach

Influence of Stream Discharge on Wetted Width

Flow (cfs)	Normal Depth (ft)	Normal Depth (m)	Wetted Width (ft)	Wetted Width (m)	Cummulative Percent Increase
1	0.34	0.10	3.16	0.96	
2	0.47	0.14	5.39	1.64	70.5%
3	0.52	0.16	5.47	1.67	72.0%
4	0.58	0.18	5.54	1.69	73.3%
5	0.62	0.19	5.61	1.71	74.5%
6	0.66	0.20	5.67	1.73	75.6%
7	0.70	0.21	5.73	1.75	76.6%
8	0.74	0.23	5.78	1.76	77.6%
9	0.78	0.24	5.83	1.78	78.4%
10	0.81	0.25	5.88	1.79	79.3%
11	0.84	0.26	5.93	1.81	80.1%
12	0.87	0.27	5.98	1.82	80.9%
13	0.90	0.28	6.02	1.84	81.6%
14	0.93	0.28	6.06	1.85	82.3%
15	0.96	0.29	6.10	1.86	83.0%
16	0.99	0.30	6.15	1.87	83.7%
17	1.02	0.31	6.18	1.89	84.3%
18	1.05	0.32	6.22	1.90	84.9%
19	1.07	0.33	6.26	1.91	85.5%
20	1.10	0.33	6.30	1.92	86.1%



Summary of Normalized Change in Monthly Wetted Width

For each survey transect group, an average normalized change in monthly wetted width is estimated using the monthly results for all 21 transects. These results are provided as a summary output sheet in the wetted width estimator model.

NEB Analysis Scenarios for Channel Width Estimation

NEB analysis scenarios for EDT modeling were developed by Aspect and Confluence based on a suite of proposed streamflow and habitat restoration projects advanced by the WRIA 49 Planning Unit and local stakeholders. Only projects designated as Tier 1 projects were advanced for EDT modeling. A summary of Tier 1 projects contributing to NEB by tributary watershed are shown in Table 5. Tier 1 projects contributing to NEB and the ecological parameters used to model the projects in EDT is described in further detail in the *Summary of NEB Analysis Methods and Results used for WRIA 49 Watershed Planning Memorandum* (Confluence, 2020).

To support EDT modeling efforts, available OBMEP habitat monitoring data (2014 through 2017), estimates of channel gradient and roughness, and existing and proposed condition flows for select EDT model reaches (see Table 5) were compiled for each proposed NEB project. This information was then used to estimate the monthly average channel wetted widths for the select EDT model reaches under existing and proposed flow conditions using the customized hydraulic modeling tool developed for this project. The results were then used to calculate the proportional change in average monthly channel width (expressed as proportional multipliers) resulting from the proposed projects, which were provided to Confluence as input parameters for the EDT model analysis.

Due to the bulk size, channel width estimates (outputs from the wetted width estimator model) for each NED project and associated EDT reach(es) by tributary watershed are provided as an electronic attachment to this submittal (Attachment 1).

Table 5 – Summary of NEB Analysis Scenarios and EDT Reaches Selected for Channel Width Estimation

Stream	Proposed NEB Project / Scenario	EDT Reach
Antoine	Base Scenario	16-1, 16-2, 16-4, 16-5
	Antoine Valley Ranch (AVR) with Min Offset	16-2, 16-3, 16-5
	AVR with Min Offset + Okanogan-Tonasket Irr District Flow Augmentation (OTID-FA)	16-1
	AVR with Full Offset	16-2, 16-3, 16-5
	AVR with Full Offset plus OTID-FA	16-1
Loup Loup	Irrigation Conveyance Efficiency	16-1, 16-2
Salmon	Base Scenario	16-1, 16-2, 16-3, 16-4, 16-7, 16-10, 16-12
	Salmon Lake Storage	16-3, 16-4, 16-7, 16-10, 16-12
	Salmon Lake Storage + Okanogan Source Substitution (OSS)	16-1, 16-2

Sensitivity Analysis

A sensitivity analysis approach was used to evaluate the potential effects of projected future water demand on anadromous habitat, including streamflow and wetted channel width. Under this approach, the anticipated demand effect associated with the medium growth development scenario was used to estimate the reduction in streamflow required to produce targeted reductions in baseflow channel width. This was accomplished using a modified version of the wetted width estimator model and the Goal Seek function in Microsoft Excel. Calculated wetted width values were adjusted by applying a wetted width reduction factor (e.g., 5%). The Goal Seek function was then used to "seek" a flow value corresponding to the adjusted wetted width value.

This approach was first applied to the Loup Loup Creek subbasin for channel width reductions corresponding to 0.5%, 1%, 2.5%, and 5%. Additional sensitivity analyses were performed for Antoine Creek, Bonaparte Creek, Ninemile Creek, and Salmon Creek. However, due to budget limitations, the analyses were limited to the following: (1) the most downstream EDT study reach with the exception of Salmon Creek; (2) a single representative transect from each study reach; and (3) low-flow period extending from July through October. Table 6 provides a summary of the sensitivity analyses performed as part of this work.

Table 6 – Summary of Sensitivity Analysis Parameters by Stream

Stream	EDT Reach	Transect	Analysis Period	Sensitivity Scenario
Loup Loup	16-1	A, B, C, D, E, F, G, H, I, J, K	June – Feb	0.5%, 1%, 2.5%, 5%
Bonaparte	16-1	F	June - Oct	5%
Antoine	16-1	B	June - Oct	5%
Ninemile	16-1	G1	June - Oct	5%
Salmon	16-4	C1	June - Oct	5%

The results of the sensitivity analyses are presented in the *Summary of NEB Analysis Methods and Results used for WRIA 49 Watershed Planning Memorandum* (Confluence, 2020), which is included as Appendix C of the Plan Addendum. Outputs from the modified wetted width estimator model are provided as an electronic attachment to this submittal (Attachment 2).

References

Confluence Environmental Company (Confluence), 2020, Summary of NEB Analysis Methods and Results used for WRIA 49 Watershed Planning Memo, Draft Memorandum, June 5, 2020.

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Limitations

Work for this project was performed for the Okanogan County (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

Attachment 1 – NED Project Channel Width Estimates by Tributary Watershed (provided as a separate digital file)

Attachment 2 – Results of Sensitivity Analyses (provided as a separate digital file)

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ATTACHMENT 1

NED Project Channel Width Estimates by Tributary Watershed *(provided as a separate digital file)*

ATTACHMENT 2

Results of Sensitivity Analyses
(provided as a separate digital file)