APPENDIX A

WRIA 59 RCW 90.94 PLANNING

TECHNICAL MEMORANDUM ON ESTIMATION OF FUTURE BUILDOUT AND CONSUMPTIVE USE RELATIVE TO DOMESTIC EXEMPT GROUNDWATER SUPPLY WELLS (WNR GROUP, MAY 31, 2019)

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TECHNICAL MEMORANDUM

To: **WRIA 59 Watershed Management Partnership (WMP),**
WRIA 59 Water Resources Management Board (Board) and
Stevens County Land Services Planning Department

From: **Eugene N.J. St.Godard, P.G., L.Hg., CWRE**
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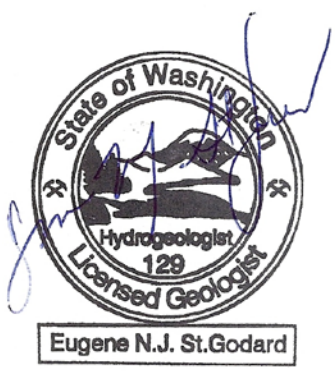
Date: **May 31st, 2019**

Project No. **045-006-01 – WRIA 59 ESSB (RCW 90.94) Planning**

Subject: **Technical memorandum on Estimation of Future Build-out and Consumptive Use Relative to Domestic Exempt Groundwater Supply Wells**

SIGNATURES: This Technical Memorandum and Hydrogeological interpretations were made by Eugene N.J. St.Godard, a licensed geologist/hydrogeologist (L.Hg. #129) in the State of Washington.



Date Signed: - May 31, 2019

I. INTRODUCTION

The Colville River Watershed, Water Resource Inventory Area (WRIA) 59, is located almost wholly within Stevens County in northeastern Washington. In 1977, the Washington State Department of Ecology, adopted an instream flow rule regulating the surface waters of WRIA 59 (Chapter 173-559 WAC). Over the past twenty years, Stevens County, in conjunction with other local governments, conservation district, tribes and citizens (referred to generally as the "WRIA 59 Planning Group") developed a Watershed Plan, conducted instream flow studies to determine if instream flow rule implemented in 1977 (WAC-173-559) should be modified, evaluated potential water storage projects, and developed a feasibility study for a water bank for promoting economic growth. Over the past year, in response to the adoption of RCW 90.94.020, Stevens County, in conjunction with the WRIA 59 Watershed Management Partnership (WMP) and WRIA 59 Water Resource Management Board (Board) is developing an Addendum to the Watershed Plan to evaluate the impact of future domestic permit-exempt wells within WRIA 59.

The WRIA 59 Board and WMP, under the leadership of Stevens County, has been collecting data within the mainstem and subbasins for over a decade. This data was used as the foundation for developing future water consumptive use estimates for the next 20-years. The basin contains three major aquifer systems: 1) A deep confined aquifer in the main Colville River Valley; 2) A shallow unconfined aquifer present in various areas on the main valley floor and the lower tributaries; and 3) the bedrock fractured aquifers located throughout the basin and tributaries.

Stevens County used historic building permit data collected since 2001 for unincorporated areas in WRIA 59 to help estimate future domestic consumptive use by permit-exempt groundwater uses (referred to generally as "exempt wells"). This study included the estimation of future domestic in-house consumptive use, and outdoor use from lawn/garden watering relying on a GIS based aerial lawn survey was conducted to determine average lawn size at a basin and subbasin level.

For the purpose of this study, **LAWN** is defined as: ***"any outdoor watering of lawn, gardens, and/or landscaping that could be visually identified on aerial photographs."*** For estimation of "lawn size", the acreage included a combined measurement of any of these outdoor irrigated features.

Estimation of Future Permit Exempt Domestic Water Uses

The evaluation of future exempt well consumptive use study was initiated as a result of the passage of the streamflow restoration legislation, Engrossed Substitute Senate Bill (ESSB) 6091, which was passed by the Washington State legislature on January 18, 2018. It was enacted as a response to the Washington State Supreme Court's Hirst decision.[1] The legislation was subsequently codified as Chapter 90.94 RCW and is formulated to address the potential effects of future consumptive use from domestic exempt wells on stream flows.

Specifically, RCW 90.94.020 directs Water Resource Inventory Area (WRIA) 59 to undertake the following:

> *(4)(a) In collaboration with the planning unit, the initiating governments must update the watershed plan to include recommendations for projects and actions that will measure, protect, and enhance instream resources and improve watershed functions that support the recovery of threatened and endangered salmonids. Watershed plan recommendations may include, but are not limited to, acquiring senior water rights, water*

[1] *Whatcom County v. Hirst*, 186 Wn.2d 648, 381 P.3d 1 (2016).

conservation, water reuse, stream gaging, groundwater monitoring, and developing natural and constructed infrastructure, which includes, but is not limited to, such projects as floodplain restoration, off-channel storage, and aquifer recharge. Qualifying projects must be specifically designed to enhance streamflows and not result in negative impacts to ecological functions or critical habitat.

(b) At a minimum, the watershed plan must include those actions that the planning units determine to be necessary to offset potential impacts to instream flows associated with permit-exempt domestic water use. The highest priority recommendations must 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. The watershed plan may include projects that protect or improve instream resources without replacing the consumptive quantity of water where such projects are in addition to those actions that the planning unit determines to be necessary to offset potential consumptive impacts to instream flows associated with permit-exempt domestic water use.

In summary, Chapter 90.94 RCW requires the WRIA 59 WMP and Board to update their existing Watershed Management Plan (Version 2 dated March 15, 2007) to address the potential impacts on stream flows from future domestic exempt wells. Under Chapter 90.94 RCW, the Plan must be updated to include measures to offset future domestic exempt wells over the next 20 years (through 2038). In order to meet this obligation, the WMP and the Board have developed this Technical Memorandum to support future planning document amendments. This study was conducted by the Water & Natural Resource Group, Inc. (WNR Group), in close cooperation with the Stevens County Land Services Department and the WRIA 59 Plan Addendum Subcommittee formed by the WRIA 59 Board.

WRIA 59 Watershed Planning

The WRIA 59 Watershed Planning Team has been conducting watershed planning activities in WRIA 59 since 1999. The group developed a Watershed Plan, adopted on November 30, 2004 and revised in March of 2007. The Board and WMP completed a Detailed Implementation Plan (DIP) on March 31, 2006, which outlines potential projects to be completed in the watershed. In addition, the group has also recently completed a feasibility analysis on water banking in the Colville River Basin. The Board and the WMP have been active in the watershed throughout the Phase 4 planning which encompasses implementing some of the projects identified within the DIP. Upon the passage of ESSB 6091, the WMP and Board reconvened and quickly began addressing the issues surrounding the domestic exempt wells as outlined in the new law. The Board formed a "WRIA 59 Addendum Subcommittee" to develop the technical data needed to prepare the Watershed Plan Addendum. The data, conclusions and recommendations outlined in this Technical Memorandum were developed by the subcommittee members.

II. PHYSICAL SETTING OF COLVILE RIVER BASIN

The Colville River Watershed is a 1,007-square mile area located mostly in Stevens County (Figure 1). The watershed lies in a generally north-south orientation that is approximately 45 miles long and 23 miles wide and extends from near the towns of Springdale and Loon Lake at the southern end of the basin to near the town of Kettle Falls at the northwestern extent of the basin (Kahle et al, 2003). The Colville River begins as Sheep Creek in the headwaters near Loon Lake, and flows in a generally northerly direction until the Colville River empties into the Columbia River (Lake Roosevelt) approximately two miles west of Kettle Falls.

The WRIA 59 Planning Unit summarized the watershed into 19 subbasins as shown in Table 1 and on Figure 1. Flows within most tributaries listed below have been periodically monitored by the WRIA group since 2007 in order to determine if water is available for future allocation within some of the subbasins.

Table 1: Summary of Subbasins Located in WRIA 59 Watershed

Upper Watershed	Middle Watershed	Lower Watershed
Sheep Creek	Colville River South	Colville River North
Deer Creek	Sherwood Creek	Gold Creek
Grouse Creek	Chewelah Creek	Haller Creek
Bulldog Creek	Thomason Creek	Mill Creek
Cottonwood Creek	Blue Creek	Little Pend Oreille River
Waitts Creek	Stensgar Creek	
Huckleberry Creek	Stranger Creek	

Under Ecology's WRIA 59 Instream Flow Rule, surface water in WRIA 59 is available for future appropriation only from the mainstem of the Colville River from October 1 through July 15, and tributaries are inferred to be over appropriated because of existing water rights (Chung and Slattery, 1977). Regulation of surface waters in WRIA 59 is defined in Chapter 173-559 WAC, in which flows are set for two stations within the Colville River. These stations are defined in WAC 173-559 as: 1) Upper Colville River located at river mile 32.1 which sets flows from the confluence of Sheep and Deer Creeks to Stensgar Creek; and 2) Lower Colville River located at river mile 5.0 which sets flows from Lake Roosevelt to confluence with Stensgar Creek. However, only the gauge station in the lower watershed at Meyers Falls has remained in continuous operation. Flows within most tributaries listed below have been periodically monitored by the WRIA group since 2007 in order to determine if water is available for future allocation within some of the subbasins.

Physiographically, the Colville River Basin is composed of hilly and mountainous terrain of the Selkirk Mountains, which is bisected by the generally north-south river valley that in most places is less than 3-miles wide (Kahle et al, 2003). The geology of WRIA 59 is complex and comprises several types of bedrock overlain in many places with various types and thicknesses of unconsolidated sediment such as silt, sand, gravel and clay (Ely and Kahle, 2004). The sediments occur mostly as till, outwash, alluvium, and glacial-lake flood deposits. At least two periods of glaciation have influenced the topography and sedimentation of the region. A comprehensive study of the hydrogeologic conditions within WRIA 59 was completed by the USGS and is presented in their report "Water Resources of the Ground-Water System in the Unconsolidated Deposits of the Colville River Watershed, Stevens County, Washington", prepared by USGS for WRIA 59 Planning Unit (Kahle et al, 2003). This report provides a detailed interpretation of the hydrogeologic setting of the basin, and is summarized below. In 2004, the USGS developed a conceptual model and numerical simulation of the groundwater flow systems of the Colville River (Ely and Kahle, 2004). The modeling report also provides a detailed description of the sediments and how they were deposited are presented in the USGS modeling report (Ely and Kahle, 2004).

Hydrogeologic Units

In general, groundwater aquifers in WRIA 59 are located within three primary hydrogeologic units: 1) the shallow unconfined aquifer which appears to be in direct hydraulic continuity with the Colville River and its tributaries, 2) the lower confined aquifer which is located at depth within the main Colville Valley and is separated by 20-300 feet of a relatively impermeable clay layer identified as the Colville Valley Confining Unit (Ely and Kahle, 2004), and 3) Bedrock fractures where groundwater is present within fractures and/or faults within the bedrock that are mainly exposed in the high-altitude areas of the watershed where it is not overlain by till, and in the deep bedrock beneath the unconsolidated valley fill where its depth is largely unknown (Ely and Kahle, 2004). The USGS reports generally define the hydrogeologic units within WRIA 59 into three aquifer and two confining units:

- Upper Outwash Aquifer (UA);
- Till confining unit (TC);
- Colville Valley confining unit (VC);
- Lower Aquifer (LA); and
- Bedrock (BR), which hosts the lower yielding bedrock fracture aquifers.

The lithologic and hydrogeologic characteristics of the hydrogeologic units are summarized in Figure 2. In general, groundwater typically mimics the surface water drainage pattern of the watershed. Groundwater appears to move from the topographically high tributary-watershed areas toward the topographically lower Colville River valley floor. Directions of groundwater-flow in the upper outwash aquifer are shown on Figure 3. The lower confined aquifer typically is found in the main Colville River Valley and is separated from the upper outwash aquifer by a clay layer ranging up to 300 feet thick. Flow within this lower confined aquifer is generally to the north, mimicking the main valley floor as shown on Figure 4.

Hydraulic Continuity of Ground and Surface Waters of the Colville River

Hydraulic continuity between the upper aquifer and the Colville River is generally inferred. In 2003, description of the hydraulic connection between the shallow groundwater and the surface water is and conducted analysis of flow measurements from the tributaries to the main stem Colville River (Kahle et al, 2003). The USGS report concluded there is an average loss of 10.8 percent of the tributary flow reaching the valley floor did not register in flows at the mainstem gauge. These loses are likely attributable to the movement of water into the shallow groundwater aquifer (Kahle et al, 2003). It is assumed that the streams loose water to the shallow aquifers within the tributary valleys and within the main valley floor.

The USGS study also determined that there are both loosing and gaining reaches along the Colville River to the shallow aquifer. The 2003 report summarized that during low flow times, a 16.8 percent gain occurs between the confluence of Sheep and Deer Creek and the Betteridge Road near Valley. The 2003 report concluded an average of a 15.2 percent loss in Colville River flow from the Betteridge Road and Schmidlekofer Road near Chewelah. Below Schmidlekofer Road, the Colville River gains and losses are less than 2.5 percent. These results, in addition to the general hydrogeologic conditions observed throughout the Colville River valley in the upper aquifer, suggests that the streams and river are in hydraulic connection with the shallow aquifer.

The USGS 2004 Conceptual Model and Numerical Simulation report presents the results of the steady state model developed by the USGS for the watershed. The model was run using three alternatives throughout the basin and determined that there is some hydraulic connection between the upper and lower aquifers. However, this connection can vary throughout the watershed. Ecology has further attempted to define this connection by running analytical equations using the model derived hydraulic parameters and potentially site-specific data resulting in potential hydraulic connection of 9 to 20 percent (Covert, 2015, personal communication/unpublished data). Utilizing the site-specific analytical equations, a groundwater withdrawal from the lower aquifer may result in an impact to the Colville River of approximately 9 to 20 percent which would require mitigation. Figure 5 presents a potential future withdrawal from the lower aquifer near Chewelah, in which a 1,000 gpm withdrawal would result in approximately 91 gpm being induced leakage from the river, or approximately 9.1 percent (Covert, 2015). Discussions with Ecology have suggested that any future potential water rights issued from the lower aquifer would require a potential 10 to 20 percent mitigation to the Colville River surface flows.

Wells completed in bedrock fractures are considered to impact the surface waters within the same subbasin. However, some wells may intercept fractures that are recharging or discharging adjacent subbasins.

III. APPROACH

In order to meet the obligations of RCW 90.94.020, the WRIA 59 Addendum Subcommittee, developed an approach to estimate future consumptive use impacts from domestic exempt wells through the 20-year period from 2018 through 2038. The subcommittee reviewed the Land Services Department's dataset of historic building permits relying on permit exempt domestic water supply, census data and state issued population growth projections. The subcommittee considered the County's database of permits from 2001 to 2017 in the rural areas of WRIA 59, located outside of the municipal/public water service areas, to be the most reliable indication of future growth.

Furthermore, the subcommittee also considered the County's database geographically by subbasin and hydrogeologically by aquifer type, as more specifically described below.

Estimated Population Growth

To estimate the amount of rural population growth in WRIA 59 over the next 20 years, the subcommittee reviewed the County-wide population growth projection information provided by the U.S. Census and the Washington State Office of Financial Management (OFM). In addition, the subcommittee reviewed historic Stevens County building permit information. After review of all available data the subcommittee concluded that, while informative, the Census and OFM projections were not as helpful as the site-specific building permit information.

The Census population projections for Stevens County are provided in low, medium, and high projections and estimates the number of people per home at 2.48 (US Census, 2018). The overall population range from the Census from 2018 to 2038 would create and housing demand between -24 homes/year and 119 homes/year. The newest (2017) twenty-year OFM population projections for Stevens County range between a County-wide population loss of 4,684 people to a gain of 23,213. When converted to number of homes/years required to accommodate population changes, the range is between -94 homes/year and 468 homes/year.

While the Census and OFM projects help inform the population growth estimates for WRIA 59, neither source is very useful for the purposes of satisfying RCW 90.94.020 for the following reasons:

- Growth projections from the Census and OFM sources are calculated to the County wide scale and not just in WRIA 59.
- There is not a way to identify how much of the projected growth will rely on a rural domestic water supply.
- The growth projections (low, medium and high) create such a wide population range, (from negative growth to over 9,000 new homes over the next twenty years) that it is difficult to pick an appropriate estimate.

For the reasons stated above, the study estimated the 20-year growth projects in WRIA 59 that would rely on a rural domestic water supply using historical building permit information from Stevens County.

Buildout Analysis

Stevens County Land Services Department has been tracking the issuance of building permits since 2001. The dataset relied on for this memorandum includes only the permits issued for construction of structures outside of the city limits and Group A and Group B public water system service areas. Furthermore, the dataset included only those structures used for dwellings which were solely served by a domestic exempt well (e.g. a permit for a shop on a property was removed from the analysis). Table 2 presents the historical database as synthesized for only domestic exempt groundwater users as determined from historical rural building permits in the watershed. Location of the wells, as defined by the aquifer type throughout the basin, is shown in Figure 6. Figure 6 is a map showing the location of the permitted wells, as plotted on the parcel centroid, of the 950 domestic exempt groundwater wells completed in WRIA 59 from 2001 through 2017. Table 3 presents a summary of the average permits per year, and the average permits per year per subbasin in WRIA 59. Figure 7 presents a graphical presentation of the historical permits in rural WRIA 59.

From 2001 through 2017, Stevens County issued 950 permits for rural homes utilizing domestic exempt groundwater wells within WRIA 59. This results in an average annual exempt well growth of 55.8 per year. Utilizing the past historical record of permits, and assuming a growth pattern similar for the next 20 years, an estimated 1,118 additional homes relying on domestic exempt well will be constructed in WRIA 59 through 2038.

The analysis shows an average of 55.8 homes per year have been permitted in rural WRIA 59 areas from 2001 through 2017. When the data from 2001 through 2010 is averaged, the annual average is 66.8 homes/year. However, 2010 to 2017, the annual average falls to 40.3 homes per year. The data appears to track the economic conditions, as 2001 to 2010 is generally representative of good economic conditions which would be favorable to construction of homes, and 2010 to 2017 was during a harder economic condition in the county which would result in a slowing of housing construction. Therefore, in the opinion of the Board subcommittee, the average as observed from 2001 through 2017 would be a representative number for future planning as it covers a good range of economic conditions and growth in the county.

In order to determine the areas within the watershed with the highest growth, the average annual domestic exempt wells per year for each subbasin were ranked. Figure 8 shows a bar graph identifying the weighted average of permits annually in each subbasin. As shown in Figure 9, when ranked by the projected number of future groundwater exempt wells by subbasin the five basins with the highest number of permits are: 1) Colville River North, 2) Little Pend Oreille River, 3) Sheep Creek, 4) Mill Creek, and 5) Haller Creek.

The County wanted to consider where potential areas in WRIA 59 may be favorable to future development based on the past permit locations. First, to determine where potential future growth may occur, Stevens County created a GIS layer showing areas where permit exempt development was *unlikely* to occur, by merging layers for floodplains, wetlands, lakes, cities, public utility districts, steep slopes, and publicly owned lands. This “unlikely to develop” layer was used to create a “developable lands layer” by extracting all areas that were *not* covered by the “unlikely to develop” layer. This layer was then joined to the sub-basin layer, allowing the developable acres within WRIA 59 to be calculated for each subbasin (Figure 10).

Table 2: WRIA 59 Permits by Year by Sub-basin (2001 – 2017)

SUBBASIN/YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Grand Total
Blue Creek		4		3	2	1	1		1				1					13
Bulldog Creek	2	3	1	1	2	2		1	2	1	4	1				1	1	22
Chewelah Creek	2	2	1	3	8	4	5	6	1	3	4	2	4		3	2	2	52
Colville River N	13	7	18	9	19	14	19	10	5	4	6	6	6	5	4	13	4	162
Colville River S	4	4	4	8	8	7	7	1		3	3	3	1	4		3	2	62
Cottonwood Creek		3	1		2		1	1	1			1			1		1	12
Deer Creek	1	1	1			2	1		2			3				1	1	13
Gold Creek	1	1				2	1	1		1							1	8
Grouse Creek	1	1			2		3	1		2	1	1	1	1	2	1		17
Haller Creek	6	4	2	7	5	7	4	2	1	4	2	5	3	4	5	3	1	65
Huckleberry Creek		1	1	1	2	3	3	2	2	1		3	1	1	2		2	25
Little Pend Oreille River	2	5	9	9	13	11	14	9	11	11	7	3	11	2	8	5	10	140
Mill Creek	10	4	13	6	7	7	7	8	5	3	7	7	3	5	5	7	8	112
Sheep Creek	7	10	9	11	14	6	14	8	6	5	5	3	4	2	2	5	7	118
Sherwood Creek	1			2	1			1		1				1			2	9
Stensgar Creek	2	3	4		3	2	5	4	3	3	1	3	2	2		1	3	41
Stranger Creek	3	2	1	7	7	4	4		4	2		1	1	1	3	2		42
Thomason Creek		1	2	1	1		2	4	1	2			1	1				16
Waitts Creek	2		1	2		1	1	1		5	1	1		1	2		3	21
Grand Total	57	56	68	70	96	73	92	60	45	51	41	43	39	30	37	44	48	950

Table 3: Summary of Average Permits by Year and by Subbasin

WRIA 59-Rural Permits

Year	Permits
2001	57
2002	56
2003	68
2004	70
2005	96
2006	73
2007	92
2008	60
2009	45
2010	51
2011	41
2012	43
2013	39
2014	30
2015	37
2016	44
2017	48
Avg/yr	55.8

SUBBASIN	Total 2001-2017	Avg/yr
Blue Creek	13	0.8
Bulldog Creek	22	1.3
Chewelah Creek	52	3.1
Colville River N	162	9.5
Colville River S	62	3.6
Cottonwood Creek	12	0.7
Deer Creek	13	0.8
Gold Creek	8	0.5
Grouse Creek	17	1.0
Haller Creek	65	3.8
Huckleberry Creek	25	1.5
Little Pend Oreille River	140	8.2
Mill Creek	112	6.6
Sheep Creek	118	6.9
Sherwood Creek	9	0.5
Stensgar Creek	41	2.4
Stranger Creek	42	2.5
Thomason Creek	16	0.9
Waitts Creek	21	1.2

Table 4: Average Number of Permits per Year

2001 - 2010 Avg	66.8
2010 – 2017	40.3
2001 - 2017 Avg	55.8

Second, the County undertook an analysis to double-check the County's "unlikely to develop layer" with actual building permit data. Starting with the County's location referenced building permit dataset, the County developed a well location layer assuming the well is located in the center of the parcel. The County used this approach because the water well logs for individual wells do not uniformly specify the exact well location. The County overlaid its "unlikely to develop" layer and determined that less than 1% of the wells that were permitted from 2001 through 2017 fell within the areas identified to be "unlikely to develop".

As a result of this analysis, the subcommittee considered that some subbasins may have large land areas but relatively small amounts of "developable lands." Consequently, the subcommittee asked for the technical report to consider the amount of potential future development on "developable lands" in each subbasin. As shown on Figure 10, approximately 72% of the basin is classified as "unlikely to develop". This analysis showed that only 28% of the basin would comprise potentially developable land, which is primarily located in the lower portions of the tributaries.

Utilizing the above referenced methodology, using all domestic water wells (not dependent upon aquifer type) the top four priority basins in WRIA 59 based on future land area for development are: Colville River North, Little Pend Oreille River, Sheep Creek, and Mill Creek.

Analysis Based on Aquifer Type

In addition to considering the location of permit exempt domestic water users, the subcommittee considered the aquifer source. As referenced earlier, there are three distinct aquifers within WRIA 59: 1) unconsolidated aquifers, 2) Colville Valley lower confined aquifer, and 3) bedrock fracture aquifers. In order to develop an understanding of the aquifer types which were primarily being used by future domestic exempt well water users, the County's dataset of building permits relying on permit exempt domestic water users was further analyzed with the following methodology:

1) The Washington State DNR Geologic map (Stoffel et al, 1991) layer was then overlaid in the GIS database;
2) The USGS WRIA 59 hydrogeologic map (Kahle et al, 2003), was used to identify the mapped lower Colville Valley unconfined aquifer;
3) A query was conducted to identify the wells located only within the geologic layers of Qgf, Qgd, Qs, and Qa, those units in which the USGS hydrogeologic reports for WRIA 59 (Kahle and others, 2003; Ely and Kahle, 2004) identified the

unconsolidated aquifers as being present within. These wells were identified as the unconsolidated aquifer wells;

4) A query was conducted to identify the number of wells which were located only within bedrock mapped at surface. These wells were identified as bedrock wells.
5) A query was then conducted to identify all the bedrock wells which lie solely within the footprint of the mapped lower confined aquifer. These wells were identified as confined aquifer wells.
6) A query was then entered to identify wells that were located within the footprint of the lower aquifer and within the geologic units of the upper aquifer (as identified in #4). These wells could be using water from either aquifer, but appeared to mostly be withdrawing water from the first shallow water encountered. Therefore, these wells were counted under a new category of lower/upper aquifer.
7) The remaining wells which were not grouped into the categories were further reviewed to determine their classifications. These wells were primarily being mapped within small valleys or plateaus on the high ridges surrounding WRIA 59. Upon further review of well logs in the area of these wells, WNR Group determined that the wells appeared have been drilled through a thin layer of soil (which is mapped as something else besides the Qgf, Qgd, Qs, and Qa of the upper aquifer) and completed into bedrock. Approximately 25 percent of the well logs were reviewed before it was determined that these wells should be grouped into the bedrock well classification.

After the well log aquifer review, it appeared that most wells in the watershed are completed into the deep bedrock fractures. Table 5 presents the summary of the aquifer classification of the 950 wells reviewed under this study.

Table 5: Summary of Wells per Aquifer

Aquifer Type	# Wells	Percent
Bedrock/Bedrock Other	515	54.21%
Upper Aquifer	324	34.11%
Lower Aquifer	60	6.32%
Upper/Lower Aquifer	51	5.37%

The lower aquifer wells have a smaller effect on the surface water (less than 20 percent) throughout the watershed, as they are withdrawing water directly from the lower confined aquifer which is in direct hydraulic continuity with Lake Roosevelt near the mouth of the watershed. Therefore, only development pressure maps for the Bedrock/Bedrock Other wells and the combined Upper Aquifer and Upper/Lower Aquifer were developed. When the two different individual aquifer type wells are plotted on the potential developable lands map, and weighted throughout the watershed, a different priority of watersheds emerges. Figure 11 presents a color weighted map showing the development pressure which will occur from bedrock wells. Using only bedrock wells, the highest development pressured subbasins are Colville Valley North, Sheep Creek, Little Pend Oreille River, and Haller Creek.

The highest ranking subbasin for bedrock wells, Colville Valley North, located on the valley floor was further reviewed. A review of well logs, and location of wells revealed that most development is occurring at the outer edges of the valleys where wells are drilled into the shallow bedrock and not the deep glacial valley fill deposits. This occurs for several reasons such as avoiding building within the flood plain or near other protected critical areas. Figure 12 presents a color weighted development map of the subwatersheds based on wells withdrawing water from the upper unconsolidated aquifer. These are the wells that would have more continuity with the surface waters of the basin. As shown on this map, the Little Pend Oreille River basin ranks the highest, with Colville River North, Chewelah Creek and Mill Creek ranking high.

The general conclusion of the aquifer type development pressure analysis is that it appears that most pressure on the streams and main stem will be occurring in the lower portions of the watershed.

IV. CONSUMPTIVE USE QUANTIFICATION

In order to estimate the future impacts to surface water from new domestic exempt wells in WRIA 59, the study estimated uses for indoor and outdoor use. Most consumptive use from a home is directly related to the size of lawn and garden being irrigated. This section addresses the projected consumptive use which was calculated on a subbasin level. Projected future rural domestic permit exempt water users per subbasin are outlined in Table 2. The total projected buildout of the WRIA 59 watershed over the next 20 years (2018-2038) is estimated at 1,118 homes.

The subcommittee reviewed available historical data collected on domestic water use over the years of watershed planning. After review of this data, the subcommittee determined that the data was not sufficient enough to conduct the future growth analysis. The subcommittee reviewed the recently completed Ecology ESSB 6091 – Streamflow Restoration – Recommendations for Water Use Estimates, completed in June 2018. This document reviews the methodologies for indoor and outdoor uses, and the general assumptions that can be used for estimating consumptive use. The document discusses previous studies to base its recommended consumptive values. The document states:

> *To estimate the impacts of indoor water use, the population to be served by future permit-exempt domestic wells can be multiplied by assumed water use. A 2016 study by the Water Research Foundation (DeOreo, et al., 2016) determined an average per capita water use of 59 gallons per day (gpd) in homes provided municipal water in 23 areas across the U.S. and Canada. This result is based on actual flow monitoring and survey responses from 737 homes. The 59 gpd average is down 15.4 percent from results found during a 1999 American Water Works Association Research Foundation study (Mayer and DeOreo, 1999). Some homes supplied by Tacoma Water were monitored*

> *for the 2016 report, producing an average 51 gpd per capita indoor water use. Bearing in mind that homes supplied municipal water are more likely to be fitted with water saving appliances, an assumption of 60 gpd per capita seems reasonable when estimating water use for permit exempt wells.*

After review of the Ecology guidance documents, and discussion on other data available throughout the watershed, the subcommittee decided to use the procedures outlined within the Ecology ESSB 6091 Publication 18-11-007.

The subcommittee decided to use this guidance in estimating indoor and outdoor use.

Indoor Household Consumptive Water Use in WRIA 59

Homes in rural Stevens County within WRIA 59 and outside of water supply service areas typically use a domestic exempt groundwater well to withdraw potable water and septic system to process waste. The following assumptions are made in order to develop the indoor water use estimated:

- Water is used year-round within the house;
- The home is connected to a domestic groundwater well and a septic system;
- Within Stevens County, the average household size is 2.48 people per home (US Census, 2018);
- An average indoor use of 60 gallons per day per person occurs (Ecology, 2018); and
- An assumed consumptive use value is 10-percent for homes connected to septic systems (Ecology, 2018).

The subcommittee relied on the assumptions in Ecology's June 2018 document, and estimated consumptive use of 14.88 gallons per day per home (60 gpd *2.48 pp/home *0.1) for indoor use per home. The estimated future buildout for rural WRIA 59 was determined to be and average 55.8 homes per year, resulting in an average daily consumptive use of 831.8 gallons per day, or 0.932 acre-feet per year. For a 20-year estimate with a total of 1,118 homes using exempt domestic wells, it would result in a total of 18.64 acre-feet of indoor household consumptive use.

Outdoor Home Consumptive Use in WRIA 59

The majority of water used at rural homes is typically used for irrigation of lawns and gardens. RCW 90.44.050 allows a residential home using a domestic exempt groundwater well to irrigate a maximum of one-half acre of lawn and/or garden. However, users of domestic exempt wells typically irrigate lawns and gardens smaller than one-half acre due to power and infrastructure limitations and/or groundwater availability limitations due to hydrogeologic controls. It is inferred that these conditions may exist in WRIA 59, so a lawn analysis program was under taken to determine average lawn/garden size for permit exempt users within WRIA 59.

In order to estimate irrigation water needs for the areas in WRIA 59, the WNR Group used standard crop irrigation requirements for pasture/turf as published in the Natural Resource Conservation Service Washington Irrigation Guide (WIG), as outlined in Appendix B of the WIG (1992). The irrigation requirement is the estimate of a crop water duty required to fully irrigate the crop over the defined irrigation season. The irrigation season for the WRIA 59 area is documented beginning on May 15th and ending October 10th.

The Washington Irrigation Guide (USDA, 1990) was developed for use in estimating historical crop use water requirements. The WIG provides technical information and procedures that can be used for planning and management of irrigation systems as well as developing quantities of crop consumptive use for various areas throughout Washington State (Appendix B of WIG, 1992). The crop use requirements are derived from a modified Blaney-Criddle method and generally uses historical rainfall and precipitation data prior to 1980. The guide provides net irrigation requirements, based on long-term average climate conditions, for various crops and locations throughout the state. This data may not be truly representative of recent trends in decreased precipitation and higher temperatures, but can be used as an average crop requirement from long term historical precipitation and temperature records. The basic inputs to the modified Blaney-Criddle method include mean monthly temperature, precipitation and latitude.

For WRIA 59, two representative stations are identified in the WIG (Chewelah and Colville). Table 6 and 7 shows these WIG irrigation requirements for Chewelah and Colville, respectively. The irrigation requirement for lawns near Chewelah is 25.45 inches/year and 26.60 inches/year for Colville. For this analysis, the WNR Group used the average of the two stations, or 26.025 inches/year (2.17 ft/acre/year).

Numerous methodologies are available to estimate total and net irrigation requirements for lawn and gardens. Ecology has published several Guidance and Procedural documents for estimating consumptive use. Specifically, Guidance 1210 (2005) – “Determining Irrigation Efficiency and Consumptive Use” and Procedure 1210 – “Policy for the Evaluation of Changes to Enable Irrigation of Additional Acreage” outline generally accepted methodologies for determining consumptive use of various crops in Washington State. Ecology will also generally accept evaporation from the irrigation system as a documented consumptive use. For pop-up sprinkler irrigation, an assumed evaporation rate of 10-percent is added to the consumptive use of the lawn (Ecology Guid-1210, 2005).

For this analysis, Ecology Guidance 1210 was used. For the study, a lawn sprinkler system was assumed to have an average application efficiency of 80 percent consumptive (crop ET plus evaporation). Return flows are estimated at 20 percent.

Table 6: WIG for Pasture Near Chewelah, Washington													
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Mean Temperature	23.7	30.4	37.1	46	54.1	60.6	66.0	64.9	56.8	45.8	34.4	27.7	
Total Precip (inches)	2.56	1.76	1.64	1.45	1.97	1.36	0.80	1.12	1.04	1.41	2.46	3.12	20.69
Effective Precip (ins)	0.00	0.05	0.96	1.02	1.44	1.06	0.76	0.92	0.75	0.87	0.01	0.00	7.84
Pasture Irrigation Requirement	0.00	0.00	0.00	0.00	1.56	5.57	8.03	6.38	3.82	0.09	0.00	0.00	25.45

TABLE 7: WIG for Pasture Near Colville, Washington													
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Mean Temperature	24.5	31.0	37.3	46.2	54.5	61.3	67.9	66.5	58	46.2	33.8	27.5	
Total Precip (inches)	2.22	1.45	1.21	1.05	1.62	1.48	0.77	1.16	0.89	1.17	2.05	2.49	17.56
Effective Precip (ins)	0.00	0.05	0.74	0.73	1.20	1.16	0.75	0.98	0.65	0.73	0.00	0.00	6.98
Pasture Irrigation Requirement	0.00	0.00	0.00	0.00	1.77	5.59	8.41	6.59	4.07	0.18	0.00	0.00	26.60

Home Lawn Analysis

In order to properly estimate the consumptive use of outdoor water, the WNR Group and Stevens County conducted a GIS aerial imagery analysis to estimate the average lawn size within WRIA 59, and for each subbasin. In addition, the data was synthesized to determine what the average lawn size is for homes within each of the aquifer types (unconsolidated, lower confined, and bedrock).

Lawn Irrigation Analysis Methodology

The purpose of this survey was to obtain a statistically significant estimate of the average extent of irrigated lawn and/or garden for homes on private water supply in WRIA 59. The analysis was completed by Gene St. Godard, a Hydrogeologist for WNR Group, and Adam Cares, a Natural Resource Planner for Stevens County. Relying on the County's building permit dataset from 2001 to 2017, the following process was used to perform the analysis:

- A sample size calculator was used to determine a required sample size of 274 parcels to achieve a 95 percent confidence level with a +/- 5 percent confidence interval.

- Using ArcGIS, each of the 950 total parcels were assigned a random number, and then 274 of those numbers were randomly selected for the lawn survey.
- Aerial imagery from 2015 and 2017 with a resolution of 1 foot / pixel, already owned by the Stevens County GIS Department, was used to visually review the extent of irrigated lawn/garden on each parcel.
- The "measure" tool in ArcGIS pro was used to measure the lawns and gardens in square feet, and the results of each measurement were immediately recorded in a table.
- Screenshots were taken from 26 of the measured parcels to provide examples and some representative surveys. These surveys are available within the Stevens County database maintained at the Land Services Department.
- Tabular data was exported to Excel for analysis in the overall watershed, each subbasin, and by aquifer type.

Average Lawn Size Estimate by Sub-Basin

As stated previously, the term lawn is used for all outdoor irrigation of turf, garden, and or landscaping. Measured lawn sizes ranged in size from zero to 103,620 square feet (2.38 acres). Eighty-five of the properties surveyed contained no outdoor watering of lawns or gardens. Fourteen lawns of the 274 surveyed had irrigation larger than the one-half acre. The average lawn size in WRIA 59 calculated through this analysis is approximately 0.1468 acres (6,394.4 square-feet).

The lawn size database was further synthesized to determine the average lawn size in each subbasin (Table 9). As shown in Table 8, Chewelah Creek exhibited the largest average lawn size at 0.3229 acres (14,063.7 square-feet), while Deer Creek contained the smallest average of 0.0453 acres (1,971.6 square feet). Figure 13 presents a graphical presentation of lawn size by subbasin.

The County and WNR also considered if the 14 homes that recorded a lawn size over one-half acre also have an irrigation water right. Ecology's Water Resources Tracking System (WRTS) database, which contains records of water rights for WRIA 59, was reviewed to determine if a water right or claim was associated with the property which would allow irrigation over one-half acre. Table 9 summarizes those 14 properties and if the WRTS database showed an associated water right or claim. Four properties contained no references to associated water rights. An additional two had recorded short form claims considered to be permit exempt water uses. Therefore, it appears eight of these 14 properties can irrigate over the one-half acre. Although these properties could possibly irrigate under a water right or claim, the data was left within the lawn irrigation analysis, and was still considered to be irrigated under a domestic exempt well.

TABLE 8: WRIA 59 LAWN ANALYSIS

Subbasin	Ft2 Avg Lawn	Acre Avg Lawn
Chewelah Creek	14063.7	0.3229
Gold Creek	12813.0	0.2941
Colville River S	7927.2	0.1820
Stranger Creek	7686.9	0.1765
Huckleberry Creek	6944.5	0.1594
Haller Creek	6808.3	0.1563
Colville River N	6771.3	0.1554
Blue Creek	6601.0	0.1515
Stensgar Creek	6113.1	0.1403
Cottonwood Creek	5879.7	0.1350
Mill Creek	5866.5	0.1347
LPOR	5694.1	0.1307
Grouse Creek	5315.0	0.1220
Sheep Creek	5275.2	0.1211
Bulldog Creek	5138.7	0.1180
Waitts Creek	3566.0	0.0818
Sherwood Creek	3307.5	0.0759
Thomason Creek	2719.3	0.0624
Deer Creek	1971.6	0.0453
WRIA 59	**6394.4**	**0.1468**

TABLE 9: Summary of Lawns over ½-ACRE and WRTS Database

OBJECT ID	APPLICATION DATE	Subbasin	Aquifer	Parcel Acres	Estimated Lawn Size (sq. ft)	Aerial Photo Year	Water Right?
455	2007-04-16	Chewelah Creek	Upper	7.472684	103620	2015, 2017	Cert
941	2009-06-22	Little Pend Oreille River	Bedrock/Other	27.10574	43062	2015, 2017	CLAIM
486	2009-07-16	Huckleberry Creek	Upper	34.46534	40477	2015, 2017	Cert
126	2007-07-16	Colville River N	Upper	18.66896	39387	2015, 2017	None
325	2017-05-18	Mill Creek	Upper/Lower Aquifer	13.64391	35476	2015, 2017	Cert
882	2006-10-16	Colville River S	Lower	49.31883	33241	2015, 2017	Cert
568	2010-08-17	Little Pend Oreille River	Upper	78.76284	30454	2015, 2017	Sh-CL**
848	2006-02-22	Colville River N	Lower	19.01643	29347	2015, 2017	Cert
831	2017-12-13	Stensgar Creek	Upper/Lower Aquifer	18.57118	28578	2015, 2017	Sh-CL
186	2004-06-29	Stranger Creek	Upper	28.93181	27859	2015, 2017	None
869	2003-03-25	Sheep Creek	Lower	35.0013	25857	2015, 2017	Chg Cert
524	2006-03-06	Colville River S	Lower	21.29691	24527	2015, 2017	Cert
466	2003-04-02	Colville River S	Upper	35.80905	22397	2015, 2017	None
470	2012-02-28	Colville River S	Lower	60.85901	22065	2015, 2017	None

Average Lawn Size by Aquifer Type

The data was also synthesized to determine if there was any correlation between irrigation of lawn and the aquifer type being used to supply the water. A survey of this data determined that the largest average lawn sizes are those wells founded in the lower confined aquifer. The smallest lawns were associated with wells withdrawing water from the deep bedrock aquifers in the basin. Table 10 summarizes the findings of this analysis. Figure 14 presents a graphical presentation of the lawn size versus aquifer type.

Table 10: Lawn Analysis Size Relative to Aquifer Type

AQUIFER TYPE	AVERAGE LAWN AREA (FT2)	AVERAGE LAWN AREA (ACRES)
Lower Aquifer	12,209.8	0.2803
Upper/Lower Aquifer	11,441.6	0.2627
Upper Aquifer	8,264.6	0.1897
Bedrock & Bedrock other	4,156.9	0.0954

The data from the analysis is consistent with the technical data because the wells founded in the lower aquifer wells typically have the highest yields, and as such would have more water physically available to water lawns. The deep lower aquifer is only found within the main valley floor of the Colville River Valley. The second largest lawn sizes were those drawing water from the Upper/Lower classification. These wells are also found along the main valley floor where yields are higher in the shallow unconfines and deeper confined aquifer. The third largest lawns are found on properties withdrawing water from the upper unconfined aquifer. These wells are typically found on the floor of the tributary valleys, from the valley floor to the headwaters. These aquifers typically are thin and have lower yields, due to the mixture of silts, sands and gravels within the saturated zones. The lowest average lawn size is found in properties utilizing wells founded in the deep bedrock fractures. These wells typically have very low yields, in most cases less than 5 gallons per minute (gpm). The physical availability of water at these locations is typically suitable to only supply indoor water use, and some limited outdoor use. Most of the wells founded in bedrock are located at properties near the headwaters of the drainages, in more remote forested locations. Many of these wells may also only be supplying water for seasonal use in mountain vacation homes.

Average Lawn Size by Year

While reviewing the data, the subcommittee also wanted to determine that the data was not biased by potentially only having older homes having large lawns, and newer homes, having smaller lawns. The data from 274 homes analyzed in the lawn analysis was also organized into lawn size by home construction date. Table 11 presents the data from the analysis and Figure 15 presents a graphical presentation. As the data shows, the largest lawns are from homes built in 2009. The analysis shows no lawn size for homes built in 2016. This data was further checked to determine that all permits issued in 2016 were issued to rural homes that drilled wells into the bedrock fractures, and did not have lawns. Therefore, 2016 is considered an anomaly. On average, there does not appear to be a trend that the older the home was built, the larger the size of the irrigated lawn or garden.

Table 11: Average Lawn Size by Year

Year	Acres-Lawn
2001	0.1469
2002	0.2021
2003	0.1600
2004	0.1049
2005	0.1037
2006	0.2134
2007	0.2204
2008	0.0783
2009	0.3013
2010	0.1560
2011	0.1107
2012	0.0985
2013	0.1377
2014	0.1279
2015	0.0832
2016	0.0000
2017	0.1404

Outdoor Consumptive Use Findings

To estimate the amount of household irrigation water in WRIA 59, the WNR Group used the Stevens County Land Services Department permit analysis with the Lawn Irrigation Analysis to determine the approximate 20-year projection amount of consumptive use in each subbasin in WRIA 59. In order to develop this assessment, the following assumptions were made:

1) The future buildout over the next 20-years for homes using domestic exempt well will be 1,118 homes, and developed within the same subbasin distribution as that defined in building permit analysis for 2001 – 2017 and shown in Table 2.
2) Each home in the basin will have an average of 2.48 people per domestic exempt well.
3) Indoor water use is estimated at 60 gpd, resulting in a 6 gpd per person consumptive use, or 14.88 gallons per day per home.

4) The average lawn size for the entire watershed is calculated as 0.1468 acres, and the average lawn per subbasin is described in Table 8.
5) The average irrigation duty for a lawn throughout the basin is 26.025 inches/year (2.17 feet/acre/year).
6) Lawn and garden efficiency were assumed to have an average application efficiency of 80 percent, and return flows are estimated at 20 percent. Therefore, a general consumptive use of 80-percent was used for the evaluation of outdoor water use.

Attachment 1 of this memo presents the tables and calculation spreadsheets used to estimate the indoor and outdoor consumptive use for each of the subbasins. Table 12 outlines the results of the consumptive use analysis. The table accounts for indoor consumptive use and the estimated subbasin lawn analysis consumptive use calculations.

Table 12 ranks the subbasins to determine where the greatest consumptive use may occur. As shown on the table, and on Figure 16, the Colville River North subbasin may receive the most pressure from future development requiring approximately 76.6 acre-feet of consumptive use mitigation water, followed by Little Pend Oreille River (56.2 acre-feet), Chewelah Creek (50.0 acre-feet), Mill Creek (46.2 acre-feet), and Sheep Creek 43.6 acre-feet). The range of mitigation required under this analysis ranged from the high of 76.6 acre-feet of the Colville River North to a low of 2.0 acre-feet in Deer Creek.

Over 20 years, through 2038, it is estimated that 1,118 homes will be constructed throughout the WRIA 59 watershed. The distribution of these homes has been determined from past development permit trends. It is estimated that by 2038, these future domestic permits exempt groundwater well users will have a total consumptive use impact of approximately 434.8 acre-feet of water.

Consumptive Use Estimates Related to Proposed Flows

Total consumptive use estimates were developed for each of the subbasins in WRIA 59. These estimates are presented as an annual acre-foot and a flow value as cfs (Table 13). The WRIA 59 WMP has developed agreed upon tributary flows during their Phase 4 Planning (St.Godard, 2015). These flows were developed with cooperation of Ecology and WDFW. The recommended ISF for the tributaries and the projected percentage of flow from estimated future exempt well users are shown in Table 13. As shown on the table, the estimated annual impairment to the Colville River is 0.6 cfs after 20 years and the construction 1,118 new homes. This flow is estimated at only 1.8 percent of the recommended low flow in August of each year.

Table 12: Consumptive Use by WRIA 59 Subbasins for 20 Years and Comprehensive Plan Update

Subbasin	Homes/Yr	Cu Indoor (AF/Yr)	Average Lawn Size (acres)	Cu Lawn (AF/Yr)	Total Cu/Year (AF- for annual homes)	Homes in 20 yrs	Total Cu (AF) in 20 Yrs	Total Cu (AF) thru 2040 for Comp Plan
Colville River N	9.53	0.16	0.1554	3.67	3.83	190.60	76.6	84.3
Little Pend Oreille	8.24	0.14	0.1307	2.67	2.81	164.80	56.2	61.8
Chewelah Creek	3.06	0.05	0.3229	2.45	2.50	61.20	50.0	55.0
Mill Creek	6.59	0.11	0.1347	2.20	2.31	131.80	46.2	50.8
Sheep Creek	6.88	0.11	0.1211	2.07	2.18	137.60	43.6	48.0
Colville River S	3.65	0.05	0.1820	1.65	1.70	73.00	34.0	37.4
Haller Creek	3.82	0.06	0.1563	1.48	1.54	76.40	30.8	33.9
Stranger Creek	2.47	0.04	0.1765	1.08	1.12	49.40	22.4	24.6
Stensgar Creek	2.41	0.04	0.1403	0.84	0.88	48.20	17.6	19.4
Huckleberry Creek	1.47	0.02	0.1594	0.58	0.60	29.40	12.0	13.2
Bulldog Creek	1.29	0.02	0.1180	0.38	0.40	25.80	8.0	8.8
Gold Creek	0.47	0.01	0.2941	0.34	0.35	9.40	7.0	7.7
Grouse Creek	1.00	0.02	0.1220	0.30	0.32	20.00	6.4	7.0
Blue Creek	0.76	0.01	0.1515	0.29	0.30	15.20	6.0	6.6
Waitts Creek	1.24	0.02	0.0818	0.25	0.27	24.80	5.4	5.9
Cottonwood Creek	0.71	0.01	0.1350	0.24	0.25	14.20	5.0	5.5
Thomason Creek	0.94	0.02	0.0624	0.15	0.17	18.80	3.4	3.7
Sherwood Creek	0.53	0.01	0.0759	0.10	0.11	10.60	2.2	2.4
Deer Creek	0.76	0.01	0.0453	0.09	0.10	15.20	2.0	2.2
TOTAL	**55.82**	**0.91**	**0.14554211**	**20.83**	**21.74**	**1116.40**	**434.8**	**478.3**

Table 13: WRIA 59 CU Annual Attenuated Analysis

Subbasin	Cu (AF)	Cu (cfs)	Cu (GPM)	Recommended ISF (CFS)	% of ISF Recommendation
Haller Creek	30.8	0.0426	19.13	2.00	2.13
Sheep Creek	43.6	0.0603	27.07	3.64	1.66
Stranger Creek	22.4	0.0310	13.93	8.00	0.39
LPOR	56.2	0.0778	34.90	21.00	0.37
Mill Creek	46.2	0.0639	28.69	17.50	0.37
Gold Creek	7.0	0.0097	4.35	3.00	0.32
Colville River N	76.6	0.1060	47.56	33.00	0.32
Blue Creek	6.0	0.0083	3.73	2.70	0.31
Waitts Creek	5.4	0.0075	3.38	3.00	0.25
Huckleberry Creek	12.0	0.0166	7.45	7.00	0.24
Stensgar Creek	17.6	0.0243	10.90	11.00	0.22
Bulldog Creek	8.0	0.0111	4.97	5.70	0.19
Chewelah Creek	50.0	0.0692	31.05	38.00	0.18
Colville River S	34.0	0.0470	21.11	33.00	0.14
Grouse Creek	6.4	0.0088	3.96	6.24	0.14
Cottonwood Creek	5.0	0.0069	3.10	5.40	0.13
Sherwood Creek	2.2	0.0030	1.35	2.50	0.12
Deer Creek	2.0	0.0027	1.22	5.87	0.05
Thomason Creek	3.4	0.0047	2.11	----	-----
WRIA 59 (low flow August)	**434.7**	**0.6015**	269.96	33.0	1.82
WRIA 59 (high flow April/May)	**434.7**	**0.6015**	269.96	200.0	0.30

Note: Total WRIA and N & S Colville River used 33 cfs as proposed lowest flow in August (200 cfs is highest proposed in April/May)
Note: Chewelah Creek ISF combines recommendation of 10 cfs for Main Chewelah Creek and 18 cfs for N.F. Chewelah Ck

CONCLUSIONS AND FINDINGS

The WNR Group has developed this Technical Memo to present the data analysis conducted for the WRIA 59 RCW 90.94 consumptive use assessment. The study has developed the following findings:

- Based on review of historic permit data, it is estimated that approximately 1,118 future homes using permit exempt water sources will potentially be constructed within the WRIA 59 watershed from 2018 through 2038, or 55.8 homes per year;
- Utilizing historical building permit data within WRIA 59 appears to be more representative of project growth than data deciphered from the census database. Therefore, the historical building permit data analysis was used for future growth projections;
- Development pressure, as defined from future groundwater well construction, the five highest priority basins are: 1) Colville River North, 2) Little Pend Oreille River, 3) Sheep Creek, 4) Mill Creek, and 5) Haller Creek.

- Future planning was weighted in each subbasin to the actual acreage of potential developable land, and not the total acreage of the subbasin. This would allow a comparable weighted average to identify where the priority basins were occurring. When analyzed on a developable land ratio, the priority basins were identified as 1) Colville River North, 2) Mill Creek, and 3) Thomason Creek;
- After review of hydrogeologic conditions for each of the domestic exempt wells, it was estimated that 54.2 percent of wells were completed into bedrock fractures, 34.1 percent into the upper unconsolidated aquifer, 6.3 percent into the lower confined aquifer, and 5.4 percent located where both the upper and lower aquifers are present.
- Wells completed in the lower aquifer were determined by the USGS to have a less than 20 percent effect on the surface waters in the basin. However, for this analysis, all deep confined aquifer wells were considered to have 100 percent effect on the Colville River aquifer.
- Wells completed in bedrock fractures are considered to stress surface waters within the subbasin at which the well head is located. However, some wells may intercept fractures that are recharges and/or discharge to adjacent subbasins.
- Weighted maps showing the development pressure which will occur only from Bedrock wells show the highest development pressured subbasins are the Colville Valley North, Sheep Creek, Little Pend Oreille River, and Haller Creek.
- Weighted development maps of the subwatersheds based on wells withdrawing water from the upper unconsolidated aquifer were also developed. These are the wells that would have more continuity with the surface waters of the basin. This analysis of wells only withdrawing from the unconsolidated upper aquifer show that the Little Pend Oreille River basin ranks the highest, with Colville River North, Chewelah Creek and Mill Creek ranking high.
- The general conclusion of the aquifer type development pressure analysis is that it appears that most pressure on the tributary streams and main stem will be occurring in the lower portions of the watershed near Colville and Kettle Falls.
- Consumptive use from domestic use for all of WRIA 59 was calculated to be 0.91 acre-feet per year, or 18.2 acre-feet for the 20-year buildout.
- A total 274 homes were randomly selected at a 95 percent confidence interval, in order to determine the average lawn size throughout WRIA 59. The lawn sizes ranged in size from zero to 103,620 square feet (2.38 acres). Eighty-five of the properties surveyed contained no outdoor watering of lawns or gardens. Fourteen lawns of the 274 surveyed had irrigation larger than the one-half acre. The average lawn size throughout WRIA 59 was determined to be approximately 0.1468 acres (6,394.4 square-feet).
- Chewelah Creek exhibited the largest average lawn size at 0.3229 acres (14,063.7 square-feet), while Deer Creek contained the smallest average of 0.0453 acres (1,971.6 square feet).

- Using an average of the WIG water duty values (26.025-inches or 2.17 ft), and an 80 percent consumptive use value, an estimate of 20.83 acre-feet per year of water would be consumed by the lawns of 1,118 new homes in WRIA 59.
- A survey of the lawn size data was compared to aquifer type at the well location. This data determined that the largest average lawn size occurred from those wells founded in the lower confined aquifer. The smallest lawns were associated with wells withdrawing water from the deep bedrock aquifers in the basin. It is apparent that the size of the lawn is directly related to the type of aquifer type present at the domestic well use location.
- The data showed there is no definable trend in lawn size relative to construction date of the home.
- Weighted development pressure maps based on the final consumptive use data estimates highest for the Colville River North subbasin (76.6 acre-feet of consumptive use water), followed by Little Pend Oreille River (56.2 acre-feet), Chewelah Creek (50.0 acre-feet), Mill Creek (46.2 acre-feet), and Sheep Creek 43.6 acre-feet). The range of mitigation for domestic exempt wells under this analysis ranged from the high of 76.6 acre-feet of the Colville River North to a low of 2.0 acre-feet in Deer Creek.
- The total indoor and outdoor consumptive use for all the homes projected to be built in WRIA 59 through 2038 is estimated at 434.8 acre-feet.

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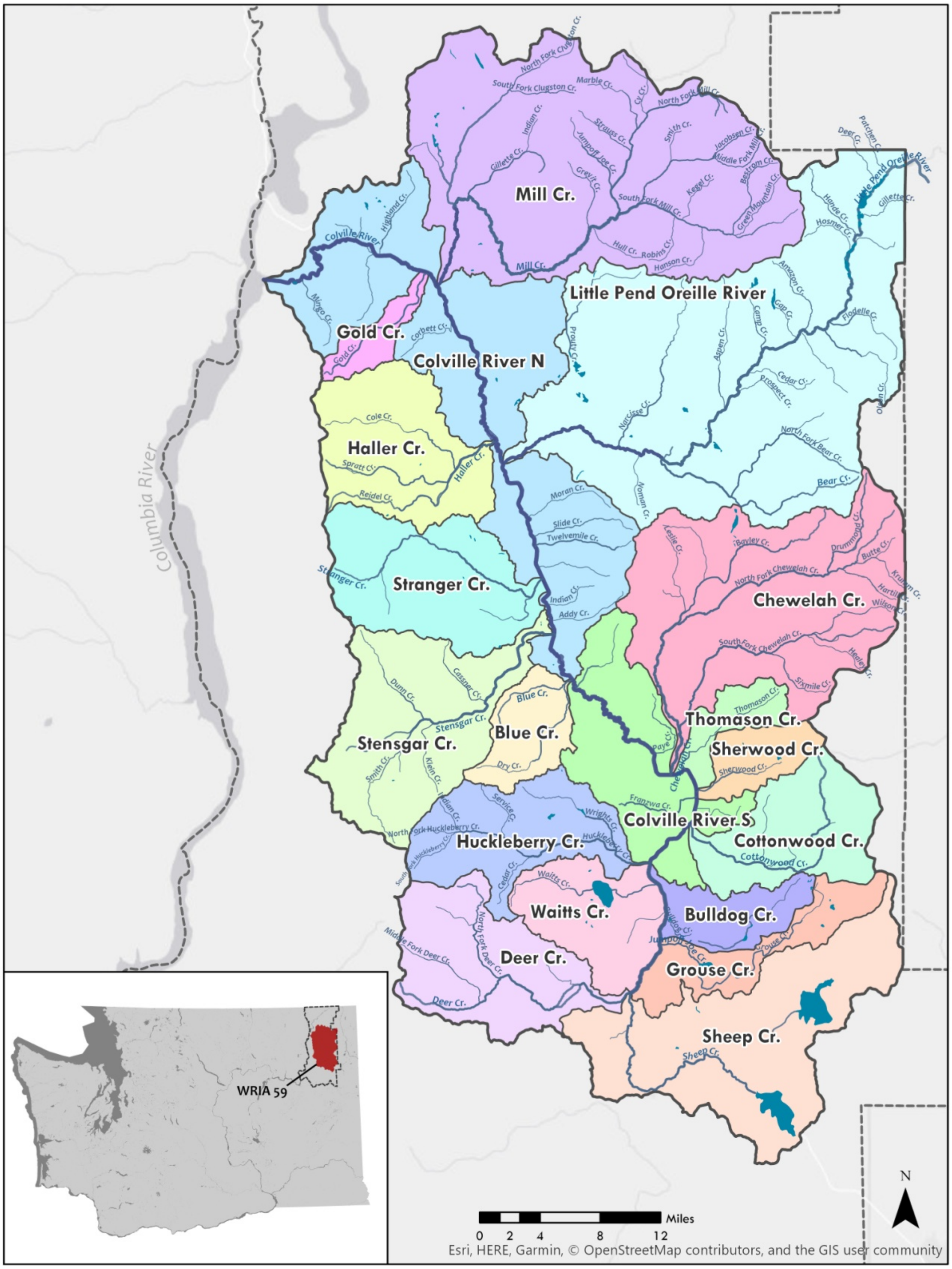

Figure 1: Map showing location of WRIA 59 and Location of Subbasins.

Hydrogeologic unit	Unit label	Range of thickness [estimated average thickness], in feet	Lithologic and hydrologic characteristics
Upper outwash aquifer	UA	10-480 [100]	Unconfined aquifer consisting of sand, gravel, cobbles, and silt with minor clay or till interbeds. Unit occurs in most stream valleys and terraces tributary to the Colville River. Includes geologic units Qal, Qgf, and Qti.
Till confining unit	TC	4-250 [70]	Low-permeability unit consisting of compacted and poorly sorted clay, silt, sand, gravel, and cobbles with locally occurring sand and gravel lenses. Includes geologic unit Qti.
Colville Valley confining unit	VC	1-570 [150]	Low-permeability unit consisting mostly of glaciolacustrine silt and clay overlain in places by mostly fine-grained stream alluvium. Unit occurs throughout the length of the Colville River valley and part way up some of the tributary valleys. Discontinuous lenses of aquifer material within the unit contribute usable quantities of water to some wells. Includes geologic units Qal and Qla.
Lower aquifer	LA	2-289 [60]	Generally confined aquifer consisting mostly of sand and some gravel. Unit occurs in most of the Colville River valley beneath the Colville Valley confining unit. The unit is unconfined where it is not fully saturated or is exposed at land surface (near Kettle Falls). Thickness and extent of unit is not well known.
Bedrock	BR	—	Unit includes conglomerate, sandstone, siltstone, shale, quartzite, dolomite, argillite, granite, and basalt. Locally yields usable quantities of water where rocks are fractured. Yields generally are small. Includes geologic unit Tybr.

Figure 2: Lithologic and hydrologic characteristics of the hydrogeologic units in the Colville River Watershed, Stevens County, Washington (from Ely and Kahle, 2004).

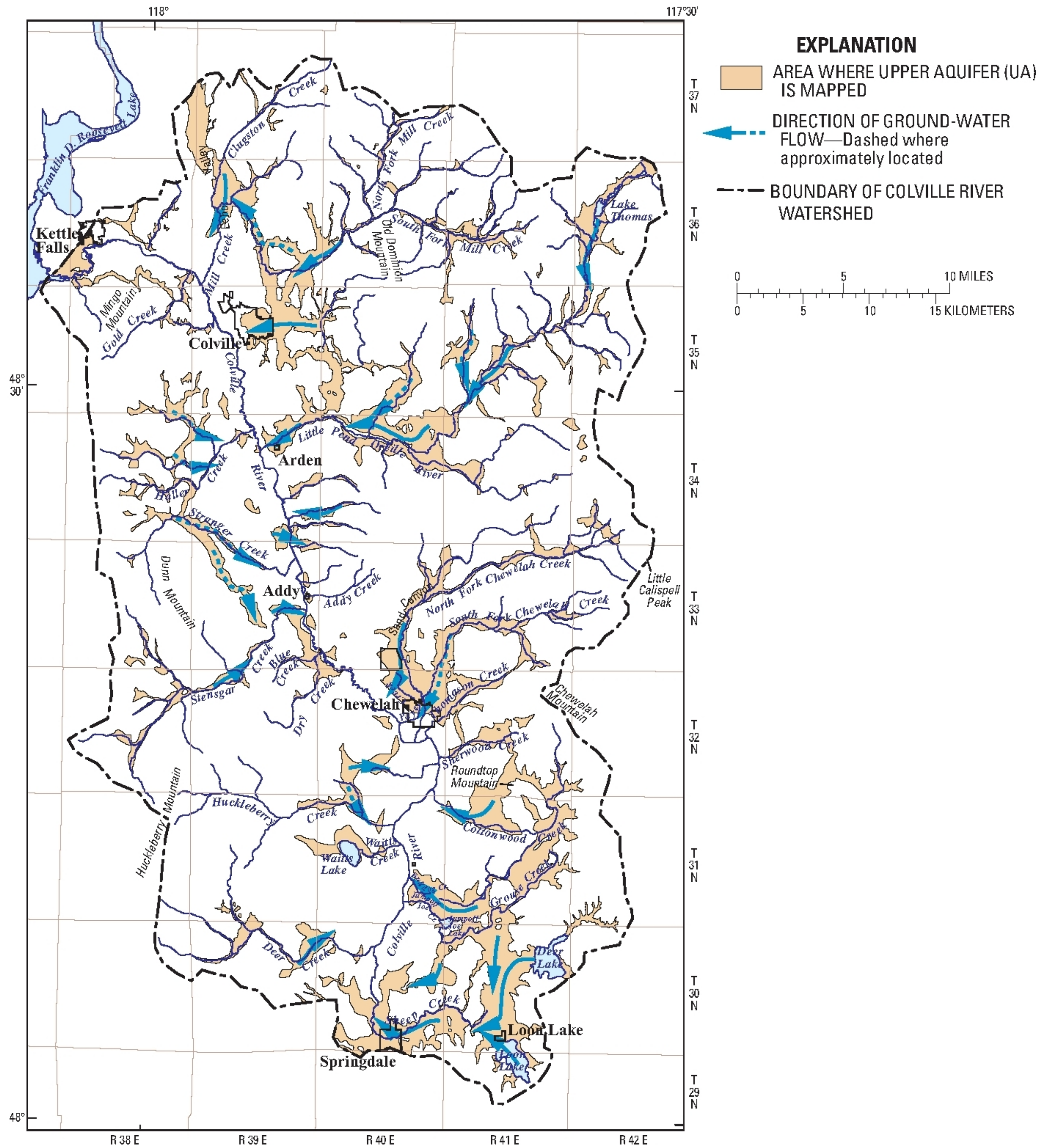

Figure 3: Areal extent and direction of groundwater flow in the Upper outwash aquifer in the Colville River Watershed (from Kahle and others, 2003).

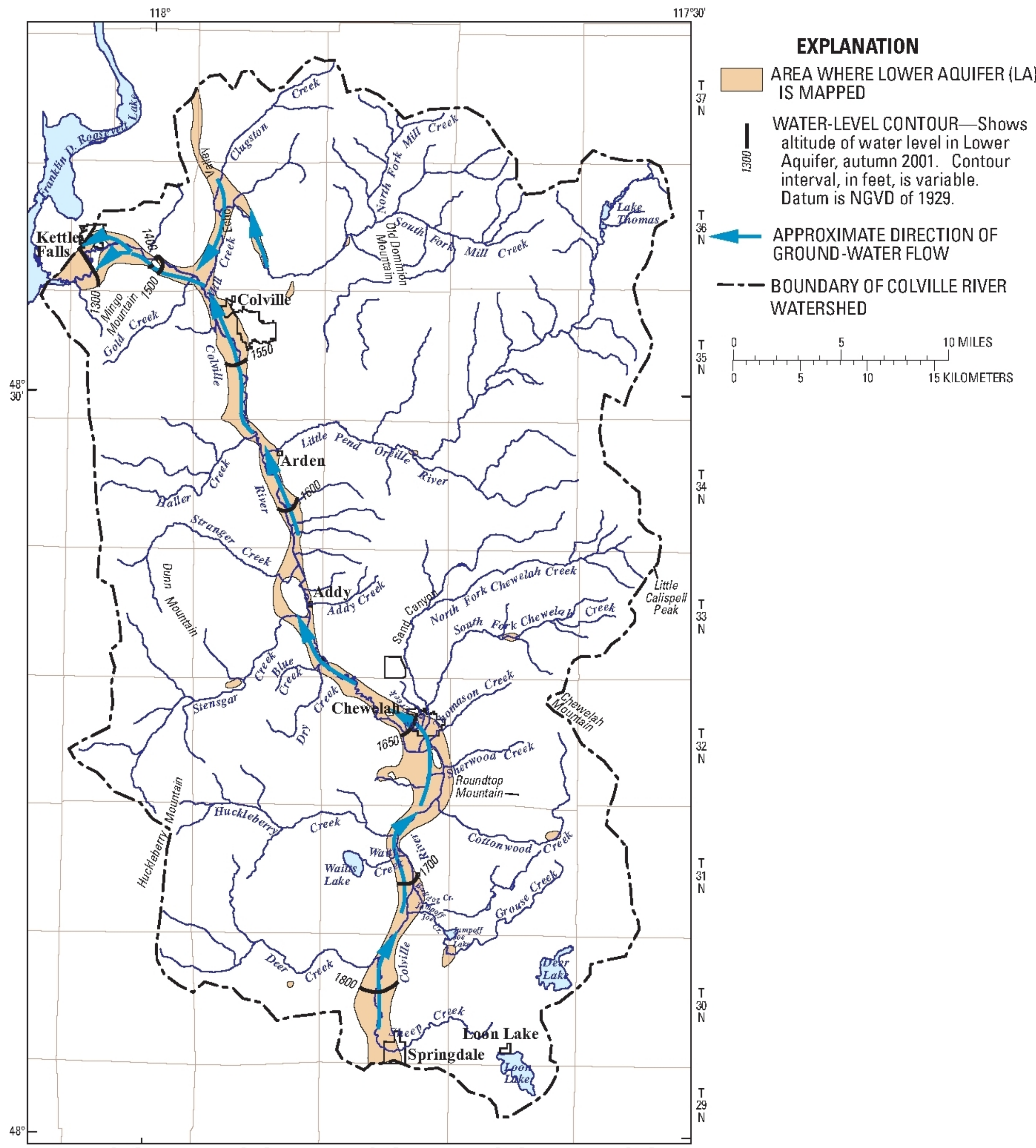

Figure 4: Areal extent and direction of groundwater flow in the Lower (confined) aquifer in the Colville River Watershed (from Kahle and others, 2003).

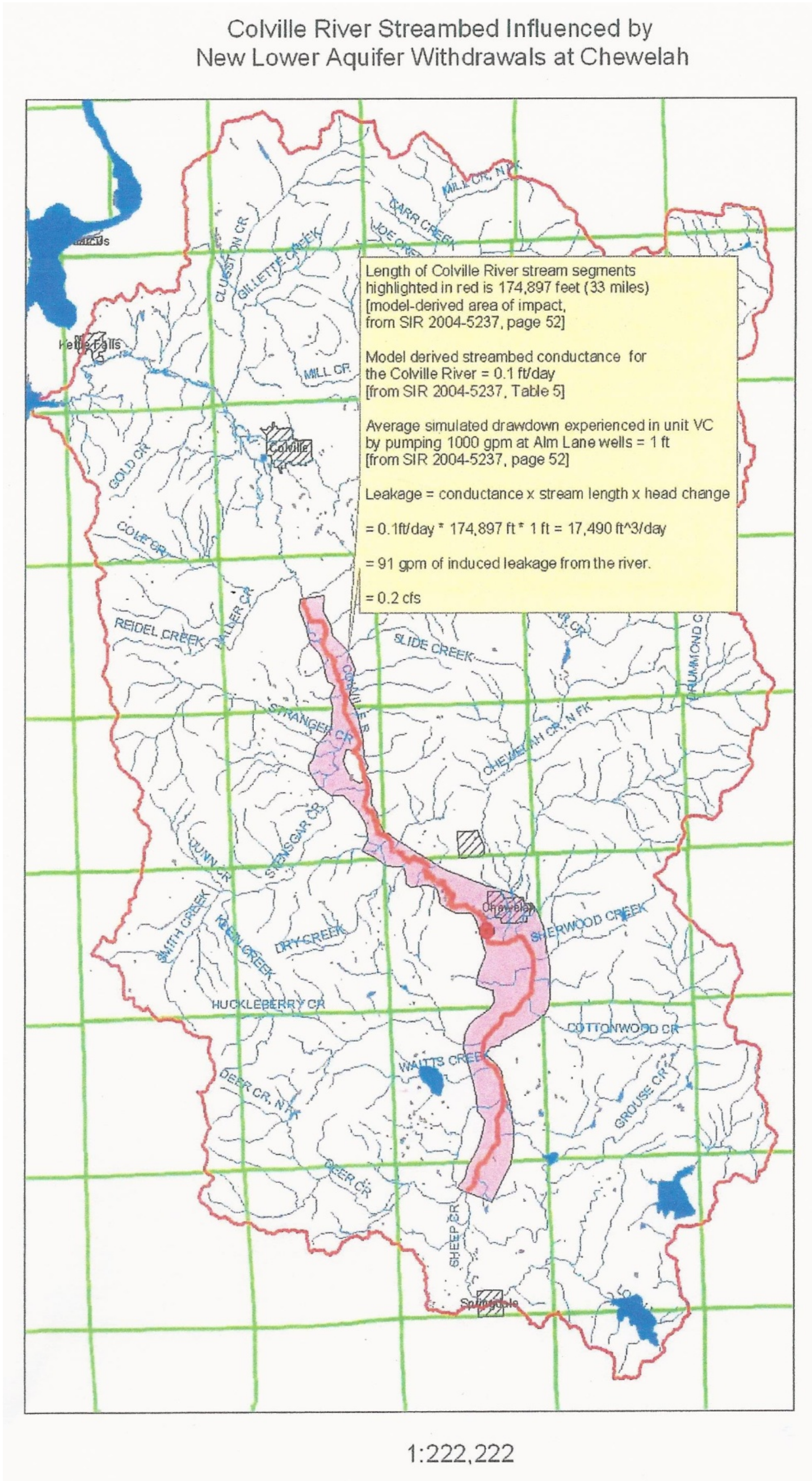

Figure 5: Analytical model of a proposed 1000 gpm withdrawal from lower aquifer near Chewelah, WA and the theoretical hydraulic connection to the Colville River (from Covert, 2015, unpublished data).

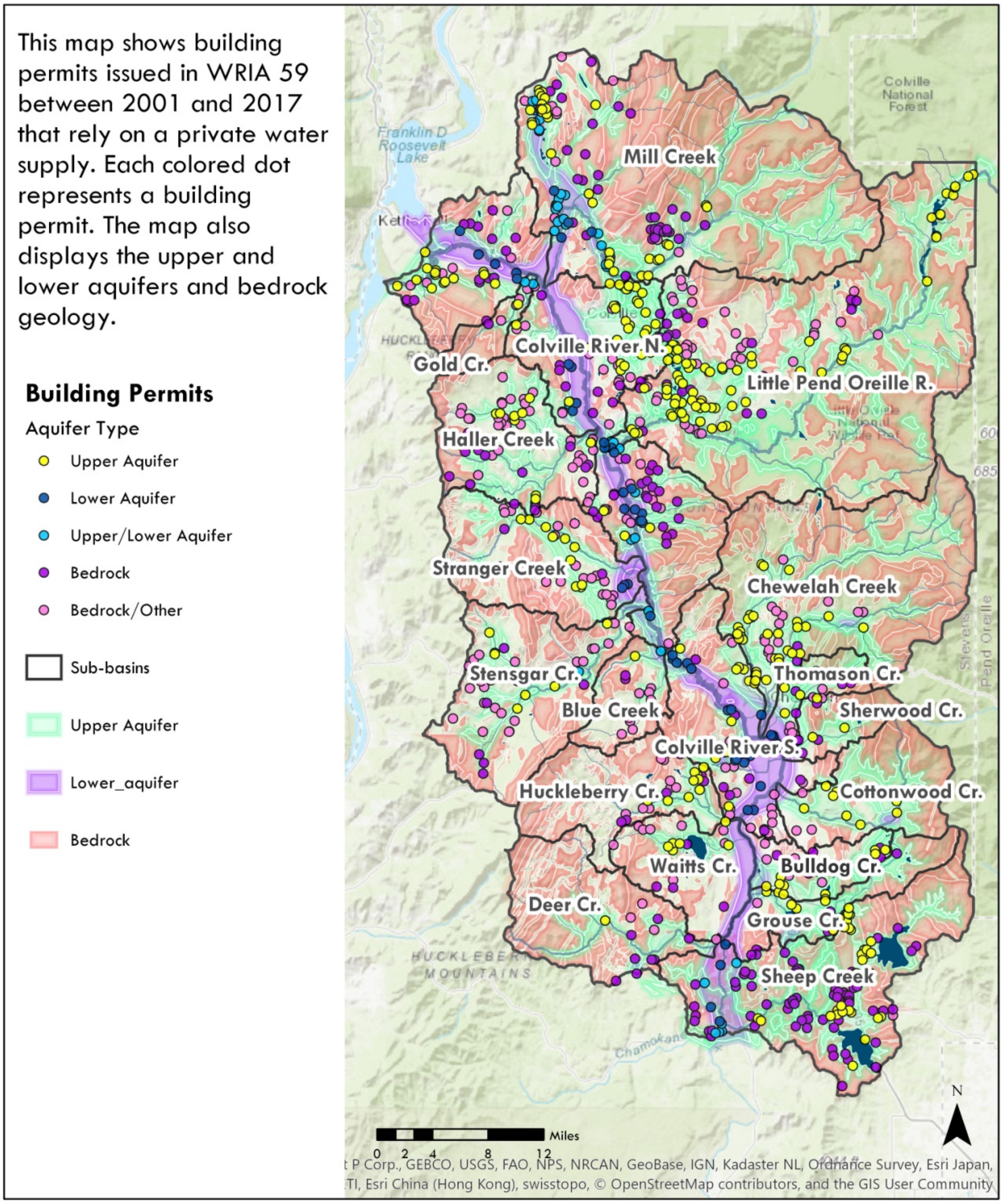

Figure 6: Map showing location of the 950 wells permitted in WRIA 59 by Stevens County Planning, and area which is unlikely to develop due to public ownership, slope, critical area, etc.

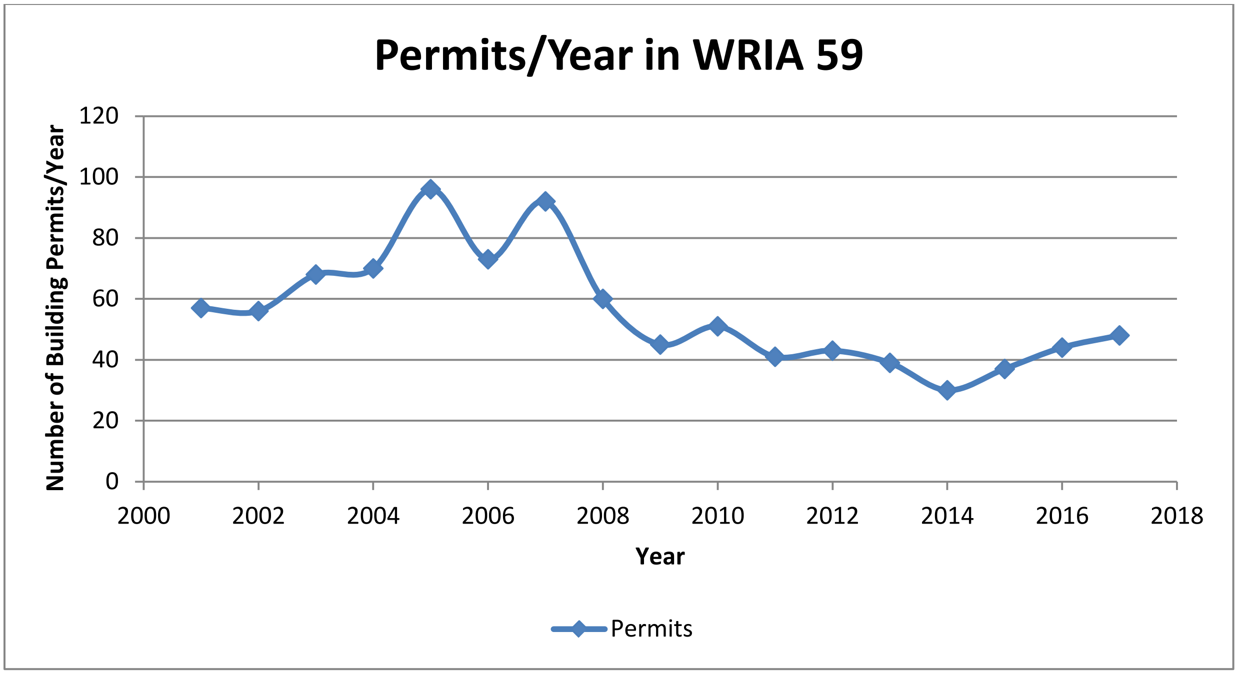

Figure 7: Graphical presentation of the average permits per year for rural WRIA 59.

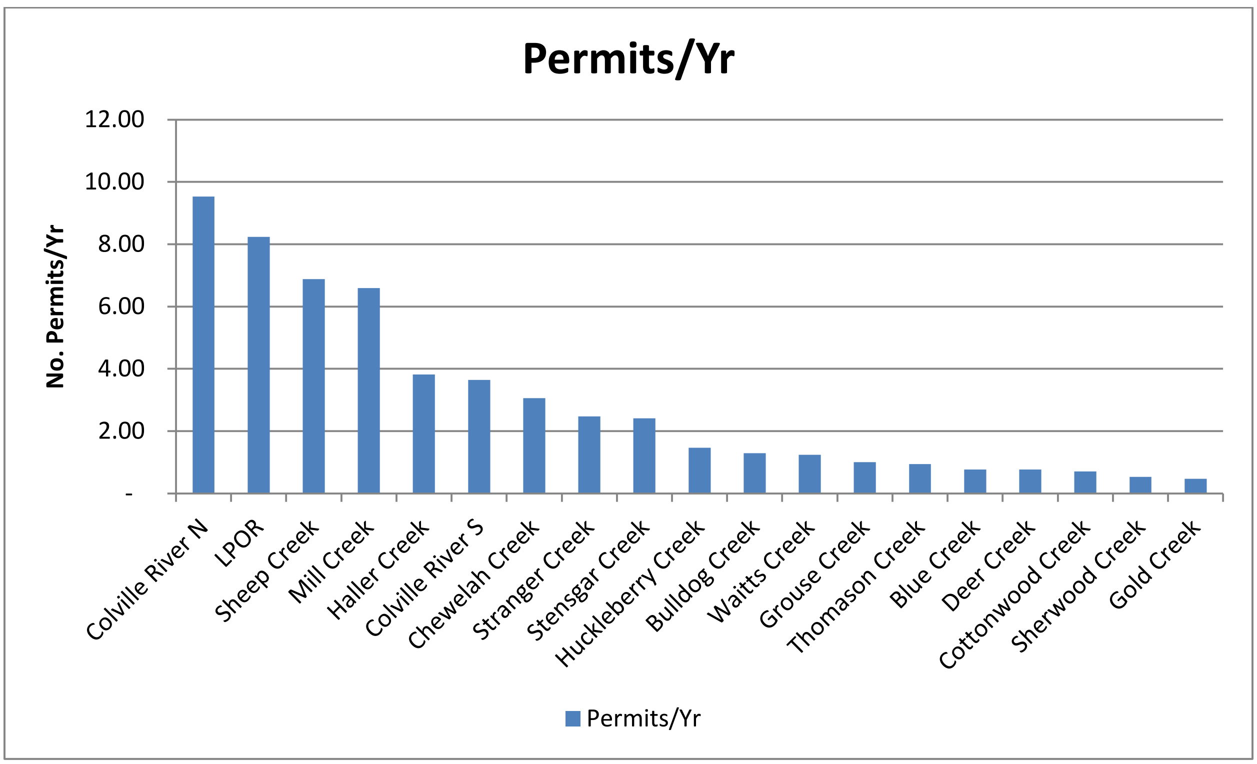

Figure 8: Weighted graph of the historical (2001-2017) permits per year per subbasin.

This map compares the total number of building permits issued in each subbasin. The darker sub-basins had more building permits issued.

Building Permits

Aquifer Type
- Upper Aquifer
- Lower Aquifer
- Upper/Lower Aquifer
- Bedrock
- Bedrock/Other

Total Building Permits
- ≤17
- ≤25
- ≤52
- ≤65
- ≤162

Sub-basin	Building Permits
Colville River N	162
Little Pend Oreille River	140
Sheep Creek	118
Mill Creek	112
Haller Creek	65
Colville River S	62
Chewelah Creek	52
Stranger Creek	42
Stensgar Creek	41
Huckleberry Creek	25
Bulldog Creek	22
Waitts Creek	21
Grouse Creek	17
Thomason Creek	16
Deer Creek	13
Blue Creek	13
Cottonwood Creek	12
Sherwood Creek	9
Gold Creek	8
Grand Total	**950**

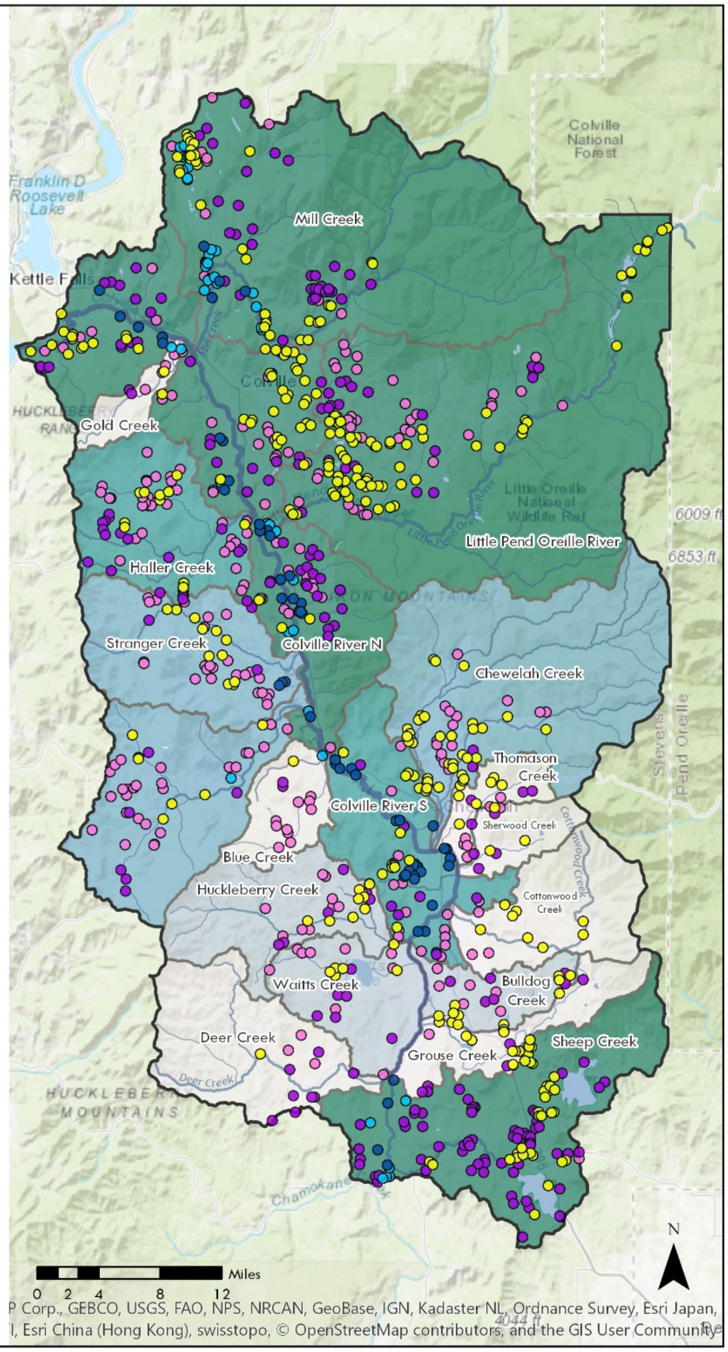

Figure 9: Subbasin Development Pressure Map showing priority basins based on number of wells versus potentially developable subbasins acres.

This map displays lands within WRIA 59 that are classified as unlikely to develop. Seven land cover types within the WRIA were identified as unlikely to develop: flood zones, wetlands, lakes, cities, public utility districts, steep slopes, and publicly owned lands.

Probable Area of Future Development

Unlikely to Develop

Sub-basin	Developable Acres
Colville River N	23,412
Little Pend Oreille River	21,348
Sheep Creek	20,847
Mill Creek	15,056
Stensgar Creek	14,443
Haller Creek	11,430
Colville River S	9,604
Stranger Creek	8,836
Chewelah Creek	8,767
Waitts Creek	7,489
Huckleberry Creek	7,229
Deer Creek	6,630
Cottonwood Creek	5,444
Grouse Creek	5,374
Bulldog Creek	5,171
Blue Creek	4,578
Thomason Creek	1,993
Sherwood Creek	1,385
Gold Creek	939

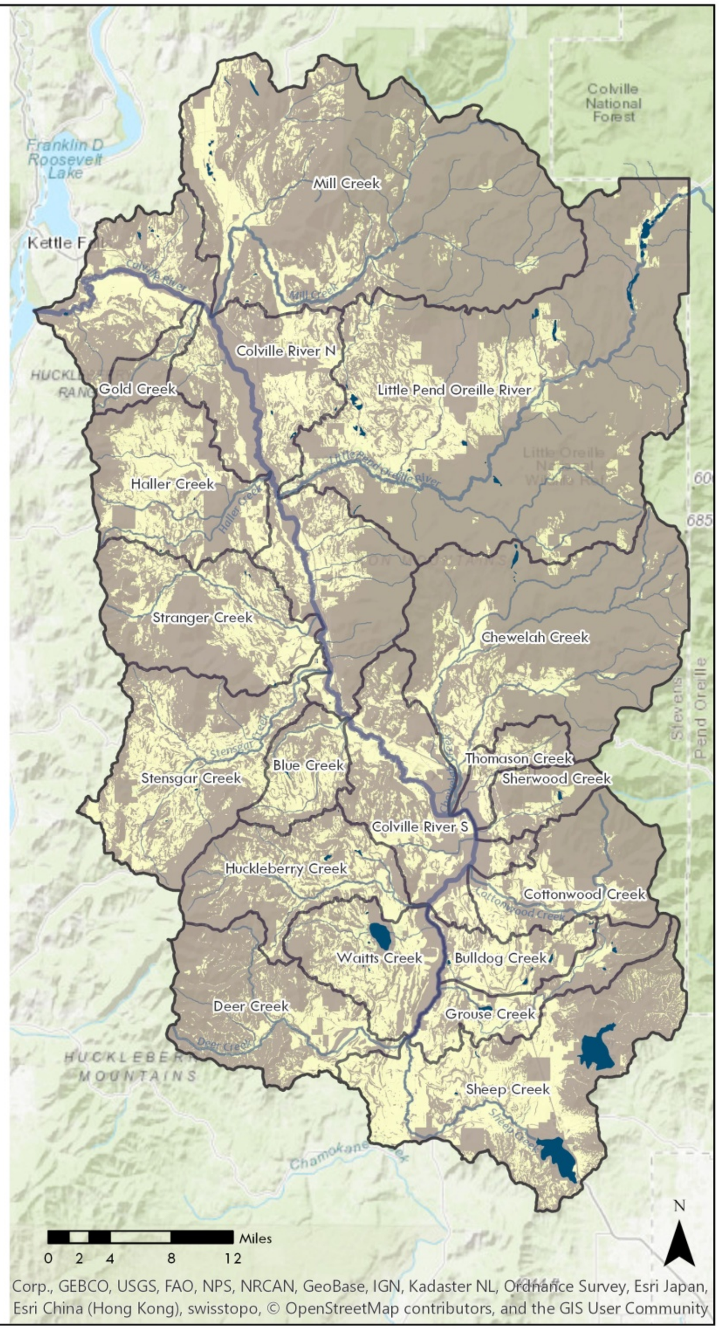

Figure 10: Map showing areas where potential future development may occur based on GIS Analysis of "unlikely to develop criteria". Brown shaded areas are unlikely to develop and cover 72% of basin.

This map compares the number of building permits that intersect with 'Bedrock' and 'Bedrock/Other' layers in each sub-basin. Building permits were included in the count if their centroid fell within the Bedrock or Bedrock/Other layers. Darker purple indicates a higher number of permits.

Building Permits

Aquifer Type

- Bedrock
- Bedrock/Other

Bedrock + Bedrock Other Permits

- ≤9
- ≤17
- ≤33
- ≤63
- ≤83

Categorized using Jenks Natural Breaks Optimization

Sub-basin	Bedrock/Bedrock Other Permits
Colville River N	83
Sheep Creek	75
Little Pend Oreille River	63
Haller Creek	54
Mill Creek	44
Stensgar Creek	33
Stranger Creek	28
Colville River S	23
Chewelah Creek	17
Waitts Creek	15
Huckleberry Creek	15
Blue Creek	12
Deer Creek	12
Bulldog Creek	12
Thomason Creek	9
Sherwood Creek	6
Gold Creek	5
Grouse Creek	5
Cottonwood Creek	4

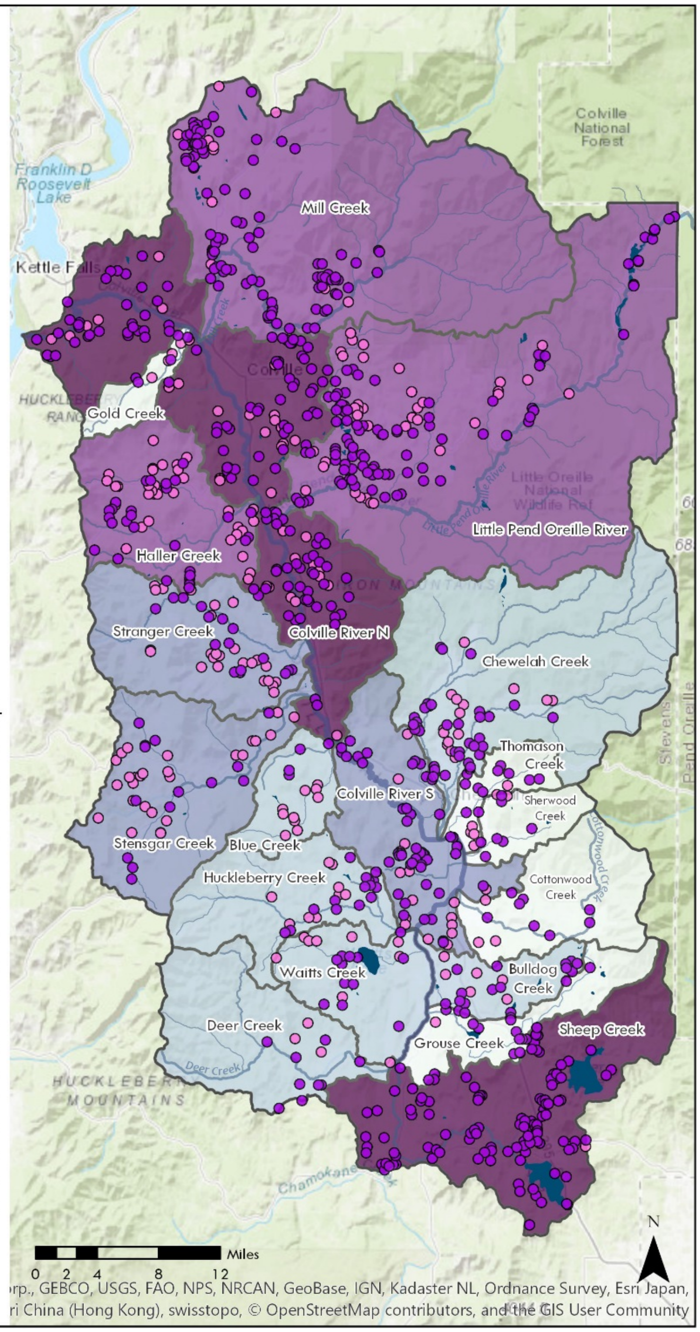

Figure 11: Map showing development pressure by subbasin based solely on Bedrock wells.

This map compares the amount of building permits that intersect with the Upper Aquifer in each sub-basin. Building permits were included in the count if their centroid fell within the upper aquifer layer. Darker blues indicate higher numbers of upper aquifer permits (yellow dots).

Building Permits

Aquifer Type

- Upper Aquifer
- Upper/Lower Aquifer

Upper Aquifer Permits

- ≤3
- ≤8
- ≤13
- ≤48
- ≤73

**Calculated using Jenks Natural Breaks Optimization*

Sub-basin	Upper Aquifer Building Permits
Little Pend Oreille River	73
Colville River N	48
Chewelah Creek	35
Mill Creek	34
Sheep Creek	34
Colville River S	13
Stranger Creek	11
Grouse Creek	11
Haller Creek	11
Bulldog Creek	10
Huckleberry Creek	10
Cottonwood Creek	8
Stensgar Creek	7
Thomason Creek	7
Waitts Creek	6
Sherwood Creek	3
Deer Creek	1
Blue Creek	1
Gold Creek	1
Grand Total	324

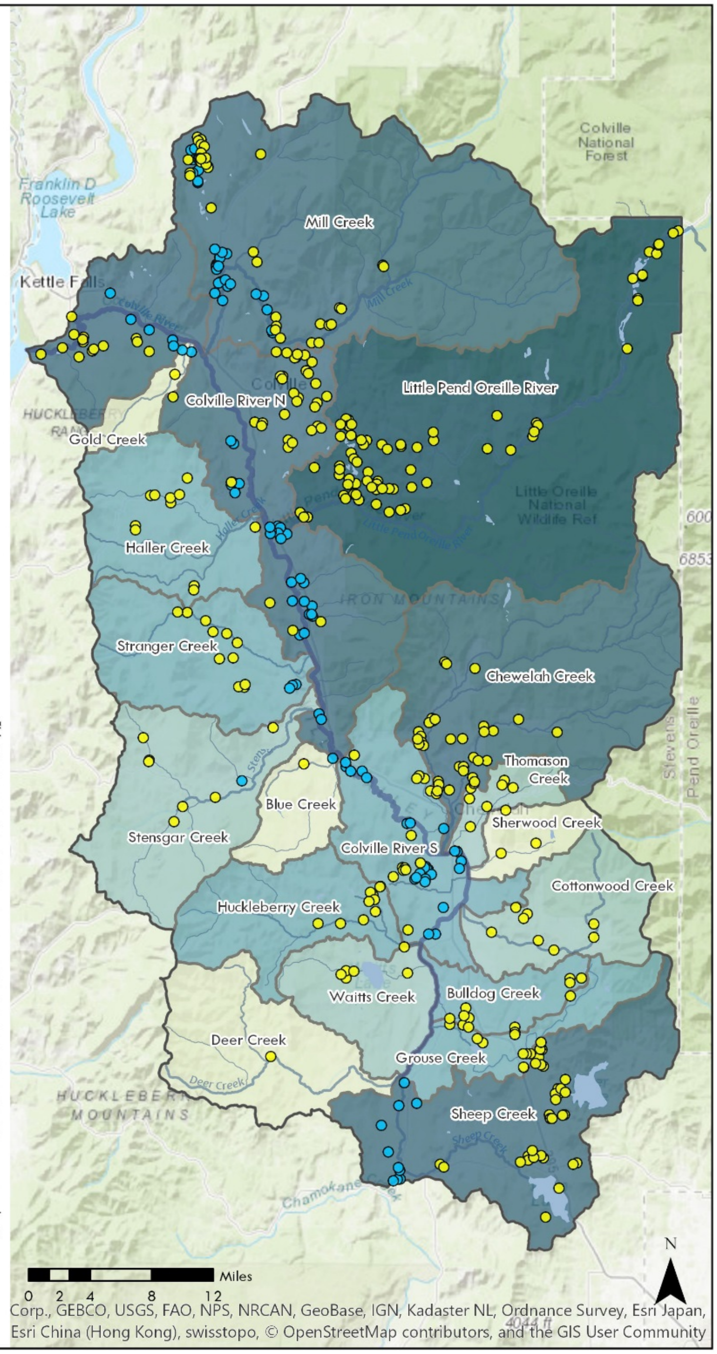

Figure 12: Map showing development pressure by subbasin based on Unconsolidated & Upper/Lower Aquifer wells.

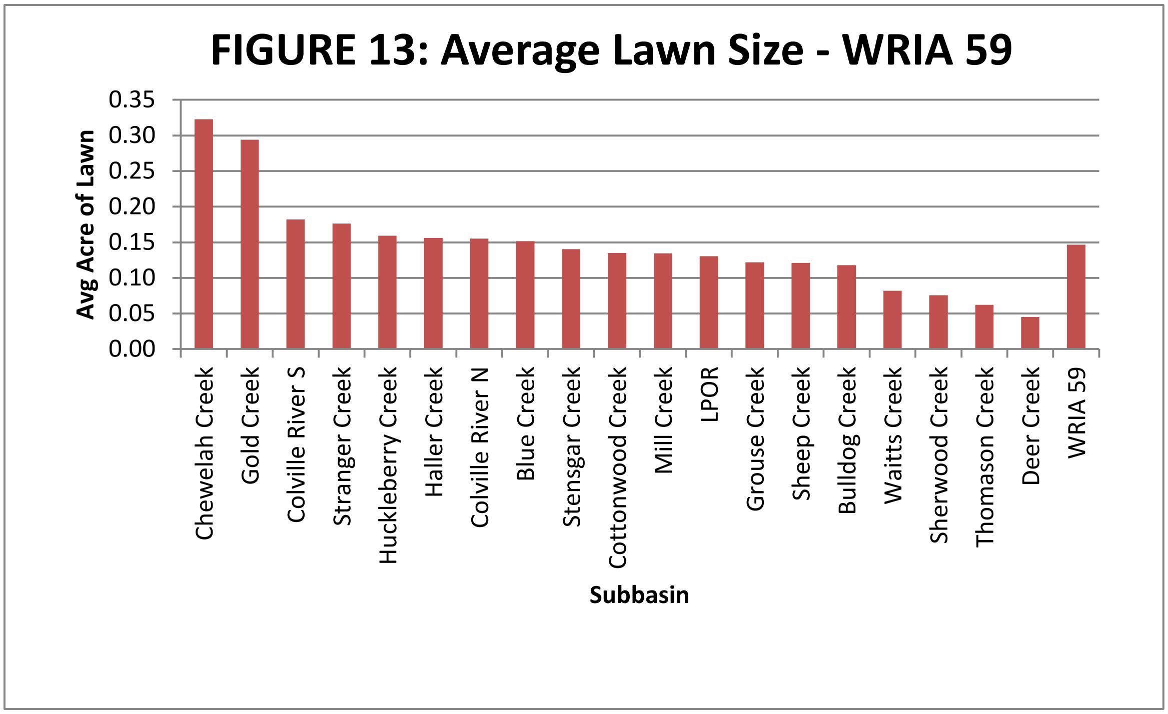
FIGURE 13: Average Lawn Size - WRIA 59
Avg Acre of Lawn
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Chewelah Creek
Gold Creek
Colville River S
Stranger Creek
Huckleberry Creek
Haller Creek
Colville River N
Blue Creek
Stensgar Creek
Cottonwood Creek
Mill Creek
LPOR
Grouse Creek
Sheep Creek
Bulldog Creek
Waitts Creek
Sherwood Creek
Thomason Creek
Deer Creek
WRIA 59
Subbasin

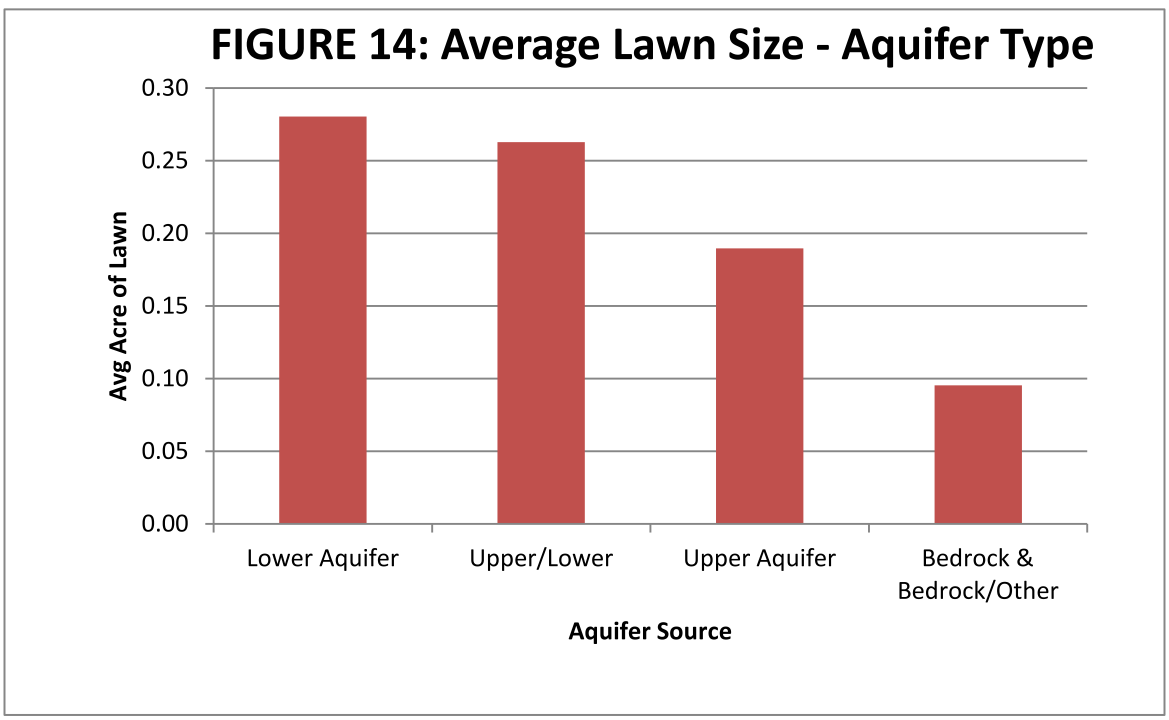
FIGURE 14: Average Lawn Size - Aquifer Type
Avg Acre of Lawn
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Lower Aquifer
Upper/Lower
Upper Aquifer
Bedrock & Bedrock/Other
Aquifer Source

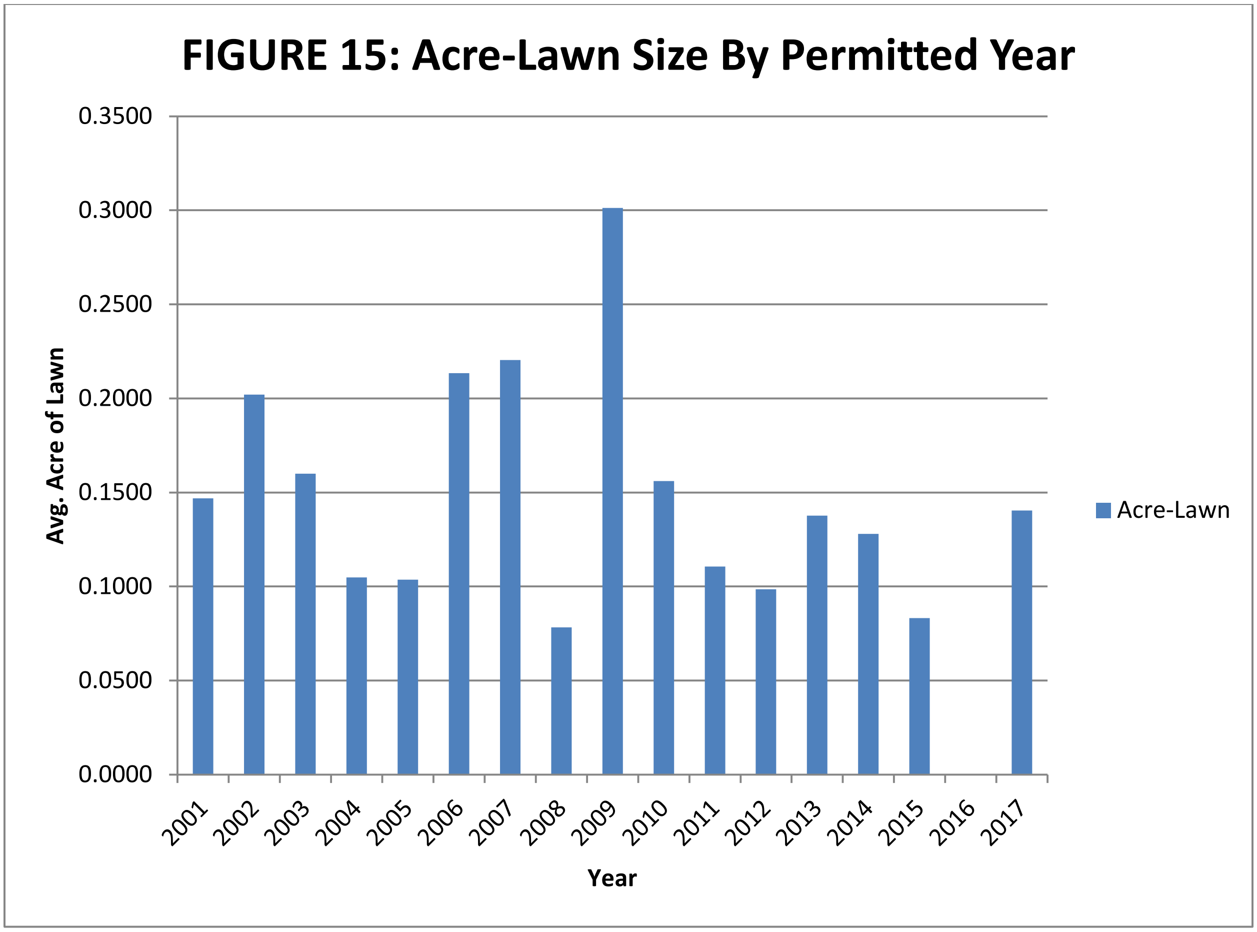
FIGURE 15: Acre-Lawn Size By Permitted Year
0.3500
0.3000
0.2500
0.2000
0.1500
0.1000
0.0500
0.0000
Avg. Acre of Lawn
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year
Acre-Lawn

This map compares estimated future consumptive use by sub-basin. Darker green indicates a higher consumptive use estimate for 2018 -2038.

Total CU Needed to 2038

- ≤5.40 AF
- ≤12.00 AF
- ≤34.00 AF
- ≤56.20 AF
- ≤76.60 AF

*Categorized using Jenks Natural Breaks Optimization

- Developable Lands

Sub-basin	Total CU Needed to 2038
Colville River N	76.6 AF
Little Pend Oreille River	56.2 AF
Chewelah Creek	50.0 AF
Mill Creek	46.2 AF
Sheep Creek	43.6 AF
Colville River S	34.0 AF
Haller Creek	30.8 AF
Stranger Creek	22.4 AF
Stensgar Creek	17.6 AF
Huckleberry Creek	12.0 AF
Bulldog Creek	8.0 AF
Gold Creek	7.0 AF
Grouse Creek	6.4 AF
Blue Creek	6.0 AF
Waitts Creek	5.4 AF
Cottonwood Creek	5.0 AF
Thomason Creek	3.4 AF
Sherwood Creek	2.2 AF
Deer Creek	2.0 AF
Grand Total	**434.8 AF**

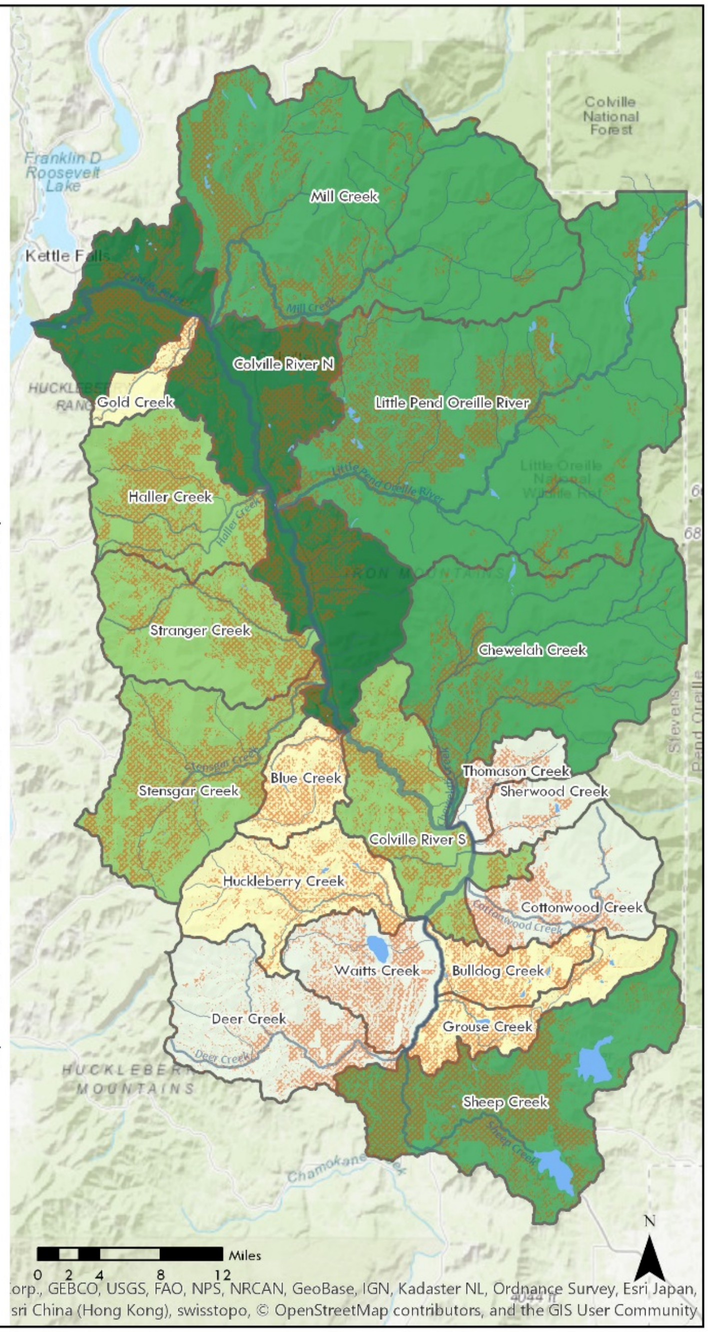

Figure 16: Map showing development pressure by subbasin based on Consumptive Use Estimates.

ATTACHMENT A

Consumptive Use Estimates per Subbasin

AVERAGE LAWN IN WRIA 59 USING AVERAGE WIG OF 26.025

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement (feet)	Total Irrigation Requirement (feet)	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.1468	Lawn/garden	26.025	0.32	0.45	70	10	0.36	0.09

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
55.8	0.93	20.30	21.23	424.66

AVERAGE LAWN IN BLUE CREEK

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement (feet)	Total Irrigation Requirement (feet)	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.1515	Lawn/garden	26.025	0.33	0.47	70	10	0.38	0.09

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
0.76	0.01	0.29	0.30	5.96

AVERAGE LAWN IN BULLDOG CREEK

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement	Total Irrigation Requirement	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.118	Lawn/garden	26.025	0.26	0.37	70	10	0.29	0.07

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
1.29	0.02	0.38	0.40	7.98

AVERAGE LAWN IN CHEWELAH CREEK

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement	Total Irrigation Requirement	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.3229	Lawn/garden	26.025	0.70	1.00	70	10	0.80	0.20

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
3.06	0.05	2.45	2.50	50.00

AVERAGE LAWN IN COLVILLE RIVER NORTH

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement	Total Irrigation Requirement	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.1554	Lawn/garden	26.025	0.34	0.48	70	10	0.39	0.10

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
9.53	0.16	3.67	3.83	76.59

AVERAGE LAWN IN COLVILLE RIVER SOUTH

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement	Total Irrigation Requirement	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.182	Lawn/garden	26.025	0.39	0.56	70	10	0.45	0.11

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
3.65	0.06	1.65	1.71	34.15

AVERAGE LAWN IN COTTONWOOD CREEK

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement	Total Irrigation Requirement	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.135	Lawn/garden	26.025	0.29	0.42	70	10	0.33	0.08

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
0.71	0.01	0.24	0.25	4.99

AVERAGE LAWN IN DEERCREEK

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement (feet)	Total Irrigation Requirement (feet)	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.0453	Lawn/garden	26.025	0.10	0.14	70	10	0.11	0.03

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
0.76	0.01	0.09	0.10	1.96

AVERAGE LAWN IN GOLD CREEK

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement	Total Irrigation Requirement	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.2941	Lawn/garden	26.025	0.64	0.91	70	10	0.73	0.18

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
0.47	0.01	0.34	0.35	7.01

AVERAGE LAWN IN GROUSE CREEK

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement	Total Irrigation Requirement	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.122	Lawn/garden	26.025	0.26	0.38	70	10	0.30	0.08

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
1	0.02	0.30	0.32	6.38

AVERAGE LAWN IN HALLER CREEK

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement	Total Irrigation Requirement	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.1563	Lawn/garden	26.025	0.34	0.48	70	10	0.39	0.10

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
3.82	0.06	1.48	1.54	30.87

AVERAGE LAWN IN HUCKLEBERRY CREEK

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement	Total Irrigation Requirement	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.1594	Lawn/garden	26.025	0.35	0.49	70	10	0.40	0.10

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
1.47	0.02	0.58	0.61	12.11

AVERAGE LAWN IN LITTLE PEND OREILLE RIVER

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement	Total Irrigation Requirement	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.1307	Lawn/garden	26.025	0.28	0.40	70	10	0.32	0.08

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
8.24	0.14	2.67	2.81	56.13

AVERAGE LAWN IN MILL CREEK

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement	Total Irrigation Requirement	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.1347	Lawn/garden	26.025	0.29	0.42	70	10	0.33	0.08

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
6.59	0.11	2.20	2.31	46.20

AVERAGE LAWN IN SHEEP CREEK

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement	Total Irrigation Requirement	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.1211	Lawn/garden	26.025	0.26	0.38	70	10	0.30	0.08

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
6.88	0.11	2.07	2.18	43.59

AVERAGE LAWN IN SHEERWOOD CREEK

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement (feet)	Total Irrigation Requirement (feet)	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.0759	Lawn/garden	26.025	0.16	0.24	70	10	0.19	0.05

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
0.53	0.01	0.10	0.11	2.17

AVERAGE LAWN IN STENSGAR CREEK

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement	Total Irrigation Requirement	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.1403	Lawn/garden	26.025	0.30	0.43	70	10	0.35	0.09

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
2.41	0.04	0.84	0.88	17.56

AVERAGE LAWN IN STRANGER CREEK

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement	Total Irrigation Requirement	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.1765	Lawn/garden	26.025	0.38	0.55	70	10	0.44	0.11

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
2.47	0.04	1.08	1.12	22.43

AVERAGE LAWN IN THOMASON CREEK

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement	Total Irrigation Requirement	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.0624	Lawn/garden	26.025	**0.14**	**0.19**	70	10	**0.15**	**0.04**

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
0.94	0.02	0.15	0.16	3.22

AVERAGE LAWN IN WAITTS CREEK

Method	Number of irrigated acres	Crop Type	Crop requirement in inches (WIG)	Crop Irrigation Requirement	Total Irrigation Requirement	App. Efficiency (%)	% Total Evaporated	Total Consumed (af)	Return Flow (af)
Spray heads w/hose feed	0.0818	Lawn/garden	26.025	**0.18**	**0.25**	70	10	**0.20**	**0.05**

PROJECTED HOMES (per year)	Cu @ 6 gpd/person; 2.48 people/home (in Acre-Ft)	Cu for Lawns (in Acre-Ft)	Total Cu/Yr for Homes (in Acre-Ft)	Needed Cu in 2038 (20 yrs)
1.24	0.02	0.25	0.27	5.44

APPENDIX B

WRIA 59 MANAGEMENT PLAN ADDENDUM

PROPOSED PROJECTS

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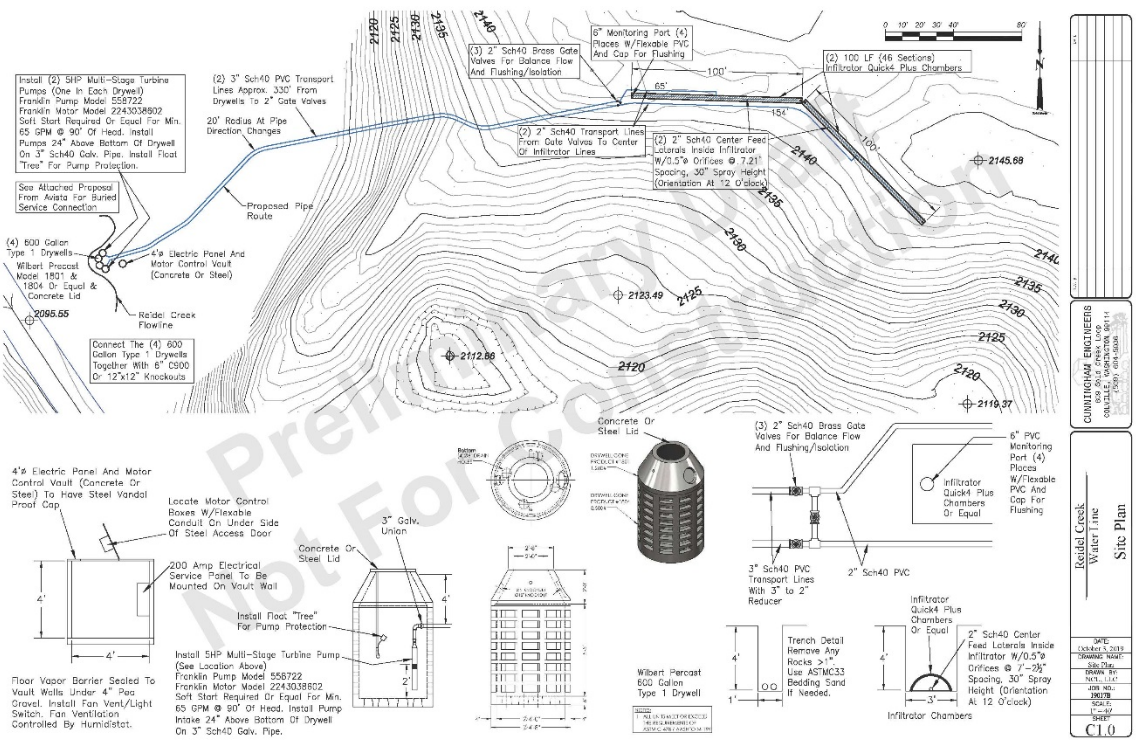
APPENDIX B

WRIA 59 Watershed Management Plan Addendum

Proposed Projects

November 14, 2019



CONFLUENCE LAW

WR GROUP

Contents

Overview

This report memorializes the projects identified as high and medium priority by the WRIA 59 planning unit for offsetting new permit-exempt domestic groundwater uses in accordance with RCW 90.94.020. A more specific description of the process the planning unit conducted to develop this list and prioritization is included in the WRIA 59 Watershed Plan Addendum.

This report is organized alphabetical by subbasin in the Colville River Watershed, with each project itemized by project number. The estimated amount of consumptive use of future permit-exempt water uses by subbasin is summarized at the beginning of each subbasin section. For each project, this report identifies the WRIA 59 planning unit's designation, type of project, location, summary, permitting, reference documents and estimated cost. Some additional information compiled in preliminary feasibility work is also included, where applicable.

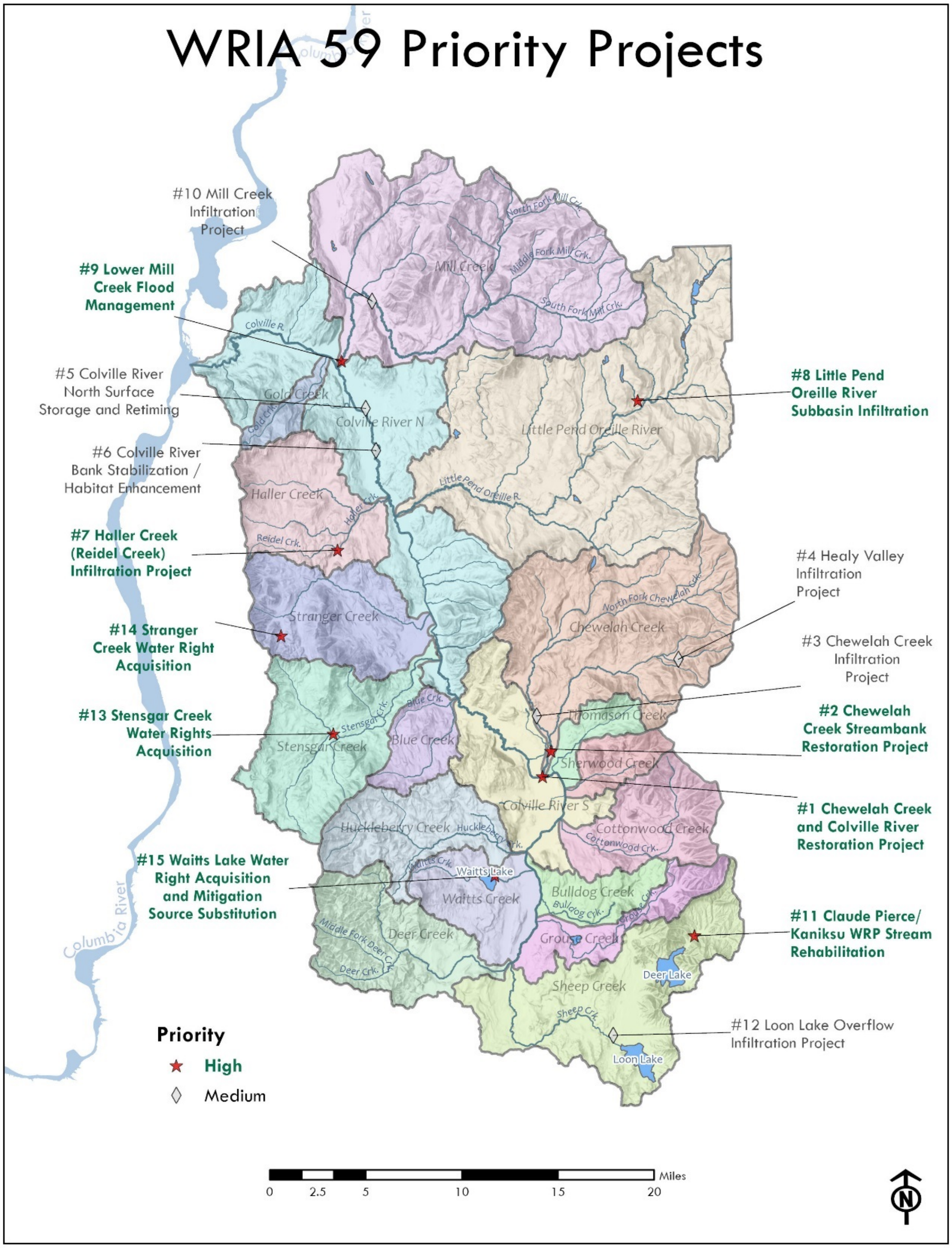
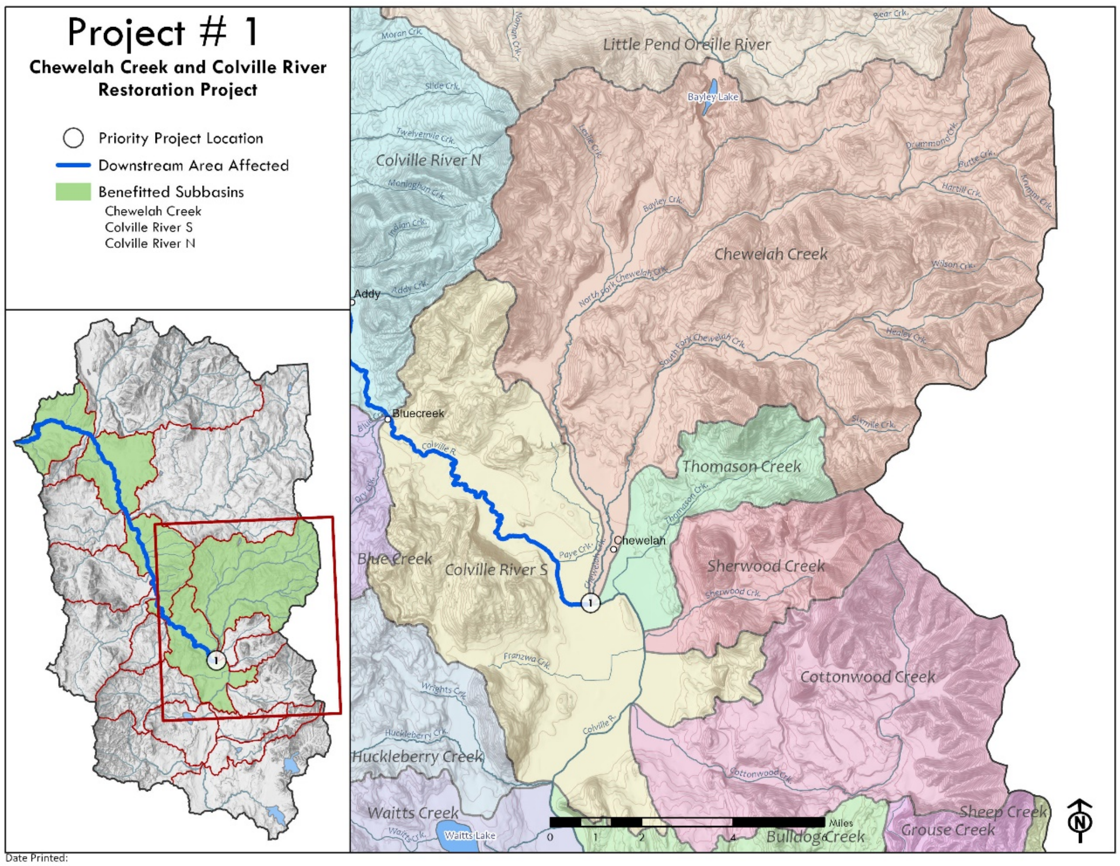


Figure 1: WRIA 59 Map showing location of High and Medium Priority projects identified by the WRIA 59 Planning Unit for the RCW 90.94 Assessment.

Chewelah Creek Subbasin

Demand: 55 AF projected as consumptive use need by 2040

Project 1: Chewelah Creek and Colville River Restoration Project



Designation

High

Type of Project

Developing Natural and Constructed Infrastructure

Location of Project

Colville River

Summary

The project is located on the lower reach of Chewelah Creek and the Colville River near the confluence. The goal of the project is to restore habitat function in the lower reach of

Chewelah Creek and the Colville River between State Highway 395 and Alm Lane. The instream and riparian habitat of the project area is degraded by channelization and sediment loading. The current alignment of Chewelah Creek flows into the Colville River at an approximately 90 degree angle causing erosion of the opposite bank and flooding of adjacent property.

The project will address persistent challenges related to the heavily modified (dredged and straightened) segment of the Colville River. The project will add a high-flow channel to Chewelah Creek and modify the floodways of Chewelah Creek and the Colville River. The project will improve instream and riparian habitat and improve the resilience of the channel/floodplain system. Potential site-specific stream enhancement include: riparian planting, bank stabilization, creation of a braided channel, channel terracing, re-meandering of the channel and introduction of large woody debris.

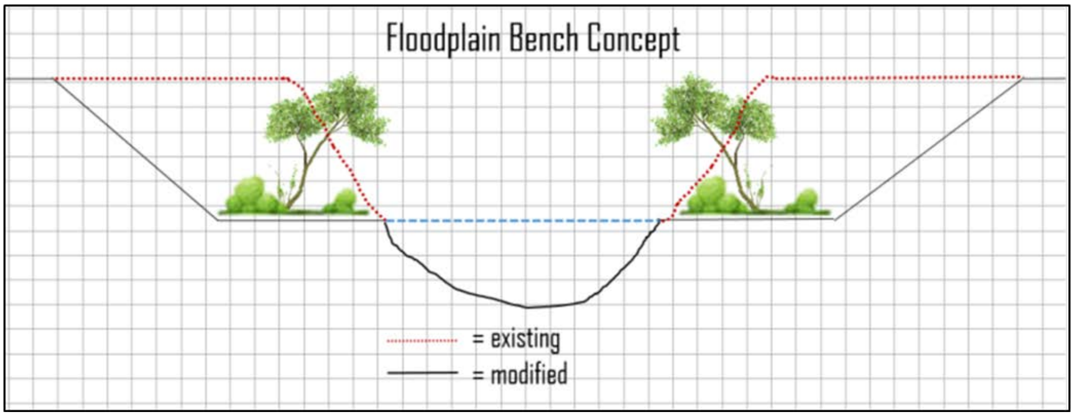
This is a stakeholder-driven project that would balance various land management interests while providing instream benefits. If successful, the project could serve as a model for future channel improvement efforts in the subbasin. The project has been planned in concept by landowners, agencies, and other stakeholders. Additional feasibility analysis and design work is needed to move this project toward implementation.

In July 2019, the Department of Ecology issued a grant which, in part, funded feasibility work to analyze the potential channel realignment of Chewelah Creek and Colville River. The feasibilty funding supported the following:

- Hydraulic modeling of the lower ½ mile of Chewelah Creek;
- Development of floodplain and cross section drawings;

- A drone survey to develop a two-foot contour map of 25 acres of adjacent property;
- Conduct a wetland delineation at the site;
- CADD drawings of the site; and
- Proposed engineering drawings and cost estimates, all of which were incorporated into the Addendum.

Below is a drawing of a proposed concept to reconnect the Colville River to its floodplain.



Below is an aerial photograph depicting the location of stagnant and stranded floodwater following a high-water event.

The project proposes to:

- Construct a new floodway channel on Chewelah Creek to reduce flood volume. The new channel would allow full summer flow to remain in the existing channel.
- Construct a floodway weir to direct sediment into a side channel and reduce aggradation of the main channel during flood conditions.
- Use streambarbs along the main channel to dissipate flow energy, prevent erosion and maintain alignment between the stream channel and the floodway weir.
- Improve wetland function through improvement of plant species diversity and composition.
- Widen floodways for Chewelah Creek and the Colville River. Actual floodway dimensions and design will vary depending on landowner preferences.

The Summary Technical Memorandum is attached hereto as Appendix D.

There may be temporary impacts to water quality during construction. There may also be some property that is currently used for agricultural purposes that may converted to riparian habitat. The feasibility study indicates that the project will assist in reducing the severity and duration of seasonal flooding, reduce mass wasting and other erosion and improve instream and riparian habitat.

Need for Feasibility Study: Prefeasibility conducted in late summer 2019. The Summary Technical Memorandum is referenced below and attached as Appendix C. Additional work is needed to coordinate with property owners and agencies to develop a final design plan.

Permitting Need

Hydraulic Permit from Washington Department of Ecology under Chapter 77.55 RCW; compliance with Clean Water Act permitting requirements depending on final design plan; County Critical Areas Ordinance and Shoreline Management Act permitting.

Reference Information

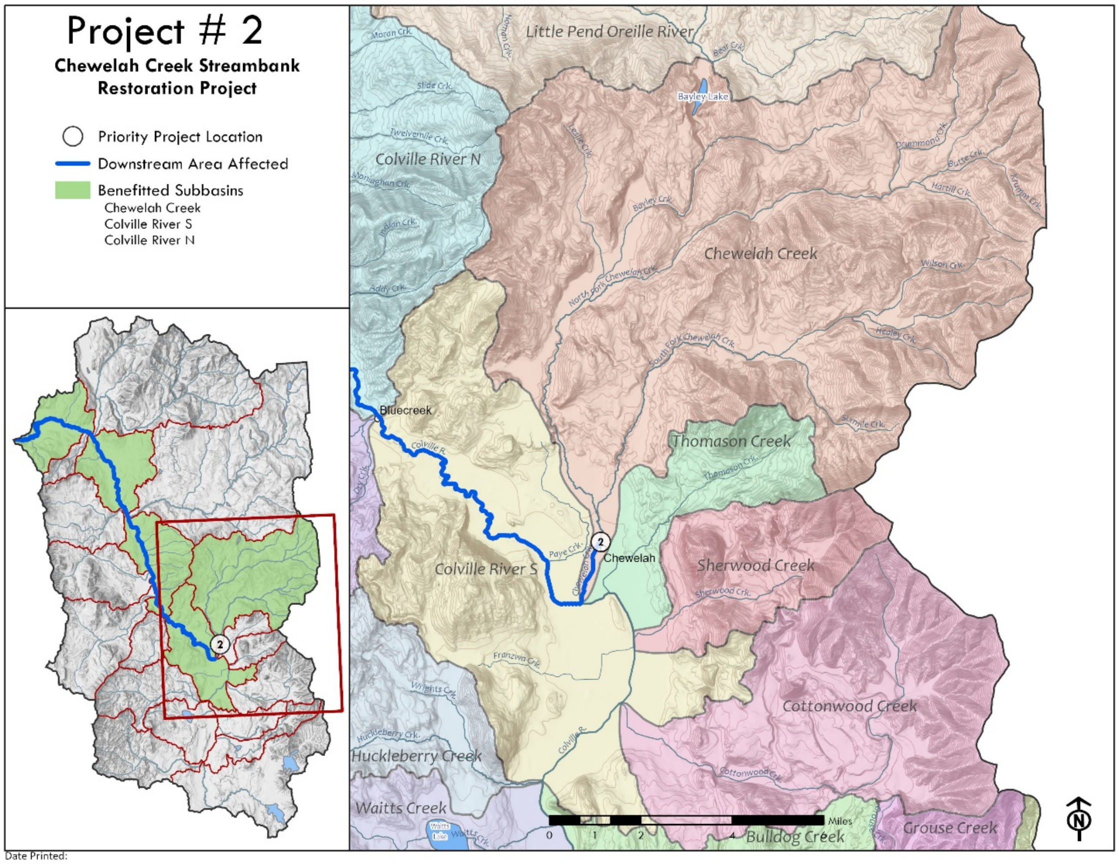
Stevens County, Voluntary Stewardship Program, Colville River Restoration and Channel Improvement Project.

WNR Group, Inc., Technical Memorandum, Technical Memorandum on Chewelah Creek/Colville River Restoration Project Feasibility (October 31, 2019), enclosed with the Addendum to the Watershed Plan as Appendix D.

Cost

See Cunningham Engineering (proposed Sept. 30, 2019) in Appendix D.

Project 2: Chewelah Creek Streambank Restoration Project



Designation

High

Type of Project

Developing Natural and Constructed Infrastructure

Location of Project

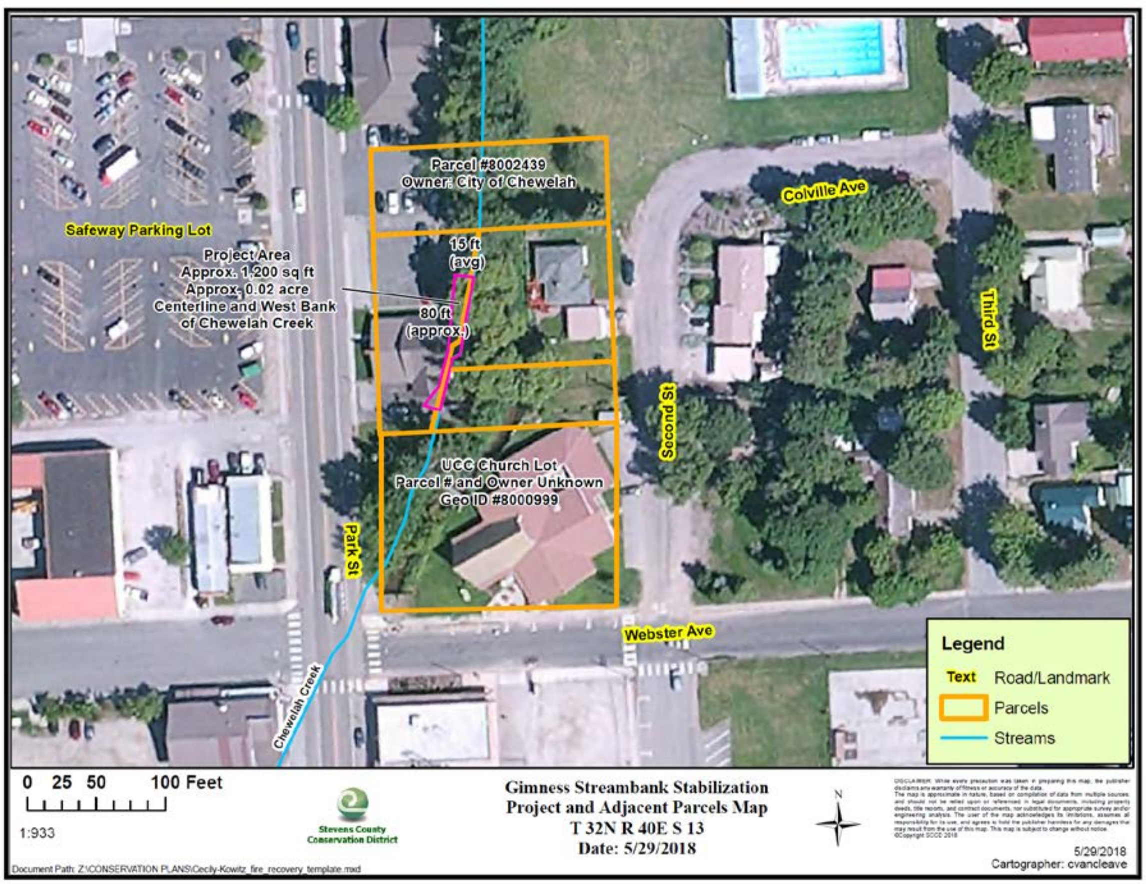
Chewelah Creek

Summary

The Stevens County Conservation District (SCCD) proposes a project to provide protection from accelerated bank erosion to existing structures while allowing natural processes to occur within the stream corridor to the greatest extent possible. The project area is on Chewelah Creek in the City of Chewelah. The riparian area through the City has been degraded in parts through hardening of the riparian area. SCCD proposes to place large woody debris, large rocks and other natural and artificial materials to enhance instream habitat, stabilize the streambank, and restore the bank so that it can withstand future erosive flows in Chewelah Creek. The project will utilize bioengineering techniques in tandem with structure protection constructed from natural elements. Furthermore, the project will remove noxious weeds and dead trees from the project area and utilize vegetative cuttings and native vegetation along Chewelah Creek. The completed project will reduce the sediment load continuing downstream, aiding to the lessoning of sediment accumulation in the Colville River mainstem.

Additionally, the project may be used to show other landowners along Chewelah Creek opportunities to stabilize banks other than dumping concrete into the stream. Depending on the timing of the project and other issues, SCCD may involve Jenkins High School students in replanting efforts.

SCCD has a completed engineering report and permitting, referenced below and attached hereto. Additional funding is needed to implement the project.



Need for Feasibility Study: No.

Permitting Need

The project has completed engineering, SEPA review, HPA approval and obtained an opinion letter from the U.S. Army Corps Engineers for coverage under Clean Water Act Nationwide Permits.

Reference Information

Chewelah Cr Streambank Restoration, Engineering Report from Wayne Cornwall, P.E. (June 28, 2016), enclosed as Attachment 1

City of Chewelah, Determination of Non-Significance (DNS), SCUP-01-2018 – SSDE-01-2018 (July 5, 2018), enclosed as Attachment 2

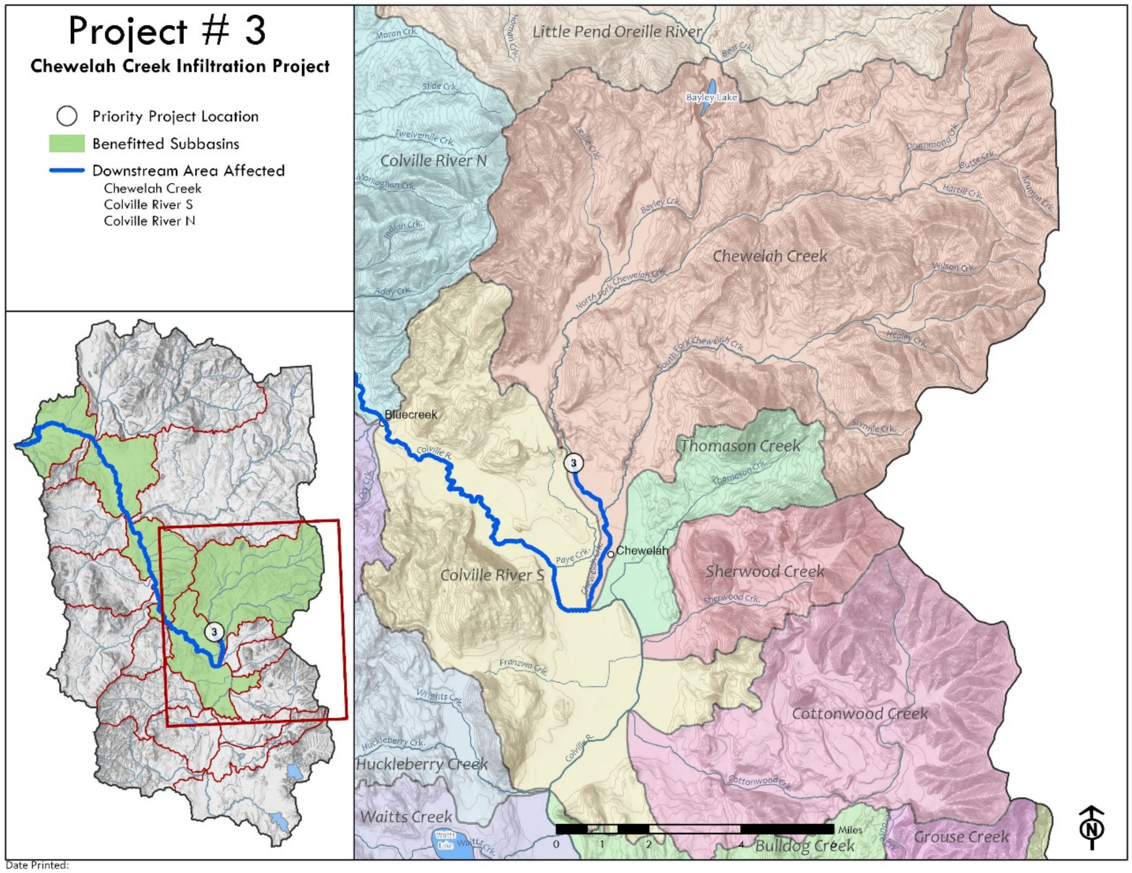
Grant Application No. SETHA-2019-StCoCD-00008, Stevens County Conservation District, Chewelah Creek Streambank Restoration (March 28, 2019), enclosed as Attachment 3

Hydraulic Project Approval Permit No. 2018-1-163+01, Chewelah Vision Clinic (Aug. 30, 2018), enclosed as Attachment 4

Cost

$48,408.27

Project 3: Chewelah Creek Infiltration Project



Designation

Medium

Type of Project

Developing Natural and Constructed Infrastructure

Location of Project

Chewelah Creek

Summary

This project proposes to divert spring flows from North Fork Chewelah Creek for off-stream infiltration. The infiltration facility would be located on private property. The proposed project site was formerly irrigated agricultural lands. The water rights were transferred from the property over the past few years but the diversion structure, easement and power remain available for use. The private property owner is interested in considering an infiltatration project on the property to improve flows in Chewelah Creek. The project will divert water during the high flow period in the spring and distribute water through a shallow aquifer recharge facility on the property. The recharge to the aquifer will allow water to return to the surface water flows later in the summer and fall to supplment flows with cooler groundwater.

WNR Group estimates that groundwater is approximately 25 to 30 feet below the surface. WNR Group estimates that additional research will be needed to determine suitability for a shallow aquifer recharge facility. Specifically, a feasibility study needs to be conducted to drill a test well to determine hydrogeologic conditions and a drone land use survey to develop a contour map for the site development plan.

Chewelah Creek is estimated to require 50 acre-feet of off-set water over the planning period. Preliminary review has determined that Chwewelah Creek would have availble waters to divert during the spring run-off. If water is diverted at the site, it would also assist it mitigating frequent flooding which occurs downstream at the City Park. The Planning Unit has predicted that a cost effective diversion and infiltration system could be designed to meet the off-set requirements. The infiltration site is located approximately ¼- ½ mile from the creek on private property, which would allow suffient time for the infiltrated water to return as base flow to the tributary.

Project impacts include inundation of land that could be used for agricultural production. Flooding the area for storage would likely limit crop selection and future land uses in the affected area.

Need for Feasibility Study: Yes, additional work is needed to consider the depth of groundwater, soil conditions and prepare design materials.

Permitting Need

Water right permit from Ecology to convey water to infiltration; HPA permit from WDFW; Compliance under the Clean Water Act; County Critical Areas Ordinance and Shoreline Management Act permitting.

Reference Information

Chapter 173-200 WAC; RCW 90.03.370; Gene St.Godard

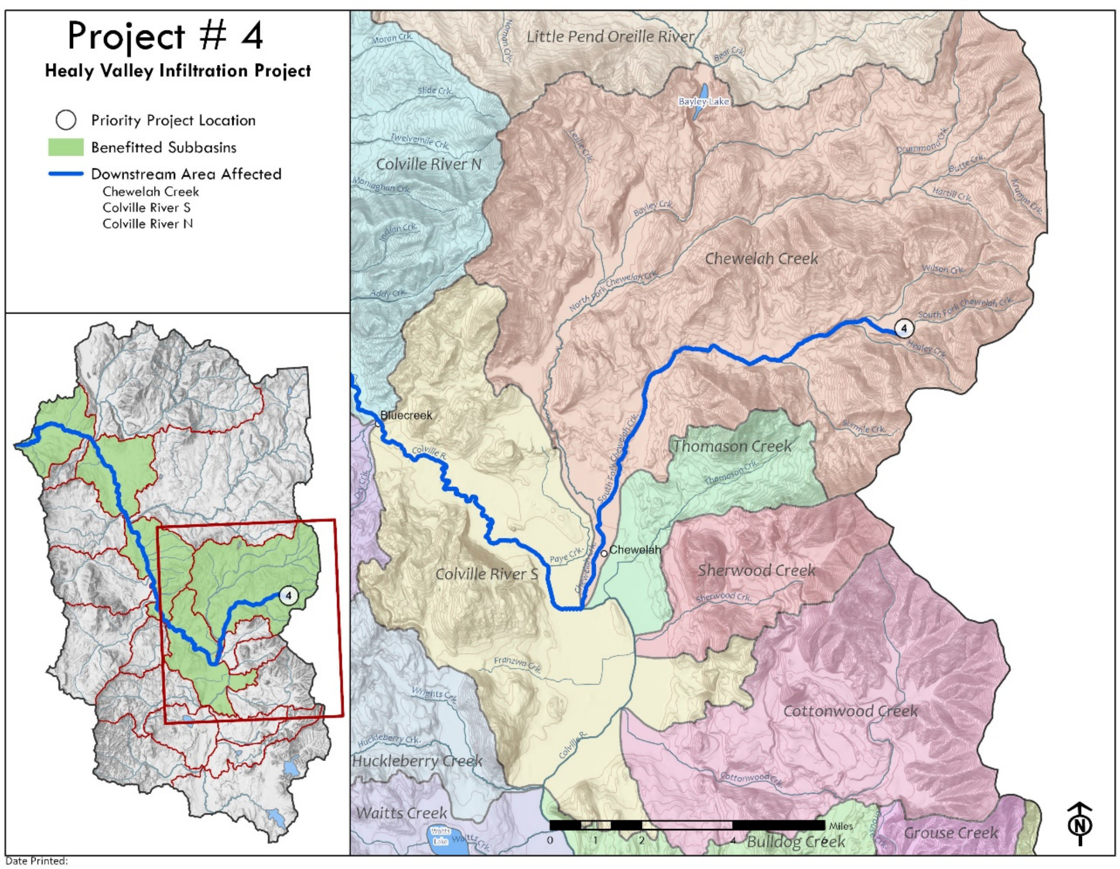
Stevens County Board of County Commissioners, Resolution 108-2003, In Support of Lobbying for the Creation of Water Storage Projects in Stevens County Watersheds (Sept 9, 2003).

Stevens County PUD, Resolution 7-2003 Support of Lobbying for the Creation of Water Storage Projects in Stevens County Watershed Areas (July 1, 2003).

Cost Estimate

Metric	Range	
	Low	High
Feasibility Study/Design	$ 40,000	$ 75,000
Preliminary Construction Cost	$ 350,000	$ 600,000
Estimated Land Purchase Cost	$ 30,000	$ 50,000
Legal-Land Purchase/Easements	$ 10,000	$ 20,000
Permitting/Surveying/Engineering	$ 95,000	$ 165,000
Annual O&M Costs	$ 55,000	$ 65,000
Totals	$ 580,000	$ 975,000

Project 4: Healey Valley Infiltration Project



Designation

Medium

Type of Project

Developing Natural and Constructed Infrastructure

Location of Project

Chewelah Creek; Section 23 T.33N R.41E

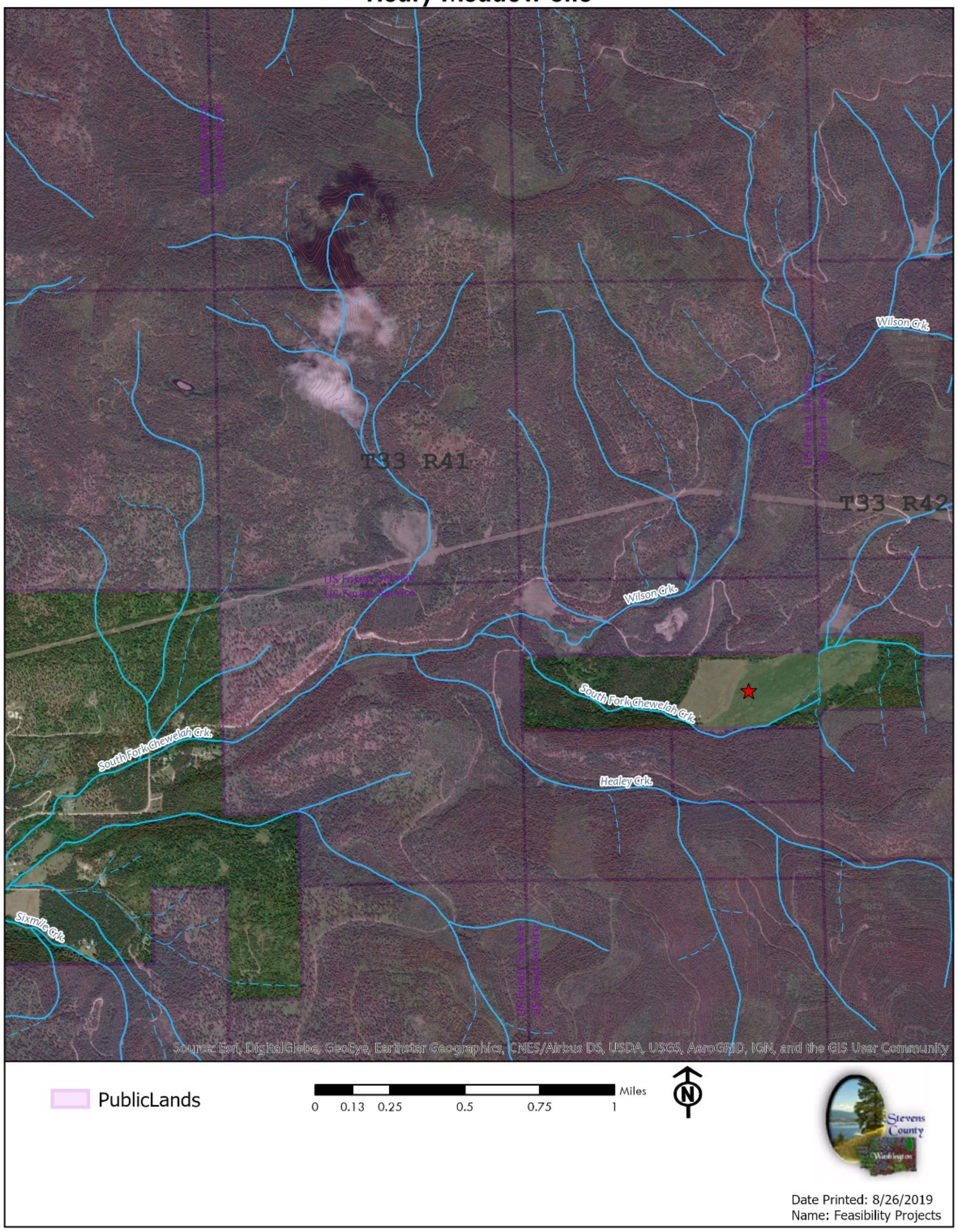
Summary

This project would divert spring flows from South Fork Chewelah Creek for off-stream storage and later-season shallow aquifer recharge in the Wilson Healey Meadow area. The project proposes to divert flows into a shallow aquifer infiltration facility or water storage facility on private property. The project would include seasonal storage with permanent structures, low earthen berms and a series of infiltration areas. The spring flow would be retained and then pumped back to the creek in the summer; and if infiltration trenches, the water will be introduced to the subsurface throughout the high flow season and allow to retuen to the creek as baseflow.

A feasibility study is necessary before proceeding. The feasibility study will likely need to include drilling a minimum of one exploratory hole in the site to decipher geologic conditions, installation of a piezometer and testing of the vadose zone and aquifer. The 2003 GeoEngineers report considered a site near Burnt Valley Road in Section 22, T. 33 N., R. 41E W.M., however the WRIA 59 planning unit recommended considering a site farther up in the basin near Healey Meadow in Sections 23 or 24, T. 33N., R. 41E., W.M. The 2003 GeoEngineers report recommend a biologic survey, wetland delineation and assessment (possibly, depending on property location), geotechnical study, hydrogeologic study, environmental site assessment.

Recharge to the creeks during the low flow summer and fall months will enhance the fluvial environment by increasing stream flows with cooler groundwater in South Fork Chewelah Creek. In addition, diversion of the high flows during the spring runoff to a storage or infiltration facility would assist in mitigatign the spring time flooding downstream within the City of Chewelah.

Healy Meadow Site



Permitting Need

Water right permit from Ecology to convey water to infiltration facility; HPA permit from WDFW; compliance the Clean Water Act; County Critical Areas Ordinance and Shoreline Management Act permitting.

Reference Information

GeoEngineers, 2003, Assessment Report: Multi-Purpose Water Storage Opportunities, Water Resource Inventory Area, Figure 2-20.

Chapter 173-200 WAC; RCW 90.03.370

Stevens County Board of County Commissioners, Resolution 108-2003, In Support of Lobbying for the Creation of Water Storage Projects in Stevens County Watersheds (Sept 9, 2003)

Stevens County PUD, Resolution 7-2003 Support of Lobbying for the Creation of Water Storage Projects in Stevens County Watershed Areas (July 1, 2003)

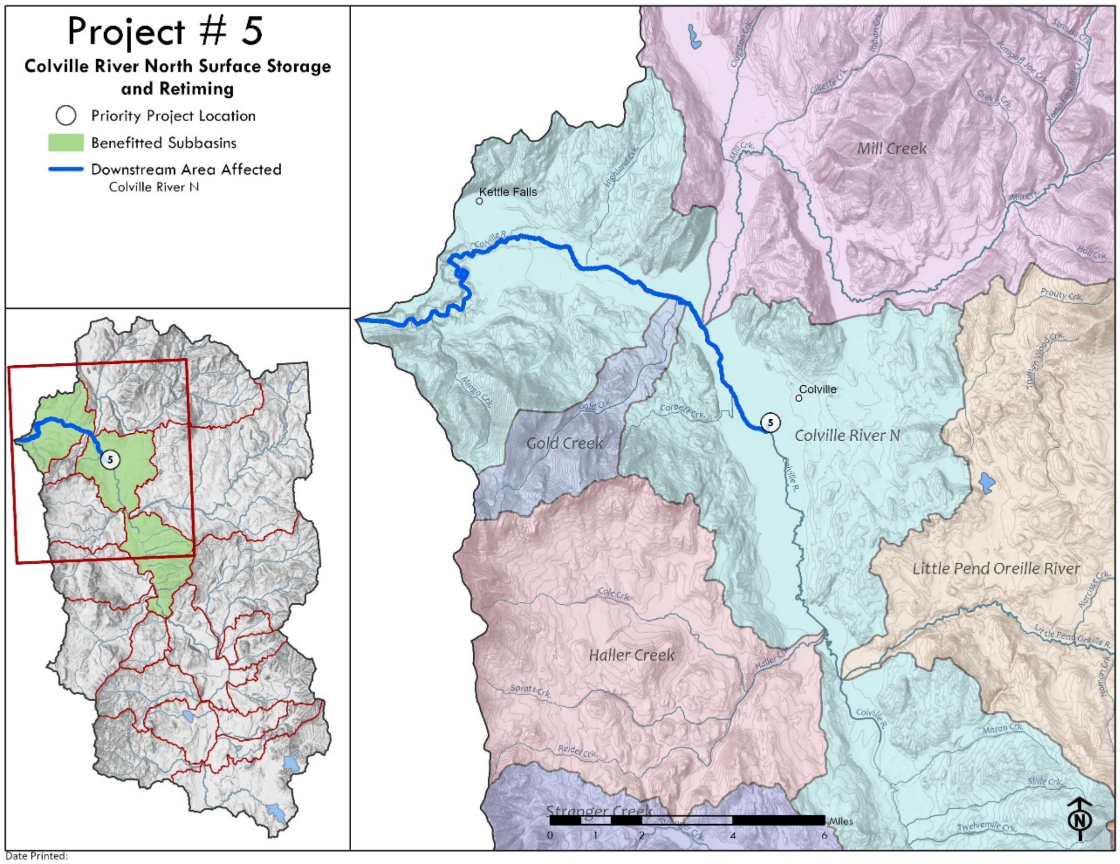
Cost

2003 GeoEngineers Report estimated total project cost at $1,970,850 (adjusted for inflation: $2,704,023)

Colville River North Subbasin

Demand: 84.3 AF projected as consumptive use need by 2040

Project 5: Colville River North Surface Storage and Retiming



Designation

Medium

Type of Project

Developing Natural and Constructed Infrastructure

Location of Project

Colville River North Subbasin

Summary

Washington Department of Fish & Wildlife and the City of Colville propose a project to create approximately 15 acres of surface storage ponds on city parcels located adjacent to the Colville River. The project proposes to take restoration actions to increase seasonal ponds, perennial riverine, oxbow and depressional/sloped wetlands to support instream flows and ecosystem function. The City's parcels, with certain restoratation actions, could support instream flows and shallow aquifer recharge.

The project would help to capture streamflow and stormwater runoff which enters the property and retain it on the landscape in the restored wetlands/surface water storage for a more gradual release to streamflows and or groundwater recharge. Construction of new off-channel storage facilities and remandering of streamflow channels could change the stream morphology and flow regime downstream of the intake.

This project also includes remeandering two straight ditched stream channels to improve floodplain/bank storage, water quality, and restore riparian cover and fish habitat. The project will likely increase diversity of flora and fauna in the ecosystem and improve wetland function. Furthermore, the project may provide stopover and nesting habitat for waterfowl. The project proponets also intend to incorporate opportunities at the site for outdoor environmental education for the area schools.

In June 2019, the WRIA 59 Water Resource Management Board recommended seeking funding for additional feasibility studies. The Board's proposal was to conduct a wetland delineation/categorization, soil borings, drone survey to develop a two-foot contour map of property and water flow estimates. Unfortunately, due to time constraints, additional feasibility was not conducted.

Permitting Need

Water right permit from Ecology to convey water to infiltration; HPA permit from WDFW; compliance with the Clean Water Act; County Critical Areas Ordinance and Shoreline Management Act permitting.

Washington Department of Fish and Wildlife and City of Colville are supportive of the project.

Reference Information

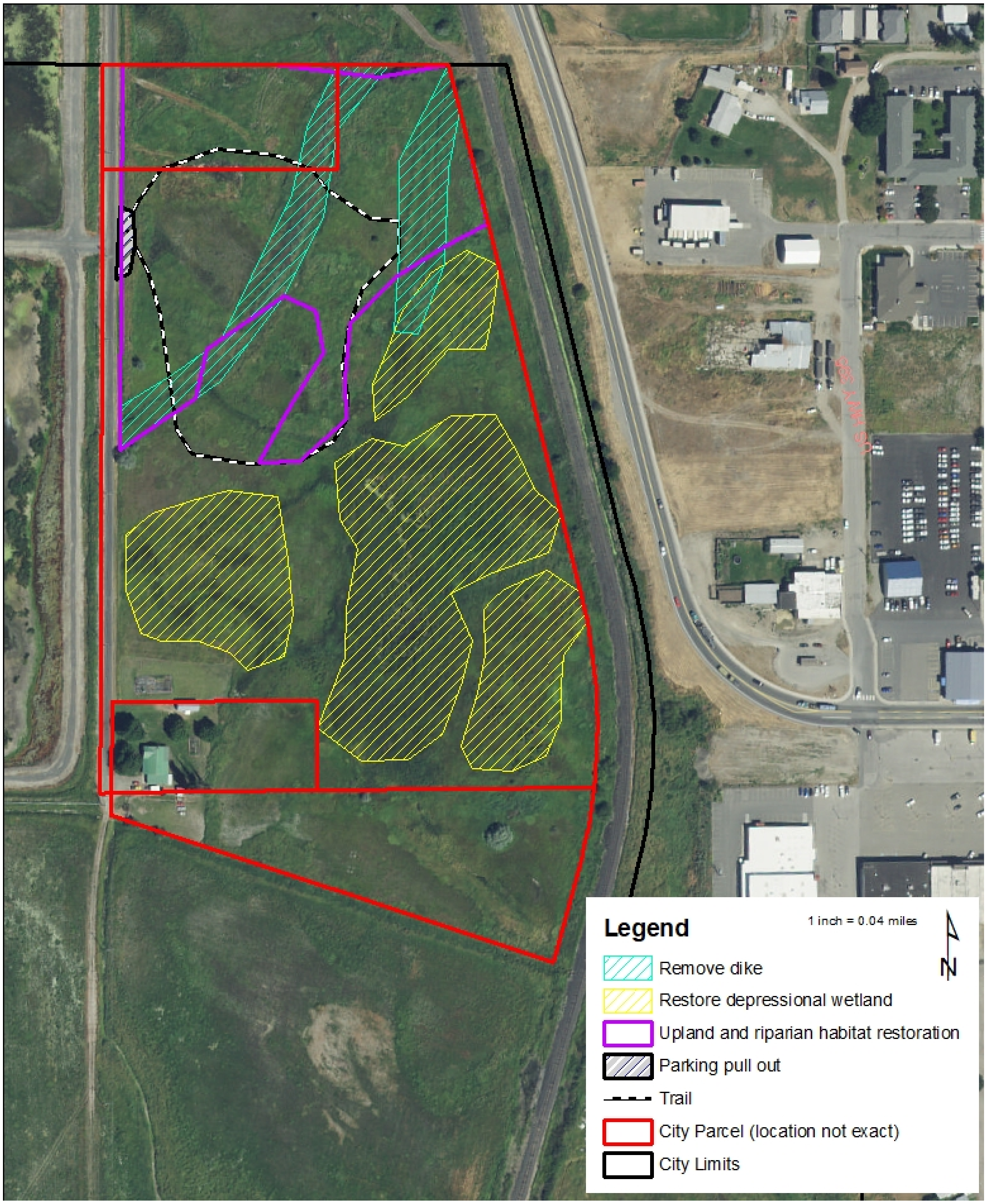
Washington Department of Fish and Wildlife Migratory Bird Stamp & Art Print Program, 2019-2021 Migratory Bird Habitat Project Proposal, Colville Valley Wetland Restoration (March 13, 2019).

Letter from Louis F. Janke, Mayor, City of Colville to Erik Johansen, Stevens County (June 13, 2019).

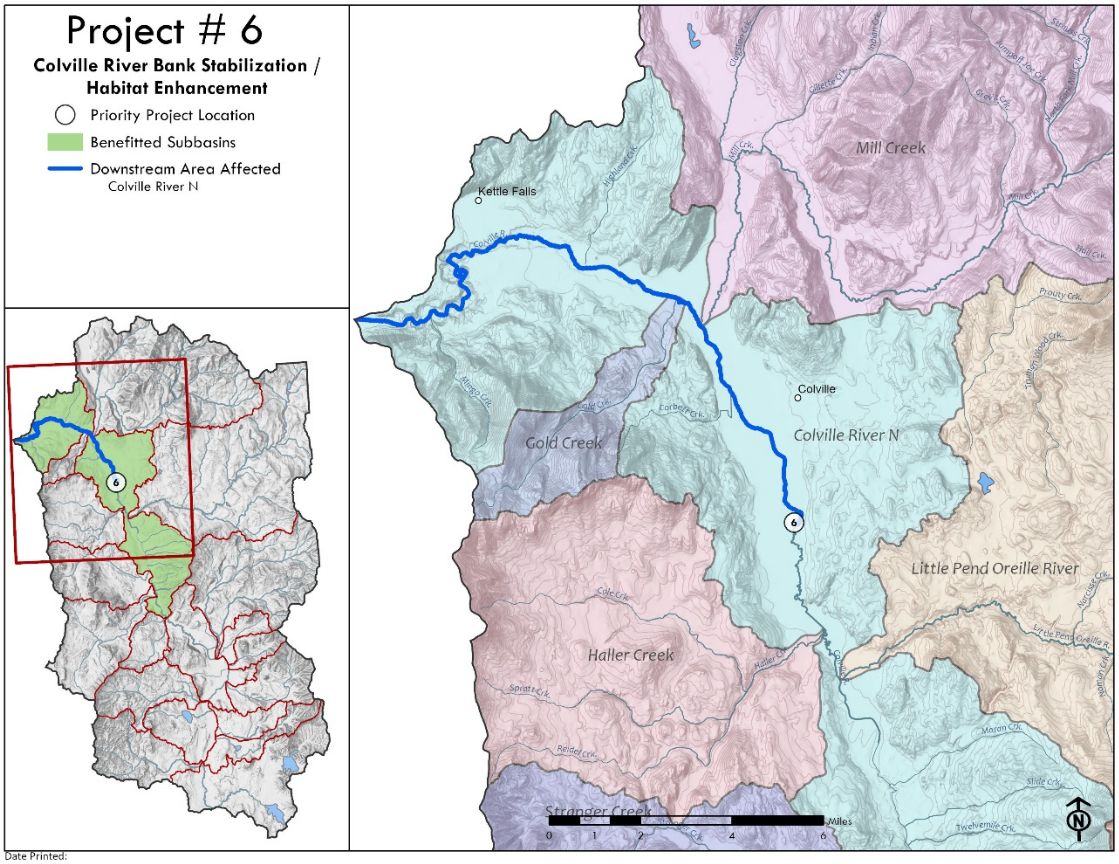
Cost

Approx. $115,000 to $150,000.

Design Concept - Colville Wetland Restoration



Project 6: Colville River Stabilization/Habitat Enhancement



Designation

Medium

Type of Project

Developing Natural and Constructed Infrastructure

Location of Project

Colville River North Subbasin

Summary

This project proposes to improve the habitat and function of a reach of the Colville River by increasing the meander corridor and reconnecting the floodplain. The SCCD has identified reaches of the Colville River with severe bank erosion and mass wasting, contributing to the loss of productive farm ground, excessive sediment and lack of fish and wildlife habitat in the riparian area. SCCD has identified 21 sites of severe erosion on the mainstem and river restoration opportunities. The project proposes to rely on bioengineered plantings, large woody debris and native planting to improve slope stability, encourage sinuosity of the river and improve riparian shading and habitat. The project will include excavation to reslope the riparian area and install rootwads and curb logs on the riverbank. The project will also plant riparian plants in the riparian area to improve stability and increase shade. The project will follow best practices for selecting and plantings in the riparian area.

This project will continue SCCD's successful work on two nearby sites. Above is a picture of work completed by SCCD on the mainstem Colville River The completion of this work has improved the instream and riparian habitat of the Colville River and encouraged other adjacent landowners to improve riverine habitat. The project proposed in this Addendum will continue the work completed by SCCD and rely on best management practices, integrated streambank stabilization guidelines and establishing sustainable limits for channel migration.

Instream impacts during construction will be addressed through best management practices and in accordance with permit requirements.

Additional work is needed to coordinate with property owners and agencies to develop a final design plan. The project proponent will work with closely with permitting agencies for final design.

Permitting Need

HPA permit from WDFW; compliance with the Clean Water Act; County Critical Areas Ordinance and Shoreline Management Act permitting.

Reference Information

Stevens County Conservation District, Colville River Project Stream Restoration, Bank Stabilization , Northern Half of Project (August 30, 2016)

Stevens County Conservation District, Colville River Project Stream Restoration, Bank Stabilization, Southern Half of Project (August 30, 2016)

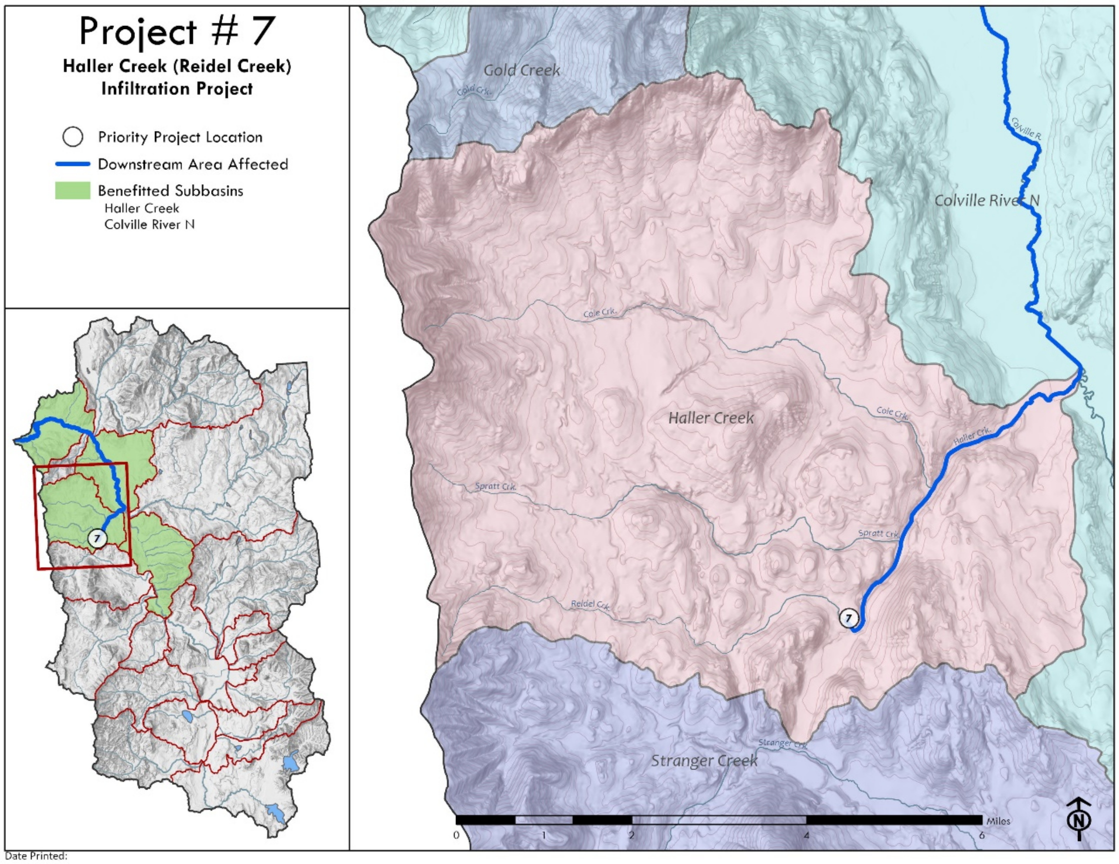
Cost

Estimated to be approximately $950,000, the cost estimate will be revised during the development of the final design.

Haller Creek Subbasin

Demand: 30.8 AF projected as consumptive use need by 2040

Project 7: Haller Creek (Reidel Creek) Infiltration Project



Designation

High

Type of Project

Developing Natural and Constructed Infrastructure for Groundwater Infiltration

Location of Project

Reidel Creek, a tributary to Haller Creek

Summary

This project would divert spring flows from Reidel Creek (a tributary to Haller Creek) to an infiltration facility on DNR property upstream of the confluence of Reidel and Hallers Creeks. The project site is a former gravel pit. Water can potentially be diverted from Reidel Creek approximately 300 feet northeast of Riedel Creek Road (north of the proposed site). The water would then need to be conveyed over an approximately 40 – 50 foot lift to the infiltration site.

From 2007 to 2014, the WRIA 59 planning unit collected stream flow data in Haller Creek (WNR Group, 2015). The data showed that, in general, flows identified through the stream flow study and wetted width analysis, were available during the spring to meet the project needs of approximately 31 acre-feet. In 2015, the WRIA 59 Flow Subcommittee, which included representatives from Ecology and WDFW, recommended that the Haller Creek subbasin had sufficient flows in most years from December 1st to June 30 to support some diversionary uses. WNR Group estimated that diversion of 31 acre-feet annually during February to June would mitigate for new permit-exempt water uses.

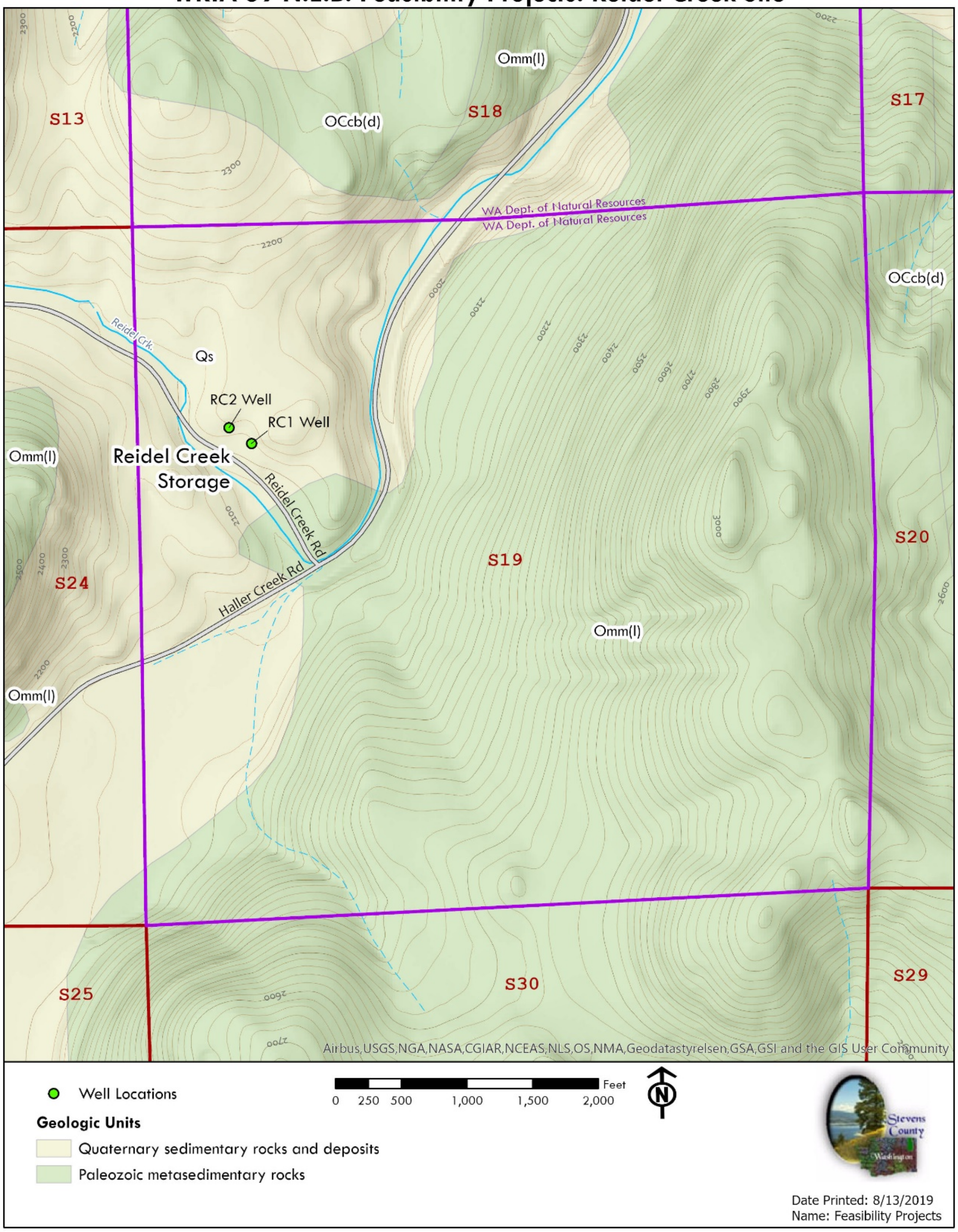
In July 2019, the Department of Ecology issued a grant to Stevens County which, in part, funded feasibility funding of this project. DNR issued a land use license to Stevens County to conduct feasibility studies. The initial feasibility screening was conducted to determine if hydrogeologic conditions beneath the former gravel pit are conducive to the proposed project. The feasibility study also included drilling two exploratory holes at the site to decipher geologic conditions, installation of two piezometers and sampling. Furthermore, a drone survey was conducted to develop a two-foot topographic contour map. WNR Group concluded that the site's subsurface soils appear to be capable of infiltrating 28 gallons per minute under saturated conditions. A copy of the Feasibility Study report is attached to this Addendum as Appendix E.

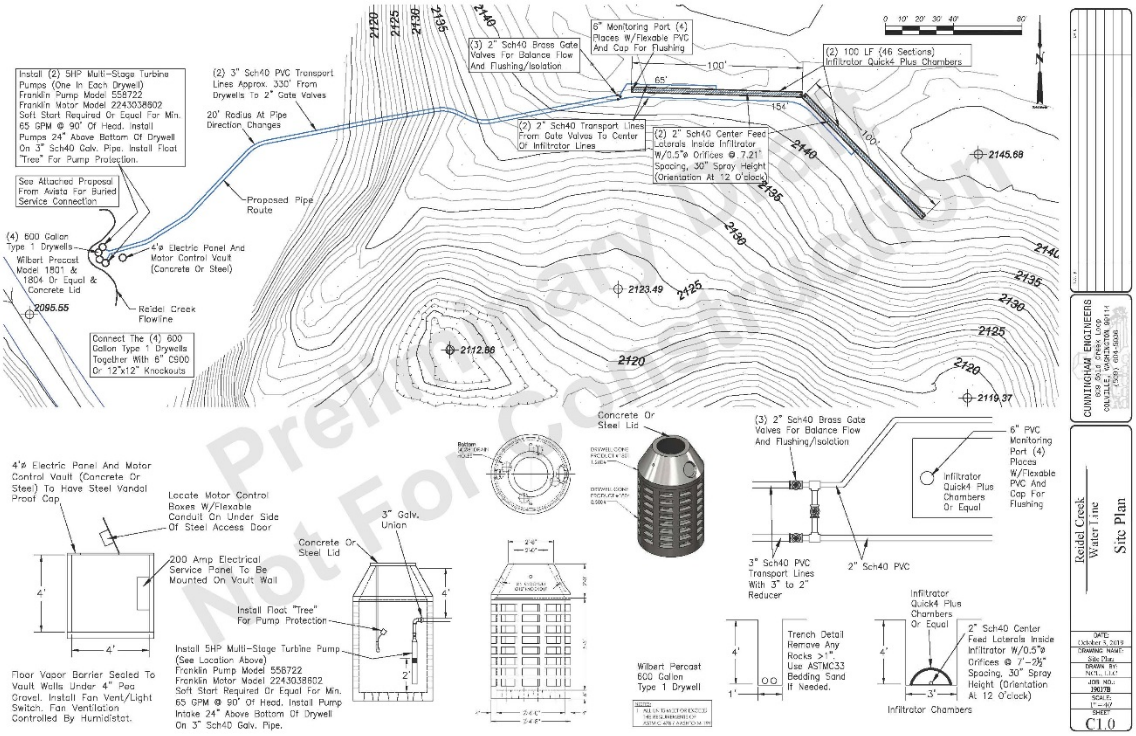
The project proposes to capture excess flow during the spring run-off, convey and infiltrate the excess water to the groundwater through an infiltration gallery, to return as instream flow in Reidel and Haller Creeks during low flow conditions. The project proposes to:

- Divert water from Reidel Creek through stilling wells located approximately 300 feet northwest of the infiltration trench.
- The stilling wells will convey approximately 86,400 gallons of water per day (80 gpm), nine hours a day, from mid-March to mid-May.
- The pumping infrastructure will allow the project to increase flows from 80 gpm to 160 gpm for future mitigation, if needed.
- Divert a minimum of 31 acre-feet at the current proposed design, and a maxiumum of 83 acre-feet annually if the period of operation is enlarged.

Recharge to the creeks during the low flow summer and fall months will enhance the fluvial environment by increasing stream flows with cooler groundwater.

WRIA 59 N.E.B. Feasibility Projects: Reidel Creek Site





Construction of a stilling basin near Reidel Creek may cause temporary water quality impacts. Construction of power conveyance and pump facilities to the stilling basin may also have temporary impacts on some portion of riparian habitat. The project proponents will work to reduce impacts. The feasibility technical assessment anticipates that this project will recharge groundwater in Reidel and Haller Creeks.

Permitting Need

Water right permit from Ecology to convey water to infiltration. Preliminary discussions between representatives of the WRIA 59 planning unit and Ecology anticipate that this project will qualify for priority processing. HPA permit from WDFW; compliance with the Clean Water Act; County Critical Areas Ordinance and Shoreline Management Act permitting.

Reference Information

John Covert, Washington Department of Ecology, Mitigation Opportunities, October 25, 2018.

Stevens County Board of County Commissioners, Resolution 108-2003, In Support of Lobbying for the Creation of Water Storage Projects in Stevens County Watersheds (Sept 9, 2003)

Stevens County PUD, Resolution 7-2003 Support of Lobbying for the Creation of Water Storage Projects in Stevens County Watershed Areas (July 1, 2003)

WNR Group, et al, WRIA 59 Colville River Basin Water Bank Feasibility Study (2015).

WNR Group, Inc., Technical Memorandum, Technical Memorandum on Chewelah Creek/Colville River Restoration Project Feasibility (November ___, 2019), enclosed with the Addendum to the Watershed Plan as Appendix D.

Cost

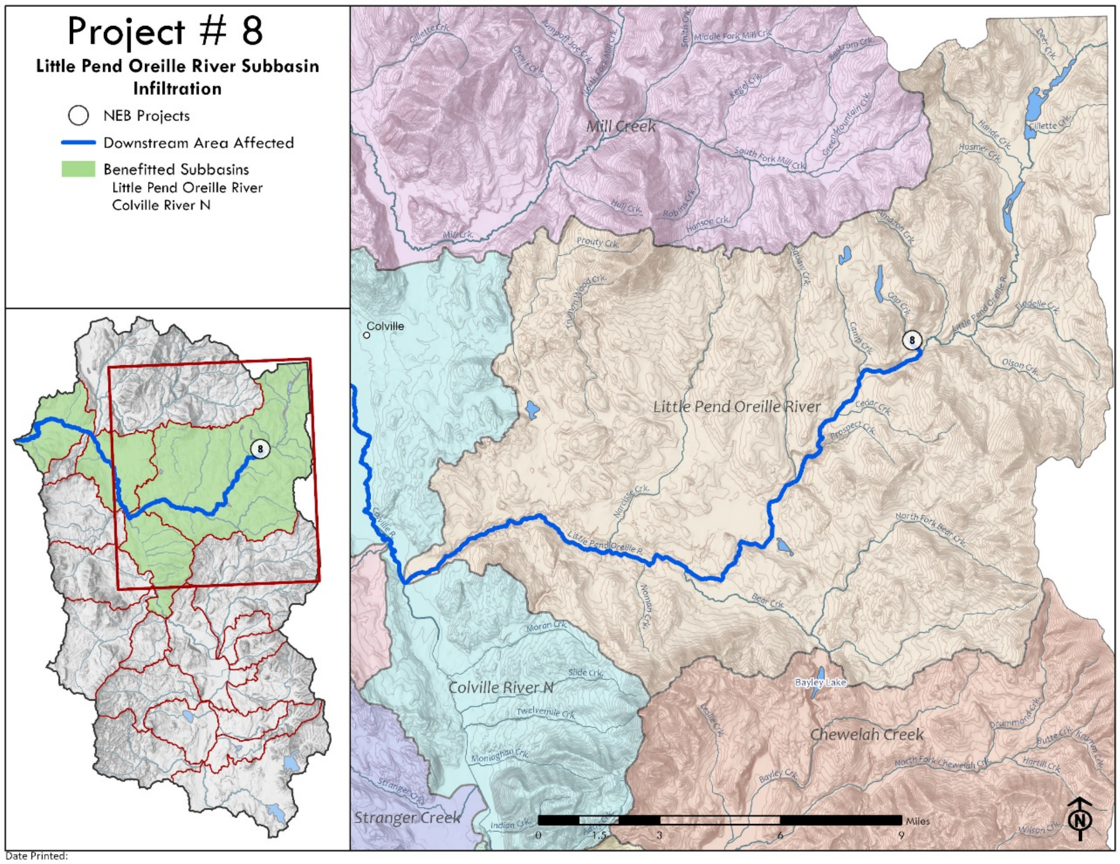
The engineer's preliminary construction estimate is $158,000 (with a 15 percent construction and programmatic continency). This estimate includes equipment transport, rental and mobilization, construction of the stilling wells, conveyance and infiltration gallery. This project estimate also includes $39,992.00 to have power supplied to the pump station. The engineer has identified a shorter path for power that may reduce this cost but will require an easement with a private property owner.

However, this cost estimate does not include the cost for a long-term land use easement with the Department of Natural Resources. That cost will be negotiated if the project moves forward. Also, annual O&M costs, including power costs, are not included in the estimate, and will need to be further refined.

Little Pend Oreille River Subbasin

Demand: 61.8 AF projected as consumptive use need by 2040

Project 8: Little Pend Oreille River Infiltration Project



Designation

High

Type of Project

Developing Natural and Constructed Infrastructure

Location of Project

Little Pend Oreille River subbasin

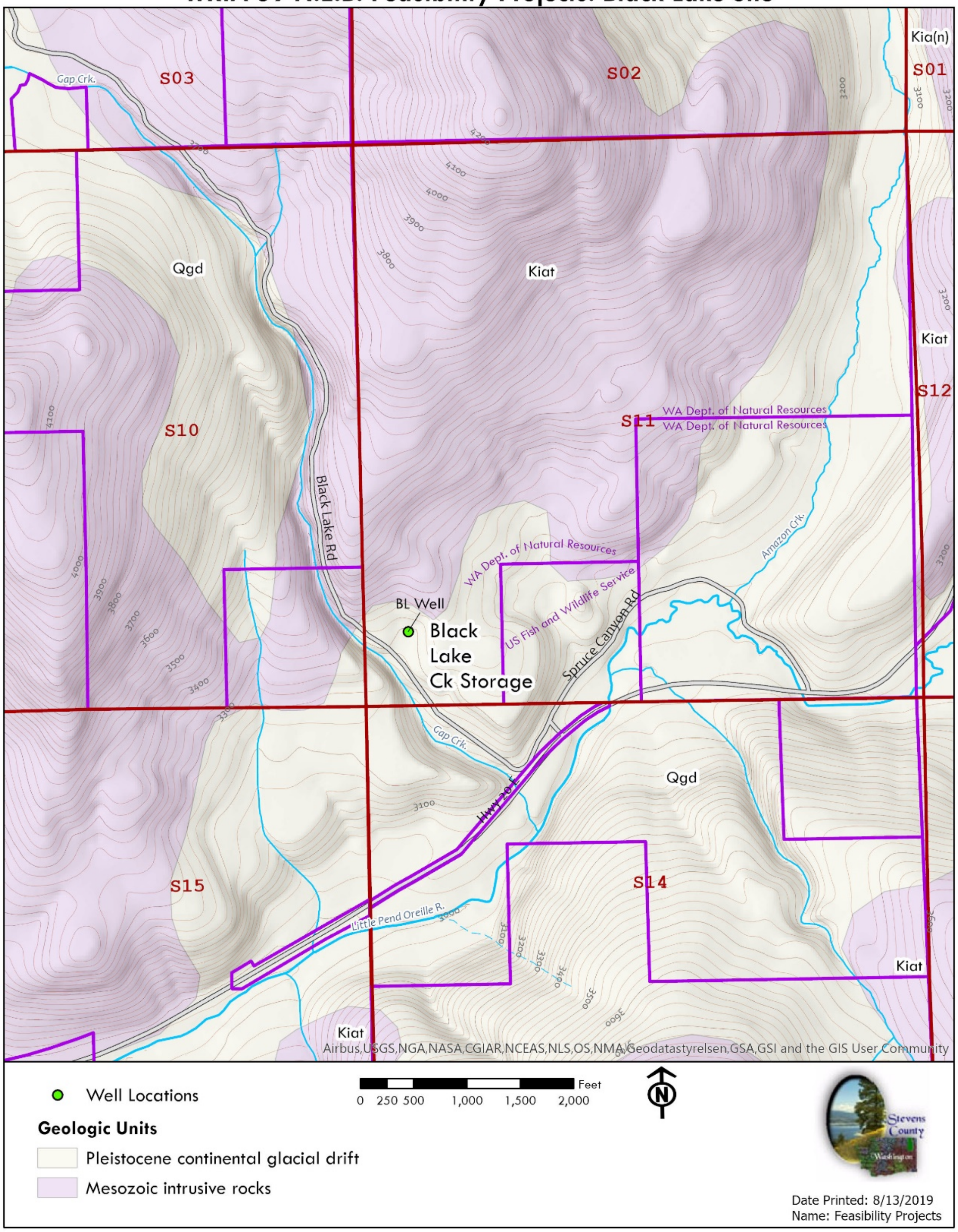
Summary

The Little Pend Oreille River Infiltration Project proposes to store water in the Little Pend Oreille River basin to provide flow benefits and offset new permit-exempt domestic water uses. The project proposes to divert spring run-off flows into a shallow aquifer infiltration facility or water storage facility. The project would include seasonal storage with permanent structures, low earthen berms, and a series of infiltration trenches. The spring flow would be retained and then infiltrated in the summer for streamflow impacts in the late summer and fall low flow period. In 2015, the WRIA 59 Flow Subcommittee, which included Ecology and WDFW, recommended that the LPOR drainage had sufficient flows in most years from April 1 to June 30 for some diversionary uses (WNR Group, 2015).

Ecology funded the prefeasibility work to consider the hydrogeologic conditions of a site in the tributary below Black Lake Creek owned by DNR and within the Little Pend Oreille River basin. The site encompasses an area that would capture high flows from Black Lake Creek/Squaw Creek drainage, a tributary to the Little Pend Oreille River (LPOR) and convey the flood water to an old gravel pit owned by DNR. The feasibility research included drilling one exploratory hole at the site to decipher geologic conditions and collect soil samples in order to consider porosity and permeability. A licensed survey completed a one-foot topographic survey. The feasibility study demonstrated that the site could likely only store about 10 acre-feet for a cost of $375,000. The planning unit was concerned about the cost of the project and the low quantity of water which could be re-timed. Therefore, this project was deemed not feasible, and removed from the preliminary list.

However, the consultant team identified other sites near Black Lake and other parcels owned by public entities in the Little Pend Oreille River basin for additional investigation which may be suitable for storage and/or infiltration projects. The Washington Department of Natural Resources has other sites in the Little Pend Oreille River basin that may include more suitable sites. Additionally, there may be a site upstream of Black Lake that could hold more than 31 acre-feet. The planning unit supports an infiltration or storage project in the Little Pend Oreille subbasin, and additional feasibility work needs to be completed for other sites within the subbasin. Therefore, the planning unit has maintained this type of proposed project for the LPOR basin, and would like to pursue another property option for construction of an infiltration project.

WRIA 59 N.E.B. Feasibility Projects: Black Lake Site



Construction of a water stilling basin near a creek may cause temporary water quality impacts. Construction of power conveyance and pump facilities to the stilling basin may also have temporary impacts on some portion of riparian habitat. The project proponents will work to reduce impacts.

Need for Feasibility Study: Yes, as described above, additional site investigation needs to be completed.

Permitting Need

Water right permit from Ecology to convey water to infiltration. Preliminary discussions between representatives of the WRIA 59 planning unit and Ecology anticipate that this project will qualify for priority processing. HPA permit from WDFW; compliance with the Clean Water Act; County Critical Areas Ordinance and Shoreline Management Act permitting.

Reference Information

John Covert, Washington Department of Ecology, Mitigation Opportunities, October 25, 2018.

WNR Group, et al, WRIA 59 Colville River Basin Water Bank Feasibility Study (2015).

WNR Group, Inc., Technical Memorandum, Technical Memorandum on Chewelah Creek/Colville River Restoration Project Feasibility (November ___, 2019), enclosed with the Addendum to the Watershed Plan as Appendix D.

Cost

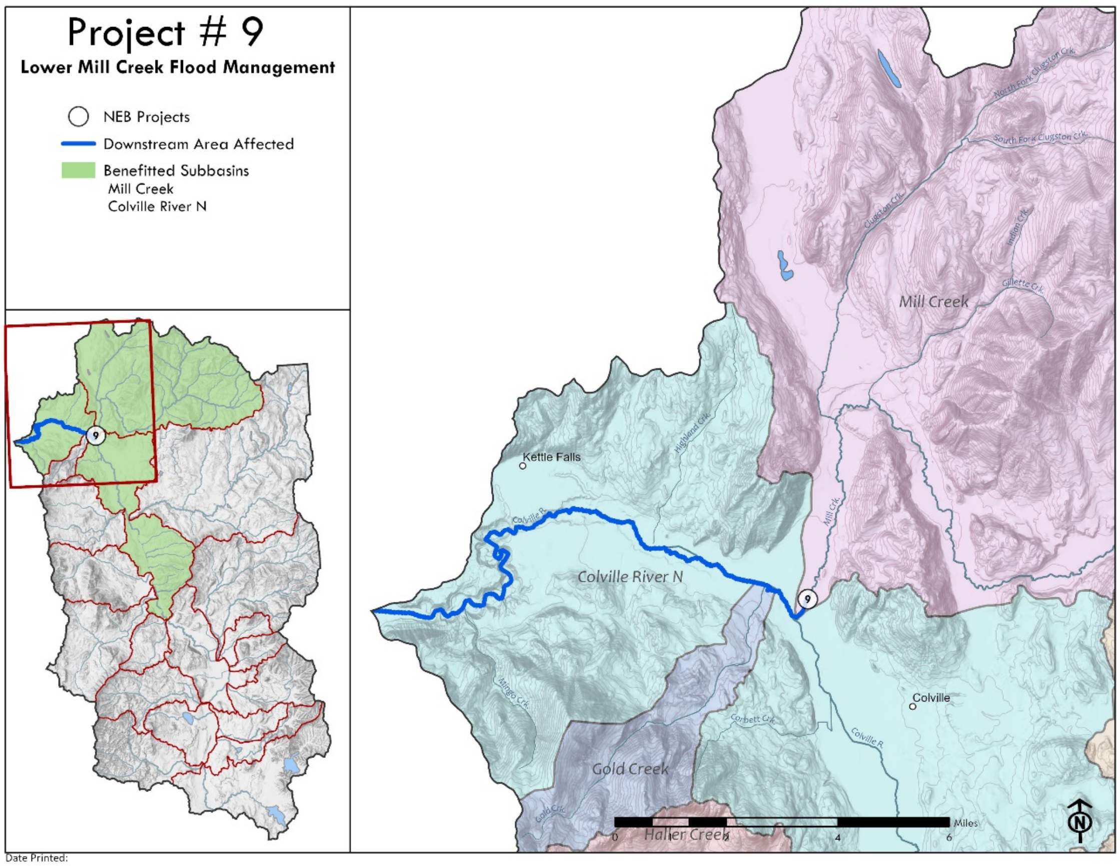
Metric	Range	
	Low	**High**
Feasibility Study/Design	$ 80,000	$ 125,000
Preliminary Construction Cost	$ 450,000	$ 700,000
Permitting/Surveying/Engineering	$ 125,000	$ 220,000
Annual O&M Costs	$ 50,000	$ 75,000
Totals	$ 705,000	$ 1,120,000

Note: Costs may also include negotiated compensation to Washington Department of Natural Resources Trust for projects completed on their properties.

Mill Creek Subbasin

Demand: 50.8 AF projected as consumptive use need by 2040

Project 9: Lower Mill Creek Flood Management



Designation

High

Type of Project

Developing Natural and Constructed Infrastructure/Habitat Enhancement

Location of Project

Mill Creek from Colville River to Spanish Prairie, Williams Lake Road. Approximately two miles upstream of the confluence near where Hwy 395 crosses the creek.

Summary

Instream and riparian habitat in the Mill Creek subbasin are degraded by flooding and sediment loading. Mill Creek is one of the largest tributaries of the Colville River, contributing nearly 20 percent of its flow. The lower portion of Mill Creek, including Clugston Creek, has been dredged multiple times since the 1900s. There are areas of the stream bank that are not well protected with vegetation root structure. Sediment is raising bed levels and increasing flooding and loss of productive farm ground. Persistent flooding has threatened structures, roads and railroads in the area. Landowners have met over the past 5-6 years trying to find solutions and funding to address flooding, sediment loading, drought impacts and water quality impacts. The Mill Creek Watershed Management Committee and local interested partners have considered opportunities to store water when there is excess runoff and high streamflows and release that water later in the season during low-flow periods.

In 2012, the SCCD conducted a general feasiblity study to consider water storage possibilities in the Mill Creek Watershed. The SCCD's study identified nine potential off-channel storage sites and ten instream sites. The study suggested that an off-channel storage would be more feasible but additional detailed study is needed. A preliminary need assessment has been done but further work is needing to be done to consider the project and opportunities for habitat improvement.

Impacts: To be determined

Need for Feasibility Study: Yes.

Permitting Need

HPA permit from WDFW; Compliance with the Clean Water Act; County Critical Areas Ordinance and Shoreline Management Act permitting.

Reference Information

Stevens County Conservation District, Lower Mill Creek Study (Nov. 21, 2012), enclosed as Attachment 5

Stevens County Conservation District, Mill Creek Watershed Plan Implementation Project, Draft, Chapter 6, Feasiblity Study of Water Storage Possibilities in the Mill Creek Watershed (Grant No. G0200314), enclosed as Attachment 6.

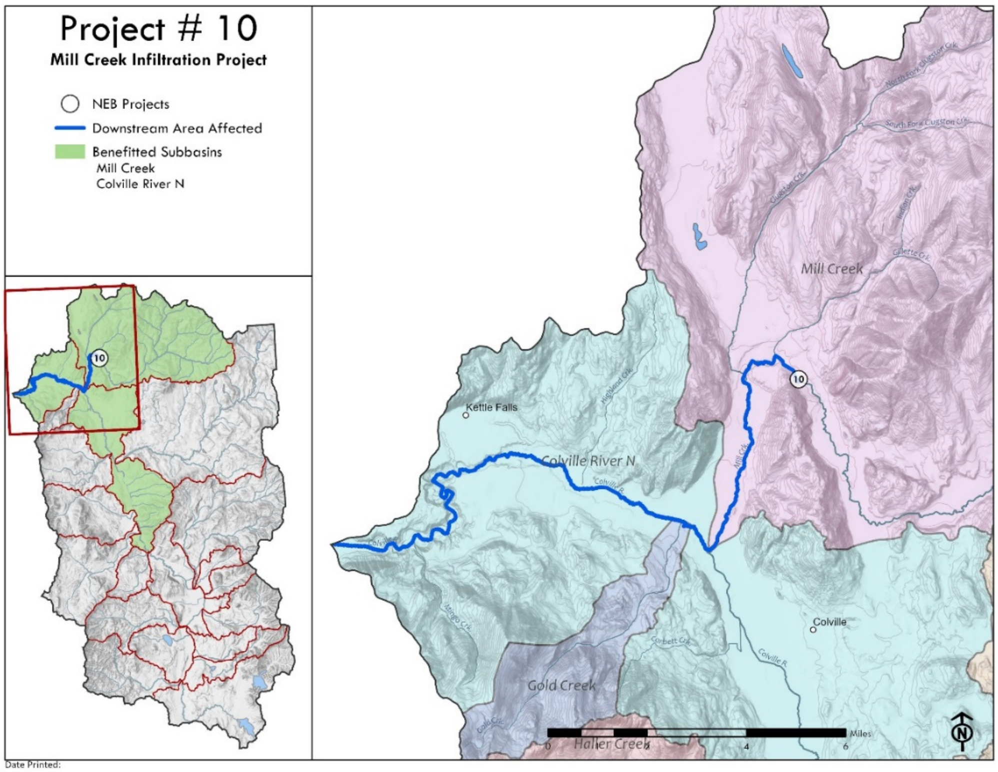
Stevens County Board of County Commissioners, Resolution 108-2003, In Support of Lobbying for the Creation of Water Storage Projects in Stevens County Watersheds (Sept 9, 2003)

Stevens County PUD, Resolution 7-2003 Support of Lobbying for the Creation of Water Storage Projects in Stevens County Watershed Areas (July 1, 2003)

Cost

To be determined. There are likely opportunties for cost-sharing and community support.

Project 10: Mill Creek Infiltration Project



Designation

Medium

Type of Project

Developing Natural and Constructed Infrastructure

Location of Project

Mill Creek

Summary

This project would divert spring flows for shallow aquifer infiltration on DNR property in the Mill Creek subbasin. The project proposes to divert flows into a shallow aquifer infiltration facility or water storage facility. The project would include seasonal storage with permanent structures, low earthern berms and a series of infiltration areas, or a direct diversion conveyed to infiltration trenches. The introduced water would infiltrate to the shallow aquifer to recharge stream flows during low flow periods or can be left in the aquifer until needed and then withdrawn from the aquifer through wells for beneficial use. The planning unit feels there are several opportunities for sites in the subbasin to construct a facility that can meet the required 46.2 acre-feet required over the planning period.

Impacts: Construction of a storage pond and/or infiltration trenches and conveyance structures.

Permitting Need

Water right permit from Ecology to convey water to infiltration; HPA permit from WDFW; Compliance with the Clean Water Act; County Critical Areas Ordinance and Shoreline Management Act permitting.

Reference Information

John Covert, Washington Department of Ecology, Mitigation Opportunities, October 25, 2018.

Chapter 173-200 WAC; RCW 90.03.370

Stevens County Board of County Commissioners, Resolution 108-2003, In Support of Lobbying for the Creation of Water Storage Projects in Stevens County Watersheds (Sept 9, 2003)

Stevens County PUD, Resolution 7-2003 Support of Lobbying for the Creation of Water Storage Projects in Stevens County Watershed Areas (July 1, 2003)

Cost

	Range	
Metric	**Low**	**High**
Feasibility Study/Design	$ 70,000	$ 95,000
Preliminary Construction Cost	$ 500,000	$ 900,000
Permitting/Surveying/Engineering	$ 130,000	$ 250,000
Annual O&M Costs	$ 55,000	$ 95,000
Totals	$ 755,000	$ 1,340,000

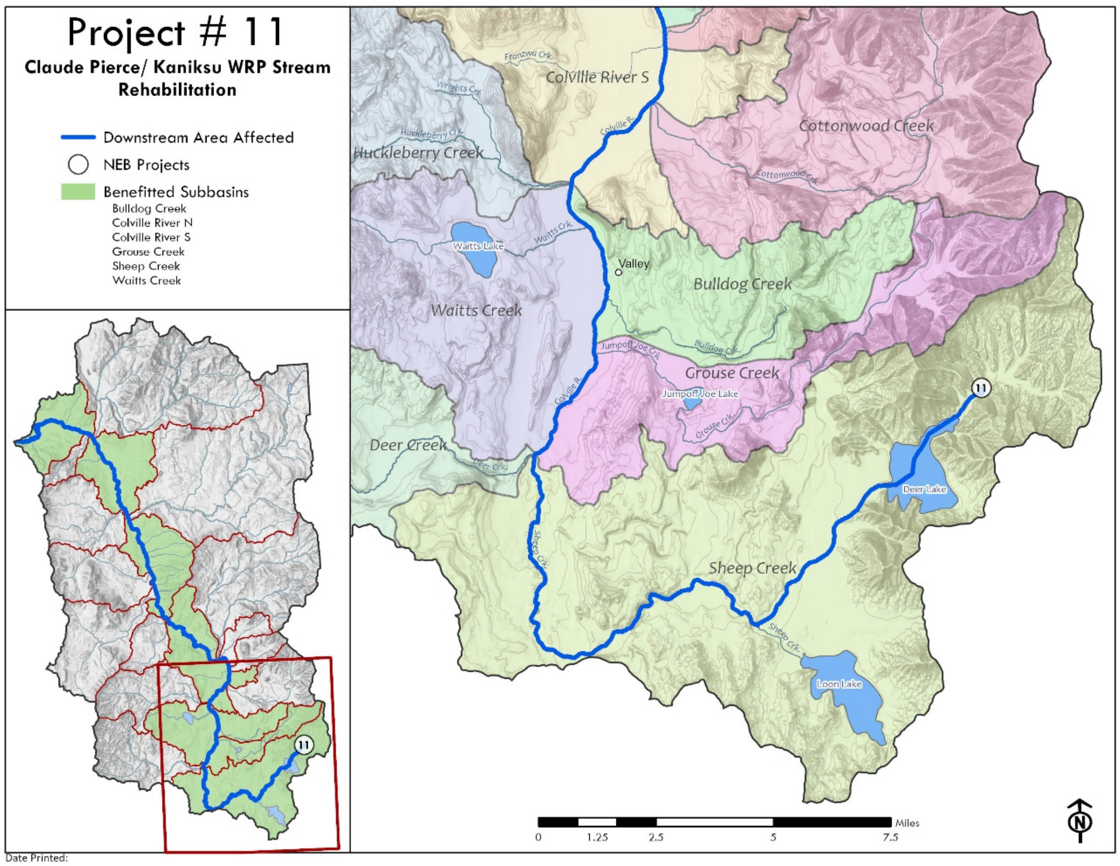
Note: Costs may also include negotiated compensation to Washington Department of Natural Resources Trust for projects constructed on their properties.

.

Sheep Creek Subbasin

Demand: 48 AF projected as consumptive use need by 2040

Project 11: Claude Pierce/Kaniksu Ranch WRP Stream Rehabilitation



Designation

High

Type of Project

Developing Natural and Constructed Infrastructure/Habitat Enhancement

Location of Project

Sheep Creek

Summary

This project proposes habitat restoration to impove instream functions and water storage on property upstream of Deer Lake in the Sheep Creek basin. This project will provide beaver-function analogs and improve sinuosity. In 2019, Hancock Forest Managent installed two beaver dam analogs in an area classified as freshwater emergent wetlands according to the Washington State Hydrological GIS layer. Below is a picture of an installed beaver-function analog.

There is an unnamed fish-bearing stream that dissects the meadow which has become deeply incised. The steam channel's incision has disconnected it from the floodplain. The project will encourage storage in a natural depression to improve fish and wildlife habitat and expand current restoration efforts.

Need for Feasibility Study: No; however, a final design needs to be completed.

Permitting Need

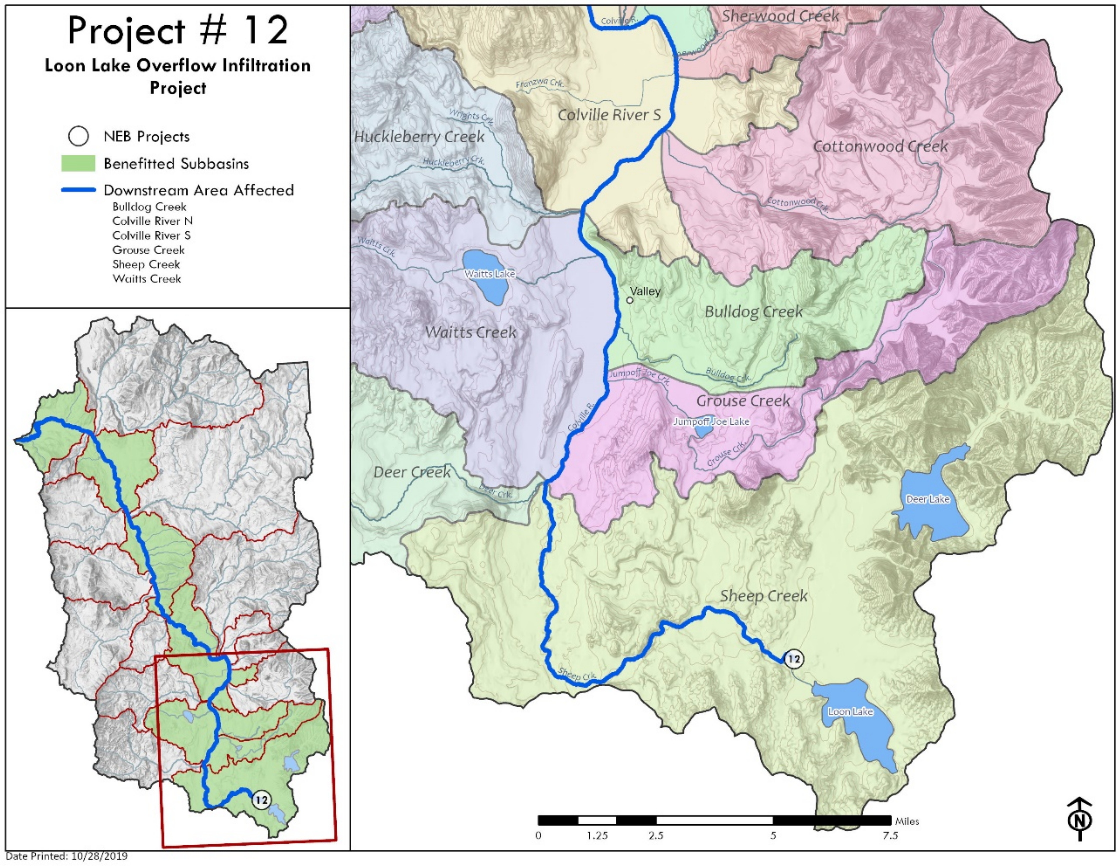
HPA from WDFW; compliance with the Clean Water Act, County Critical Areas Ordinance and Shoreline Management Act permitting.

Reference Information

Cost

To be determined.

Project 12: Loon Lake Overflow Infiltration Project



Designation

Medium

Type of Project

Developing Natural and Constructed Infrastructure

Location of Project

Parcel 8007826 downstream of Loon Lake, Tributary to Sheep Creek

Summary

This project would divert excess water in the spring from the Loon Lake overflow structure and infiltrate into the ground at the Stevens County gravel pit. The project proposes to divert flows into a shallow aquifer infiltration facility or water storage facility. The project would include seasonal storage with permanent structures, low earthen berms and a series of infiltration areas and/or a direct diversion to constructed infiltration trenches.

The proposed gravel pit currently has active mining occuring. However, the County believes that during the planning period, all or a portion of the gravel pit may become inactive, thus allowing for a potential project to be disigned and constructed. The exisitng pit is located a few hundred feet from the drainage outlet of Loon Lake. When overflow water from the lake is released, the water could be captured and used for recharging groundwater which could return to Sheep Creek as baseflow.

Impacts:

Need for Feasibility Study: Yes, the 2003 GeoEngineers report recommend biologic survey and assessment (possibly, depending on property location), geotechnical study, hydrogeologic study, environmental site assessment.

Permitting Need

Water right permit from Ecology to convey water to infiltration; HPA permit from WDFW; Compliance with the Clean Water Act and Shoreline Management Act permitting.

Reference Information

GeoEngineers, 2003, Assessment Report: Multi-Purpose Water Storage Opportunities, Water Resource Inventory Area, Figure 2-16 (Section 29 T30N R41E - The source parcel in the Report appears to be different but the concept the same);

Stevens County Board of County Commissioners, Resolution 108-2003, In Support of Lobbying for the Creation of Water Storage Projects in Stevens County Watersheds (Sept 9, 2003)

HDR, Loon Lake Storage and Infiltration Project, Final Programmatic Report (June 8, 2009)

Stevens County PUD, Resolution 7-2003 Support of Lobbying for the Creation of Water Storage Projects in Stevens County Watershed Areas (July 1, 2003)

Chapter 173-200 WAC; RCW 90.03.370

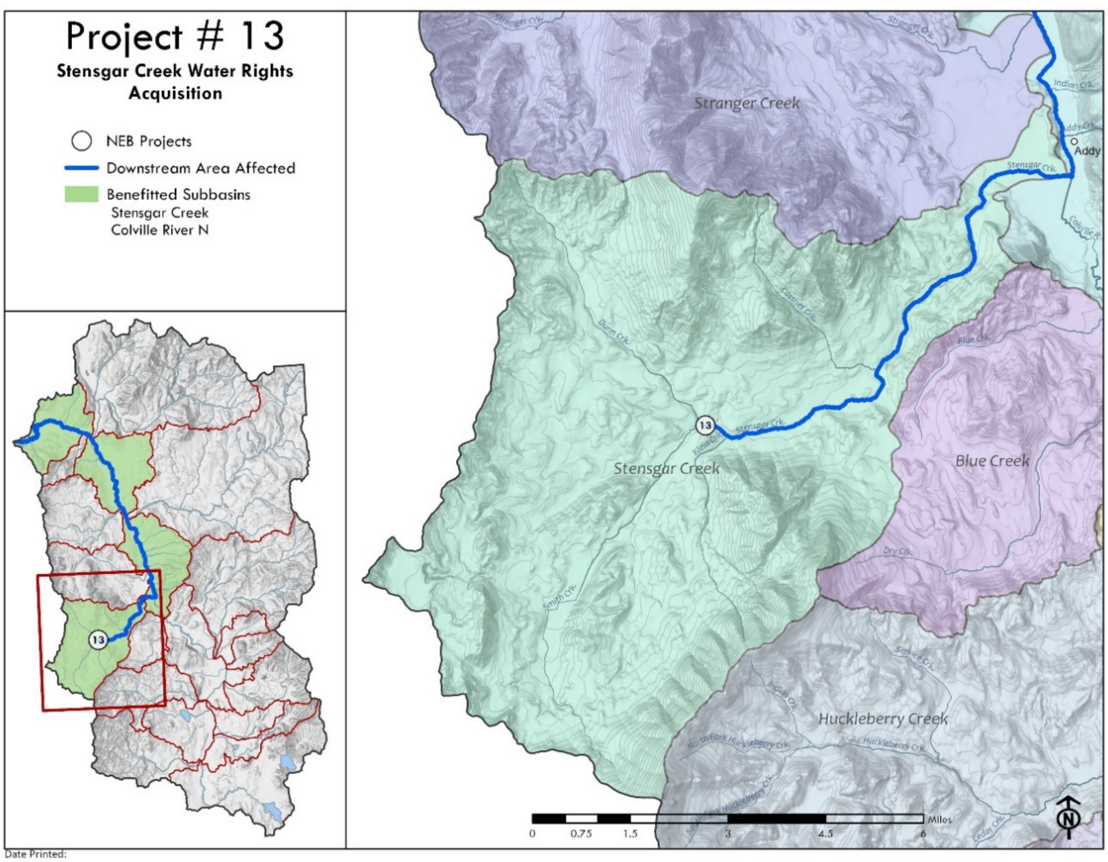
Cost

2003 GeoEngineers Report estimated total project cost at $826,644 (adjusted for inflation: $1,134,165.51)

Stensgar Creek Subbasin

Demand: 19.4 AF projected as consumptive use need by 2040

Project 13: Stensgar Creek Water Right Acquisition



Designation

High

Type of Project

Acquiring Senior Water Rights

Location of Project

Stensgar Creek

Summary

This project would seek to acquire water rights and place them into the State Trust Water Right Program, administered through the WRIA 59 Water Bank or other locally controlled entity. The 2015 WRIA 59 Water Bank Feasibility Study opined that there is moderate feasibility for water banking in this subbasin because there are water rights that appear to have been continuous beneficial use of the diversions that predate the instream flow rule.

The planning unit supports a water right acquisition when a water right becomes available for willing sellers at a market price. The water right will need to include consumptively used water rights to offset the estimated future use of permit-exempt water uses in the subbasin. The project will need to conduct an extent and validity review of the water right and negotiate and implement a purchase and sale agreement.

The primary impact of this project is the removal of water rights used for agricultural purposes and transferred to instream flows for mitigation for new water uses.

Permitting Need

Costs for due diligence, contract negotiation and extent and validity analysis for acquiring water rights.

Reference Information

Water Resource Inventory Area 59, Colville River Basin, Water Bank Feasibility Study, Task 4 Memo, Table 5, page 9. June 15, 2015.

Cost

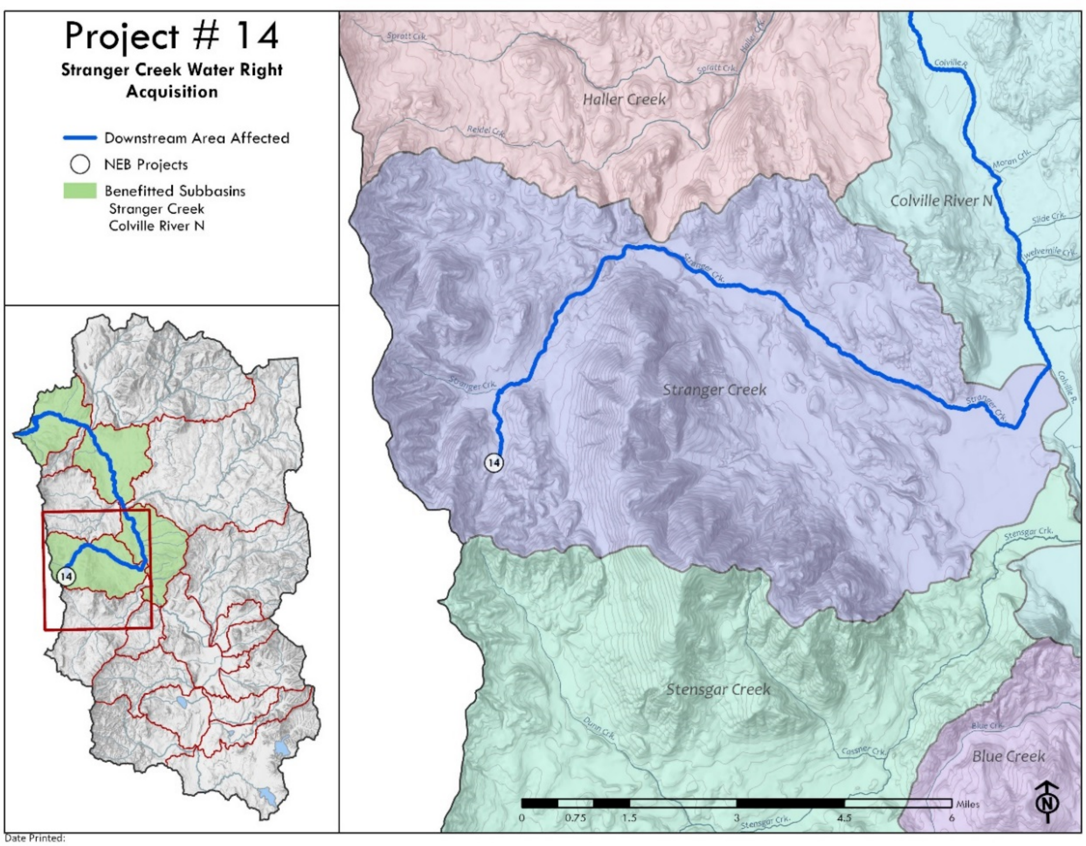
Metric	Range	
	Low	High
Water Right Unit Cost ($/AF)	$ 1,100	$ 2,200
Water Right Demand (AF)	19.40	19.40
Water Right Cost	$ 21,340	$ 42,680
Transaction Costs	$ 10,000	$ 10,000
Totals	$ 31,340*	$ 52,680*

*The planning unit notes that it is very unlikely that a water right for exactly 19.40 a.f. may become available for sale, therefore, this project should be considered for the acquisition of more or less of the amount of water actually needed in that specific subbasin.

Stranger Creek Subbasin

Demand: 24.6 AF projected as consumptive use need by 2040

Project 14: Stranger Creek Water Right Acquisition



Designation

High

Type of Project

Acquiring Senior Water Rights

Location of Project

Stranger Creek Subbasin

Summary

This project would seek to acquire water rights from Stranger Creek and place them into the State Trust Water Right Program, administered through the WRIA 59 Water Bank. Stevens County is working with owners of a water right high in the Stranger Creek watershed. The Stranger Creek water right exceeds the 24.6 acre-feet annually for consumptive use needed to offset permit-exempt domestic water uses through the year 2040 (22.4 acre-feet for the planning period through 2038). Stevens County will work with the landowner to transfer the water rights to the State Trust Water Right Program as mitigation for new permit-exempt water uses.

In August 2019, the Department of Ecology issued a grant which, in part, funded feasibility work on this project. Specifically, the funding authorized the preliminary evaluation of the extent and validity of the water right and opportunity to transfer the water right to the State Trust Water Right Program. The extent and validity analysis demonstrates at least 35 acre-feet of consumptively used water rights available for transfer. The technical report is included in the Plan Addendum as Appendix C. Stevens County intends to seek grant funding to acquire the water right.

Permitting Need

Costs for due diligence, contract negotiation and extent and validity analysis for acquiring water rights.

Reference Information

Water Resource Inventory Area 59, Colville River Basin, Water Bank Feasibility Study, Task 4 Memo, Table 5, page 9. June 15, 2015.

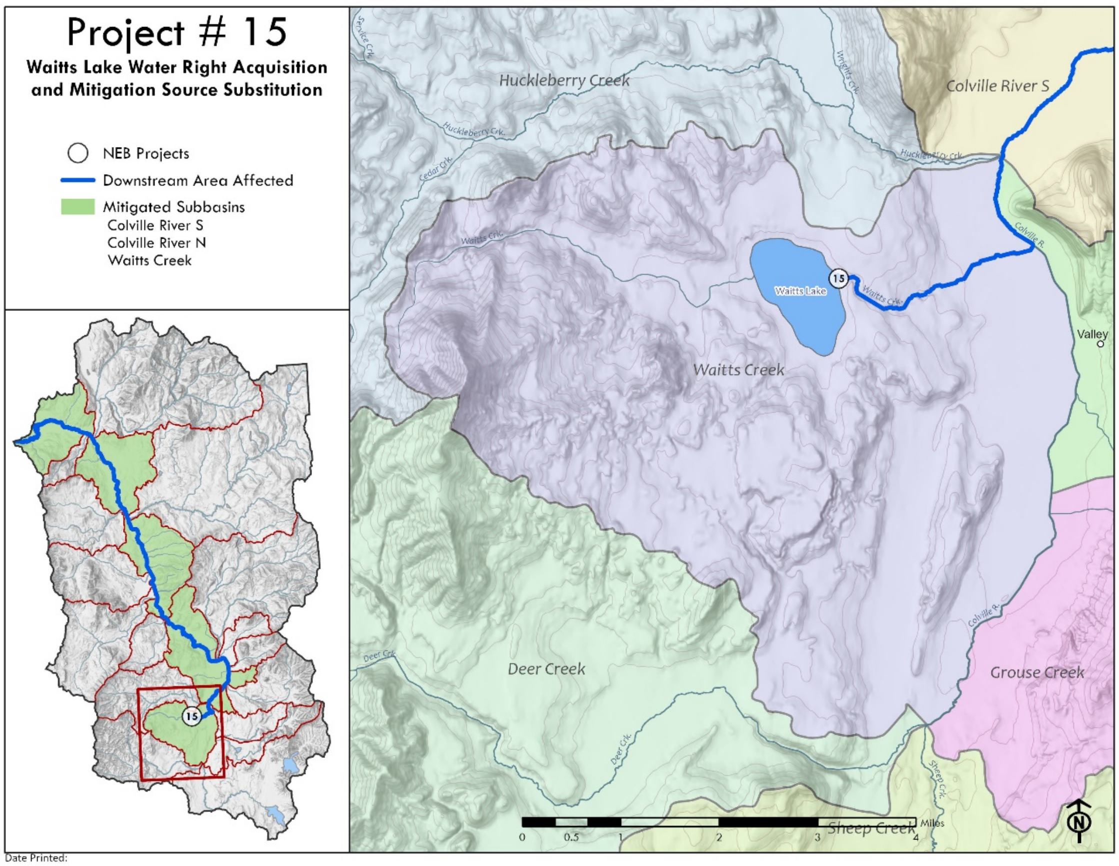
Cost

Approximately $90,000

Waitts Creek Subbasin

Demand: 5.9 AF projected as consumptive use need by 2040

Project 15: Water Right Acquisition and Mitigation Source Substitution



Designation

High

Type of Project

Acquiring Senior Water Rights

Location of Project

Waitts Lake, Waitts Creek

Summary

This project proposes to purchase Lake Sullivan Water Rights from Ecology's Office of Columbia River (OCR) to substitute for the Colville River water rights currently used to mitigate for Avista's Kettle Falls generating station. Avista's generating station is currently mitigated by water rights from Waitts Creek and Waitts Lake, within the Colville River Basin. The water rights were historically used for irrigation and for domestic use and include a reservoir permit component for storage in Waitts Lake and are currently held in the State Trust Water Right Program.

Avista's groundwater wells at its generating station have been found to be in hydraulic continuity with the Columbia River, therefore the groundwater right permit can be mitigated by water rights from the Columbia River Basin. Stevens County, Avista and representatives from Ecology's Eastern Regional Office and OCR met in July 2018 to discuss this project. OCR expressed a willingness to assign a portion of the State's Trust Water Rights to Avista, if compensated according to a Water Service Contract, in exchange for the use of Avista's Trust Water Rights from the Colville River basin to mitigate for new permit-exempt water uses under Chapter 90.94 RCW.

Ecology issued a certificate of the change of use of the Waitts Lake Water Rights currently held by the State Trust Water Right Program as the use of water in the amount of 15 gallons per minute, two acre-feet per year for continuous domestic supply and stock watering purposes; 814 gallons per minute 564.1 acre-feet per year for seasonal irrigation of 198 acres from May 15 to September 30; and fire protection as needed. Described below:

G3-21870C(A)

Trust Water Right Assigned Control Number:	5080279
Source:	2 wells
Use:	Irrigation of 198 acres, domestic supply & stock water
Period of Use:	Irrigation from May 15 to Sept. 30; domestic supply and stock water continuous year-round
Instantaneous Quantity (Qi):	829 gpm
Annual Quantity (Qa)	566.1 total AFY (564. 1 for irrigation, and 2.0 AFY for domestic and stockwatering
Priority Date	Oct. 1, 1973
Point of Diversion:	Two wells within SE1/4SW1/4 of Section 15, T. 31N., R. 40 E.W.M., Stevens County, Washington.
Place of Use:	W1/2SE1/4 and the SW1/4 lying east of Lapray Rd (Farm to Market Rd.), All in Section 15, T. 31N., R. 40 E.W.M.

Surface Water Claim No. 043871

Trust Water Right Assigned Control Number:	5080269
Source:	Outlet of Waitts Lake
Use:	Irrigation
Period of Use:	May 1 to Sept 15
Instantaneous Quantity (Qi):	Noted as entire flow
Annual Quantity (Qa)	426.89 AFY
Priority Date	1867
Point of Diversion:	N1/2SW1/4 of Section 15, T. 31N., R. 40E., W.M.
Place of Use:	N1/2SW1/4 of Section 15, T. 31N., R. 40 E., W.M.

Surface Water Claim No. 74 (a portion of):

Trust Water Right Assigned Control Number:	5080291
Source:	Waitts Lake
Use:	Irrigation of 198 acres
Period of Use:	May 1 to Sept 15
Instantaneous Quantity (Qi):	1.19 cfs
Annual Quantity (Qa)	564.1 AFY
Priority Date	July 21, 1919
Point of Diversion:	N1/2SW1/4 of Section 15, T. 31N., R. 40E., W.M.
Place of Use:	W1/2SE1/4 and the SW1/4 lying east of Lapray Rd (Farm to Market Road), All in Section 15, T. 31N., R. 40 E., W.M.

Reservoir Certificate No. 538 (a portion of):

Trust Water Right Assigned Control Number:	Unknown
Source:	Waitts Lake, Outlet to Waitts Creek, Reservoir Certificate
Use:	Water Storage and Irrigation
Period of Use:	Not noted
Instantaneous Quantity (Qi):	Not noted
Annual Quantity (Qa)	Grantor's portion is assumed to be 237.6 acre-feet of the total 564.1 AFY
Priority Date	July 21, 1919
Point of Diversion:	SE1/4 of Section 17, T. 31N., R. 40 E.W.M.
Place of Use:	Sec. 17 and N1/2 Sec. 20, T. 31N., R. 40 E.W.M., for irrigation of lands located at: W1/2SE1/4 and the SW1/4 lying east of Lapray Rd (Farm to Market Rd.), All in Section 15, T. 31N., R. 40 E.W.M.

This project is a high priority project for the WRIA 59 planning unit because it allows for the use of consumptively used water rights within the Colville River watershed to offset future permit-exempt domestic water use in accordance with RCW 90.94.020. The Waitts Creek and Waitts Lake water rights are considered a high priority project because the water rights are in the Upper Colville River Basin, senior priority to the rule, can be used to offset consumptive use, during the irrigation season, and some use year-round.

In October 2018, Stevens County, on behalf of the WMP and Board, applied for grant funding to acquire Sullivan Lake water rights from Ecology to substitute for the Waitts Lake water rights. In January 2019, Ecology approved the grant application. Ecology is currently working with Avista to effectuate the source substitution.

A total of 566.1 AF would be made available to benefit not only Waitts Creek, but also to offset the consumptive use impact of new permit exempt water uses in the larger Colville River Watershed. The extent and validity of the water rights were considered in 2011, and determined to include 451.45 AF of consumptively used water rights.

Permitting Need

Superseding water right permit for Avista to document a source substitution.

Reference Information

Washington Department of Ecology, Certificate of Change of Groundwater Certificate No. G3-21870C, Issued September 23, 1976, together with Certificate of Change Vol. I-3, Issued September 28, 1982, Recorded: Vol II-3, PP. 49 (Sept. 21, 2011).

Letter from Keith Stoffel, Section Supervisor, Water Resource Program to City of Chewelah, re Application for Change/Transfer under Ground Water Certificate No. G3-21870C STEV-10-05 (March 31, 2011).

Application for Grant Funding, WRSRP-2019-STCLSD-00033, WRIA 59 Water Right Acquisition and Source Substitution (October 31, 2018).

Letter from Mary Verner, Department of Ecology to Erik Johansen, Stevens County re approval of Application for Grant Funding (January 24, 2019).

Cost

$859,150 – Grant application approved in January 2019.

WRIA 59-wide

Project 16: Develop Watershed Improvement Best Management Practices Manual

Designation

High

Type of Project

Developing Natural and Constructed Infrastructure

Location of Project

Various

Summary

The WRIA 59 planning unit proposes to develop a manual, or multiple manuals to provide information to landowners on opportunities for small-scale water storage, improving organic matter in soil, water conservation, and irrigation efficiences. This project will benefit the Colville River Watershed by encouraging landscape scale community efforts to encourage more efficient water use and more natural hydrograph patterns through improved soil, storage and irrigation efficiencies.

The planning unit anticipates the creation of best management practices for improving soil and water conservation. As well as information on small scale storage including planning resources, permitting requirements and other local resoruces. The project will produce standard operating procedures and design manual for WRIA 59 landowners to encourage sustainable water use throughout the watershed. The planning unit recognizes that these small-scale projects will have wide ranging and profound impacts on the overall health of the Colville River watershed. The purpose of this project is to encourage projects in all the subbasins of the Colville River to improve water retention and reduce the outflow of water from the basin during the spring runoff. The planning unit anticipates the development of local expertise in these actions and encouraging the participation of landowners throughout the watershed. Many small actions supported in the local community can produce cumulative and long-lasting benefits to the watershed.

Permitting Need

To be determined

Reference Information

Washington Department of Ecology, Stormwater Management Manual for Eastern Washington, Pub. No. 04-10-076 . Sept. 2004

W.J. Rawls, et al, Effect of soil organic carbon on soil water retention, Geoderma, Vol 116, Issue 1-2, pg. 61-76 Sept. 2003; B. Minasny, A.B. McBratney, Limited effect of organic matter on soil available water capacity, European Journal of Soil Science,

Ecology Water Resources Program, Policy/Interpretative Statement Regarding Collection of Rainwater for Beneficial Use, POL-1017 (2009).

Washington State Conservation Commission, Conservation Districts of Washington, Irrigation Efficiencies Grants Program, information available online at: https://scc.wa.gov/iegp/

Stevens County Board of County Commissioners, Resolution 108-2003, In Support of Lobbying for the Creation of Water Storage Projects in Stevens County Watersheds (Sept 9, 2003)

Stevens County PUD, Resolution 7-2003 Support of Lobbying for the Creation of Water Storage Projects in Stevens County Watershed Areas (July 1, 2003)

Cost

To be determined

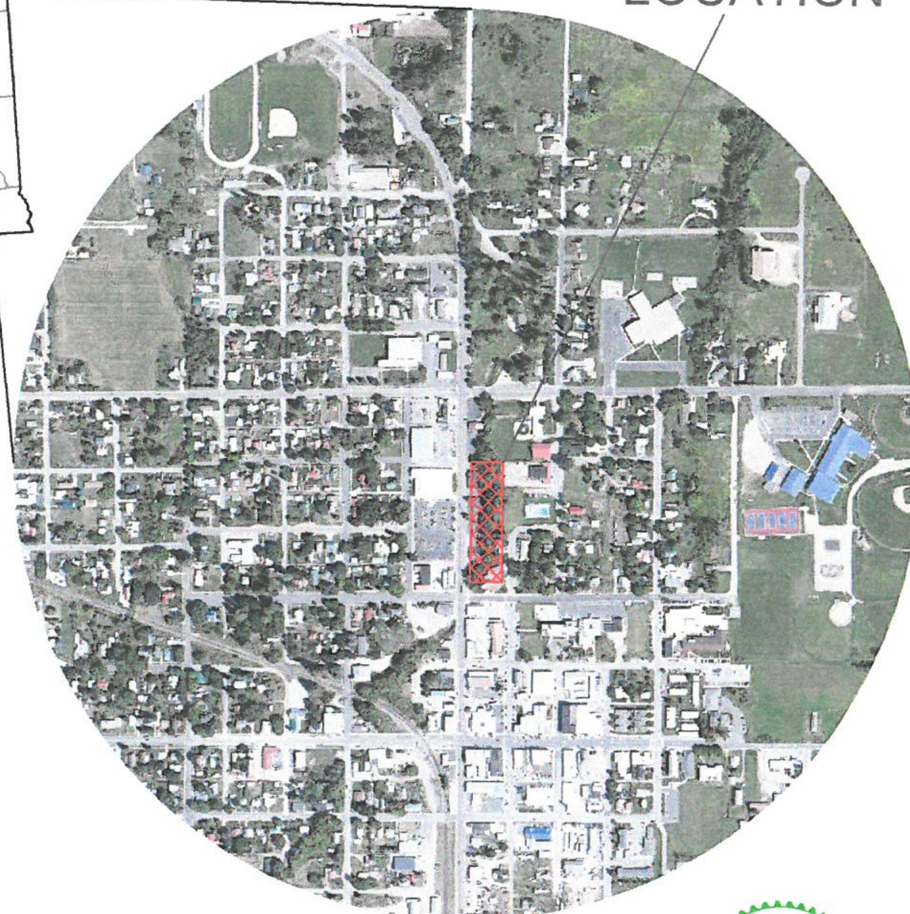
Attachment 1

Chewelah Cr Streambank Restoration, Engineering Report

from Wayne Cornwall, P.E. (June 28, 2016)

CHEWELAH CR STREAMBANK RESTORATION

WASHINGTON STATE



NOT TO SCALE

SHEET INDEX

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Wayne Cornwall
6/28/16

STEVENS COUNTY CONSERVATION DISTRICT (SPONSOR)

CHARLIE KESSLER
WATER QUALITY COORDINATOR
232 WILLIAMS LAKE RD.
COLVILLE, WA 99114
PH: (509) 685-0937 EXT 111
CELL: (509) 936-0972
CKESSLER@CO.STEVENS.WA.US

CORNWALL ENGINEERING (ENGINEER)

WAYNE CORNWALL, PE
3719D HARVEY CREEK RD
HUNTERS, WA 99137
PH: (509) 680-3108
CORNWALLENGINEERING@GMAIL.COM

MAP COURTESY: USGS Earthstar Graphics SIO 2016 Microsoft Corp. Bing

PURPOSE: STREAMBANK RESTORATION	PROJECT: SCCD CHEWELAH CR	STATE: WASHINGTON
PROPERTY: CHEWELAH VISION CLINIC	LOCATION: R BANK CHEWELAH CR	COUNTY: STEVENS
ADDRESS: 306 N PARK ST CHEWELAH, WA 99109	NEAR: UPSTREAM OF PARK ST	LOCATION: CITY OF CHEWELAH
	LAT: 47.278286°	APPLICANT: Stevens Co. Conserv. Dist.
REFERENCE #: .	LONG: -117.715341°	CREATED BY: G.NG DESIGNED BY: W.C.
DATUM: ELEVATIONS - NAVD88	WATER BODY: CHEWELAH CREEK	DATE: JUNE 28, 2016
FILE NAME: Gimness_ChewelahCrk.DWG	COVER SHEET	SHEET NUMBER 1 OF 7

CHEWELAH CR STREAMBANK RESTORATION

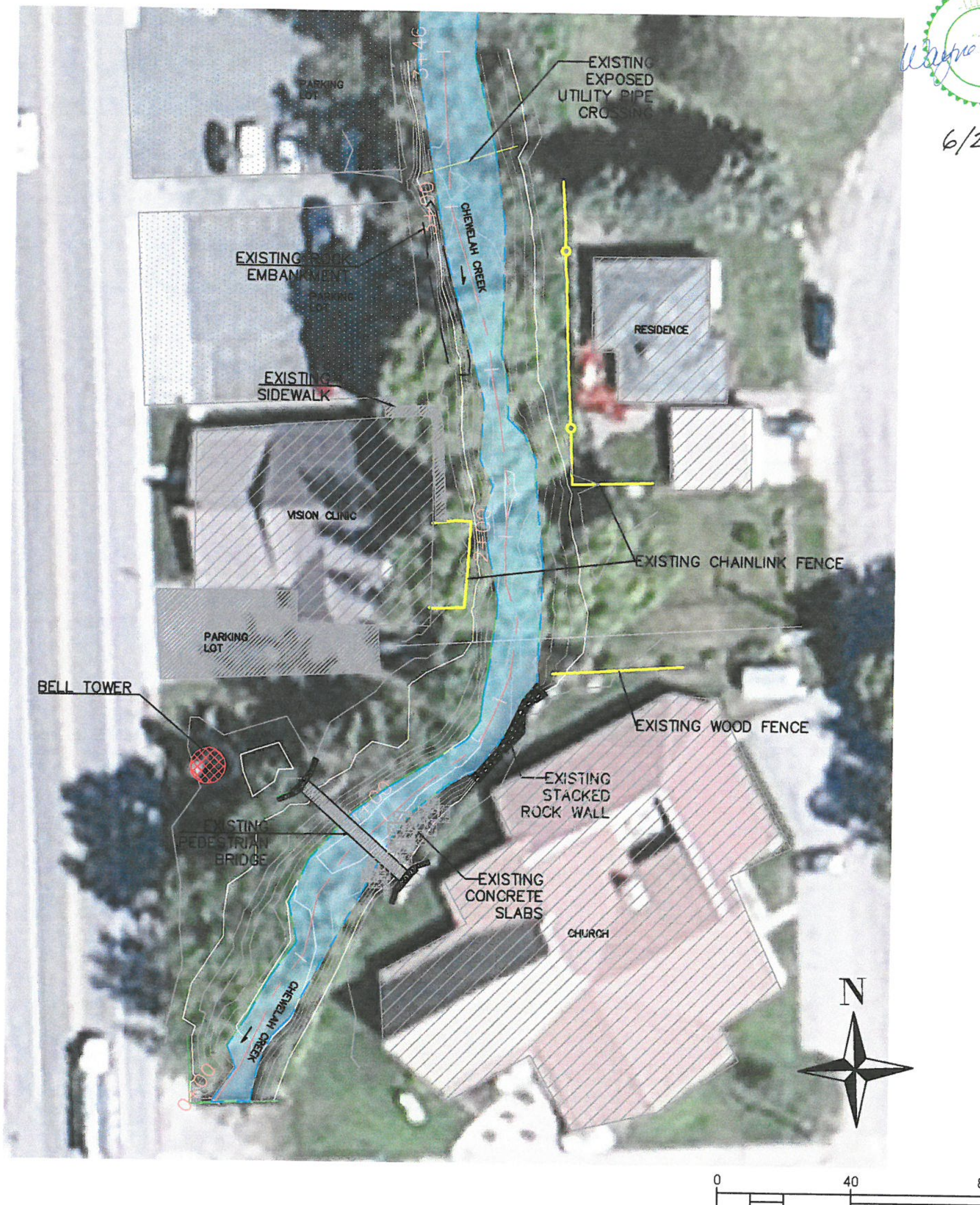
PURPOSE

THE PRIMARY SCOPE OF THE PROJECT IS TO PROVIDE PROTECTION FROM ACCELERATED BANK EROSION TO EXISTING STRUCTURES (VISION CLINIC) WHILE ALLOWING NATURAL PROCESSES TO OCCUR WITHIN THE STREAM CORRIDOR TO THE GREATEST EXTENT POSSIBLE. THIS WILL BE ACCOMPLISHED BY UTILIZING BIOENGINEERING TECHNIQUES IN TANDEM WITH STRUCTURAL PROTECTION CONSTRUCTED FROM NATURAL ELEMENTS. IN ADDITION THE PROJECT WILL REMOVE NOXIOUS WEEDS AND DEAD TREES FROM THE PROJECT AREA, UTILIZE VEGETATIVE CUTTINGS AND PLANT NATIVE VEGETATION ALONG STREAM.

GENERAL NOTES

1. THE DESIGNS AND DRAWINGS HAVE BEEN PREPARED EXCLUSIVELY FOR THIS PROJECT AND SHOULD NOT BE APPLIED FOR ANY PURPOSE OR PROJECT EXCEPT THE ONE SPECIFIED IN THE PROJECT TITLE. ADDITIONAL DESIGNS ARE PROPOSED FOR ADJACENT PROPERTIES WHICH CAN BE APPLIED INDEPENDENTLY OR SIMULTANEOUSLY DEPENDING ON FUNDING, LANDOWNER PREFERENCE AND PERMITTING.
2. THE PLAN AND SURVEY USED IS APPROXIMATE BASED ON TOPOGRAPHIC SURVEY DATA COLLECTED BY CORNWALL ENGINEERING AND EMERSON SURVEYING ON MAY 20, 2016. SHEET 7 OF 7 INCLUDES CONTROL POINT AND NAVD88 ELEVATION. COORDINATES SHALL NOT BE USED OR TRUSTED AS SURVEY GRADE WITHOUT CONSULTATION WITH THE ENGINEER AND HIS SURVEYOR.
3. THE LOCATIONS SHOWN IN THESE PLANS ARE APPROXIMATE AND RELY ON LAYOUT AND STAKING IN THE FIELD BY THE ENGINEER OR SPONSOR.
4. THE DETAILS SHOWN IN THE DESIGN MAY BE MODIFIED IN THE FIELD BY THE ENGINEER OR SPONSOR. THIS MODIFICATION AND COORDINATION IS EXPECTED AS PART OF THE PROJECT WORK AND SHALL BE ACCOUNTED FOR IN THE ASSOCIATED BID ITEMS.
5. ALL WORK BELOW THE ORDINARY HIGH WATER LINE SHALL BE COMPLETED WITHIN THE IN-STREAM CONSTRUCTION WINDOW FOR THE ASSOCIATED WATER BODY. THOSE PORTIONS OF THE PROJECT WORK THAT OCCUR OUTSIDE OR ABOVE THE ORDINARY HIGH WATER CHANNEL (ABOVE THE CORPS JURISDICTIONAL LINE) ARE NOT SUBJECT TO THE WORK PERIODS DESCRIBED ABOVE.
6. EVERY REASONABLE EFFORT SHALL BE MADE TO CONDUCT THE RESTORATION ACTIVITIES SHOWN IN THESE DRAWINGS, IN A MANNER THAT MINIMIZES THE ADVERSE IMPACT TO THE STREAM ECOLOGY.
7. ALL ACTIVITIES THAT INVOLVE WORK ADJACENT TO OR WITHIN THE WETTED CHANNEL MUST MEET WATER QUALITY STANDARDS, PURSUANT TO THE CLEAN WATER ACT OR APPLICABLE STATE AND LOCAL LAW.
8. AERIAL IMAGERY IS COMPLIMENTS OF USGS EARTHSTAR GRAPHICS SIO 2016 MICROSOFT CORPORATION, BING MAPS, WHICH IS OVERLAID TO REFERENCE THE LOCATION OF THE PROJECT BUT IS NOT TO BE CONSIDERED ACCURATE.
9. INSTREAM HABITAT, STABILIZATION, ENHANCEMENT AND/OR RESTORATION PRACTICES INVOLVE THE PLACEMENT OF LARGE WOODY DEBRIS, LARGE ROCKS AND OTHER NATURAL AND ARTIFICIAL MATERIALS. THESE PRACTICES ARE DESIGNED TO STABILIZE STREAMBEDS, BANKS AND FLOODPLAINS BY RESTORING NATURAL PROCESSES WHERE ANTHROPOGENIC FORCES HAVE ADVERSELY AFFECTED THE FLUVIAL SYSTEM. HOWEVER THEY CAN CARRY POTENTIAL HAZARDS. STEVENS COUNTY CONSERVATION DISTRICT AND LANDOWNERS SHOULD ADDRESS SAFETY CONCERNS AS THEY SEE FIT.
10. ALL WOODY STRUCTURES PROPOSED WILL BE DESIGNED TO INDEPENDENTLY WITHSTAND BOTH BUOYANT AND HYDRAULIC DRAG FORCES FOR THE 100YR FLOOD EVENT. IN GENERAL, WOODY DEBRIS HAS THE POTENTIAL TO MOBILIZE DURING HIGH WATER FLOW CONDITIONS RESULTING IN INJURY, DEATH, AND/OR PROPERTY LOSS.
11. IN GENERAL, CHANNEL EROSION, MIGRATION AND/OR AVULSIONS CAN BE EXPECTED TO OCCUR TO SOME DEGREE OVER TIME. THESE CHANNEL BEHAVIORS ARE NATURAL AND ARE EXPECTED. COMPLETELY ELIMINATING THESE PROCESSES HAS SEVERE DETRIMENTAL IMPACTS TO THE FLUVIAL ECOSYSTEM AND ASSOCIATED HABITATS.
12. AFTER CONSTRUCTION, LONG-TERM EROSION PROTECTION MEASURES MUST BE ENACTED. THESE MEASURES WILL CONSIST OF NATIVE RIPARIAN SPECIES PLANTINGS, EROSION CONTROL FABRIC, SEEDING, AND MULCHING. MAINTENANCE ACTIVITIES MAY BE REQUIRED.
13. EXISTING IRRIGATION EXISTS ON THE SITE, REMOVE AND REPLACE. INCORPORATE THE USE OF IRRIGATION DURING REPLACEMENT FOR IRRIGATION OF LIVE CUTTINGS, NATIVE PLANTINGS AND LANDSCAPING SOD.
14. PERIODICAL INSPECTION OF THE BIOENGINEERING SLOPE PROTECTION SHOULD OCCUR AT LEAST BIANNUALLY IN THE FALL AFTER LEAF FALL AND AGAIN IN THE LATE SPRING/EARLY SUMMER AFTER HIGH FLOWS IN THE STREAM HAVE SUBSIDED. IRREGULARITIES SHALL BE FURTHER INVESTIGATED BY THE ENGINEER OR SPONSOR. MAINTENANCE MAY BE REQUIRED TO ENSURE THE FUNCTIONALITY OF THESE DESIGNS.

PURPOSE: STREAMBANK RESTORATION	PROJECT: SCCD CHEWELAH CR	STATE: WASHINGTON 6/28/16
PROPERTY: CHEWELAH VISION CLINIC	LOCATION: R BANK CHEWELAH CR	COUNTY: STEVENS
ADDRESS: 306 N PARK ST	NEAR: UPSTREAM OF PARK ST	LOCATION: CITY OF CHEWELAH
CHEWELAH, WA 99109	LAT: 47.278286°	APPLICANT: Stevens Co. Conserv. Dist.
REFERENCE #: .	LONG: -117.715341°	CREATED BY: G.NG DESIGNED BY: W.C.
DATUM: ELEVATIONS - NAVD88	WATER BODY: CHEWELAH CREEK	DATE: JUNE 28, 2016
FILE NAME: Gimness_ChewelahCrk.DWG	NOTES	SHEET NUMBER 2 OF 7



Wayne Cornell
6/28/16

PURPOSE: STREAMBANK RESTORATION	PROJECT: SCCD CHEWELAH CR	STATE: WASHINGTON
PROPERTY: CHEWELAH VISION CLINIC	LOCATION: R BANK CHEWELAH CR	COUNTY: STEVENS
ADDRESS: 306 N PARK ST CHEWELAH, WA 99109	NEAR: UPSTREAM OF PARK ST	LOCATION: CITY OF CHEWELAH
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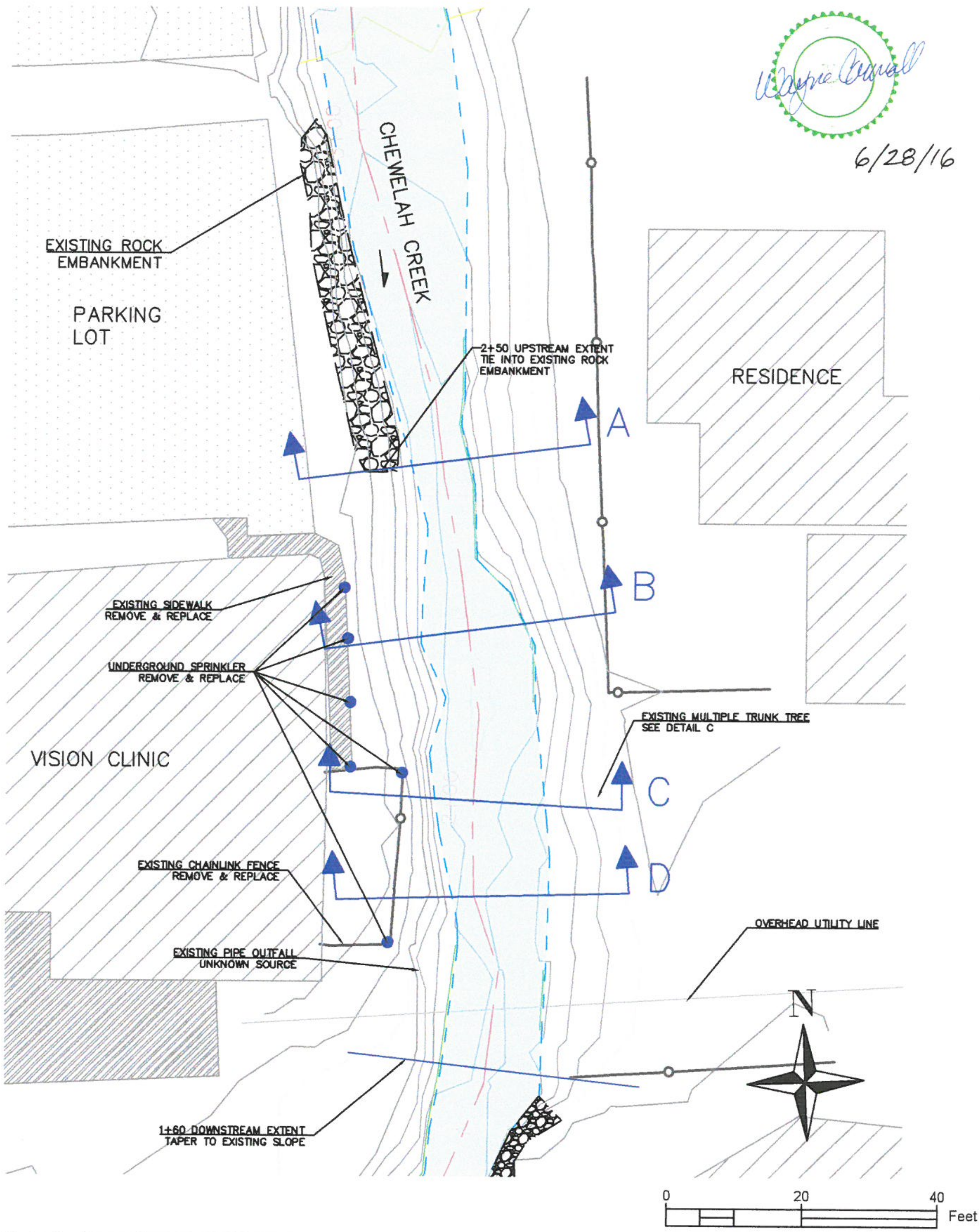
DATUM: ELEVATIONS - NAVD88	LONG: -117.715341°	CREATED BY: G.NG DESIGNED BY: W.C.
	WATER BODY: CHEWELAH CREEK	DATE: JUNE 28, 2016
FILE NAME: Gimness_ChewelahCrk.DWG	EXISTING PLAN	SHEET NUMBER 3 OF 7



PURPOSE: STREAMBANK RESTORATION	PROJECT: SCCD CHEWELAH CR	STATE: WASHINGTON
PROPERTY: CHEWELAH VISION CLINIC	LOCATION: R BANK CHEWELAH CR	COUNTY: STEVENS
ADDRESS: 306 N PARK ST CHEWELAH, WA 99109	NEAR: UPSTREAM OF PARK ST	LOCATION: CITY OF CHEWELAH
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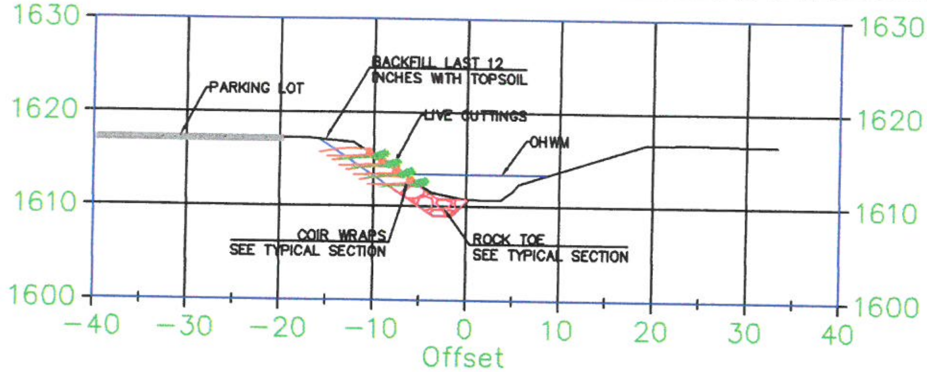
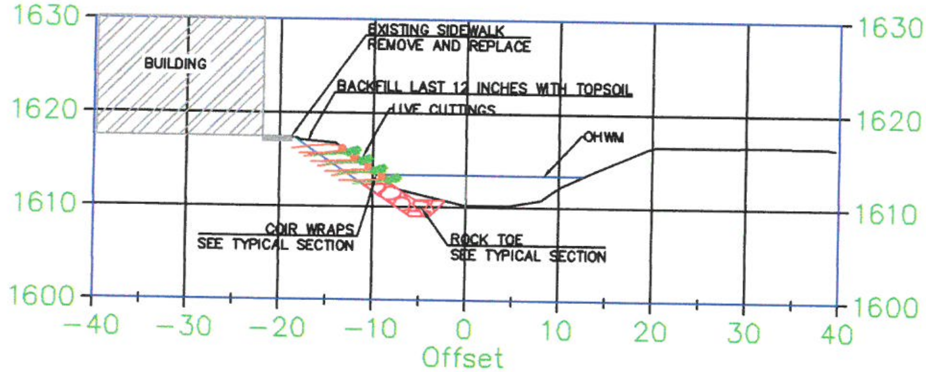
REFERENCE #: .	LONG: -117.715341°	CREATED BY: G.NG DESIGNED BY: W.C.
DATUM: ELEVATIONS - NAVD88	WATER BODY: CHEWELAH CREEK	DATE: JUNE 28, 2016
FILE NAME: Gimness_ChewelahCrk.DWG	PROPOSED PLAN	SHEET NUMBER 4 OF 7

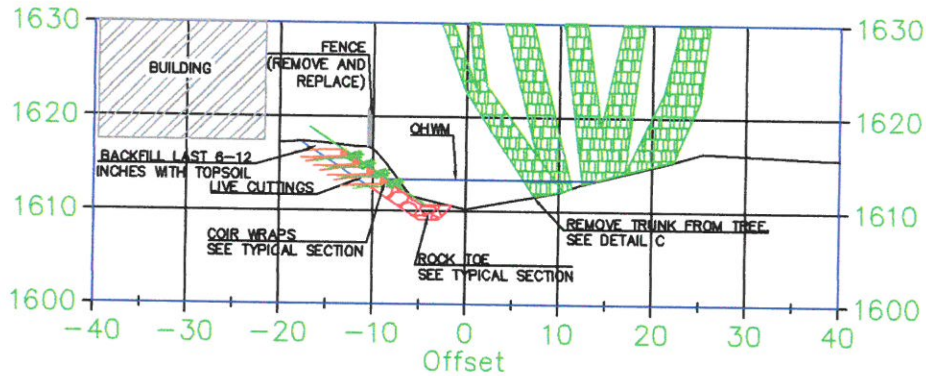


SECTION A

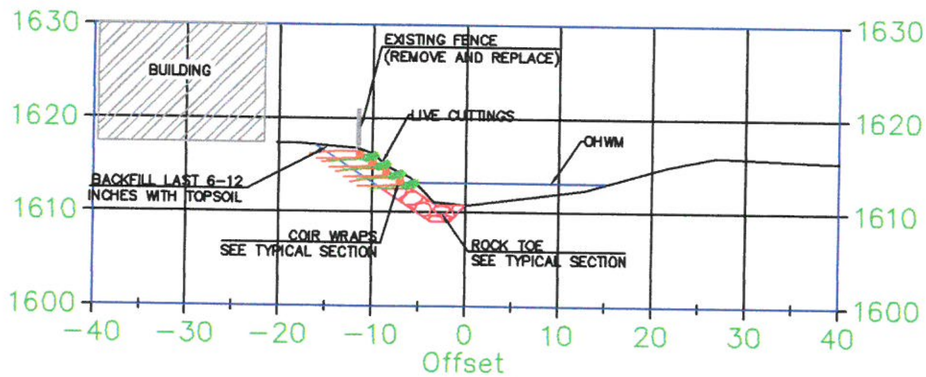
6/28/16



SECTION B



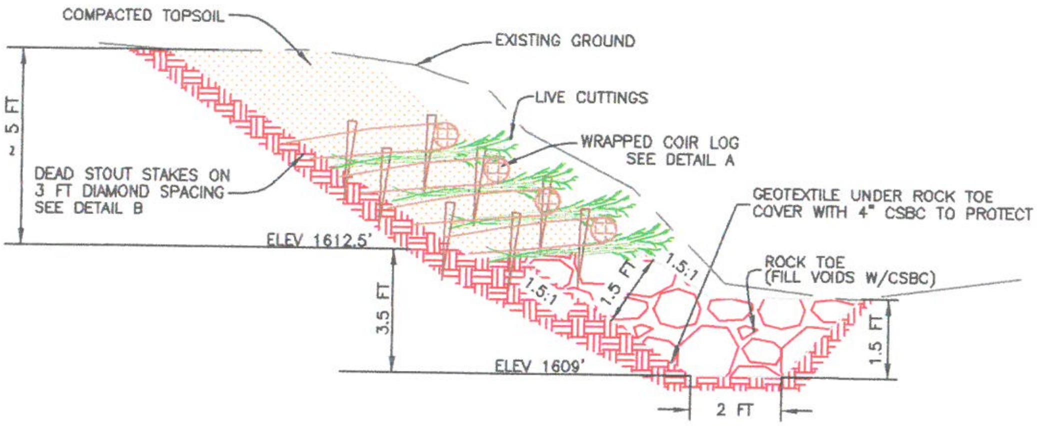
SECTION C



SECTION D

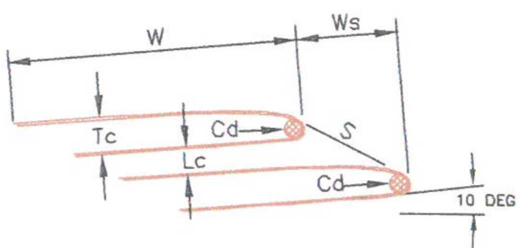
PURPOSE: STREAMBANK RESTORATION	PROJECT: SCCD CHEWELAH CR	STATE: WASHINGTON
PROPERTY: CHEWELAH VISION CLINIC	LOCATION: R BANK CHEWELAH CR	COUNTY: STEVENS
ADDRESS: 306 N PARK ST CHEWELAH, WA 99109	NEAR: UPSTREAM OF PARK ST	LOCATION: CITY OF CHEWELAH
REFERENCE #: .	LAT: 47.278286° LONG: -117.715341°	APPLICANT: Stevens Co. Conserv. Dist. CREATED BY: G.NG DESIGNED BY: W.C.
DATUM: ELEVATIONS - NAVD88	WATER BODY: CHEWELAH CREEK	DATE: JUNE 28, 2016
FILE NAME: Gimness_ChewelahCrk.DWG	CROSS SECTIONS	SHEET NUMBER 5 OF 7

6/28/16



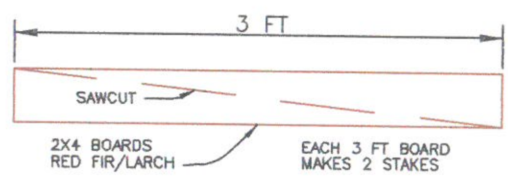
BANK PROTECTION TYPICAL SECTION

NOT TO SCALE



DETAIL A

NOT TO SCALE



DETAIL B

NOT TO SCALE

COIR WRAP DIMENSIONS							
Station	Section	W (FT)	Ws (FT)	S	Tc (IN)	Lc (IN)	Cd (IN)
1+60 TO 2+50	SHT 6	6+	1.50	1.5:1	9	3	8

LIVE CUTTINGS						
Station	Section	DIA (IN)	LENGTH (FT)	CUTTINGS/FT EACH ROW	NUMBER ROWS	SPECIES
1+60 TO 1+80	SHT 6	0.5–3	6–8	8	3	WILLOW
1+80 TO 2+50	SHT 6	0.5–3	6–8	8	4	WILLOW

GENERAL NOTES

1. GEOTEXTILE FOR SOIL SEPERATION SHALL MEET WSDOT STD. SPEC. 9–33.2(1) TABLE 3 – NON-WOVEN
2. COIR LOGS SHALL MEET WSDOT STD. SPEC. 9–14.5(7).
3. COIR FABRIC USED IN THE SOIL WRAP SHALL BE NEDIA KOIRWRAP 1200 OR EQUIVALENT INSTALLED PER MANUFACTURERS RECOMMENDATIONS.
4. COIR FABRIC SHALL BE ANCHORED ON A 3 FOOT MINIMUM SPACING WITH DEAD STOUT STAKES CONSTRUCTED PER DETAIL B. ANCHORS SHALL BE INSTALLED AT EACH LAYER DURING THE SOIL LIFT CONSTRUCTION TO FULLY ANCHOR THE COIR FABRIC TO THE UNDERLYING LAYERS. WIRE ANCHORS MAY BE USED FOR TEMPORARY ANCHORING, BUT THE STRUCTURAL ANCHORING MUST BE COMPLETED WITH DEAD STOUT STAKES. DEAD STOUT STAKES ARE TO BE DRIVEN BY HAND STOPPING JUST PRIOR TO THE POINT OF REFUSAL AND "BOUNCE-BACK".
5. COIR WRAP SHALL BE FILLED WITH COMPACTED SOIL. SOIL SHALL BE COMPRISED OF MIXTURE CAPABLE OF SUSTAINING VEGETATIVE GROWTH. TYPICALLY THE SOIL EXCAVATED FROM THE BANK IS SUITABLE.
6. ADDITIONALLY ANCHOR FULLY THROUGH THE COIR WRAP AND COIR LOG ON 18 INCH SPACING WITH 2 FOOT LONG 1X1 WOOD STAKES.
7. LIVE CUTTINGS SHALL CONFORM TO THE DIMENSIONS IN THE TABLE AND SHALL BE HARVESTED FROM DORMANT LOCAL STOCK. CUTTINGS SHOULD BE FROM HEALTHY MATERIAL FREE FROM ROT, SPLITS, DISEASE AND INSECT INFESTATION. CUTTINGS SHOULD BE MADE FROM 2+ YEAR OLD MATERIAL, NOT FIRST YEAR WHIPS.
8. LIVE CUTTINGS SHOULD BE SOAKED FOR A MINIMUM OF 24 HOURS IN COOL, AERATED WATER. OPTIMAL IS 5 TO 7 DAYS OF SOAKING. REFERENCE NRCS STREAMBANK SOIL BIOENGINEERING FIELD GUIDE FOR LOW PRECIPITATION AREAS FOR ADDITIONAL INFORMATION.

ROCK TOE GRADATION	
% PASSING	DIAMETER (IN)
100	15
84	10 TO 12
50	4 TO 6
16	#40 TO #4 SIEVE
5–10	#200 SIEVE

CSBC GRADATION	
% PASSING	DIAMETER (IN)
99–100	1 1/4
80–100	1
50–80	5/8
25–45	#4 SIEVE
3–18	#40 SIEVE
7.5 MAX	#200 SIEVE

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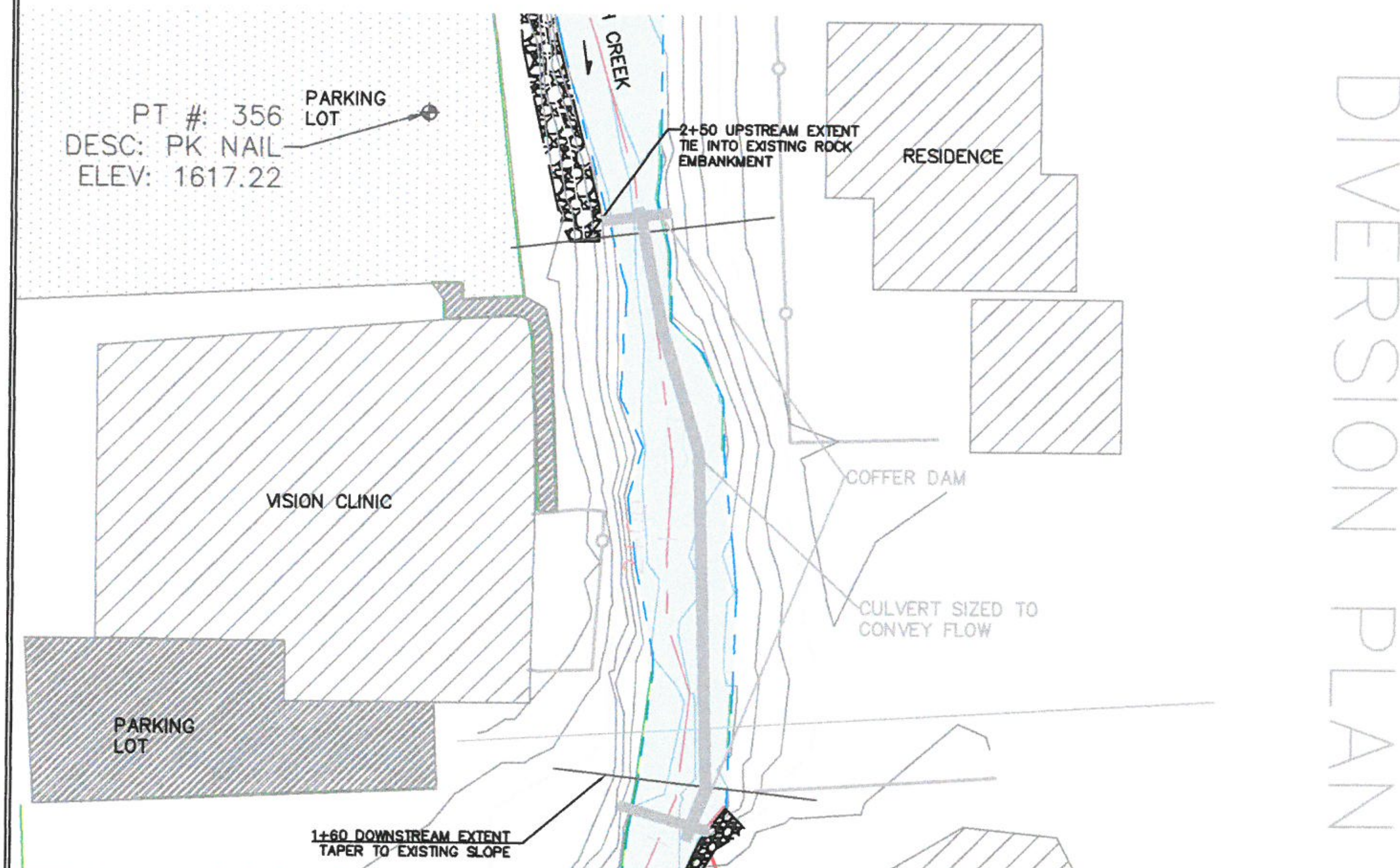
FILE NAME: Gimness_ChewelahCrk.DWG	BANK PROTECTION DETAILS	SHEET NUMBER 6 OF 7

6/28/16

DETAIL C



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FILE NAME: Gimness_ChewelahCrk.DWG	DETAIL C & DIVERSION PLAN	SHEET NUMBER 7 OF 7

Attachment 2

City of Chewelah, Determination of Non-Significance (DNS), SCUP-01-2018 – SSDE-01-2018 (July 5, 2018)

CITY OF CHEWELAH
301 E. Clay Street, Chewelah, WA 99109
P.O. Box 258
Phone: 509-935-8311

DETERMINATION of NON-SIGNIFICANCE (DNS)

SCUP-01-2018 – SSDE-01-2018

Description of proposal:	Request for a Shoreline Conditional Use Permit to perform bank stabilization along Chewelah Creek to provide protection from accelerated bank erosion to Chewelah Vision Clinic building.
Proponent:	William Gimness
Location:	Parcel 290000, 306 N. Park St., Chewelah, WA 99109; NW ¼ section 13, Township 32N, Range 40E, Stevens County, WA
Documents available to review at:	Chewelah City Hall, 301 E. Clay St., Chewelah, WA 99109
Lead Agency:	City of Chewelah

The lead agency for this proposal has determined that it does not have a probable significant adverse impact on the environment. An environmental impact statement (EIS) is not required under RCW 43.21C.030(2)(c). This decision was made after review of a completed environmental checklist and other information on file with the lead agency. This information is available to the public on request.

☐ There is no comment period for this DNS.

☒ This DNS is issued after using the optional DNS process in WAC 197-11-355. There is no further comment period on the DNS.

☐ This DNS is issued under WAC 197-11-340(2); the lead agency will not act on this proposal for 14 days from the date below.

You may appeal this threshold determination by addressing those criteria as set forth in CMC 18.20.050 and CMC 16.04.240 and then by filing per CMC 18.20.050.B such with the Chewelah City Council for service to the SEPA responsible official(s).

Appeals and comments must be submitted no later than **July 19th, 2018 by 5:00 PM.**

Responsible Official	City Administrator
Contact Person	Jackie Caro, Contract Planner
Mailing Address	301 E. Clay Street, Chewelah, WA 99109
Phone	(509) 835-3770

Date: **Signature:** Michael Frizzell

CC: SEPA Agency Notification List

For Publication on July 5th, 2018

Attachment 3

Grant Application No. SETHA-2019-StCoCD-00008,

Stevens County Conservation District,

Chewelah Creek Streambank Restoration (March 28, 2019)

General Information

Project Title	Chewelah Creek Streambank Restoration Project
Project Short Description	Chewelah Creek flows through the City of Chewelah and has caused considerable degradation to banks with in the city. The Eye Clinic is on the creek and has experienced bank erosion that has the potential to cause structural damage to the building. Stevens County Conservation District (SCCD) has been looking into this situation since 2015. The project would provide a bioengineered approach to alleviating the threat of catastrophic bank failure.
Project Long Description	Chewelah Creek is a water of statewide significance. Each spring it carries large flows that threaten streambanks within the City of Chewelah. SCCD has been active in preventing streambank erosion in the City of Chewelah since 1997. In 2015, SCCD organized a stream walk for landowners, state and federal regulatory agencies, city officials, and the interested public. It was agreed at that time that the potential for serious bank erosion to add significant sediment to Chewelah Creek as well as perhaps man-made objects to the creek should be addressed. SCCD worked with a local engineer to obtain designs for treating the situation on one stream segment within the city. Attempts to get these designs implemented have failed because of the lack of funding to help the interested landowners. Because of this, SCCD has reduced the potential project area to make a project more financially feasible. The current landowner is very much in favor of the project and local, state, and federal approval have been granted. The City of Chewelah has issued a determination of non-significance, WDFW has issued a HPA, and the Corps of Engineers issued a letter of permission. The primary scope of the project is to provide protection from accelerated bank erosion to exisitng structures while allowing natural processes to occur within the stream corridor to the greatest extent possible.This will be accomplished by utilizing bioengineering techniques in tandem with structure protection constructed from natural elements. In addition the project will remove noxious weeds and dead trees from the project area and utilize vegetative cuttings and native vegetation along the stream. Since the original design of 2016, the exisiting rock embankment upstream of the project area is no longer in place due to bank erosion. This situation will be addressed by taking the approriate measures to key all the proposed work back into the bank to prevent Chewelah Creek from cutting behind the proposed stabilization project. A copy of the stamped design is uploaded to this application.

Jenkins High School students will be involved in the planting of native vegetation as a part of this project. Aubrey Markel the agricultural sciences teacher will et her students involved with collecting willow cuttings and asisting in the planting during the project.

Total Cost	$56,918.27	Total Eligible Cost $48,408.27
Effective Date	7/1/2019	Expiration Date 6/30/2020
Ecology Program	Shorelands	
Project Category	✔ Restoration or Enhancement Environmental Emergency Statewide Significance	

Will Environmental Monitoring Data be collected? No

Overall Goal

To restore a portion of the bank of Chewelah Creek

To protect structures along the creek

To provide an educational opportunity for local high school students

To serve as a demonstration site to show others in the city what is possiblle to protect their streambank

Task Number	2		
Task Title	Construct Streambank Stabilization project	Task Cost	$45,908.27*
Task Description	The placement of large woody debris, large rocks, and other natural and artificial materials will be used to enhance instream habitat, stabilize the streambank, and restore the bank so that it can withstand future erosive flows in Chewelah Creek. These practices are designed to stabilize streambeds, banks, and floodplains by restoring natural processes where anthropogenic forces have adversely affected the fluvial system. All woody structures will be designed to independently withstand both buoyant and hydraulic drag forces for the 100 year flood event. All work below the ordinary high water line shall be completed within the WDFW instream construction work window for Chewelah Creek; generally 1 July to 30 September. The flow of Chewelah Creek will be diverted away from the bank involved in the project as long as there is work below the ordinary high water line. Native willows such as Drummond, coyote, or McKenzie willow will be used to provide long term erosion protection for the completed project. These willows will either be purchased from regional suppliers or gathered by high school student volunteers.		
Task Goal Statement	The primary scope of the project is to provide protection from accelerated bank erosion to existing structures - The Eye Team vision clinic adjacent to Chewelah Creek - while allowing natural processes to occur within the stream corridor to the greatest extent possible. This will be accomplished by utilizing bio-engineering techniques in tandem with structural protection constructed from natural elements. In addition the project will remove noxious weeds and dead trees from the project area and utilize vegetative cuttings and native vegetation along the stream.		
Task Expected Outcomes	Stabilize approximately 80 feet of eroding bank on the right bank of Chewelah Creek in the City of Chewelah. The completed project will prevent further material from entering Chewelah Creek where it can cause serious flooding issues as it passes through several culverts on its way to the Colville River. It will also reduce the sediment load that would eventually be deposited in the Colville River which already has a sediment deposition issue.		

How does this project restore or enhance the natural environment?

The bank behind the vision clinic is eroding severely and is in danger of failing entirely, depositing sediment and possibly building materials into the creek. With a box culvert just downstream of the project site, any material added to the creek has the potential of blocking the culvert and causing considerable collateral damage to a church and to Highway 395. A blockage at the site will also affect residences on the other side of the creek and businesses upstream of the site.

The project will use bioengineering techniques to stabilize the streambank and will be used as a demonstration of what can be done in urban areas to prevent active bank erosion. There are several areas along Chewelah Creek within the City of Chewelah that are susceptible to severe bank erosion. This project will be used to show other landowners along the creek that there are ways of stabilizing banks other than dumping large chunks of concrete into the stream.

The use of native woody vegetation as a part of the project will enhance this reach and will hopefully encourage others to do the same. At least one upstream landowner has already contact SCCD about the potential of doing some planting on their site. Depending upon the timing of the project and liability issues, Jenkins High School students may be encouraged to assist in the planting.

From a failing slope, the project site will be converted into a fully vegetated, stable environment. SCCD has had previous experience conducting bank stabilization within the city limits. In a 1997 project, concrete sidewalk slabs were removed from 400 feet of Chewelah Creek in the city park. ArmorFlex mats were installed and covered with sod to stabilize the bank while allowing recreational access to the creek for the many families that use the park. The park has withstood several flood events in the last 21 years and the banks are still functioning as designed.

Has a THA Grant been previously awarded for this project or a similar one at the same site? Yes No ✔

If yes, please indicate:

Prior Grant's Number:
Year:
Project Title:

Identify sources and type of funding other than through this program grant. Include expected dates of participation. Upload letters of commitment, offer letters, application approvals etc.

Source and Type of Funding

Source	Amount	Percentage	Status	Dates of Participation
Washington Conservation Commission	$5,000.00		paid to	August 2016

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, SEATTLE DISTRICT
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

Regulatory Branch September 20, 2018

Mr. William Gimness
306 North Park Street
Chewelah, Washington 99109

Reference: NWS-2018-46
Chewelah Vision Clinic
Bank Stabilization

Dear William Gimness:

We have reviewed your application to install a coffer dam to isolate the work area and use a bioengineered design of rock and plantings to stabilize the streambank of Chewelah Creek at Chewelah, Stevens County, Washington. Based on the information you provided to us, Nationwide Permit (NWP) 13, Bank Stabilization and Nationwide Permit (NWP) 33, Temporary Construction, Access, and Dewatering (Federal Register January 6, 2017, Vol. 82, No. 4), authorizes your proposal as depicted on the submitted drawings provided you implement the mitigation plan dated June 18, 2016.

In order for this authorization to be valid, you must ensure the work is performed in accordance with the enclosed *NWP 13 and 33, Terms and Conditions* and the following special conditions:

a. You shall implement and abide by the mitigation plan, Chewelah Creek Streambank Restoration dated June 18, 2016. Mitigation shall be constructed before or concurrent with the work authorized by the permit.

b. An as-built mitigation construction report and as-built drawings of the mitigation area(s) shall be submitted upon completion of mitigation construction. This report must be submitted to the U.S. Army Corps of Engineers, Seattle District, Regulatory Branch (Corps) for review and approval and must prominently display the reference number NWS-2018-0046. The year mitigation construction is completed, as determined by the Corps, represents Year 0 for mitigation monitor

c. Mitigation monitoring reports shall be submitted annually for 5 years to the U.S. Army Corps of Engineers, Seattle District, Regulatory Branch (Corps) by December 1st of each monitoring year. Year 1 monitoring will occur at least one year after completion of the mitigation site as determined by the Corps. All reports must prominently display the reference number NWS-2018-0046.

d. Your responsibility to complete the required compensatory mitigation as set forth in Special Conditions “a” through “c” will not be considered fulfilled until you have demonstrated mitigation success and have received written verification from the U.S. Army Corps of Engineers, Seattle District, Regulatory Branch.

We have reviewed your project pursuant to the requirements of the Endangered Species Act, the Magnuson-Stevens Fishery Conservation and Management Act and the National Historic Preservation Act. We have determined this project complies with the requirements of these laws provided you comply with all of the permit general and special conditions.

Please note that National General Condition 21, *Discovery of Previously Unknown Remains and Artifacts*, found in the *Nationwide Permit Terms and Conditions* enclosure, details procedures that must be followed should an inadvertent discovery occur. You must ensure that you comply with this condition during the construction of your project.

The authorized work complies with the Washington State Department of Ecology’s (Ecology) Water Quality Certification (WQC) requirements for this NWP. No further coordination with Ecology for WQC is required.

You have not requested a jurisdictional determination for this proposed project. If you believe the U.S. Army Corps of Engineers does not have jurisdiction over all or portions of your project you may request a preliminary or approved jurisdictional determination (JD). If one is requested, please be aware that we may require the submittal of additional information to complete the JD and work authorized in this letter may not occur until the JD has been completed.

Our verification of this NWP authorization is valid until March 18, 2022, unless the NWP is modified, reissued, or revoked prior to that date. If the authorized work has not been completed by that date and you have commenced or are under contract to commence this activity before March 18, 2022, you will have until March 18, 2023, to complete the activity under the enclosed terms and conditions of this NWP. Failure to comply with all terms and conditions of this NWP verification invalidates this authorization and could result in a violation of Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act. You must also obtain all local, State, and other Federal permits that apply to this project.

You are cautioned that any change in project location or plans will require that you submit a copy of the revised plans to this office and obtain our approval before you begin work. Deviating from the approved plans could result in the assessment of criminal or civil penalties. Civil administrative penalties are described in the enclosure *Clean Water Act Class I Administrative Penalties*.

Upon completing the authorized work, you must fill out and return the enclosed *Certificate of Compliance with Department of the Army Permit*. Thank you for your cooperation during the permitting process. A copy of this letter with enclosures will be furnished to Mr. Charlie Kessler, Stevens County Conservation District. If you have any questions, please contact me at dale.j.jorda@usace.army.mil or (206) 316-3967.

Sincerely,

Jess Jordan, Project Manager
Regulatory Branch

Enclosures

Attachment 4

Hydraulic Project Approval Permit No. 2018-1-163+01,
Chewelah Vision Clinic (Aug. 30, 2018)

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, SEATTLE DISTRICT
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

Regulatory Branch September 20, 2018

Mr. William Gimness
306 North Park Street
Chewelah, Washington 99109

Reference: NWS-2018-46
Chewelah Vision Clinic
Bank Stabilization

Dear William Gimness:

We have reviewed your application to install a coffer dam to isolate the work area and use a bioengineered design of rock and plantings to stabilize the streambank of Chewelah Creek at Chewelah, Stevens County, Washington. Based on the information you provided to us, Nationwide Permit (NWP) 13, Bank Stabilization and Nationwide Permit (NWP) 33, Temporary Construction, Access, and Dewatering (Federal Register January 6, 2017, Vol. 82, No. 4), authorizes your proposal as depicted on the submitted drawings provided you implement the mitigation plan dated June 18, 2016.

In order for this authorization to be valid, you must ensure the work is performed in accordance with the enclosed *NWP 13 and 33, Terms and Conditions* and the following special conditions:

a. You shall implement and abide by the mitigation plan, Chewelah Creek Streambank Restoration dated June 18, 2016. Mitigation shall be constructed before or concurrent with the work authorized by the permit.

b. An as-built mitigation construction report and as-built drawings of the mitigation area(s) shall be submitted upon completion of mitigation construction. This report must be submitted to the U.S. Army Corps of Engineers, Seattle District, Regulatory Branch (Corps) for review and approval and must prominently display the reference number NWS-2018-0046. The year mitigation construction is completed, as determined by the Corps, represents Year 0 for mitigation monitor

c. Mitigation monitoring reports shall be submitted annually for 5 years to the U.S. Army Corps of Engineers, Seattle District, Regulatory Branch (Corps) by December 1st of each monitoring year. Year 1 monitoring will occur at least one year after completion of the mitigation site as determined by the Corps. All reports must prominently display the reference number NWS-2018-0046.

d. Your responsibility to complete the required compensatory mitigation as set forth in Special Conditions "a" through "c" will not be considered fulfilled until you have demonstrated mitigation success and have received written verification from the U.S. Army Corps of Engineers, Seattle District, Regulatory Branch.

We have reviewed your project pursuant to the requirements of the Endangered Species Act, the Magnuson-Stevens Fishery Conservation and Management Act and the National Historic Preservation Act. We have determined this project complies with the requirements of these laws provided you comply with all of the permit general and special conditions.

Please note that National General Condition 21, *Discovery of Previously Unknown Remains and Artifacts*, found in the *Nationwide Permit Terms and Conditions* enclosure, details procedures that must be followed should an inadvertent discovery occur. You must ensure that you comply with this condition during the construction of your project.

The authorized work complies with the Washington State Department of Ecology's (Ecology) Water Quality Certification (WQC) requirements for this NWP. No further coordination with Ecology for WQC is required.

You have not requested a jurisdictional determination for this proposed project. If you believe the U.S. Army Corps of Engineers does not have jurisdiction over all or portions of your project you may request a preliminary or approved jurisdictional determination (JD). If one is requested, please be aware that we may require the submittal of additional information to complete the JD and work authorized in this letter may not occur until the JD has been completed.

Our verification of this NWP authorization is valid until March 18, 2022, unless the NWP is modified, reissued, or revoked prior to that date. If the authorized work has not been completed by that date and you have commenced or are under contract to commence this activity before March 18, 2022, you will have until March 18, 2023, to complete the activity under the enclosed terms and conditions of this NWP. Failure to comply with all terms and conditions of this NWP verification invalidates this authorization and could result in a violation of Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act. You must also obtain all local, State, and other Federal permits that apply to this project.

You are cautioned that any change in project location or plans will require that you submit a copy of the revised plans to this office and obtain our approval before you begin work. Deviating from the approved plans could result in the assessment of criminal or civil penalties. Civil administrative penalties are described in the enclosure *Clean Water Act Class I Administrative Penalties*.

Upon completing the authorized work, you must fill out and return the enclosed *Certificate of Compliance with Department of the Army Permit*. Thank you for your cooperation during the permitting process. A copy of this letter with enclosures will be furnished to Mr. Charlie Kessler, Stevens County Conservation District. If you have any questions, please contact me at dale.j.jorda@usace.army.mil or (206) 316-3967.

Sincerely,

Jess Jordan, Project Manager
Regulatory Branch

Enclosures

Attachment 5

Stevens County Conservation District,

Lower Mill Creek Study (Nov. 21, 2012)

LOWER MILL CREEK STUDY

INTRODUCTION

Mill Creek is one of the largest tributaries of the Colville River, contributing nearly 20 percent of the river's flow. The creek's main valley contains many homes and farms and is currently experiencing one of the fastest rates of development in Stevens County. Recently, residents near the mouth of Mill Creek have experienced problems related to the flooding of their homes, businesses, and farms.

Historically, the lower section of Mill Creek was a shallow, densely vegetated, meandering channel in which the deposition of sediment caused the streambed level to rise, leading to frequent flood events and the periodic creation of alternate channels within the valley. This process created a relatively flat and evenly sloped valley floor with a rich, organic silt loam top soil, ideal for farming. However, the potentially productive farm land was often unworkable due to flooding, native riparian vegetation and trees, and a high water table. These conditions are similar to those historically found in the Colville River Valley, into which Mill Creek flows.

In the early 1900's, extensive dredging and straightening of the Colville River began, allowing for greater use of the surrounding land. This dredging has, at multiple times, included the mouth and significant portions of Mill Creek, freeing up land for crops and houses while producing an unstable stream system dependent on dredging. In the last several decades, new barriers to dredging have come about (including increased permitting requirements and cost, and public opinion), to the point that dredging is now only pursued as an emergency effort following damaging flood events. Without regular stream maintenance, the accumulation of sediment within Mill Creek's channel causes the stream to regress towards its natural state, leading to the flooding of farmland and homes that have since been developed within the valley.

Currently, the lower two and a half miles of Mill Creek are being examined in an effort to develop flood control measures. Seven landowners have holdings immediately adjacent to the lower portion of Mill Creek, which includes four homes. Additional landowners have property and/or homes in the valley that may be at risk to future flooding. Some locations currently experience annual flooding or saturation, leading to the loss of farmable ground (specifically wheat crops), and at times, forced resident evacuations.

Current Conditions

Stream management in the recent past has mainly consisted of the periodic dredging of the streambed (roughly every ten to twenty years) in order to maintain lower streambed levels and to prevent floods or to diminish flood magnitudes. Riparian vegetation was also cleared along the stream because it was once thought that doing so would accelerate stream flow by reducing friction along the banks. However, it has since been found that such actions are highly detrimental. Together these two practices have resulted in steep, unstable and highly erodible banks, particularly at meander bends. This bank erosion has accelerated channel build up downstream where US Highway 395 and Mill Creek meet. As the streambed begins to fill in through the deposition of sediment, the creek overflows its banks and begins channel migration to the west, threatening farmland and homes.

When US Highway 395 (formerly Highway 3) was constructed across the valley, it formed a barrier to any surface water flowing down Echo Valley to the Colville River, as can be seen on aerial photos and photos of past floods. During the construction of the highway, a bridge was constructed across Mill Creek and a set of culverts were installed one-half mile west of the creek to accommodate surface flow towards the Colville River. However, during flood events, water impounds against the north side of the highway and is regulated into the river by the bridge and culvert system. This leads to a prolonged flood period for properties north of the highway. Additionally, the Kettle Falls International Railway bridge and an underground fiber optic cable now cross Mill Creek just below Highway 395, contributing to complications related to stream maintenance and flood flows.

Recent Flood History

Beginning in 1996, Mill Creek flooded for three consecutive springs with a magnitude great enough to force some local residents to evacuate. During the 1998 flood, the flood waters also threatened the Stevens County Conservation District building. That year, a Hydraulic Project Application (HPA) was approved by the Washington Department of Fish and Wildlife to “clean out [the] stream channel” and to “dredge [the] accumulated bedload to increase channel capacity”. This dredging was effective at preventing significant flooding until the spring of 2011. In 2011 and 2012, residents witnessed the return of spring time floods of a magnitude great enough to cause some to evacuate. These disruptive spring floods are expected to continue on an annual basis until a solution is implemented.

Concerns

Presently, residents of Stevens County are being negatively impacted by flood events on the lower portion of Mill Creek. Mrs. Elly Huguenin and her mother live just north of Highway 395, less than 1,200 feet from the Mill Creek and Highway 395 bridge. Over the past 16 years, Elly’s home has been flooded six times, forcing her and her family members to evacuate the house. Elly is worried that future floods may cause her to lose her home, which she would not be able to replace. In addition to the flooding of the Huguenin residence, farm lands to the north and south of Highway 395 have experience significant flooding and saturation. This has resulted in the damage or loss of crops and a shift of land use in some places from crop land to cattle pasture. The increase of cattle grazing on lands adjacent to lower Mill Creek have led to an increase in bank damage and fecal coliform bacteria present within the stream.

Water quality is also of concern in the lower Mill Creek area. Total suspended solids, which is a measure of material (mostly sediment) suspended in and being transported by the stream, has been identified as one parameter of concern. Bank stabilization efforts have been made to reduce the levels of suspended sediments in lower Mill Creek; however, additional action is needed to reduce concentrations to satisfactory levels. The other parameter of concern is fecal coliform bacteria, which is derived from mammalian wastes, including that of humans, livestock, and wildlife. The most common transport mechanism for these bacteria is rainfall events. Furthermore, during and after flood events, already high levels of fecal coliform bacteria are often exacerbated as flood waters wash manure from cattle pastures into the stream.

Fish and wildlife habitat could also be significantly enhanced in the lower Mill Creek area. By widening the riparian corridor and planting cottonwoods, willows, and other native riparian vegetation, bank stability could be improved. This vegetation would also provide additional cover for many species, including large predatory birds such as bald eagles. By reducing sediment contributed to the stream by bank erosion and by increasing shade on the stream through the promotion of riparian vegetation, clearer and cooler water can be provided for fish and other aquatic life.

Objective

Through cooperation with landowners, state and federal agencies, and the public, Stevens County Conservation District hopes to develop and implement a solution that will protect the properties of Stevens County residents, as well as improve the hydrological and ecological conditions within the watershed.

Lower Mill Creek Characterization

Physical Environment

History of Dredging Affecting Mill Creek

Dredging in the Colville Valley began in the early years of the 20th century to improve and expand farm land. Residents of the valley organized themselves into several dredging districts, each responsible for clearing and maintaining its own portion of the river. Sometime between 1906 and 1911, Dredging District Number 2 (comprised of the Colville City Chambers of Commerce and local landowners) completed work on the section of the Colville River that includes the mouth of Mill Creek. It is unknown whether a portion of the creek was also dredged as part of this effort, but any work done at the confluence of the Colville River and Mill Creek would have almost certainly affected conditions within Mill Creek. Therefore, this was likely the first significant human disturbance of the lower portion of Mill Creek.

Early aerial photos strongly suggest that Mill Creek originally was a dual channel system where it enters the Colville River. In 1933, the highway bridge was constructed across Mill Creek about

1,000 feet upstream from the Colville River. It is unknown whether it was during the construction of this bridge, or during the earlier construction of the railway bridge, that Mill Creek would have been confined to one channel at its mouth. If this was the case, such alteration of the stream would have caused a greater destabilization of Mill Creek.

In 1942, the Colville River Flood Control Association was formed and became responsible for the section of the Colville River that includes the mouth of Mill Creek. The Association worked with the state Department of Conservation and Development to dredge near the mouth of Mill Creek in 1945. In 1959, the Colville River Flood Association worked in cooperation with the Soil Conservation Service (SCS) to dredge the Colville River from Mill Creek downstream to the location of Palmer’s Siding (roughly 2,300 feet).

Sixteen years later, in 1975, the Colville River Flood Control Association came to the SCS for assistance in dredging the same stretch of the Colville River. The SCS was hesitant to take on the project without a thorough environmental assessment. As a result, landowners and the Colville River Flood Control Association funded the permitted project themselves. Dredging was completed in 1976.

From 1980 to 1997, eleven Hydraulic Project Approval (HPA) permits were issued for bank stabilization and protection projects on the lower portions of Mill Creek. The majority of these projects included armoring banks with rip rap.

After several consecutive years of significant flooding on lower Mill Creek, the Colville Flood Control Association and local landowners obtained permits for dredging and clearing the mouth of Mill Creek in 1998. Dredging took two days and involved three drag lines and 2 backhoes, as well as some additional equipment. Unfortunately, information about the volume of material removed from the creek is not available, as the Association has since disbanded and all records held by them have been disposed of.

Recent Flood History

Properties and Assets at Risk

Summary of Available Data

Aerial Reconnaissance

A photo flyover was conducted in August 2012 to provide better understanding of current conditions and to aid in communication among landowners, specialists, and technicians. Aerial photo targets were placed at 1,000 foot intervals from the mouth of Mill Creek to the crossing with Williams Lake Road. At each target, hydrologic surveys were conducted to determine current stream conditions, as described in the next section.

Aerial photos were arranged in a 24" x 120" poster format for presentation to landowners during a community review meeting this summer with the project team. From these photos, problem areas could be more easily identified and corroborated with landowner concerns. Additionally, old stream channels and damage to cropland from previous floods could be identified.

The aerial photos and the final poster are available at the Stevens County Conservation District.

Stream Morphology Surveys

In the summer of 2012, Stevens County Conservation District worked in cooperation with hydrology crews from the Colville National Forest to complete 12 stream surveys on the lower two miles of Mill Creek using the Rosgen classification system. These surveys were conducted to determine the stability and overall condition of the stream.

Of the 12 reaches surveyed, ten were classified as B4 stream types. A "B" stream type describes a channel whose width is at least 12 times its depth (width/depth ratio), is moderately entrenched (referring to how deeply the channel is cut into the surrounding landscape), has a moderate sinuosity (a measurement of how much the stream meanders), and is composed of sections of rapids and irregularly spaced scour pools. The "4" in "B4" denotes that the streambed is predominately composed of gravel size particles, along with lesser amounts of sands, cobbles, and boulders. This stream type is not well suited for handling the high sediment supply of Mill Creek.

The two remaining reaches surveyed were found to be F4 stream types. "F" channels are wide, shallow, and deeply cut into the landscape (entrenched). Width/depth ratios are greater than 12 and the channel meanders dramatically (has a high sinuosity). The high degree of entrenchment means that banks are tall and steep, often to the point of being vertical. This results in an elevated rate of bank erosion caused by both slope failure due to gravity, and by the inability of riparian vegetation to either colonize on steep banks and/or to aid in stream bank stabilization (due to bank heights exceed rooting depths). As with B4 stream types, the "4" in "F4" means that the channel bed is largely composed of gravel sized particles along with sands, cobbles, and possibly the occasional boulder. F stream types are largely unstable and contribute significantly to the sediment supply within a stream due to the high rate of bank erosion.

Through additional data collection and analysis, a natural channel design could be developed that would provide for improved sediment transport capacity, bank stability, and a decrease in flood magnitude; thereby reducing or eliminating the need for stream maintenance and providing flood protection for crop lands and residences.

Stream Flow Data

The collection of stream flow data for Mill Creek has been discontinuous over the years. The earliest data was collected by the U.S. Geological Survey, while the most recent and pertinent data has been collected by the Stevens County Conservation District.

- *U.S. Geological Survey*

  Beginning in September 1954, the U.S. Geological Survey began recording daily flow measurements for Mill Creek. This effort was suspended in September 1960 and did not resume until September of 1980. Daily recordings at the USGS gauge were ceased in September of 1986.

  This data may be used to assist specialists in developing an understanding of conditions within Mill Creek at different times in its history (i.e. before and after flooding or dredging events that occurred while flow measurements were being taken).

- *Stevens County Conservation District*

  In the spring of 2007, the Stevens County Conservation District installed a gauge near the mouth of Mill Creek to collect low flow data. To date, data has been compiled for the low flow seasons of 2007, 2008, and 2009.

  This flow data has been used by the Washington State Department of Ecology (WA DOE) and the Watershed Resource Inventory Area 59 (WRIA 59) Board to address issues related to water rights and fish habitat. The WRIA 59 Board is currently working to change regulations on water rights within Stevens County but must do so in a way that will not negatively impact stream ecology. The main concern is that water levels within Mill Creek must not fall below a WA DOE mandated level meant to protect fish and other aquatic biota. For this reason, any work done on lower Mill Creek must maintain or improve low flows within the stream.

Water Quality Monitoring

Beginning in 1997, the Stevens County Conservation District established 16 water quality sampling sites within the Mill Creek watershed. Extensive water quality sampling was conducted within the Mill Creek watershed from November 1997 to August 1999. In 2004 and 2005, sampling was conducted at 14 of these sites during high and low flow periods. This data provides a background for water quality within the watershed and identifies water quality issues that can be addressed and may be improved through future flood management actions taken on lower Mill Creek.

The following is a list of parameters tested for during each sampling period:

<u>1997- 1999:</u>

- Flow
- Specific conductance
- pH
- Water temperature
- Dissolved oxygen
- Fecal coliform
- Fecal coliform loading
- Turbidity

- Total suspended solids
- Total suspended solids loading
- Total phosphorus
- Total phosphorus loading
- Soluble reactive phosphorus
- Soluble reactive phosphorus loading
- Total nitrogen
- Total nitrogen loading
- Ammonia-nitrogen
- Ammonia-nitrogen loading
- Total Kjeldahl nitrogen
- Total Kjeldahl nitrogen loading
- Nitrate +Nitrite – nitrogen
- Nitrate + Nitrite – nitrogen loading

<u>2004 -2005:</u>

- Stream flow
- Stream temperature
- Dissolved oxygen
- Specific conductance
- pH
- Total suspended solids
- Turbidity
- Nitrate + Nitrite - nitrogen
- Ammonia – nitrogen
- Total Kjeldahl nitrogen
- Total phosphorus
- Soluble reactive phosphorus
- Total alkalinity
- Fecal coliform bacteria

Findings from the 1997-1999 study can be found in the *Mill Creek Water Quality Summary Report*, and the findings from the 2004-2005 study can be found in the *Mill Creek Watershed Plan Implementation Project.* Both documents are available at the SCCD office.

Proposed Corrective Options

Option 1 – No action

If no action is taken, the flooding of lower Mill Creek will continue and is expected to worsen. Impending floods will impact crop land immediately north of Highway 395, as well as the Huguenin residence. It is predicted that flooding will also affect the business Protection Plus during the next flood event, with flood waters likely topping Highway 395 within the next two to three flood events.

Channel migration is another serious concern, as evidence shows that Mill Creek has changed its course multiple times in its past. This is a common natural occurrence in similar stream systems. Aerial observation revealed the existence of a previous steam channel on the west side of the valley with which Mill Creek might realign itself should flooding continue. The severely undersized culvert system would not allow for the adequate passage of floodwaters.

Option 2 – Relocate Mrs. Huguenin

Mrs. Huguenin has expressed her willingness to be relocated to a house comparable to her current residence, provided it is financed by a state or federal agency. This option does not address flooding to croplands.

Option 3 – Fill and Raise the Huguenin property

A second option to protecting Mrs. Huguenin's home might be to raise the house and then to fill under it and the rest of her property, similar to the way the storage facility property was filled after being purchased from Mrs. Huguenin. This approach would likely provide her with protection from flood waters but would not address flooding to farm land. Additionally, this approach may increase flood depths on other properties, including the adjacent cropland, by reducing the area of land available for the distribution of flood waters during flood events.

Option 4 – Ditch Improvement

The owner of the self storage facility to the west of Mrs. Huguenin has expressed his openness to widen the ditch along the north side of highway. This action would not prevent flooding of the Huguenin property or adjacent crop lands, but would instead slightly reduce the depth and duration of flooding by expediting drainage of the potentially flooded properties. However, WSDOT is offering challenges to the owner of the storage facility regarding revised access across the ditch.

This option would include the following actions:

- Increasing bottom width of the ditch along the north side of the highway to 10' to allow water impounded by the highway and adjacent self-storage facility to drain west to the existing culvert system.

- Replacing the existing access to the storage facility to accommodate increased flood water drainage.

Option 5 – Storage

Water storage is another possible solution to the flooding of lower Mill Creek. By constructing either an instream or off channel storage structure, water from storm events and spring snow melt could be retained to reduce flood magnitude and then be released later in the season to supplement stream levels in the lower portion of the watershed during periods of low flow. More information on the types of storage systems and potential storage sites within the Mill Creek watershed is offered in Chapter 6 of the *Mill Creek Watershed Plan Implementation Project* available at the SCCD office.

Option 6 – Dredging

Historically, the solution to the flooding of Mill Creek has been to dredge the creek bottom and to remove gravel and sand bars, especially near the mouth of the creek. By dredging the lower

6,000 feet of Mill Creek to previous bed levels, the rate of discharge in the stream could be significantly increased. This would better accommodate flood flows and would lower flood depths north of the highway. This is considered a temporary solution unless periodically repeated.

WSDOT has expressed their hesitation to dredge under their bridge at highway 395. Furthermore, a fiber optic line runs under the riverbed just downstream from the WSDOT bridge, making dredging difficult in this location, if not unadvisable. Because both sites are relatively close to the mouth of the creek, excluding them from dredging would greatly reduce the benefits of this action.

Option 7 – Revised Dredging Strategy

In addition to the dredging proposed in Option 6, a new dredging system could be implemented to reduce the cost and permitting required for the maintenance of Mill Creek. Instead of removing sediment from the active channel, settling sites could be constructed at strategic points along the lower two and a half miles of Mill creek. The construction of an access road could allow machinery to reach the settling sites and regularly remove accumulated sediment. Additionally, this option may produce marketable materials, the proceeds from which could help to offset the cost of sediment removal.

Option 8 – Channel redesign

Upon further review of stream conditions, a channel design could be developed that would eliminate the need for dredging and sediment removal within Mill creek, as well as significantly reduce the magnitude of flooding. As discussed previously, dredging and other actions, such as changes in land use and the removal of riparian vegetation, have lead to the development of a channel that is currently in disequilibrium and is not able to effectively handle its sediment load. Natural channel design would entail changing the dimensions, patterns, and profile of the stream to create a stream type that would be suited to the valley and the sediment transport needs of the system.

Additional Studies Needed

It is recommended that the following studies be completed in order to obtain a more complete understanding of the stream system. The additional data provided by these studies will enable specialists and administrators to pursue the best possible course of action for the watershed and the residents of Stevens County.

Sediment Studies

For a stream to be in dynamic equilibrium, meaning that the bed of the stream is neither significantly building up (aggrading) nor significantly cutting down (degrading), it must be able to effectively transport sediment in order to maintain its channel. Currently, Mill Creek is aggrading. As sediment continues to accumulate at the mouth of the creek and at several places within the channel, flooding will become increasingly frequent.

- *Bedload Study*
  This study looks at particles moving along the bed of the stream. Determining the rate and volume of particles moving through Mill Creek in this way will provide specialists with the data needed to develop sediment rating curves for the stream. Sediment rating curves would be instrumental in producing a channel design that would enable the stream to transport the sediment load required to achieve equilibrium and eliminate the need for dredging.

- *Depth Integrated Suspended Sediment Study*
  This study looks at how sediment is moving within the water column of a stream. Samples are taken across a cross-section and at multiple depths, and then analyzed to determine the amount of fine particles being transported in units of weight per day. A depth integrated suspended sediment study would be particularly helpful for work on lower Mill Creek. As the stream flattens in the valley, much of the fine sediment carried within the water column may settle, adding to the material that currently needs to be dredged to decrease flooding. Additionally, data provided by this study can be collected and compared from different locations within the stream to help identify significant areas of erosion. Samples can also be collected at different times of the year to provide information on how suspended sediment loads are affected by stream stage as well as rainfall and flooding events.

Resurveying of Permanent USFS Cross-sections
The U.S. Forest Service has established 12 permanent cross-sections on lower Mill Creek. Initial surveys provided detailed information on the banks, channel, and substrate at each reach. By resurveying these cross-sections, trends in channel progression can be identified. Data for individual reaches can be expanded and refined, providing critical information about bank erosion and channel alteration through hydrologic processes.

APPENDICES

Cross section graphs
Aerial Photos and maps
Flood and dredging timeline

Attachment 6

Stevens County Conservation District,

Mill Creek Watershed Plan Implementation Project, Draft,
Chapter 6, Feasiblity Study of Water Storage Possibilities in the
Mill Creek Watershed (Grant No. G0200314)

CHAPTER 6

Feasibility Study of Water Storage Possibilities in the Mill Creek Watershed

INTRODUCTION

The Mill Creek Watershed Management Committee was concerned with flooding during storm events and during snowmelt runoff periods. The impact of this flooding is particularly evident in the Lower Mill Creek Subwatershed. This flooding results in large amounts of suspended and bedload material being added to the creek. As this material reaches the lower portion of the watershed, it settles out, aggrading the channel bottom, leading to additional over-bank flow and channel migration. These flood waters flow across fields that have been used for livestock grazing and often contribute to the fecal coliform bacteria loading found in the creek. The committee recommended that a study be made of the feasibility of providing detention storage for high flows to reduce the amount of nutrients and fecal coliform bacteria reaching surface waters; to reduce flood damage; and to provide water for the augmentation of low flows.

With the recent drought conditions throughout the state of Washington, much attention has been given to both instream and out-of-stream water needs. While there might be an abundance of water in an area, this water is not available uniformly throughout the year. In the Mill Creek Watershed, streamflows are highest in the late winter and spring when the demand for water is lowest and lowest in the summer when the demand is the highest. One solution to this dilemma is to store water when there is excess runoff and high streamflows in the winter and spring and release it during the low flow periods when it is needed by both people and fish.

The objective of this feasibility study was to identify water storage areas that had the potential to meet multiple water needs within the Mill Creek Watershed. The study does not define the water needs, but it identifies prospective storage opportunities based upon the physical characteristics of the watershed. Watershed hydrology, geology, fish distribution and habitat, and land ownership were not explored in detail during this study, but would be integral parts of any future efforts to establish off-channel storage areas.

DETENTION STORAGE OF WATER

While the Mill Creek Watershed Plan Implementation Project gave direction to explore off-channel storage possibilities, the District used this opportunity to also review the feasibility of instream storage within the Mill Creek Watershed. This decision was based in part upon comments made by former Mill Creek Watershed Management Committee members at the time that the District received this grant from Ecology. There is a strong line of thinking that instream storage is what is needed in the Mill Creek Watershed. The District hoped that including instream storage in this study would help to clarify the issues involved in this type of storage, and whether instream storage would be suitable for the Mill Creek Watershed.

A general overview of both off-channel and instream storage systems follows.

Off-Channel Storage: General Considerations

Off-channel impoundments of water are located outside of the main valley of the stream system being studied, completely off any stream or on intermittent streams. Water to fill the storage area can be diverted from established channels by gravity or through the use of a pump system. Examples of off-channel storage areas are: natural topographic depressions that are dammed; constructed ponds or basins; and wetlands, either natural or constructed. Off-channel storage may be designed to include habitat enhancement such as is found with developing wetlands areas.

Positive effects of off-channel storage

- Can provide water to augment summer low flows and provide water for out-of-stream uses
- Can vary in size and location i.e. can be located and made of sufficient size to meet small scale agricultural irrigation needs while still being able to augment low flows
- Can be designed to include wetlands and habitat improvements to provide an additional environmental benefit
- There is little instream impact associated with these storage facilities and therefore it is easier to receive the proper permits

Negative effects of off-channel storage

- It can involve considerable land area and therefore the most disruption

- Water stored will be lost to both evaporation and subsurface seepage; the later may be reduced by using a liner, but this will add considerably to the cost of the project
- Storage areas can become filled with sediment, reducing storage capacity and eventually requiring cleaning; cleaning is expensive and there is the problem of where to place the material that has been removed from the storage area
- Water stored over the summer will be warmed so that introduction in the stream system could cause temperature violations in the receiving waters; warmer water may also have low levels of dissolved oxygen that would also be in violation of the state standard; this impact could be reduced by returning the water to the stream via subsurface conveyance, but this would add considerable to the project cost

Data Needs

There is a considerable amount of information needed prior to embarking on an off-channel water storage project.

- Determine where the water need is the greatest within the watershed
- Quantify volumes and timing of runoff that is potentially available for storage by establishing stream gauging stations at prospective storage sites
- Determine when diversion of water to the storage area can be conducted based upon fish usage and habitat needs
- Determine landownership of both the storage facility and the point of diversion; evaluate the feasibility of land acquisition
- Conduct field inspections to evaluate topography, geology, access, sensitive areas
- Analyze the potential site for size of storage area needed, potential yield of the storage area, facilities required to store and transmit the water, and estimate the costs to acquire the land, construct the storage area, and manage the finished project
- Determine if there must be a change in existing water rights and determine other permitting needs for the specific project
- Determine if there are funds available to pay for such a project

Instream Storage: General Considerations

Instream storage is a common practice in Washington. Instream dams and reservoirs are placed on major streams with water flowing from the upper portions of the watershed to fill the reservoir. Water from the reservoir can be released to augment low flows or be used for out-of-stream uses such as irrigation or stock watering. Instream dams are generally placed in deeply incised channels with a relatively shallow depth to bedrock or other stable material. The ideal situation is to have a deep reservoir with a small surface area to maintain impounded water at a lower temperature than a shallow pool. Fish passage is an issue with such dams and would have to be a part of most designs.

Positive effects of instream storage

- Can positively benefit summertime low flows and temperature conditions by releasing cool water into a stream system It should be noted that the water would only be cooler downstream if the water behind the dam stratified somewhat and water released downstream was taken from lower depths. The top layer of water behind the dam would likely be warmer than the free-flowing condition. Dams have been at least partly responsible for quite a number of 303d temperature listings throughout the state of Washington.
- Can provide water for out-of-stream uses
- Can provide storage for large quantities of water

Negative effects of instream storage

- Dams on fish-bearing streams will require engineered fish passage
- Instream impact is great
- Permitting for a dam and reservoir may be difficult
- Water stored behind the dam is subject to evaporation and subsurface losses and heating up,
- There can be dissolved oxygen deficiencies in the lower levels of a stratified pond/reservoir
- With a dam and reservoir system come a great amount of liability

The data needs for instream storage are essentially the same as for off-channel storage and will therefore not be listed separately here.

Mill Creek Feasibility Study

Off-Channel Storage Possibilities

District staff used the Stevens County Soil Survey to identify soils that had the lowest permeability rate and therefore could possibly retain water without the need for some form of lining. These soils and the associated permeability rates are listed in Table 10.

Table 10 Soils commonly found in the Mill Creek Watershed with low permeability rates

Soil Type	Depth Inches	Low Permeability Feet per day	High Permeability Feet per day
Aits loam **0-40% slope**	0 – 2	1.2	4
	2 – 12	1.2	4
	12 – 45	1.2	4
	45 – 60	0.4	1.2
Cedonia silt loam **0-5% slope**	0 – 8	1.2	4
	8 – 32	1.2	4
	32 - 60	0.4	1.2
Colville silt loam	0 – 17	1.2	4
	17 – 27	0.4	1.2
	27 – 60	0.4	1.2
Martella silt loam **0-40% slope**	0 – 13	1.2	4

	13 – 30	1.2	4
	30 – 60	0.4	1.2

The occurrence of these soils in proximity to a water source was the basis for identifying areas of potential off-channel storage. All the areas selected would require excavation and most would require some kind of pumping system to fill the storage area. Not all the potential areas are feasible due to current land use or other restrictions. Table 11 lists the potential sites and their feasibility.

Table 11 Potential off-channel storage sites in the Mill Creek Watershed

SITE	FEASIBILITY
Aladdin Road	This could be a possibility depending upon landownership and current land use. Excavation would be needed but the area is adjacent to Mill Creek and could possibly be filled by a gravity system.
Pinkney City	This could be a possibility depending upon landownership and current land use. Excavation would be needed but the area is adjacent to Mill Creek and could possibly be filled by a gravity system. The area on the south side of the creek may be more suited for storage due to current land use.
Douglas Falls	The area to the west of the creek would be better suited for storage due to current land use. Excavation would be necessary. If a pumping system were to be employed, it would appear to require little lift to fill the storage area.
Echo Lakes	This may be the best possibility for a storage site because much of the land is currently in agriculture or open space. Purchase agreements must be developed with current landowners. The presence of Echo Lakes indicates that water can be stored in surface impoundments in this area. One drawback is that such a storage area would feed lower Clugston Creek and would only affect a small portion of lower Mill Creek.
Spanish Prairie	Much of the land is currently in agriculture or open space. This is very near the mouth of Mill Creek and would therefore have little affect on summer low flows. It would be subject to filling with sediment as Mill Creek approaches the confluence with the Colville River. It could abate flooding in the lower portion of Mill Creek and the Colville River Valley.
Middle Fork Mill Creek	This is on the Colville National Forest, upstream of rural residential areas. Establishing a site on national forest land would be very difficult. It would appear that pumping would be necessary to fill this storage area.
North Fork Mill Creek	This area could actually encompass part of the North Fork and thereby become an instream storage area. Small storage areas could be developed with excavation. Being this high in the watershed would limit the ability to mitigate flood levels and would potentially add only a small amount to augment low flows.
Lower Bruce Creek	Bruce Creek does not connect to Mill Creek by surface drainage and so storage in this area would have to be piped and or pumped to Mill Creek to augment low flows.
Upper Bruce Creek	Bruce Creek does not connect to Mill Creek by surface drainage and so storage in this area would have to be piped and or pumped to Mill Creek to augment low flows.

All the identified potential off-channel storage sites would require extensive investigation following the pattern presented under the data needs section above.

Instream Storage Possibilities

For potential instream storage sites, District staff used a variety of information sources:

- GeoEngineers' 2003 *Assessment Report: Multi-purpose Water Storage Opportunities, Water Resources Inventory Area 59; Colville River Watershed*,
- U.S. Department of the Interior National Wetlands Inventory, and
- Federal Emergency Management Administration Flood Insurance Rate maps.

NRCS Geographical Information System data were used to locate relatively steep-sided ravines that spread significantly upstream to potentially contain an adequate reservoir to justify the effort and the cost of dam construction. Shallow, flat-bottomed reservoirs were eliminated because of potential heating of surface water, excessive water loss due to evaporation, and the generally low water holding capacity of reservoirs with this geometry. Table 12 list potential sites and their feasibility.

Table 12 Potential instream storage sites in the Mill Creek Watershed

SITE	FEASIBILITY
Cy Creek	This site would include a portion of Aladdin Road. It would involve a dam of considerable height to pond a sufficient amount of water. It could be beneficial in augmenting low flows. Due to the proximity to Aladdin Road, need for permits, safety, and costs, this site is not feasible.
North Fork Mill Creek 3	This site is on the Colville National Forest and would probably be incompatible with the plans for the Forest.
North Fork Mill Creek 2	This site is adjacent to a portion of Aladdin Road. It could be constructed in a way that would not make the road unusable. It would be inundated by North Fork Mill Creek 1 if that site were selected. Limiting factors for this site would include permitting issues, safety, and costs.
North Fork Mill Creek 1	This site would include a portion of Aladdin Road. It would involve a dam of considerable height to pond a sufficient amount of water. It could be beneficial in augmenting low flows. Due to the inundation of Aladdin Road, the need for permits, safety, and costs, this site is not feasible
Jumpoff Joe Creek	This site would inundate a portion of Jumpoff Joe Creek Road. If this could be avoided, this site could be used to augment low

	flows while having the least impact on rural residences. It is on the Colville National Forest and would probably be incompatible with the plans for the Forest.
Middle Fork Mill Creek	This is on the Colville National Forest, upstream of rural residential areas. Establishing a site on national forest land would be very difficult.
South Fork Mill Creek 1	This is on the Colville National Forest, upstream of rural residential areas. Establishing a site on national forest land would be very difficult. This site was investigate by GeoEngineers and was found unsuitable.
South Fork Mill Creek 2	This site would span at least 3 different land ownerships; Colville National Forest, private ownership, and Washington Department of Natural Resources land. That fact alone would make a project on this site very difficult. Also, there is the potential to inundate a portion of the South fork Mill Creek Road.
Lower Mill Creek	This site was investigated by GeoEngineers and found to be unsuitable. It would inundate a portion of Aladdin Road and would affect houses along this stretch of Mill Creek.
Peterson Swamp	This site could be used to store water, but it would require some form of conveyance to Mill Creek. This could make the cost of such a project prohibitive.

Conclusions

It appears that any form of water storage in the Mill Creek Watershed would be a costly project. Permit issues make off-channel storage more feasible. Land acquisition has the potential to be quite costly. A more detailed study of specific sites would be needed before embarking on any type of project.

APPENDIX C

WRIA 59 FEASIBILITY PROJECT - PRELIMINARY EVALUATION FOR EXTENT AND VALIDITY OF STRANGER CREEK WATER RIGHT No. S3-21370

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"Solutions to water quality, quantity, permitting & planning issues"

October 20th, 2019

Stevens County/WRIA 59 WMP
Stevens County Courthouse Annex
215 S. Oak Street
Colville, WA 99114

Subject: Preliminary Evaluation for Extent and Validity of Stranger Creek Surface Water Right No. S3-21370 Completed under Ecology Grant WRSRPPG-2018-StCLSD-00012

This letter report documents Water & Natural Resource Group's (WNR Group) review of Water Right Certificate S3-21370. This report was prepared to provide a preliminary judgment into the validity and extent of the water rights which are appurtenant to three parcels located in an unnamed tributary near the headwaters of Stranger Creek (Figure 1). The evaluation was conducted by the WRIA 59 planning unit under RCW 90.94 Ecology Grant funding: WRSRPPG-2018-StCLSD-00012. The water right being evaluated is utilized for irrigation of crops at the property, which consists of three parcels (Figure 2). This analysis of the water right was conducted in order to identify potential water to off-set future domestic exempt groundwater wells within the Stranger Creek drainage. Analysis conducted by the WRIA 59 planning unit concluded that approximately 22.4 acre-feet of consumptive use water is required within Stranger Creek to off-set domestic wells through 2038 (WNR Group, May 31, 2019).

1.0 INTRODUCTION

The WNR Group was retained to perform a water right evaluation for a surface water right appurtenant to lands in the headwaters of Stranger Creek, which is located approximately 7-1/2 miles west of the Town of Addy, Washington, in Stevens County, Washington (see Figure 3). The subject property evaluated for Water Right Certificate No. S3-21370 is located approximately in the south W½SW¼ of Section 10, Township 33 North, Range 38 E.W.M. and henceforth called the Site. The properties are presently used as rural agriculture land.

The water right place of use encompasses parcel Nos. 1818615 (21 acres), 1818578 (29 acres) and 1818580 (20 acres) (see Figure 2). These parcels are owned by two separate persons, with one party owning the two northern parcels, and the other owning the southern parcel.

2.0 PURPOSE OF STUDY/SCOPE OF SERVICES

This letter report was prepared to assist the WRIA 59 planning unit in evaluating the validity and extent of the water rights appurtenant to their property west of Valley, Washington. This evaluation is presented as a preliminary screening of the Surface water right.

In order to assist with the above referenced evaluation, our specific scope of services consisted of the following:

1. Review of existing water right information for Surface water Certificate No. S3-21370.
2. Review of other water right information associated with the property.
3. Estimate water use of the Surface water withdrawal based on readily available information and crop consumptive use calculations.
4. Develop an opinion regarding whether the proponent has a valid claim to the appropriated water rights. This information is to be used by the proponent to determine the amount of water that is available for transfer into the Ecology State Water Trust program to be used for RCW 90.94 domestic groundwater off-set in WRIA 59.

3.0 WATER RIGHT DESRIPTION

Water Right Certificate No. S3- 21370

The Certificate allows for a Surface water withdrawal from a spring fed pond in the Colville River Basin at the Site. The Ecology water right file was reviewed. At this stage of the analysis, the property owner name is not revealed. A summary of water right Certificate conditions is as follows:

- Certificate of Water Right No. S3-21370.
- Right to use Surface water of a spring fed pond in tributary to Stranger Creek, within the Colville River Basin in Stevens County, State of Washington.
- Point of withdrawal located in the SW¼SW¼ of Section 10, T33N, R38E.W.M.; specifically noted on the certificate at: 900 feet north and 600 feet east from the SW ¼ of Section 10.
- Right is granted to not exceed 0.50 cfs and 112 acre-feet annually.
- Purpose (beneficial use) of withdrawal is listed as: irrigation, from May 15 to September 15, each year, for the irrigation of 35 acres.
- Right has a confirmed priority date of July 12, 1973.
- Beneficial use (as defined in original certificate) W½W½SW¼ of Section 10, T33N, R43E.

  - During this review of the water right, it appeared there was an administrative error in the described place of use. This correction of the place of use to the area of W½SW¼ of Section 10 was requested during the administrative split process discussed below.

3.1 Administrative Split

As stated previously, during the initial phase of this analysis, it was noted that there were two property owners within the described place of use of the water right, one party owning the northern two parcels, and the second owning the southern parcel. After discussions with the property owners, only that portion of the water right appurtenant to the northern two parcels were available for sale. A meeting was held with Ecology to discuss the options to proceed further with the water right acquisition. It was agreed that in order to proceed with the water right acquisition, an administrative split of the water right would be required. In October, 2019 the property owners submitted the applicable administrative split forms to Ecology in order to divide the certificate into an "A" and "B" certificate, each specific to the owner of the property.

During these discussions with Ecology, it was also noted that there had appeared to be an administrative error with the described place of use of the water right. The certificate was issued for the W½W½SW¼ of Section 10; however, since issuance of the certificate the water right had been put to beneficial use within the W½SW¼ of Section 10. Evidence within the water right file also supported that this correction should be made. A formal request was submitted to Ecology when the administrative split documents were submitted. Ecology has informed us that the described place of use will be corrected when the superseding certificates are issued to each of the property owners.

Therefore, for this analysis, the extent and validity only focused on the northern two parcels, or that area in which the superseding "A" portion of the water right will be issued. The proposed division of the water right, as outlined in the administrative split forms are:

Table 1: Summary of Superseding Certificates to be issued from Administrative Split.

Superseding Certificate	Parcel(s)	Irrigated Acres	Qi (cfs)	Qa (AF)	Place of Use
S3-21370C(A)	#1818615 and #1818578	26.3	0.376	84.16	W1/2 Sec. 10, T33N, R38E
S3-21370C(B)	#1818580	8.7	0.124	27.84	SW1/4SW1/4 Sec. 10, T33N, R38E

4.0 RECORDS REVIEW

The WNR Group conducted a review of readily available information to document the extent and validity of the Certificate.

4.1 ANECDOTAL INFORMATION

The property owner provided the following anecdotal information regarding the use of water at both properties.

- Irrigation has occurred on the property since the early 1970's using surface water collected in the spring fed pond.
- The property owners have irrigated various crops, primarily alfalfa with some oats and barley grown some years primarily on the fields in the northern part of the place of use.
- The irrigation system consisted of one surface water withdrawal with wheel lines and hand lines used for irrigating the fields.
- No meter was installed in the pumping system to record the amount of water diverted.
- The water was always used for agricultural purposes.
- Surface water was put to the beneficial use at the same locations since the issuance of the water permit, and no changes in the original place of use has occurred.
- The irrigation system configuration changes throughout the irrigation season, with

various numbers of sprinkler heads, length of wheel and handlines, and different operational pressure of the system (dynamic head) occurring.

- Over the past 10 years or so, the actual amount of irrigated lands has been reduced from the original approved 35 acres (26.3 acres for A portion of the certificate). Within the northern two properties, where approximately 26.3 irrigable acres were within the original place of use, only approximately 14.5 acres have been irrigated in the past 5 years.
- Due to the reduction in irrigated acres, the property owner understands that a partial relinquishment of the water right will occur.

4.2 WATER RIGHT FILE REVIEW-

In July 1973 a water right application to appropriate surface waters from an unnamed spring was submitted to the Department of Ecology. The original application requested an allocation of 0.65 cfs, from the spring to conduct irrigation from May 15th to September 30. The diversion was requested at a location 900 feet north and 600 feet east of the SW corner of Section 10, T33N., R.38 E.W.M.

Ecology reviewed the application, published the request, and completed a Report of Examination of the water right application in November 1974. A permit to use waters of the state was issued on January 17th, 1975 to allow a diversion of 0.5 cfs, with an annual quantity of 112 acre-feet to irrigate 35 acres from May 15th to September 30th of each year.

In April 1977, a proof of appropriation of water was submitted to Ecology that documented the full 35 acres were being irrigated. Ecology subsequently issued the Water Right Certificate on June 29th, 1977 for the certificated amounts discussed above. No changes have been requested and or made to the water right since the certificate was issued in 1977.

4.3 DOCUMENT REVIEW

The WNR Group reviewed readily available water right information, hydrogeologic reports and other data in the vicinity of the subject Site in an attempt to develop an understanding of the hydrologic conditions. The WNR Group attempted to identify uses of existing water withdrawals at and in the immediate vicinity of the Site as recorded in readily available government documents. These sources and findings are summarized in the sections that follow.

4.3.1 Aerial Photographs- A search for aerial photographs was conducted for the two Sites. Aerial photographs were difficult to acquire through readily available databases. Four aerial photographs were available from 1995, 2003, 2004, 2006, 2009, 2001, 2013, and 2016 were reviewed for the Site and are presented in Attachment A. As shown on the aerial photographs, the two properties were being used as agricultural irrigated lands. Historical aerial photographs for the existing Site were limited and could not be readily obtained.

4.3.2 Surface Topography - WNR Group reviewed available United States Geological Survey (USGS) topographic quadrangle maps for the Site and vicinity to determine the physical setting of the Site. The Site is located within the northeast extent of the Wellington Peak, Washington 7-1/2-minute quadrangle map dated 1985. As shown on Figure 4, the Site is located in the headwaters of an unnamed tributary to Stranger

Creek. The general slope of the area is a gentle slope to the north within the valley floor, toward the Stranger Creek drainage. The western portion of the property is steeper, however where the irrigation occurred it is generally flat on that portion of the property immediately west of the County Road. Elevation relief across the property is approximately 100 feet, with an elevation of 3150 feet amsl in the southern valley floor to 3040 feet amsl in the northern valley floor. The surface water diversion is from a pond at an approximate elevation of 3110 feet amsl. Shallow groundwater beneath the site is inferred to flow to the north, as interpreted from the topographic slope of the valley floor in the area of the subject property, in addition to the geologic constraints of the tributary valley.

4.4 HYDROLOGIC CONDITIONS/HYDROGEOLOGY

The WNR Group reviewed readily available hydrogeologic reports and data in the vicinity of the subject site in an attempt to develop an understanding of the hydrogeologic conditions at the subject Site. The WNR Group attempted to identify uses of existing water withdrawals at and in the immediate vicinity of the Site as recorded in readily available government documents. These sources and findings are summarized in the sections that follow.

4.4.1 Hydrogeologic Reports- Several hydrogeologic reports were readily available for the area that were prepared by the USGS, Ecology, and other entities. Two reports specifically addressed the hydrogeology within the Colville Valley. These two reports were completed by the USGS in 2003 and 2004 for the WRIA 59 Watershed Planning Unit and are listed in the bibliography of this report. The geologic surface geology map of the area is interpreted as being underlain by glacial till, without a well-defined shallow unconfined aquifer. The hydrogeologic reports do not identify a shallow silt-sand unconfined aquifer at the site. This was confirmed from the review of well logs in the tributary drainage which revealed about 20 feet of overburden, clay and gravel on top of bedrock. No shallow aquifer was encountered in the well logs and water supplies were being withdrawn from the bedrock fractures. This data would suggest that the water in the tributary is perched on top of low permeable soils and is conveyed within the stream channel and in the soils in direct hydraulic continuity with the creek.

4.4.2 Geologic Maps - The WNR Group reviewed the Washington Division of Geology and Earth Resources geologic map for northeastern Washington (1991). The geologic map of the Site (Figure 5) revealed that the subject site is underlain by Quaternary Age glacial drift (Qs) deposited over bedrock in the area. Bedrock in the valley walls consists of Ordovician marine metasedimentary rocks (Omm) consisting of shales and siltites in the valley walls (Figure 5). The unconsolidated glacial drift which fill the valley typically have low yields in the compacted clay silts interbeds, but higher yields in the sand and gravels, if present.

5.0 IRRIGATION SYSTEM CONFIGURATION

The irrigation system consists of a surface water diversion which conveys water to various lengths of wheel lines and handlines throughout the property. In general, surface water is withdrawn from a pond (developed spring) with a 15 HP GE Triclad Pump with a 2-inch outlet. The pump is powered by a 15 HP GE Model 2W15-2 pump. The diversion is located at N48.36888, W-118.01537. Figures 6 and 7 show pictures of the diversion location in the developed spring. The pump (Figure 8) is rated at a maximum pumping rate of 400 gpm. From the diversion point, water is conveyed in a 4-inch pipe to the irrigated fields (see Figure 9). The irrigation system is set-up so only certain portions of the property are irrigated at any one time (e.g. just the southern fields, just the northern hand lines, etc.). Typically, a segment of handlines is operated which contain 30 to 35 sprinkler heads rated at 7 gpm each. The system configuration cannot operate the entire irrigation system across all the irrigable land at one time. So, the property owners run the system to 35m continuously and frequently move the handlines around the fields.

6.0 CONSUMPTIVE USE ANALYSIS

No metering was conducted on the subject site. Therefore, in order to determine a potential transferable amount of water, consumptive use values were used for alfalfa on the property, which is the major crop grown on the farm.

6.1 WASHINGTON IRRIGATION GUIDE (WIG)

The Washington Irrigation Guide (USDA, 1990) was developed for use in estimating historical crop use water requirements. The WIG provides technical information and procedures that can be used for planning and management of irrigation systems as well as developing quantities of crop consumptive use for various areas throughout Washington State (Appendix A of WIG). The crop use requirements are derived from a modified Blaney-Criddle method and generally uses historical rainfall and precipitation data prior to 1980. The guide provides net irrigation requirements, based on long-term average climate conditions, for various crops and locations throughout the state. This data may not be truly representative of recent trends in decreased precipitation and higher temperatures, but can be used as an average crop requirement from long term historical precipitation and temperature records. The basic inputs to the modified Blaney-Criddle method include mean monthly temperature, precipitation and latitude.

For the property, WIG numbers were used for the area near Colville, Washington. Crop irrigation requirements were used for alfalfa at latitude of 48.33. The irrigation season is documented beginning on May 15th and ending October 10th in the WIG. The values as presented in the WIG are shown in Table 2.

As shown in Table 2, the net irrigation requirements for alfalfa near Colville, Washington is 25.03 inches (2.086 feet) per acre of land. The A-portion of the water right were used for irrigation on approximately 14.4 acres (Figure 2) from May 15th through September 15th during most years. Ecology will also generally accept evaporation from the irrigation system as a documented consumptive use. For handline irrigation, an assumed evaporation rate of 10-percent is added to the consumptive use (Ecology Guid-1210, 2005).

Utilizing this Ecology 1210 guidance, the total irrigation requirement (TIR) for the 14.4 acres (used for irrigation by the surface water right) on the property is 40.05 acre-feet and the total consumptive use (Cu) is 34.04 acre-feet for hand-line irrigated alfalfa. A summary of the irrigation requirements utilizing Ecology's WIG methodology for the site is provided in Table 3.

TABLE 2: WIG NUMBERS FOR ALFALFA NEAR COLVILLE, WASHINTON													
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Mean Temperature	24.5	31.0	37.3	46.2	54.5	61.3	67.9	66.5	58.0	46.2	33.8	27.5	
Total Precip (inches)	2.22	1.45	1.21	1.05	1.62	1.48	0.77	1.16	0.89	1.17	2.05	2.49	17.56
Effective Precip (ins)	0.00	0.05	0.74	0.73	1.20	1.16	0.75	0.98	0.65	0.73	0.00	0.00	6.98
Alfalfa Irrigation Requirement	0.00	0.00	0.00	0.00	1.64	5.25	7.95	6.21	3.83	0.15	0.00	0.00	25.03

TABLE 3: ESTIMATED TIR AND CIR									
Method	**Number of irrigated acres**	**Crop Type**	**Crop requirement in inches (WIG)**	**Crop Irrigation Requirement**	**Total Irrigation Requirement**	**App. Efficiency (%)**	**% Total Evaporated**	**Total Consumed (af)**	**Return Flow (af)**
Periodic Move (Handline)	14.4	Alfalfa	25.03	**30.04**	**40.05**	75	10	**34.04**	**6.01**

In order to determine the actual TIR required and the consumptive use for the property, the WNR Group also utilized the Blaney-Criddle method, which uses precipitation and temperature data for each year between 2015 and 2019 (more representative conditions). Tables for each of these years are presented in Attachment 2. The tables present the calculated results for consumptive use of alfalfa crops (plus irrigation system evaporation) for the property. Table 4 summarizes this data that is presented within the Attachment 2 tables.

TABLE 4: Summary of Alfalfa Crop Consumptive Use for the Years 2015 through 2019 for the 14.4 Acres at the Site			
Year	**Crop Consumptive Use Value in acre-feet per year**	**Total Crop Cu plus 10% system evaporation in AF/yr**	**Total Irrigation Requirement in AF/yr (@ 75% Efficiency)**
2015	**38.23**	**42.05**	**56.07**
2016	31.46	34.63	46.17
2017	33.59	36.95	49.26
2018	33.36	36.70	48.93
2019	32.51	35.78	47.68

As shown in Table 4, the annual crop total irrigation requirement ranges from a high of 56.07 acre-feet per year in 2015 (which was a drought year) to 46.17 acre-feet per year in 2016. This transfer is proposing to transfer the entire water right; however, only the consumptive portion of the right can be utilized for the RCW 90.94 off-set. As shown in Table 4, the total consumptive use ranges from a high of 42.05 acre-feet in 2015, to 34.63 acre-feet. However, the property owner did inform us that during 2015, there was issues with keeping the pond full, and irrigating the property. During 2015, he did not irrigate throughout the entire year, and just sporadically irrigated when sufficient water was within the pond. Therefore, if the average of the other four years is taken, an average consumptive use of 36.02 acre-feet of consumptive water appears to have been used at the site.

The WNR Group also reviewed the recent WSU AgWeatherNet data for crop consumptive use. This program was developed by WSU in conjunction with Ecology to develop a more representative estimation of irrigation requirements and consumptive use in eastern Washington. WSU maintains numerous stations throughout eastern Washington to monitor weather conditions. One of these stations is located just outside Addy, Washington, approximately six miles from the site. The WNR Group entered the appropriate information into the WSU AgWeatherNet program for the years 2015 through 2019. Table 5 presents the output of the AgWeatherNet model. As shown on Table 5, 2015 was the highest year. However, as referenced earlier. The property owner did not apply a full water duty that year. Therefore, if the average of the other four years is taken, an average consumptive use of 36.1 acre-feet of consumptive water appears to have been used at the site.

TABLE 5
Consumptive Use as Determined From Ag Weather Center

Addy Station (No. 57) - (http://weather.wsu.edu)

Crop = Alfalfa (May 15 - Sept 15)

Year	Estimated Cu (inches)	Cu (ft/ac)	acres	Cu Acre-Ft	Irr Req
2015	37.30	3.11	14.40	44.76	63.94286
2016	32.02	2.67	14.40	38.42	54.89143
2017	29.36	2.45	14.40	35.23	50.33143
2018	29.11	2.43	14.40	34.93	49.90286
2019	29.85	2.49	14.40	35.82	51.17143

6.2 Pump Metering Analysis

The Surface Water withdrawal is powered by a 2-inch diameter, 15-horsepower GE pump. The pump is rated at a maximum flow rate of 400 gpm. The pump connects to a 4-inch metal distribution piping that supplies the irrigation system. The irrigations system is set-up to operate in various segments, containing various pipe sizes and number of sprinkler heads. The property owner operated the system in various configurations and various lengths of irrigation operation over a normal irrigation season, making it very difficult to determine an average dynamic head of the irrigation system. It should also be noted that the Surface Water within the pond is at a higher elevation than most of the irrigated fields. Therefore, the elevation across the property is at approximately 100 feet; however, many of the irrigation system legs convey water at an elevation loss. Based on our review of elevation gain of the piping, discharge pressure, and friction losses associated with the distribution system, we estimate the total dynamic head associated with the operation was about 90 depending on what segment of the irrigation system was in operation.

Electrical power records were sparse for the site. Attempts to recover electrical records from Avista were not productive. The property owners only had partial records for the years 2017 and 2018. However, the entire 2019 electrical records were available.

Electrical records were reviewed for 2003 through 2009 to determine period of use and are included in Attachment D. Electrical records are summarized in Table 4 and indicate the following draw of kW for the power supply in which the irrigation system is connected.

Quantities of water diverted using the 2019 power consumption data was calculated using the methods described in WAC 173-173-160(2). As stated previously, the irrigation system was run in various configurations and for different periods of time. Many of the irrigation segments in the northern part of the property actually lose elevation. In order to calculate the water diverted, an assumed TDH value of 90 feet was used.

Table 6 summarizes the estimated use of water from 2019. During 2017, approximately 14.4 acres of land were irrigated for the "A" portion of the certificate. As shown in Table 6, in 2019, an average land application of 3.1 feet per acre is calculated, resulting in approximately 45 acre-feet of water being put to beneficial use. This is very similar to the projected irrigation requirements in the Blaney-Criddle Methodology presented earlier. However, it is above the projected WIG estimate and below the projected amounts from the AgWeatherNet model. Therefore, it is proposed that the average water duty at the property is approximately 45 acre-feet for the 14.4 acres accessed under this analysis.

Table 6 - WAC 173-173 Water Use Estimate

May-19						
Constant	K(w)	Peff	Meff	TDH	Q (gallons)	Q (acre-feet)
318600	893	0.85	0.85	90	2283981.45	7.009281696

Jun-19						
Constant	K(w)	Peff	Meff	TDH	Q (gallons)	Q (acre-feet)
318600	2870	0.85	0.85	90	7340455.5	22.52703076

Jul-19						
Constant	K(w)	Peff	Meff	TDH	Q (gallons)	Q (acre-feet)
318600	1518	0.85	0.85	90	3882512.7	11.91499397

Aug-19						
Constant	K(w)	Peff	Meff	TDH	Q (gallons)	Q (acre-feet)
318600	439	0.85	0.85	90	1122808.35	3.445772301

Sep-19						
Constant	K(w)	Peff	Meff	TDH	Q (gallons)	Q (acre-feet)
318600	19	0.85	0.85	90	48595.35	0.149133653
	5720					**44.89707873**

7.0 CONCLUSIONS

WNR Group has performed a preliminary water right extent and validity evaluation, and limited hydrogeologic review of the Site located near Addy, Washington. The following conclusions are based on review of readily available data and reports, noted in the bibliography of this letter report. The primary objective of this review was to provide a professional opinion of the validity and extent of Certificate No. S3-21370C – A portion.

The analysis provided under this evaluation has developed the following conclusions:

A-portion of Water Right (northern two parcels):

- Water Right No. S3-21370A-portion has a certificated Qi of 0.376 cfs (168.75 gpm).
- Water Right No. S3-21370A-portion has irrigated up to 26.3 acres of land in the past and has irrigated approximately 14.4 acres of land in the past five years.
- The water appears to have been beneficially used for irrigation on the property since the priority date on the Certificate.
- The water right was perfected utilizing surface water from a developed spring which forms a pond in the headwaters of an unnamed tributary to Stranger Creek.
- Surface Water has been the only source of water used to irrigate lands on the property.
- The water has been put to beneficial use and not gone any 5-year period of nonuse as documented by the property owner.

Although the meter records demonstrate a use of 45-acre feet in 2019, because of the irrigation pump and conveyance piping was run in various configurations (many to areas of lower elevation than the point of diversion) and for different periods of time, the meter records likely underestimate the total volume diverted. WNR believes that the Blanney-Criddle method is more accurate. The tentative determination for the A-portion of the water right S3-21370A includes the following: 48 AF (36 AF consumptive), 168.75 gpm for irrigation of 14.4 acres. A portion of S3-21730-A will be voluntarily relinquished to include 39.16 acre-feet, and 11.9 irrigable acres which have not been irrigated over the past 5-years. Water is typically diverted from the developed spring in the Stranger Creek drainage from middle of May through September 15.

8.0 LIMITING CONDITIONS

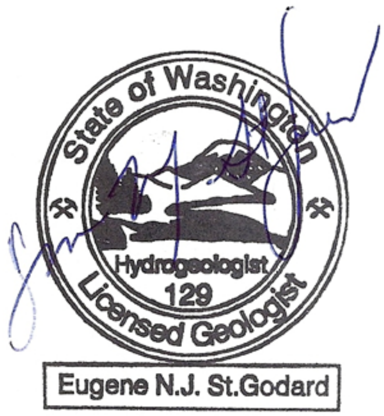
This water right validation and limited hydrogeologic letter report has been prepared for the exclusive use of the WRIA 59 WRMP and their assigns, in accordance with the standards of the environmental consulting industry at the time the services were performed. This work has been performed for the sole purpose of assisting in the interpretation of technical data and other documentation to determine the potential extent and validity of water right No. S3-21370A-portion. This letter report is governed by the specific scope of work authorized by WNR Group and is not intended to be relied upon by any other party unless specified the WRIA 59 planning unit. The findings presented herein are based upon of readily available information as of the date the assessment was performed and review of a limited number of readily available hydrogeologic documents for the area near the Site. Geologic and hydrologic data is limited for the subject area and interpretations were made for the conclusions presented in this report.

The findings of the review, as represented within this letter report, must be viewed in recognition of certain limiting conditions. The scope of work commissioned for this project does not represent an exhaustive study, but rather a reasonable inquiry, consistent with good commercial practice, in general accordance with existing environmental assessment practices. For the purposes of this assessment, only a limited number of documents were reviewed. No borings were completed in order to verify Surface Water depth, and/or aquifer characteristics. Conclusions were based on findings of others for sites near the subject property.

Validation of water use consumption and property ownership was concluded from readily available information, found mostly within state and local agency databases. The WNR Group does not warrant the accuracy of these government databases. An exhaustive title search was not completed under the scope of services for this project.

We appreciate the opportunity to be of service to the WRIA 59 planning unit in providing our services to provide the preliminary evaluation of Water Rights. Should you have any questions regarding this letter report, please do not hesitate to call us at your earliest convenience.

Very truly yours,
Water & Natural Resource Group, Inc.



Eugene N.J. St.Godard, P.G., L.Hg., CWRE
Principal Hydrogeologist/Owner
Water & Natural Resource Group, Inc.

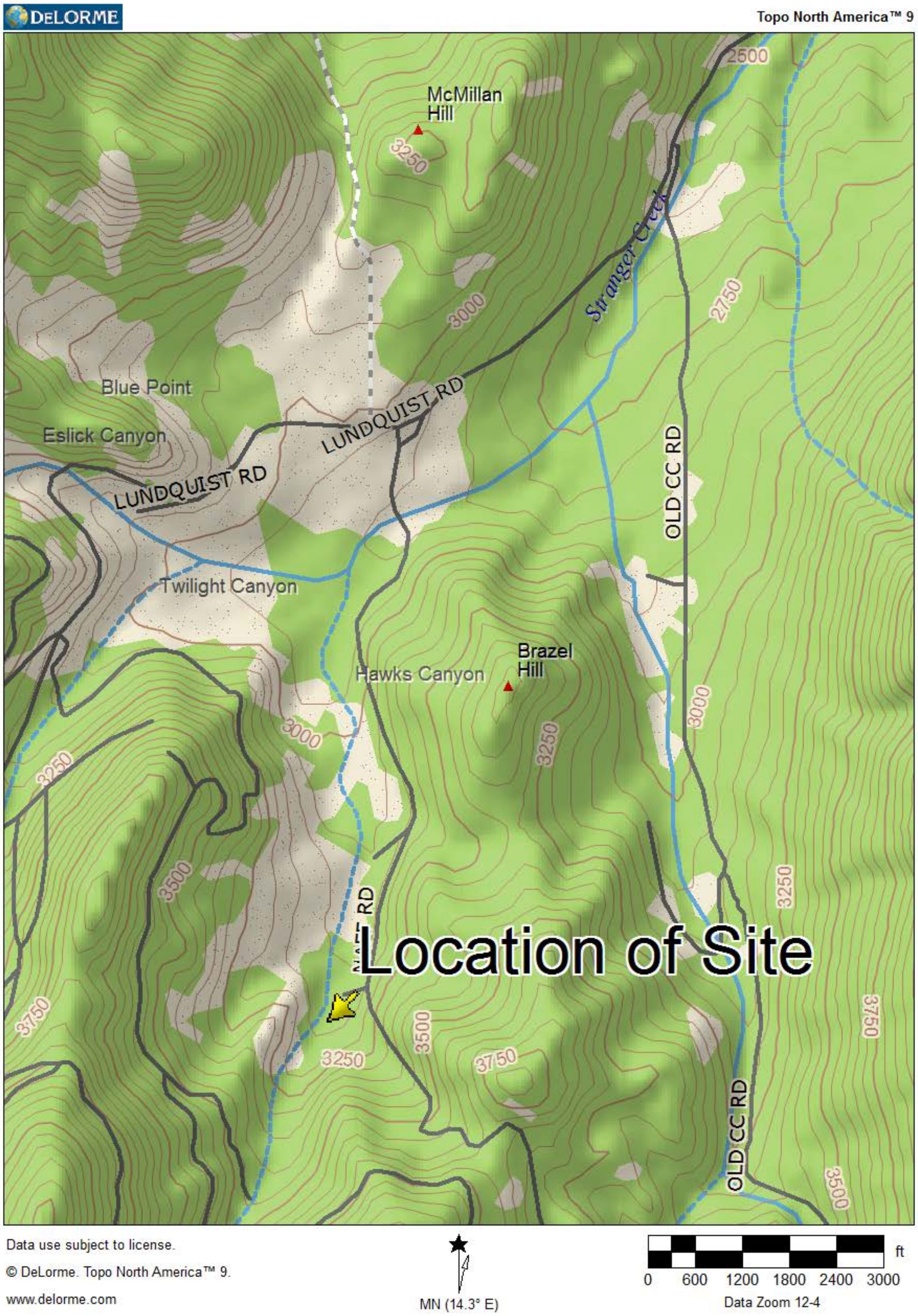


FIGURE 1: Site location of property in headwaters of Stranger Creek.

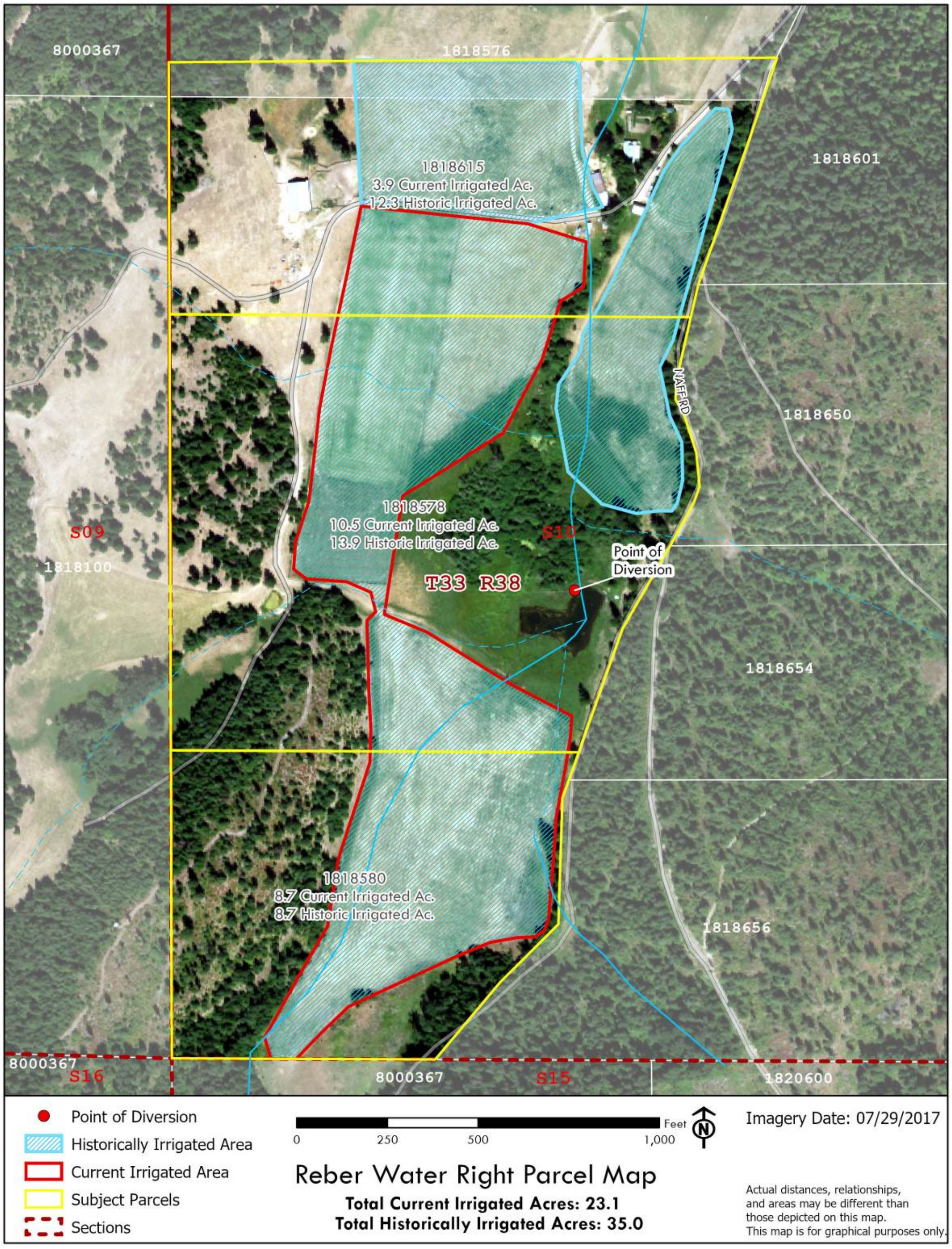


Figure 2: Parcel Map and Place of Use delineation of water right property.

Figure 3: Aerial Map Showing location of water right 7-1/2 miles west of Town of Addy.

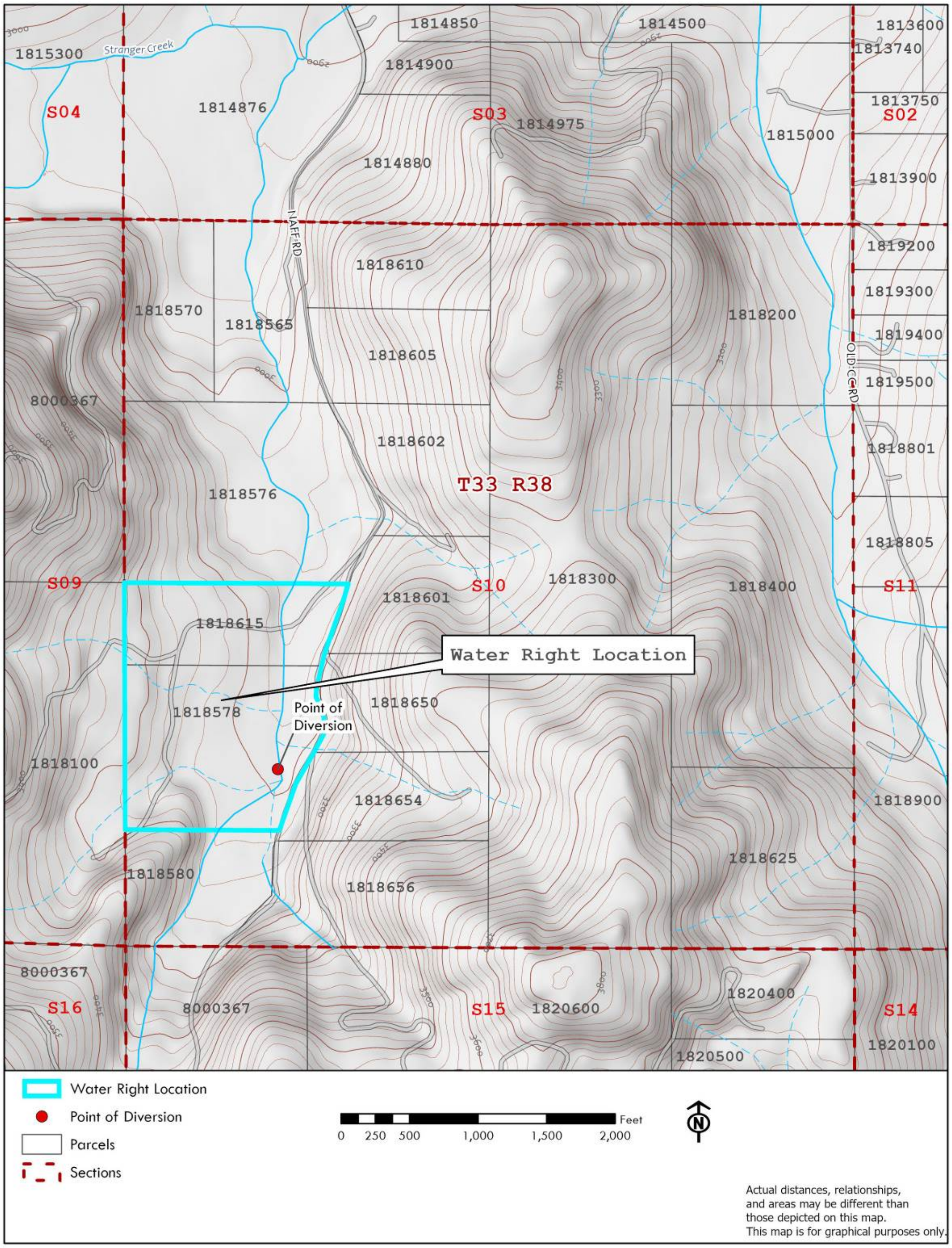


Figure 4: Topographic Map of Section 10, T33, R38E.W.M. where water right is located.

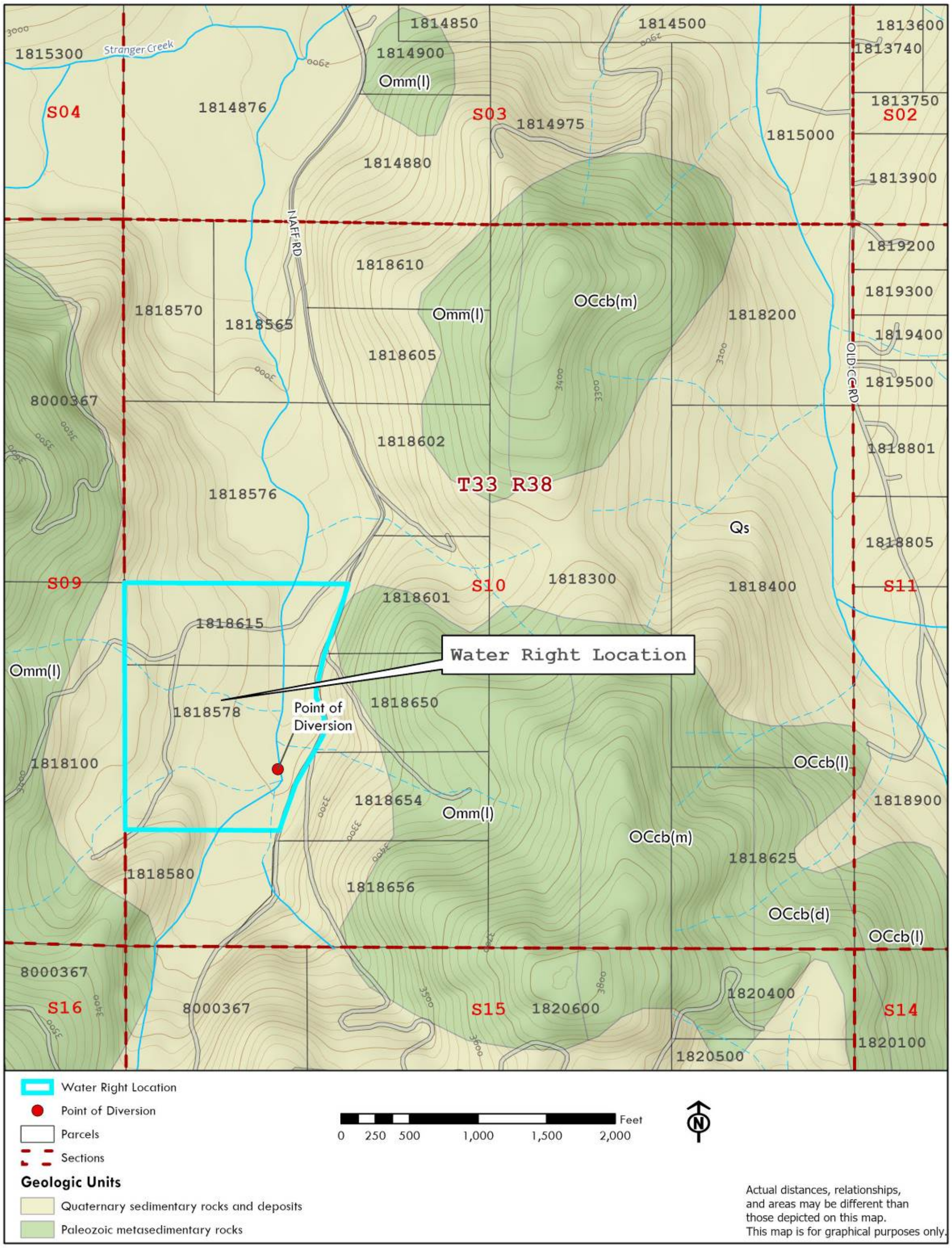


Figure 5: Geologic Map of Section 10, T33, R38E.W.M. where water right is located.

Figure 6: Photo of the Pond - Diversion point at the Site. Pump is located on right of photo.

Figure 7: Photo of the Pump House on the Pond.

Figure 8: Photo of the GE 15-HP pump and motor located at site.

Figure 9: Photo of hand lines operating at the site.

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United States Geological Survey, 1985: Wellington Peak, Washington 7-1/2-minute Topographical Map.

ATTACHMENT 1
AERIAL PHOTOGRPAHS

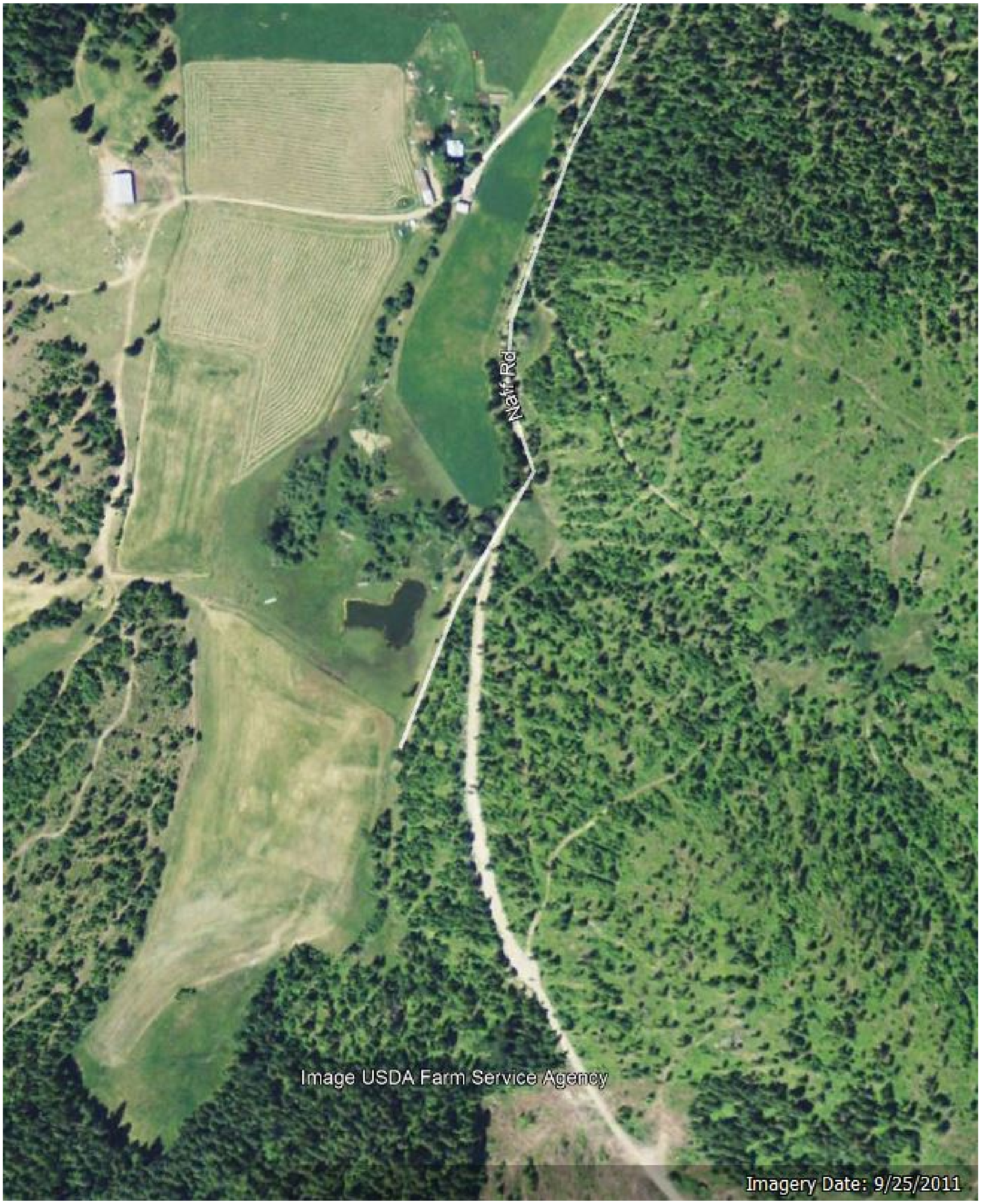
July 17, 1996 Aerial Photograph

June 2, 2003 Aerial Photograph

October 28, 2004 Aerial Photograph

June 30, 2006 Aerial Photograph

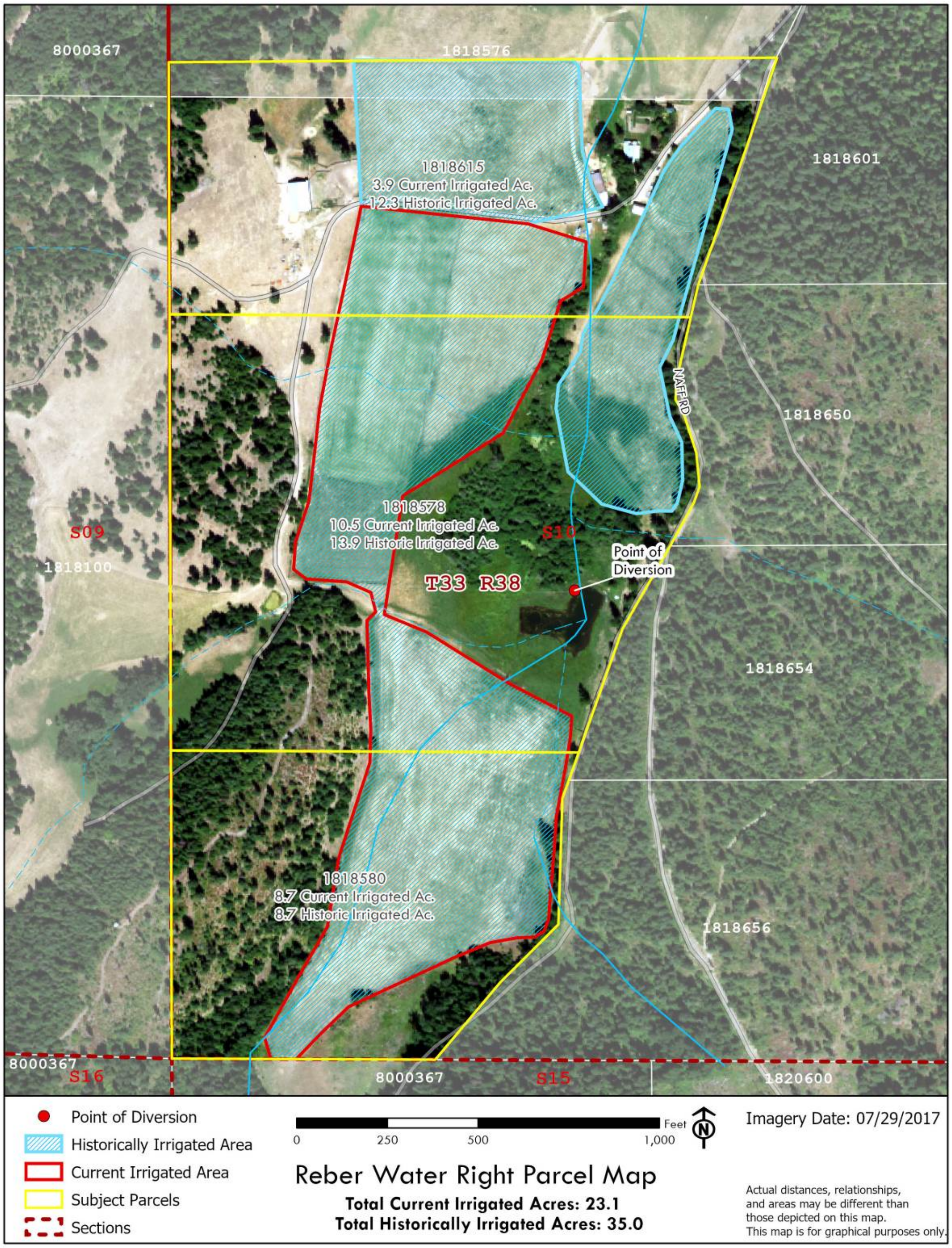
June 25, 2009 Aerial Photograph



September 25, 2011 Aerial Photograph

July 3, 2013 Aerial Photograph

August 20, 2016 Aerial Photograph



July 29 2017 Aerial Photograph

ATTACHMENT 2
BLANEY-CRIDDLE ANALYSIS TABLES

2015

Blanney-Criddle Method for Crop Consumptive Use

S3-21370C(A)

Stevens County, Washington

Month	Mean Monthly Air Temperature[2] t (degrees F)	Percent of Annual Daytime Hours[3] P (percent)	Consumptive Use Factor F	Crop Use Coefficient[4] K	Consumptive Use Uc (inches)	Precipitation[5] (inches)	Net Consumptive Use Ucn (inches)	Volumetric Net Consumptive Use[6] Ucn (acre-feet)	
January	30.89	6.15	1.90	0	0	1.91	0	0	
February	39.86	6.40	2.55	0	0	2.57	0	0	
March	46.69	8.26	3.86	0	0	1.90	0	0	
April	50.55	9.18	4.64	1.0	4.64	0.44	0.00	0.00	
May	62.76	10.54	6.61	1.0	6.61	0.80	5.81	6.98	
June	71.90	10.75	7.73	1.0	7.73	1.07	6.66	7.99	
July	74.40	10.83	8.06	1.0	8.06	0.13	7.93	9.51	
August	71.80	9.91	7.12	1.0	7.12	0.28	6.84	8.20	
September	59.67	8.45	5.04	1.0	5.04	0.42	4.62	5.55	
October	53.03	7.49	3.97	0	0.00	1.07	0.00	0.00	
November	35.62	6.22	2.22	0	0	1.92	0	0	
December	29.56	5.82	1.72	0	0	0.00	0	0	
Annual	54.29	100	NA	NA	39.20	12.51	31.86	38.23	= Cu
								42.05	= Cu + 10% Evap
								56.07	= Qa @ 75% Eff

Notes:

F = P * t   Uc = F * K   Ucn = Uc - Precip

1: Blanney-Criddle Method adapted from Schulz (1973).

2: Mean monthly air temperature obtained from Western Region Climate Center (www.wrcc.dri.edu) for Colville, Washington station No. 451630 (updated 10/10/19).

3: Percent of annual daytime hours occuring each month for site latitude (approximately 48.3 degrees) adapted from Jensen et. al. 1969.

4: Crop use coeffecient obtained from Schulz et.al. (1989) and determined as follows:

Crop	K	Area	K x %
Alfalfa	1.0	100%	1.0

5: Precipitation data obtained from Western Region Climate Center (www.wrcc.dri.edu) for Colville, Washington station No. 451630 (updated 10/10/19).

6: Volumetric net consumptive use assumes an irregable acreage of 14.4 as determined from GIS evaluation of all irregable acreage of property.

2016

Blanney-Criddle Method for Crop Consumptive Use

S3-21370C(A)

Stevens County, Washington

Month	Mean Monthly Air Temperature[2] t (degrees F)	Percent of Annual Daytime Hours[3] P (percent)	Consumptive Use Factor F	Crop Use Coefficient[4] K	Consumptive Use Uc (inches)	Precipitation[5] (inches)	Net Consumptive Use Ucn (inches)	Volumetric Net Consumptive Use[6] Ucn (acre-feet)	
January	38.13	6.15	2.34	0	0	0.00	0	0	
February	43.81	6.40	2.80	0	0	0.00	0	0	
March	56.94	8.26	4.70	0	0	2.90	0	0	
April	60.69	9.18	5.57	1.0	5.57	1.50	0.00	0.00	
May	66.55	10.54	7.01	1.0	7.01	1.71	5.30	6.37	
June	68.52	10.75	7.37	1.0	7.37	1.14	6.23	7.47	
July	67.46	10.83	7.31	1.0	7.31	1.62	5.69	6.82	
August	57.03	9.91	5.65	1.0	5.65	0.04	5.61	6.73	
September	47.52	8.45	4.02	1.0	4.02	0.61	3.41	4.09	
October	42.20	7.49	3.16	0	0.00	5.82	0.00	0.00	
November	21.27	6.22	1.32	0	0	2.18	0	0	
December	50.20	5.82	2.92	0	0	1.19	0	0	
Annual	48.05	100	NA	NA	36.92	18.71	26.23	31.48	= Cu
								34.63	= Cu + 10% Evap
								46.17	= Qa @ 75% Eff

Notes:

F = P * t Uc = F * K Ucn = Uc - Precip

1: Blanney-Criddle Method adapted from Schulz (1973).

2: Mean monthly air temperature obtained from Western Region Climate Center (www.wrcc.dri.edu) for Colville, Washington station No. 451630 (updated 10/10/19).

3: Percent of annual daytime hours occuring each month for site latitude (approximately 48.3 degrees) adapted from Jensen et. al. 1969.

4: Crop use coeffecient obtained from Schulz et.al. (1989) and determined as follows:

Crop	K	Area	K x %
Alfalfa	1.0	100%	1.0

5: Precipitation data obtained from Western Region Climate Center (www.wrcc.dri.edu) for Colville, Washington station No. 451630 (updated 10/10/19).

6: Volumetric net consumptive use assumes an irregable acreage of 14.4 as determined from GIS evaluation of all irregable acreage of property.

2017
Blanney-Criddle Method for Crop Consumptive Use
S3-21370C(A)
Stevens County, Washington

Month	Mean Monthly Air Temperature[2] t (degrees F)	Percent of Annual Daytime Hours[3] P (percent)	Consumptive Use Factor F	Crop Use Coefficient[4] K	Consumptive Use Uc (inches)	Precipitation[5] (inches)	Net Consumptive Use Ucn (inches)	Volumetric Net Consumptive Use[6] Ucn (acre-feet)	
January	17.88	6.15	1.10	0	0	1.84	0	0	
February	24.66	6.40	1.58	0	0	4.00	0	0	
March	38.79	8.26	3.20	0	0	2.98	0	0	
April	46.35	9.18	4.25	1.0	4.25	2.56	0.00	0.00	
May	56.26	10.54	5.93	1.0	5.93	2.71	3.22	3.86	
June	61.62	10.75	6.62	1.0	6.62	0.56	6.06	7.28	
July	69.40	10.83	7.52	1.0	7.52	0.04	7.48	8.97	
August	68.95	9.91	6.83	1.0	6.83	0.01	6.82	8.19	
September	59.03	8.45	4.99	1.0	4.99	0.58	4.41	5.29	
October	44.34	7.49	3.32	0	0.00	1.04	0.00	0.00	
November	37.62	6.22	2.34	0	0	3.83	0	0	
December	27.71	5.82	1.61	0	0	1.69	0	0	
Annual	46.05	100	NA	NA	36.15	15.22	27.99	33.59	= Cu
								36.95	= Cu + 10% Evap
								49.26	= Qa @ 75% Eff

Notes:
F = P * t   Uc = F * K   Ucn = Uc - Precip
1: Blanney-Criddle Method adapted from Schulz (1973).
2: Mean monthly air temperature obtained from Western Region Climate Center (www.wrcc.dri.edu) for Colville, Washington station No. 451630 (updated 10/10/19).
3: Percent of annual daytime hours occuring each month for site latitude (approximately 48.3 degrees) adapted from Jensen et. al. 1969.
4: Crop use coeffecient obtained from Schulz et.al. (1989) and determined as follows:

Crop	K	Area	K x %
Alfalfa	1.0	100%	1.0

5: Precipitation data obtained from Western Region Climate Center (www.wrcc.dri.edu) for Colville, Washington station No. 451630 (updated 10/10/19).
6: Volumetric net consumptive use assumes an irregable acreage of 14.4 as determined from GIS evaluation of all irregable acreage of property.

2018

Blanney-Criddle Method for Crop Consumptive Use

S3-21370C(A)

Stevens County, Washington

Month	Mean Monthly Air Temperature[2] t (degrees F)	Percent of Annual Daytime Hours[3] P (percent)	Consumptive Use Factor F	Crop Use Coefficient[4] K	Consumptive Use Uc (inches)	Precipitation[5] (inches)	Net Consumptive Use Ucn (inches)	Volumetric Net Consumptive Use[6] Ucn (acre-feet)	
January	24.66	6.15	1.52	0	0	4.01	0	0	
February	29.97	6.40	1.92	0	0	1.27	0	0	
March	39.78	8.26	3.29	0	0	1.82	0	0	
April	47.85	9.18	4.39	1.0	4.39	2.60	0.00	0.00	
May	63.08	10.54	6.65	1.0	6.65	1.74	4.91	5.89	
June	62.06	10.75	6.67	1.0	6.67	1.74	4.93	5.92	
July	68.45	10.83	7.41	1.0	7.41	0.00	7.41	8.90	
August	66.29	9.91	6.57	1.0	6.57	0.30	6.27	7.52	
September	55.40	8.45	4.68	1.0	4.68	0.40	4.28	5.14	
October	44.32	7.49	3.32	0	0.00	1.34	0.00	0.00	
November	35.10	6.22	2.18	0	0	1.93	0	0	
December	30.31	5.82	1.76	0	0	2.69	0	0	
Annual	52.54	100	NA	NA	36.38	14.06	27.80	33.36	= Cu
								36.70	= Cu + 10% Evap
								48.93	= Qa @ 75% Eff

Notes:

F = P * t Uc = F * K Ucn = Uc - Precip

1: Blanney-Criddle Method adapted from Schulz (1973).

2: Mean monthly air temperature obtained from Western Region Climate Center (www.wrcc.dri.edu) for Colville, Washington station No. 451630 (updated 10/10/19).

3: Percent of annual daytime hours occuring each month for site latitude (approximately 48.3 degrees) adapted from Jensen et. al. 1969.

4: Crop use coeffecient obtained from Schulz et.al. (1989) and determined as follows:

Crop	K	Area	K x %
Alfalfa	1.0	100%	1.0

5: Precipitation data obtained from Western Region Climate Center (www.wrcc.dri.edu) for Colville, Washington station No. 451630 (updated 10/10/19).

6: Volumetric net consumptive use assumes an irregable acreage of 14.4 as determined from GIS evaluation of all irregable acreage of property.

2019
Blanney-Criddle Method for Crop Consumptive Use
S3-21370C(A)
Stevens County, Washington

Month	Mean Monthly Air Temperature[2] t (degrees F)	Percent of Annual Daytime Hours[3] P (percent)	Consumptive Use Factor F	Crop Use Coefficient[4] K	Consumptive Use Uc (inches)	Precipitation[5] (inches)	Net Consumptive Use Ucn (inches)	Volumetric Net Consumptive Use[6] Ucn (acre-feet)	
January	28.94	6.15	1.78	0	0	2.48	0	0	
February	20.00	6.40	1.28	0	0	2.08	0	0	
March	32.95	8.26	2.72	0	0	0.86	0	0	
April	47.24	9.18	4.34	1.0	4.34	0.83	0.00	0.00	
May	56.61	10.54	5.97	1.0	5.97	1.25	4.72	5.66	
June	61.48	10.75	6.61	1.0	6.61	0.15	6.46	7.75	
July	65.50	10.83	7.09	1.0	7.09	0.95	6.14	7.37	
August	67.37	9.91	6.68	1.0	6.68	0.63	6.05	7.26	
September	57.37	8.45	4.85	1.0	4.85	1.12	3.73	4.47	
October		7.49	0.00	1.0	0.00		0.00	0.00	
November		6.22	0.00	0	0		0	0	
December		5.82	0.00	0	0		0	0	
Annual		100	NA	NA	35.53	14.06	27.09	32.51	= Cu
								35.76	= Cu + 10% Evap
								47.68	= Qa @ 75% Eff

Notes:
F = P * t   Uc = F * K   Ucn = Uc - Precip
1: Blanney-Criddle Method adapted from Schulz (1973).
2: Mean monthly air temperature obtained from Western Region Climate Center (www.wrcc.dri.edu) for Colville, Washington station No. 451630 (updated 10/10/19).
3: Percent of annual daytime hours occuring each month for site latitude (approximately 48.3 degrees) adapted from Jensen et. al. 1969.
4: Crop use coeffecient obtained from Schulz et.al. (1989) and determined as follows:

Crop	K	Area	K x %
Alfalfa	1.0	100%	1.0

5: Precipitation data obtained from Western Region Climate Center (www.wrcc.dri.edu) for Colville, Washington station No. 451630 (updated 10/10/19).
6: Volumetric net consumptive use assumes an irregable acreage of 14.4 as determined from GIS evaluation of all irregable acreage of property.

APPENDIX D

WRIA 59 FEASIBILITY PROJECT – TECHNCIAL MEMORANDUM ON CHEWELAH CREEK / COLVILLE RIVER RESTORATION PROJECT FEASIBILITY

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Water & Natural Resource Group, Inc.
Gene St.Godard, R.G., L.Hg.
PO Box 28755
Spokane, Washington 99228
Cell: 509-953-9395
www.wnrgroup.com

TECHNICAL MEMORANDUM

To: **WRIA 59 Watershed Management Partnership (WMP),**
WRIA 59 Water Resources Management Board (Board) and
Stevens County Land Services Planning Department

From: Eugene N.J. St.Godard, P.G., L.Hg., CWRE
Principal Hydrogeologist/Owner
Water & Natural Resource Group, Inc.

And

Adam Cares, Planner
Stevens County Planning Department

Date: October 31, 2019

Project No. 045-007-09 – WRIA 59 RCW 90.94 Feasibility Studies

Subject: Technical Memorandum on Chewelah Creek/ Colville River Restoration Project Feasibility.
Completed under Ecology Grant WRSRPPG-2018-StCLSD-00012

SIGNATURES: This Technical Memorandum and Hydrogeological interpretations were made by Eugene N.J. St.Godard, a licensed geologist/hydrogeologist (L.Hg. #129) in the State of Washington.

Date Signed: - October 31, 2019

1.0 INTRODUCTION

This Technical Memorandum documents Water & Natural Resource Group's (WNR Group) and Stevens County Planning Departments review of a potential stream realignment project on Chewelah Creek that will assist the WRIA 59 Planning Unit with developing additional Net Ecological Benefit (NEB) to the watershed under the RCW 90.94 planning process. This Memorandum was prepared to provide a preliminary judgment into the feasibility of implementing this project as outlined in the WRIA 59 Plan Addendum. The evaluation was conducted by the WRIA 59 planning unit under RCW 90.94 Ecology Grant funding: WRSRPPG-2018-StCLSD-00012.

Over the past two years, in response to the adoption of RCW 90.94.020, Stevens County, in conjunction with the WRIA 59 Watershed Management Partnership (WMP) and WRIA 59 Water Resource Management Board (Board) is developing an Addendum to the Watershed Plan to evaluate the impact of future domestic permit-exempt wells within WRIA 59. In May 2019, the WRIA 59 Board completed its assessment on estimating future domestic well impacts in each of the subbasins within the WRIA (WNR Group, May 31, 2019), and subsequently prioritized the basins according to consumptive use impacts. As a result of this analysis, numerous projects were developed within priority subbasins which could off-set the future estimated domestic consumptive use, and result in a Net Ecological Benefit (NEB) to the watershed (Figure 1). These projects were ranked high or medium in order to prioritize the potential future development of the project within the WRIA 59 Watershed Plan Addendum. This addendum will supplement the most recently approved WRIA 59 Watershed Plan completed in 2007 (Golder, 2007) and Detailed Implementation Plan (Golder, 2006).

The Board developed a conceptual project on Chewelah Creek and the Colville River that could result in net ecological benefit to off-set the estimated consumptive use of future domestic exempt wells. The project is identified as Project #1 within the WRIA 59 Board's developed list of proposed projects. The proposed project is situated at the confluence of Chewelah Creek and the Colville River, and is within both the Chewelah Creek and Colville River South subbasins (Figure 1). The project is located on private property in Section 23, T.32N., R.40E.W.M. (Figure 2).

2.0 CONCEPTUAL PROJECT AND SCOPE

A floodplain enhancement project is proposed within the Chewelah Creek and Colville River South drainages. The proposed project would add a high-flow channel to Chewelah Creek and modify the floodways of Chewelah Creek and the Colville River. The project is intended to improve floodplain connectivity, enhance riparian vegetation and wildlife habitat, and reduce the duration and severity of seasonal flooding on adjacent agricultural land. This project was developed in consultation with private property owners and staff from Stevens County Conservation District and Stevens County Land Services. The project was outlined as a potential priority project during the WRIA 59 Watershed Plan Addendum development.

In April 2019, Ecology notified the WRIA 59 Board that potential funding may be available to conduct Feasibility Studies on potential property projects within the watershed. After consultation with the WRIA 59 Board, an application was submitted to Ecology to conduct a feasibility project on the Chewelah Creek/ Colville River Restoration Project. This initial feasibility screening project was recommended to determine if the project could achieve property owner buy-in to develop a stream restoration plan to reduce flooding and stream erosion at the confluence. Funding was approved in late July 2019 to conduct the following at the Chewelah Creek/ Colville River Restoration project:

1) Conduct a drone survey of the site to develop a topographic map which could be used for a conceptual design at the site.

2) Survey stream channel cross-sections and channel centerline profile for sections of Chewelah Creek and the Colville River

3) Conduct a wetland delineation at the site to assess the impacts of potential project actions on wetlands, and to identify opportunities for wetland enhancement;

4) Developed preliminary, conceptual engineering designs for a project at the site.

3.0 SITE FEASIBILITY ASSESMENT

The Water & Natural Resource (WNR) Group, Inc. was retained by Stevens County, on behalf of the WRIA 59 Watershed Planning Unit to conduct a pre-feasibility investigation of the Chewelah Creek/ Colville River property. Tasks completed for this analysis included:

1) Contracting a licensed surveyor to develop a topographic map of the project area using a drone and survey channel cross-sections and centerline profiles for Chewelah Creek and the Colville River;
2) Contracting a wetlands specialist to perform a wetland delineation
3) Contracting a licensed engineer to conduct flood modeling and develop conceptual designs of channel improvements.

3.1 Topographic Survey

Mid-Mountain Survey of Republic, Washington was retained to develop a topographic map of the site. Measurement methods used for surveying on the project included Conventional Total Stations, RTK GPS, and UAV photogrammetry. Each site uses the Washington State Plane North (NAD83/11) coordinate system, with elevations derived from NAVD88. This Chewelah Creek/ Colville River Restoration Project's control was established by post processing static GPS data with the NGS OPUS processing service.

UAV photogrammetry included setting photo targets / ground control points (GCPs) at the site and surveying them with RTK GPS. Then a multirotor UAV was flown between 200 and 300 feet above ground level (AGL) to capture approximately 1200, 20-megapixel, digital photos of the sites. The photos and GCPs where then processed to produce orthophotos (aerial photos) and digital surface models (DSM), which provides an elevation for each pixel of the orthophoto. Finally, the orthophoto and DSM were used to extract ground points and break lines to create a topographic surface and contour lines suitable for civil engineering design.

The Chewelah Creek Stream Improvement project primarily focused on surveying centerline and cross-section profiles of the Colville River and Chewelah Creek. RTK GPS was used to measure approximately 1500 feet of creek centerline and 11 cross-sections at this site. UAV photogrammetry was used to capture approximately 60 acres of farmland adjoining the creek and river and was used to supplement data used in the cross-sections which in some locations exceeded 1300 feet in width. The GCPs used for this survey were removed after the photos were captured since they were placed in fields that were actively farmed.

The end result of the topographic surveys consisted of a high-resolution aerial map of approximately 25 acres (Figure 3), channel centerline profiles, and cross-sections for the relevant sections of Chewelah Creek and the Colville River, with five cross-sections on each stream. Surveyor maps, surveyed stream profiles, and cross-sections are attached to this Memorandum as Attachment 1.

3.2 Wetland Delineation

The WNR Group retained Jim Gleaton of Williamson Consulting in Colville Washington to conduct a wetland delineation and categorization for the project site. The delineation encompassed roughly 25 acres adjacent to the Colville River and Chewelah Creek. The wetlands were categorized using Ecology’s Eastern Washington Wetlands Rating System (2015). The wetlands were primarily classified as Category II Riverine Wetlands. The majority of the land within the project area was classified as wetlands, with two areas within the project site being classified as uplands. The upland areas include a large pile of spoils dating back to the dredging of the river, and another area that had sufficient non-wetland plant species to justify its classification as non-wetland.

Because the Wetland Delineation Report indicates that wetlands cover a substantial portion of the project area, any ground-disturbing or filling activities at this site will likely impact wetlands and require mitigation. However, the report also indicates that there are significant opportunities to enhance wetland functions and values at the site, meaning that this project could potentially be self-mitigating through wetland restoration and enhancement activities included in the project scope.   A copy of the wetlands report is included in Attachment 2.

3.3 Flood Modeling

The WNR Group retained Cunningham Engineers of Colville, Washington to complete the flood modeling and engineering tasks for the feasibility analysis. The flood modeling entailed evaluation of the channel capacity of Chewelah Creek and the Colville River for peak flows during 100-year and 25-year storms.

Existing conditions were assessed using aerial photos, site visits, and the topographic survey. The valley topography at the project site is noted as having very little change. The existing meander corridor is unnaturally narrow and bermed on the sides, making it highly susceptible to breakouts during flood conditions. These conditions magnify flood effects, with flat topography maximizing flood coverage and drainage being restricted by the narrow-dredged channel.

Information from USGS, topographic surveys, channel cross-sections, and centerline surveys was used to calculate flood volumes. The flood volumes calculated for the 100-year storm were 11,026 cfs for the Colville River and 2,757 cfs for Chewelah Creek. For the 25-year storm, the volumes were 6,469 cfs for the Colville River and 1,761 cfs for Chewelah Creek. Flood modeling was conducted to estimate what combination of cross-section width and flood depth would allow the 100-year and 25-year flood to pass and stay within adjacent landforms. For a 100-year flood event, a cross-section width of 110 feet for Chewelah Creek determined a flood depth of 2 feet. This depth allowed flood waters to remain about one foot below the adjacent landforms. A cross-section width of 700 feet for the Colville River determined a flood depth of 5 feet. This depth is 1.5 ft above adjacent landforms. Hydraulic calculations determined that a floodway width of 1400 feet and depth of 3.5 feet would allow flooding to remain even with the landforms. For a 25-year flood event, a floodway cross-section width of 110 feet for Chewelah Creek was analyzed to have a flood depth of 1.5 feet. A floodway cross-section width of 700 feet for the Colville River determined a flood depth of 3.5 feet.

TABLE 1: REQUIRED FLOODWAY DIMENSIONS FOR FLOOD EVENTS

Stream	Flood Event	Flood cfs	Floodway Width	Flood Depth
Colville River	100 Year	11,026	1,400 ft.	3.5 ft.
Colville River	25 Year	6,469	700 ft.	3.5 ft.
Chewelah Creek	100 Year	2,757	110 ft.	2 ft.
Chewelah Creek	25 Year	1,761	110 ft.	1.5 ft.

Widened floodways on each stream were proposed to reduce restrictions to flood flow. The proposed floodways were conceptually designed to accommodate the 25-year flood flow. To accommodate these flows, the proposed floodway cross section on Chewelah Creek is 110 ft. wide and 2 ft. deep, and the proposed cross section on the Colville River is 700 ft. wide and 3.5 ft. deep. Actual constructed floodway widths would depend on landowner preferences, but would require enough width to allow permanent establishment of riparian vegetation, and to create a measurable reduction in the frequency and duration of annual flooding. The engineering report and associated engineering drawings are provided in Attachment 3.

4.0 GEOLOGIC/HYDROGEOLOGIC CONCEPTUAL MODEL

The WNR Group reviewed the Washington Division of Geology and Earth Resources geologic map for northeastern Washington (1991). The geologic map revealed that the subject site is underlain by Pleistocene Age glacial and alluvial sands and gravel deposited over bedrock in the Chewelah Creek/ Colville River area. Bedrock in the highlands above the valley floors consists of Precambrian Age metasedimentary (shale/slate) rocks. Figure 4 presents a geologic map of the project site area.

Data was reviewed of aquifer characteristics on well logs in the vicinity of the Site. Based on geologic exploratory results found in well logs, the Chewelah Creek/ Colville River in the area of the site appears to be filled with sands and gravels associated with glacial and alluvial deposits, over clay that confines the lower Colville Valley Aquifer. The lower aquifer is found below the clay at depths of approximately 200-300 feet below grade. Groundwater in the deeper confined aquifer beneath the site appears to have hydraulic heads which rise to depths of approximately 40-80 feet below grade near the site, and appears to have yields greater than 50 gpm.

Groundwater is inferred to be recharged in the highlands of Chewelah Creek/ Colville River by snow pack melt and precipitation and flows through the tributary shallow unconfined aquifers and directly to surface waters in the Colville River, or losing water to the lower aquifer.

Several hydrogeologic reports were readily available for the area that were prepared by the USGS, Ecology, and other entities. Two reports specifically addressed the hydrogeology within the Colville Valley. These two reports were completed by the USGS in 2003 and 2004 for the WRIA 59 Watershed Planning Unit and are listed in the bibliography of this report. In summary, the hydrogeologic reports identify a shallow unconfined silt-sand-gravel aquifer in glaciofluvial sediments east of the site, typically found in the tributary valleys. This shallow aquifer pinches out at the valley floor, and shallow groundwater appears to be infiltrating to the lower aquifer at the Colville River valley walls. A deeper confined aquifer is present throughout the Colville Valley. This lower aquifer typically has higher yields. However, yields may vary greatly depending on silt content (Kahle and Ely, 2004). This aquifer is the main water supply for the valley floor.

It appears that the lower portions of Chewelah Creek and the Colville River, may be perched on top of less permeable soils deposited within the Colville River valley. These low permeable soils may enhance the flooding of the area due to a low probability of water infiltrating into the substrate. A review of the USDA NRCS soils map of Stevens County (Figure 5) shows that most of the site is underlain by Bossburg muck (Soil Map Unit #37). This soil is classified as Farmland of statewide importance. It is typically derived from a parent material of mixed volcanic ash and alluvium. The soil is classified as "very poorly drained" and is frequently flooded.

5.0 DESIGN OF PROPOSED MITIGATION PROJECT

The WNR Group retained Cunningham Engineers of Colville, Washington to assist the preliminary design of a floodplain restoration project. The proposed project would construct a high-flow channel on Chewelah Creek near its confluence with the Colville River, and widen the floodways of Chewelah Creek and the Colville River. The preliminary engineering design for the Chewelah Creek/ Colville River Restoration Project is included in this Memorandum as Attachment 3.

The following is a summary of the proposed project for the Chewelah Creek/ Colville River:

- A new floodway channel will be constructed on Chewelah Creek to reduce flood volume in the main channel during seasonal high flows. The side channel is designed to carry up to 40% of the 100-year flood volume (1,102 cfs).
- A floodway weir will be constructed to direct sediment into the side channel and reduce aggradation of the main channel during flood conditions.
- Streambarbs will be employed along the main channel to dissipate flow energy, prevent erosion, and maintain alignment between the stream channel and the floodway weir.
- The side channel is designed to allow full summer flow to remain in the existing channel, with the side channel being dry during non-flood conditions.
- The side channel will also allow the lower section of Chewelah Creek to flow in a manner more similar to its historic course, prior to the development of the valley and dredging of the river system;
- The side channel will require periodic cleanout of sediment buildup during non-wetted times of year.
- Widened floodways are also conceptually proposed for Chewelah Creek and the Colville River to reduce restrictions to flood flow, reconnect the channel to the floodplain, and allow for riparian restoration and enhancement within this new meander corridor (See Page 4 of Attachment 3). The conceptual floodways are designed to accommodate flows from the 25-year flood. Actual floodway dimensions and design will vary depending on landowner preferences and other site factors.

FIGURE 3: ESTIMATED EARTH QUANTITIES

The soil materials removed during floodway construction could be used to amend adjacent fields, as long as compliance is maintained with state and federal laws protecting wetlands.

Chewelah Creek Floodway:
110 ft wide x 2 ft deep x 465 ft long = 102,300 cu. ft. = 3,789 cu. yds.

Colville River Floodway:
700 ft wide x 3.5 deep x 765 ft long = 1,874,250 cu. ft. = 69,417 cu. yds.

New Diversion Floodway-Chewelah Creek:
44 ft wide x 2.5 ft deep x 500 ft long = 55,000 cu. ft. = 2,037 cu. yds.

The Chewelah Creek/ Colville River Restoration Project site conditions are amenable to a floodplain restoration project. Landowner support, financial cost, and the ability to obtain required permits are limiting factors in completing the proposed project. At this point, additional consultation is needed between property owners, agencies, and technical professionals to further evaluate the conceptual proposals, discuss specific design elements, and evaluate alternatives. Following these discussions, additional research and design will likely be required.

Hydrologic conditions at the project site are influenced by factors well outside the project scope. Flooding within the project area is partly caused by downstream "bottlenecks" which are outside the project area, and the proposed project treatments are not sufficient to solve these downstream issues. The hydrology of the Colville River Valley has been historically modified at a basin-wide scale, and therefore restoration measures are needed at a similarly large scale to make a significant impact. The scope of the proposed project is not large enough to completely alleviate the severe seasonal flooding that occurs on this section of the river. However, the feasibility study indicates that the project will make some reduction in the severity and duration of seasonal flooding, reduce mass wasting and other erosion, and improve instream and riparian habitat. If successful, this project could also serve as a model for further floodplain improvement projects by landowners in the Colville Valley.

6.0 NEB INTERPRETATION

The Chewelah Creek and Colville River Restoration Project proposes to improve the instream and riparian habitat in the lower reach of Chewelah Creek and the confluence of Chewelah Creek and the Colville River. The project is focused on portions of Chewelah Creek and the Colville River that were historically dredged and straightened. The project will improve riparian habitat, bank stabilization, create a braided channel, improved channel terracing, installation of large woody debris and remaindering of the channel. The project will improve hydrologic functions of the stream and floodplain, which in turn will improve natural ecological functions within the stream and river.

The proposed project in Chewelah Creek/ Colville River is proposed as a project to enhance Net Ecological Benefit within the WRIA 59 watershed under the RCW 90.94 process. The project will have multiple effects from: 1) reducing flooding of the agricultural fields near the confluence, 2) reducing erosion of the stream banks at the confluence of the two surface water bodies, 3) reducing sedimentation in the Colville River, and 4) enhancing fisheries habitat in the area of the project. In summary, the proposed project appears to be a Net Ecological Benefit (NEB) to the watershed.

7.0 CONCLUSIONS AND FINDINGS

The WNR Group has developed this Technical Memo to present the data collected from the Chewelah Creek/ Colville River Restoration Project Feasibility Analysis. This project was developed by the WRIA 59 Watershed Planning Unit in the Colville River South subbasin for the WRIA 59 RCW 90.94 domestic well consumptive use assessment and Watershed Plan Addendum. The feasibility study has developed the following findings:

- A new high-flow floodway channel on Chewelah Creek would reduce flood volume and sediment aggradation in the main channel.
- A 700 ft. wide floodway on the Colville River and a 110 ft. wide floodway on Chewelah Creek would provide the necessary corridor to pass flood flows from the 25-year flood event. However, in future designs, the floodway dimensions may vary based on additional factors such as project cost, landowner objectives, and existing infrastructure.
- Developing a widened floodway would provide both the Colville River and Chewelah Creek with a new sustainable meander corridor that would enhance riparian vegetation, improve wildlife habitat, reduce erosion, and reduce seasonal saturation of agricultural fields.
- To maximize the effectiveness of this project, further study should be conducted in the future along the Colville River downstream to Schmidelkofer Rd., with the aim of defining a sustainable meander corridor capable of passing 25-year flood flows for the entire extent between Highway 395 and Schmidelkofer Rd.
- Additional stakeholder discussions, studies, and design work are needed for the project to move forward.
- The proposed project is expected to provide wetland enhancement through improvement of wetland plant species diversity and composition, and conversion of two upland sites to wetlands. The project is expected to provide wildlife habitat enhancement through establishment of diverse riparian vegetation and mature trees within the channel migration zone. The project is expected to provide water quality improvement through reduction of mass wasting and sheet runoff erosion on agricultural fields. There is a fairly low risk of failure of these project elements – even if the project fails to significantly reduce flood impacts, these environmental benefits can still be expected to occur.
- If this project can successfully achieve a net improvement in flood severity, agricultural viability, channel/ floodplain connectivity, and riparian habitat enhancement, it could serve as a model for further floodplain improvement projects by landowners in the Colville Valley.
- The proposed project would provide a NEB to the watershed.

- **REFERENCES**

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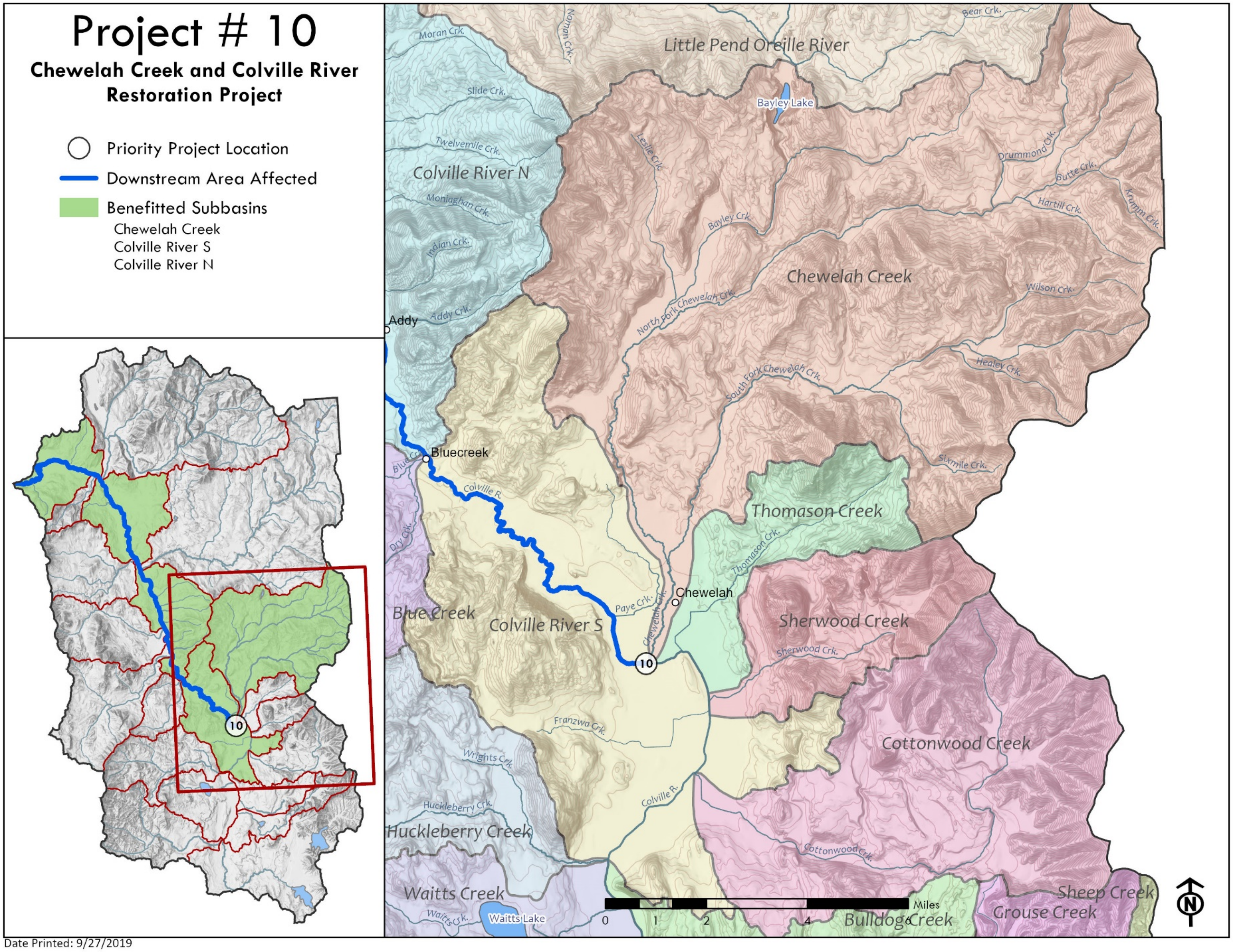


Figure 1: Project Location within Watershed

WRIA 59 RCW 90.94 Chewelah Creek/ Colville River Feasibility Technical Memorandum Figures

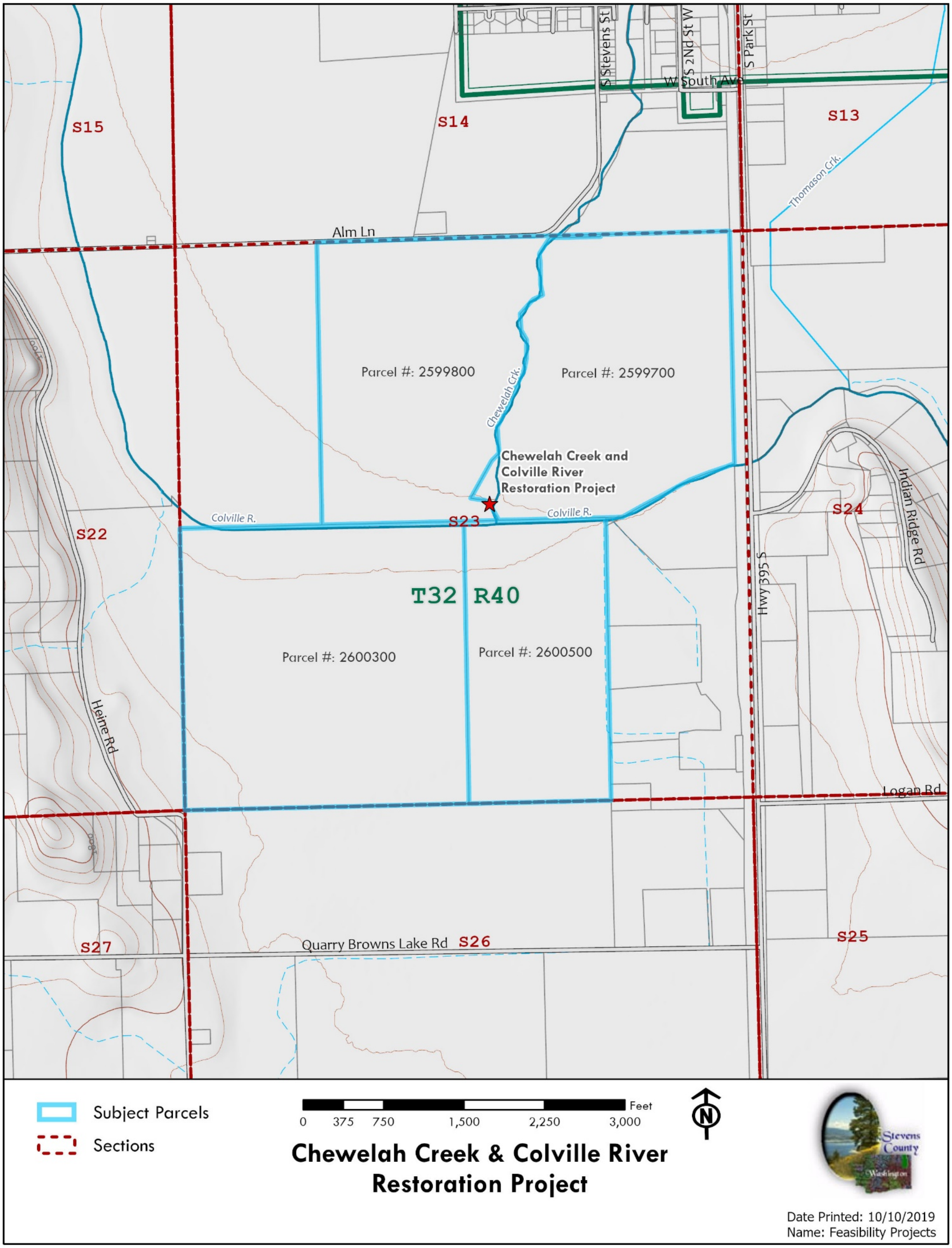


Figure 2: Subject Parcel Map

Figure 3: Aerial Drone Photo

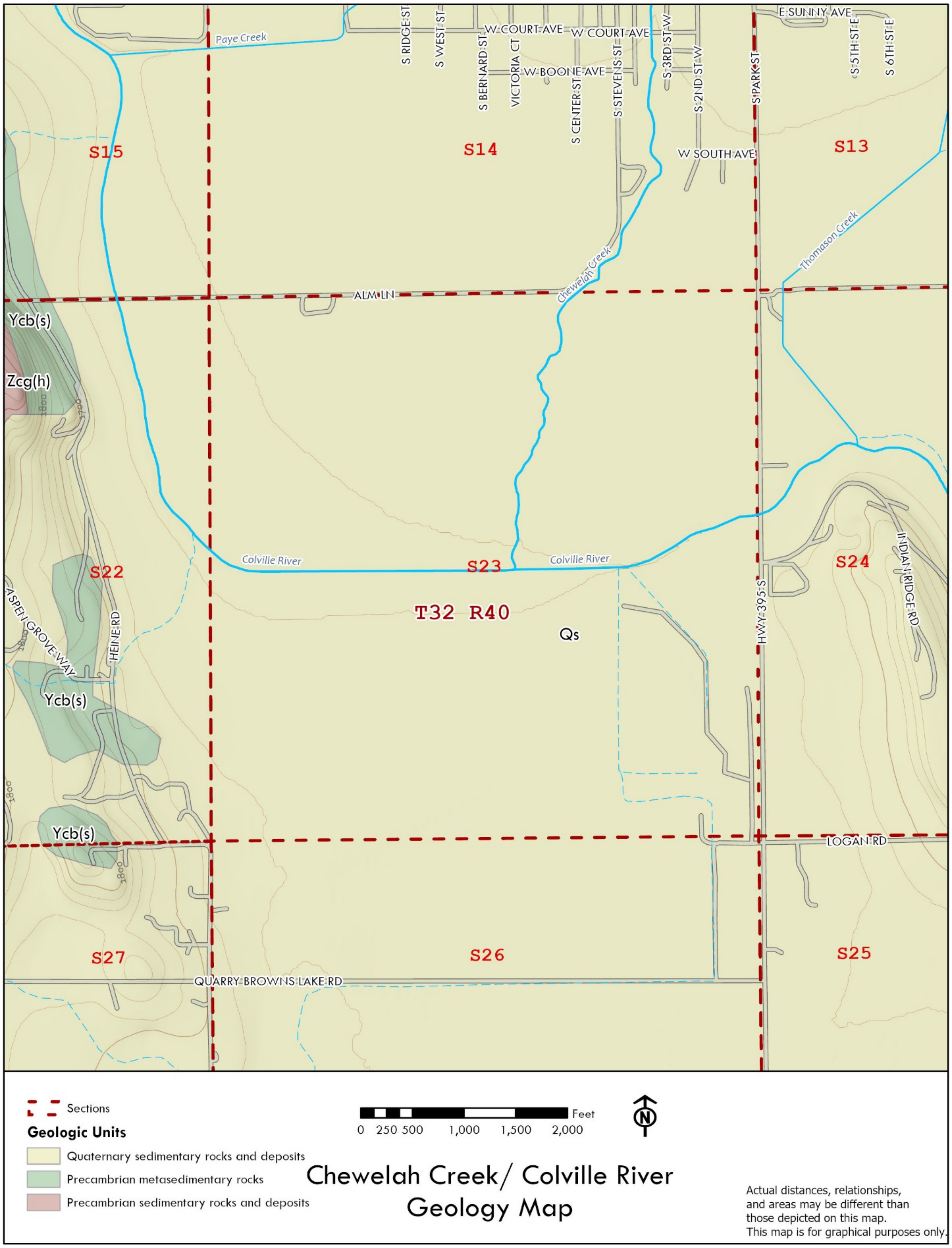
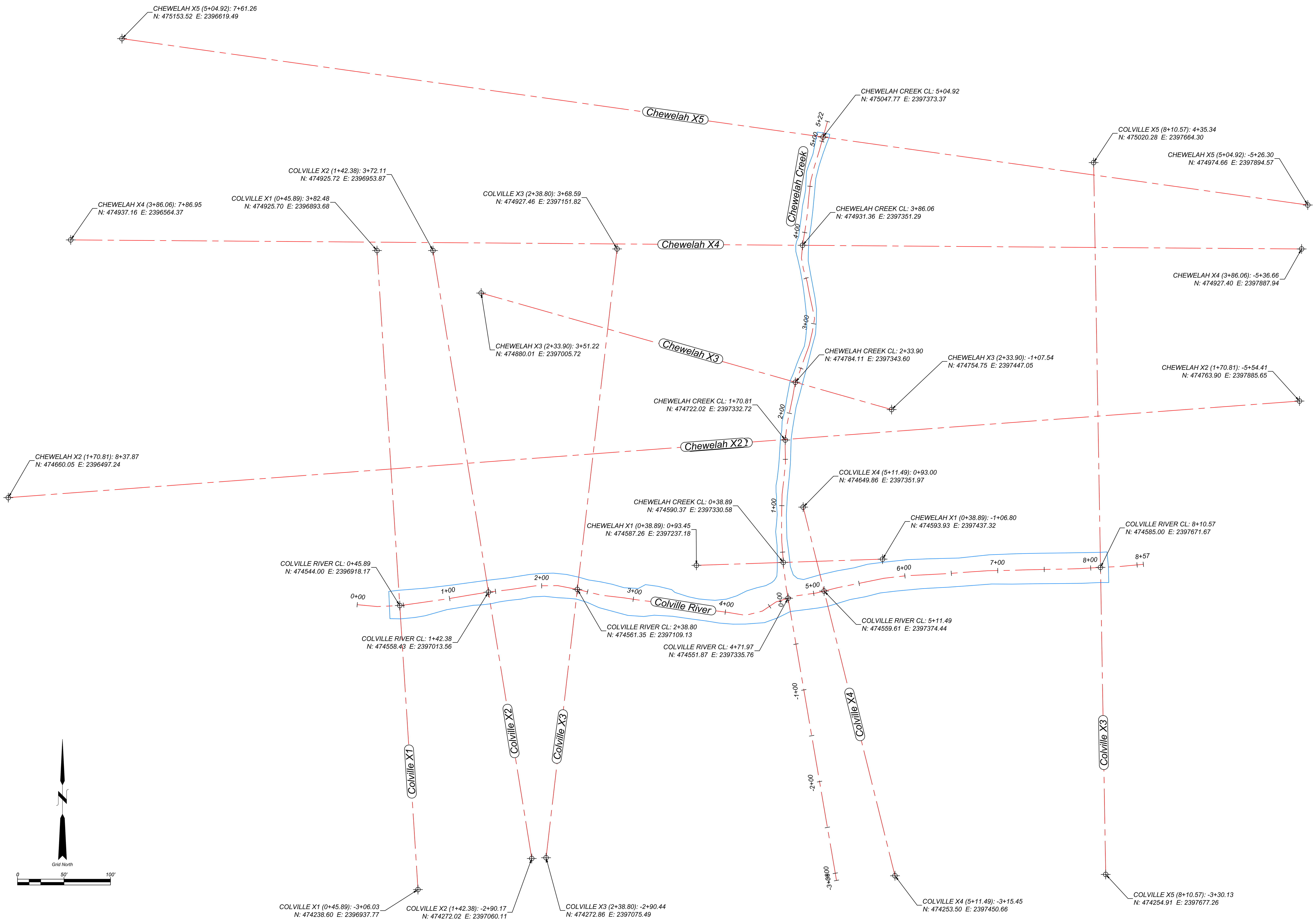


Figure 4: Geologic Map of the Are near the confluence of Chewelah Creek and Colville River.

Figure 5: Soil Map of Area near Confluence of Chewelah Creek and Colville River.

ATTACHMENT 1

SURVEYOR MAPS AND CROSS SECTIONS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Chewelah X5
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COLVILLE X5 (8+10.57): 4+35.34
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CHEWELAH X5 (5+04.92): -5+26.30
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Chewelah Creek
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CHEWELAH X4 (3+86.06): 7+86.95
N: 474937.16 E: 2396564.37
COLVILLE X3 (2+38.80): 3+68.59
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CHEWELAH CREEK CL: 3+86.06
N: 474931.36 E: 2397351.29
Chewelah X4
CHEWELAH X4 (3+86.06): -5+36.66
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CHEWELAH X3 (2+33.90): 3+51.22
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Chewelah X3
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Colville X1
Colville X2
Colville X3
Colville X4
Colville X3
Grid North
0
50'
100'
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N: 474238.60 E: 2396937.77
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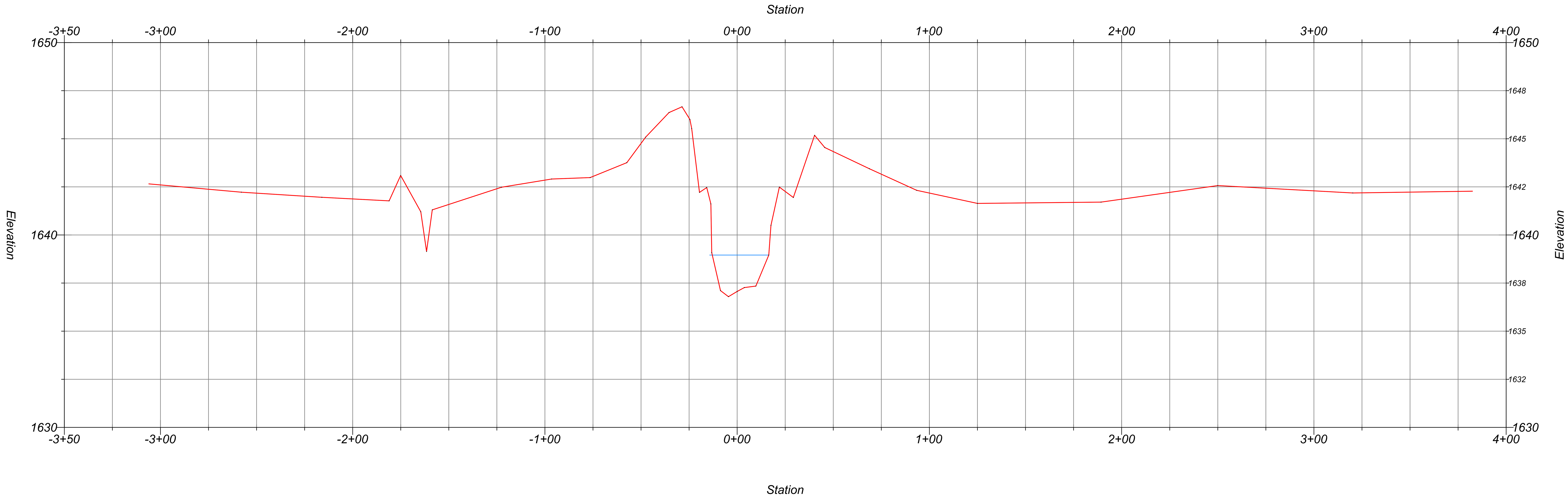
Colville X1 (0+45.89) PROFILE



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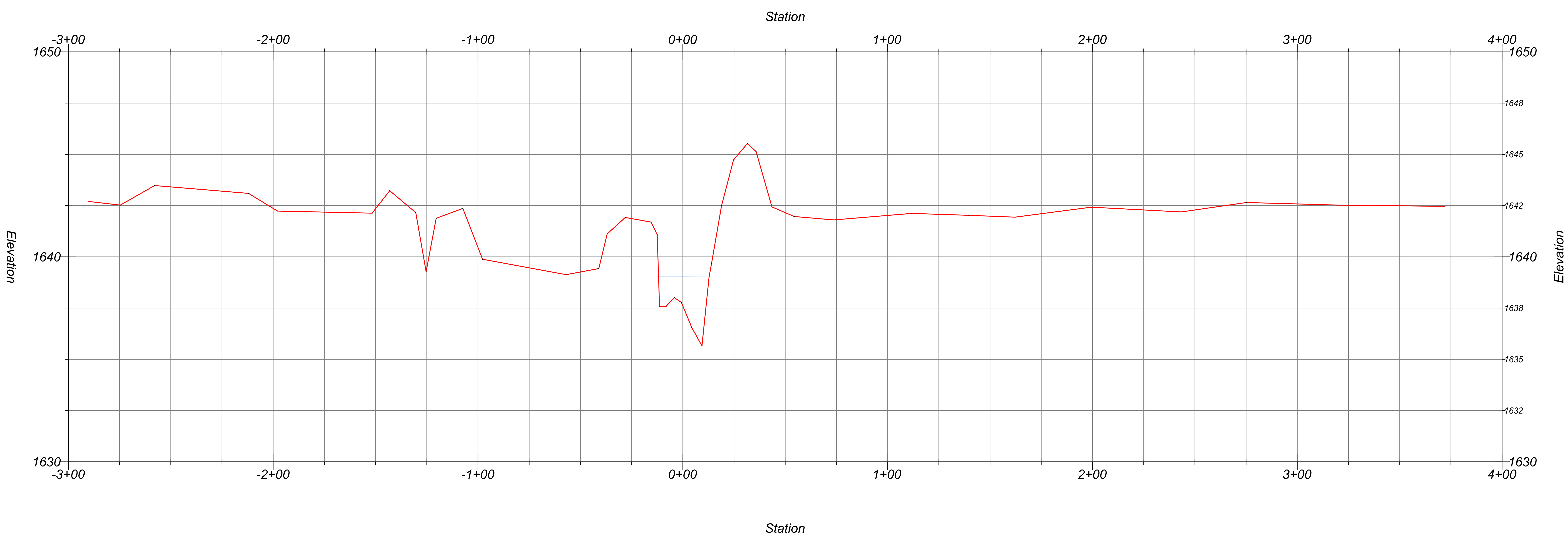
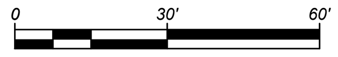
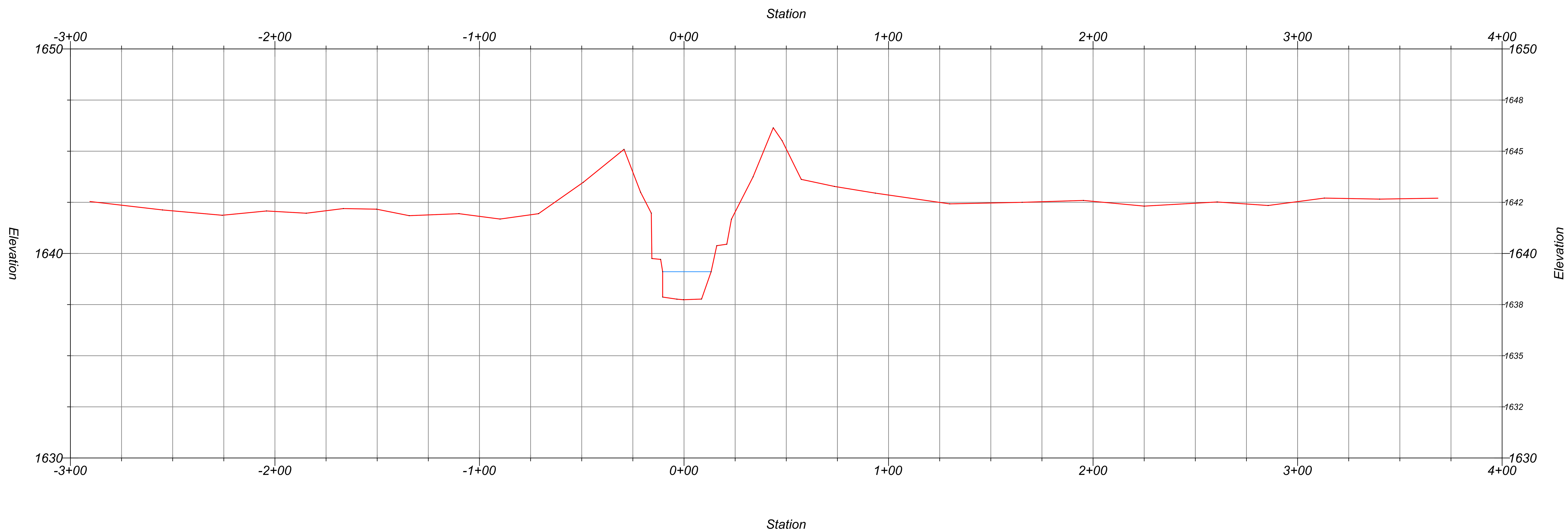




Colville X3 (2+38.80) PROFILE



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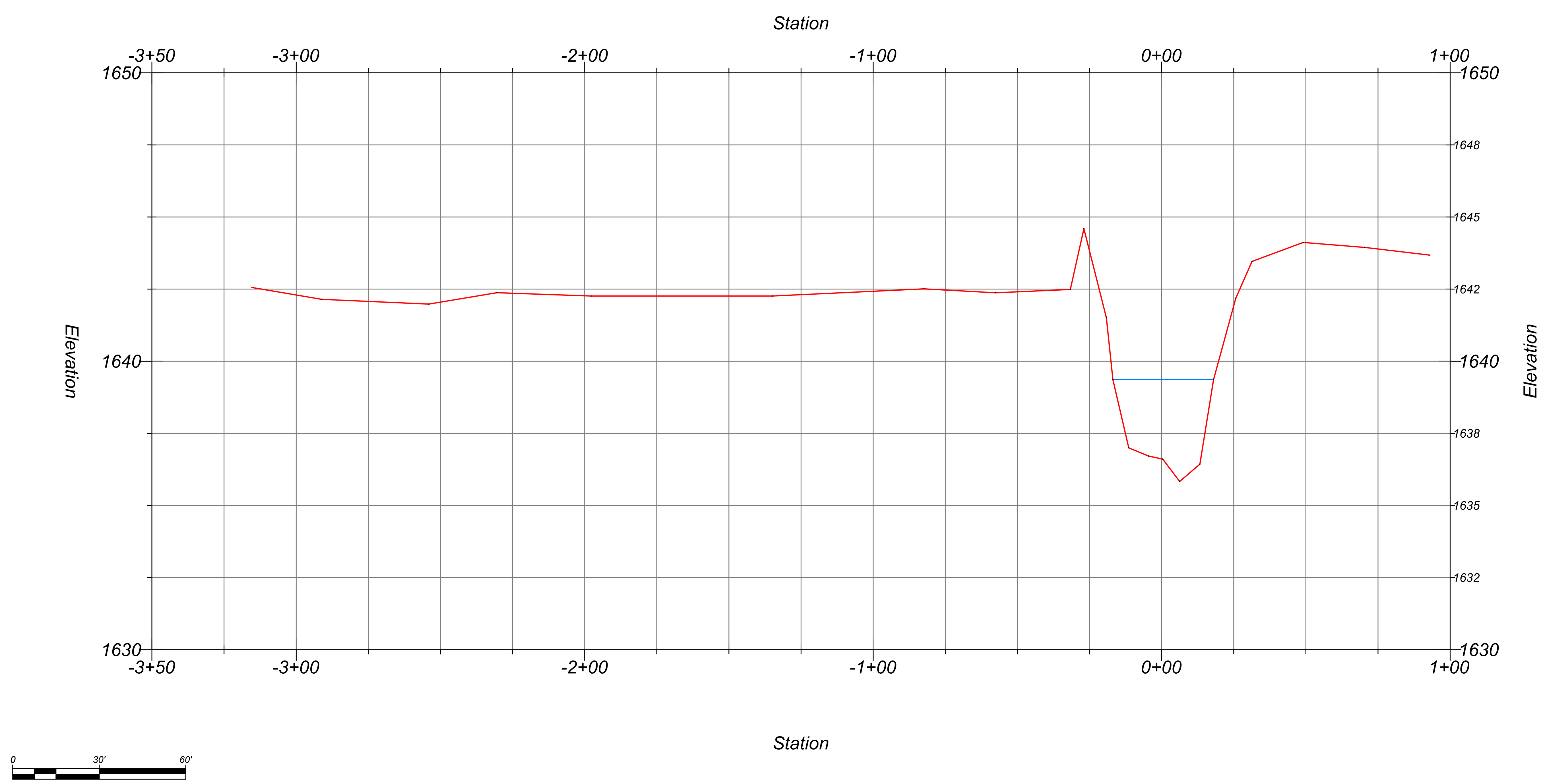
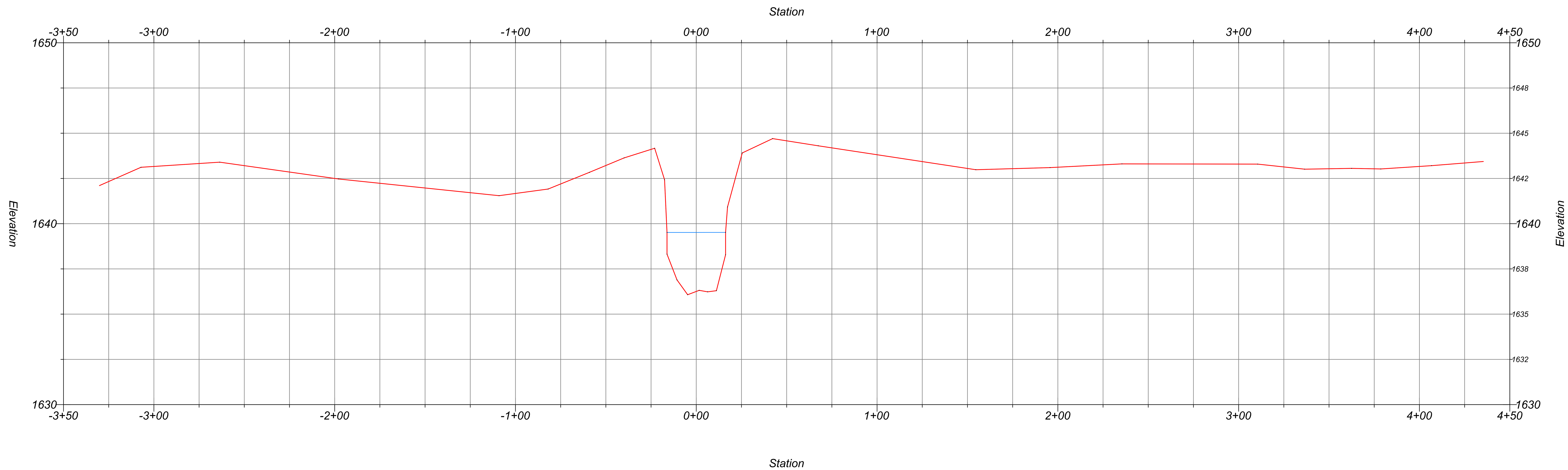
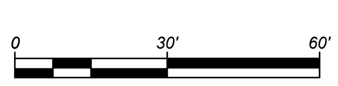
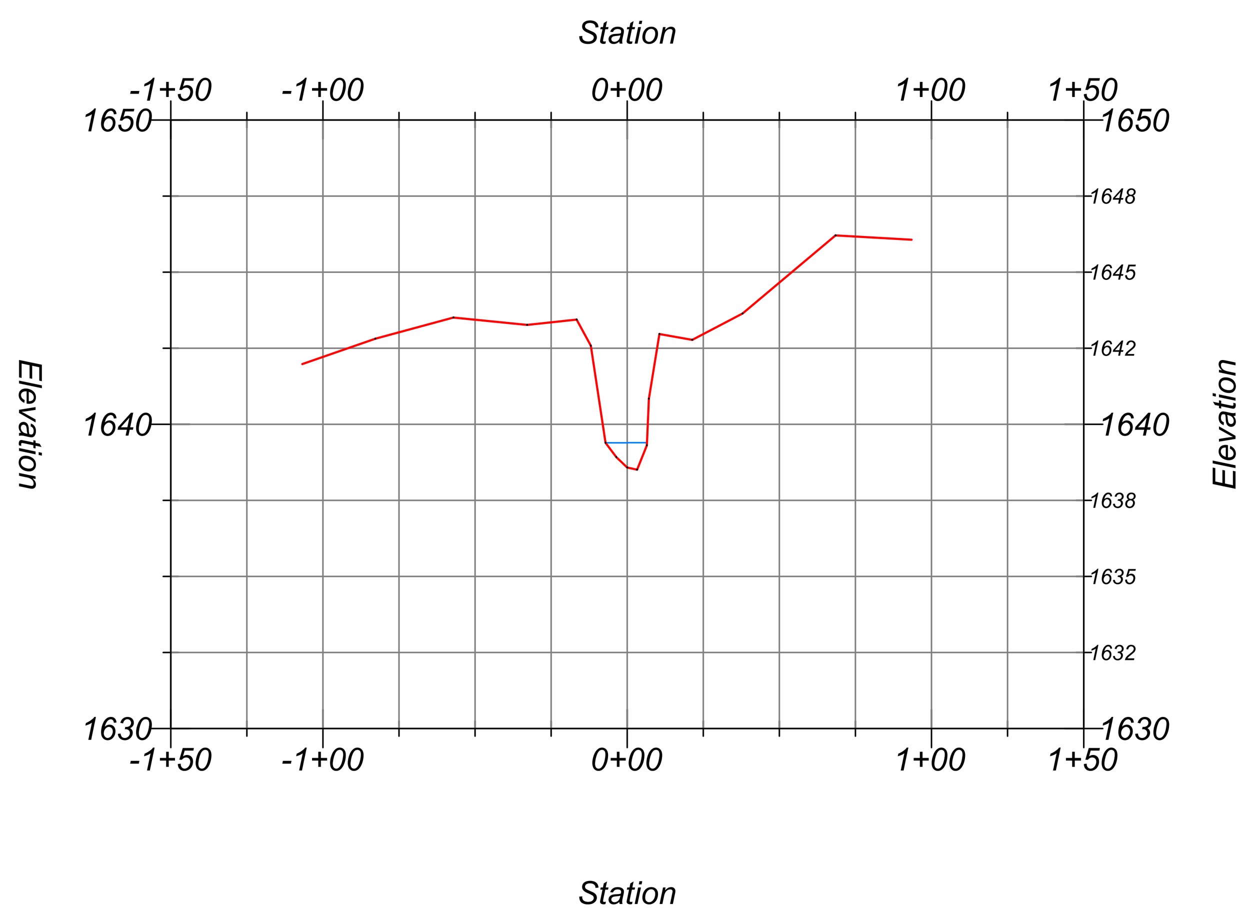


Colville X5 (8+10.57) PROFILE

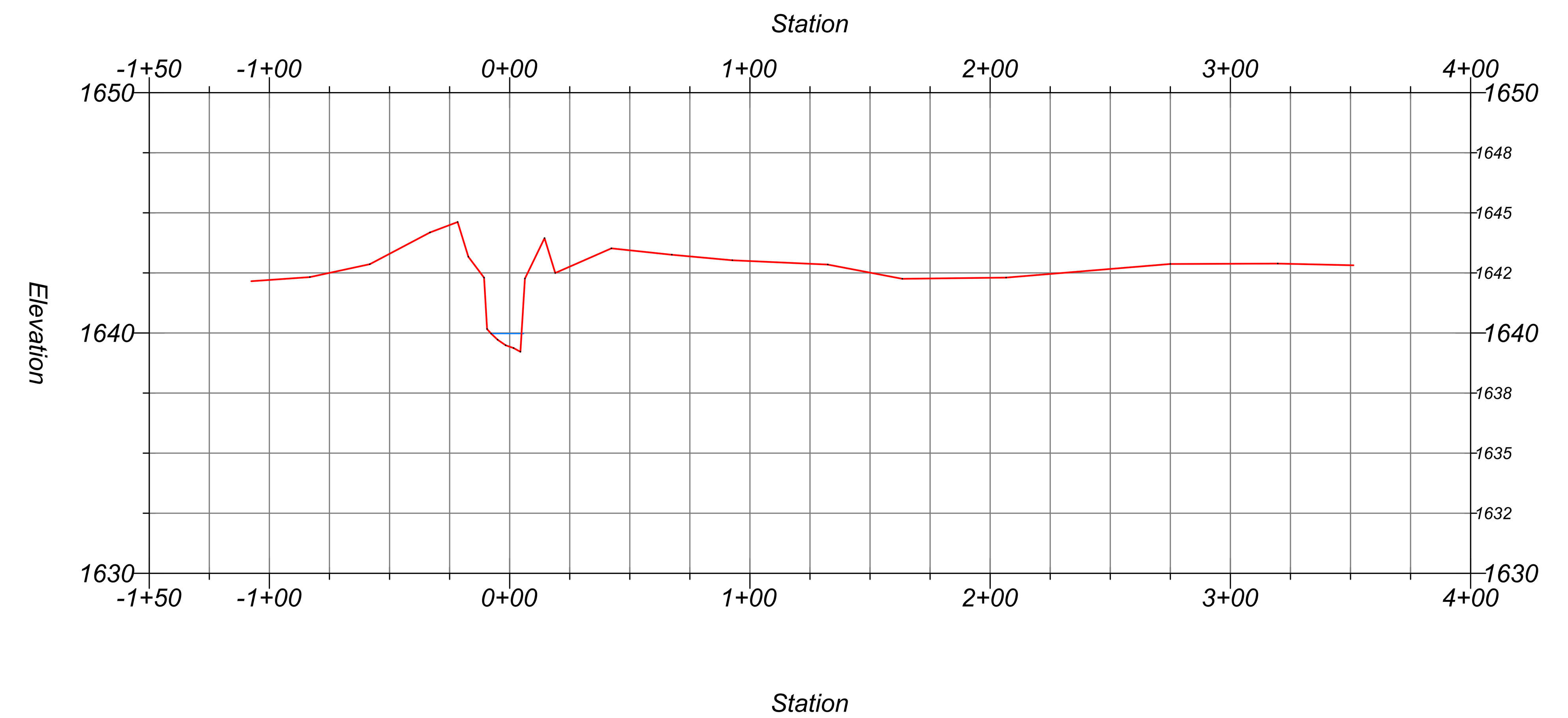




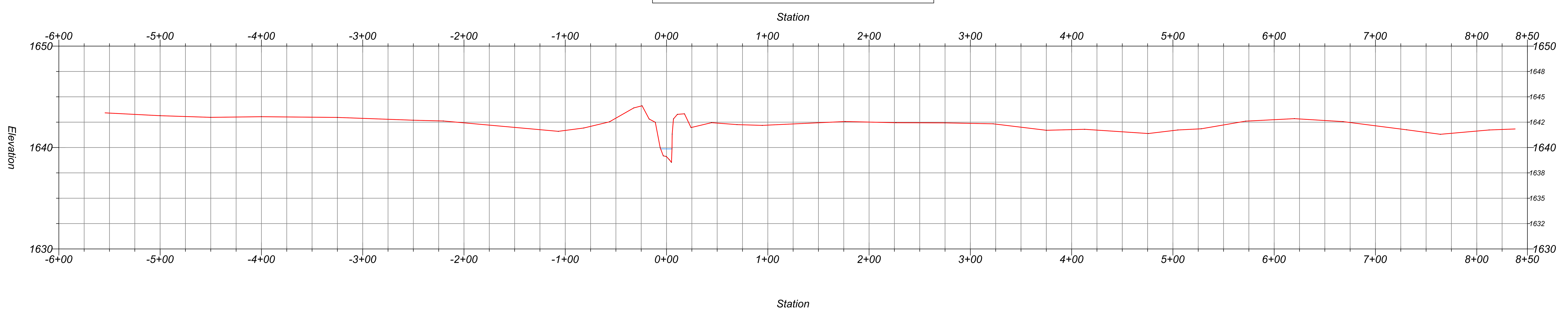
Chewelah X1 (0+38.89) PROFILE



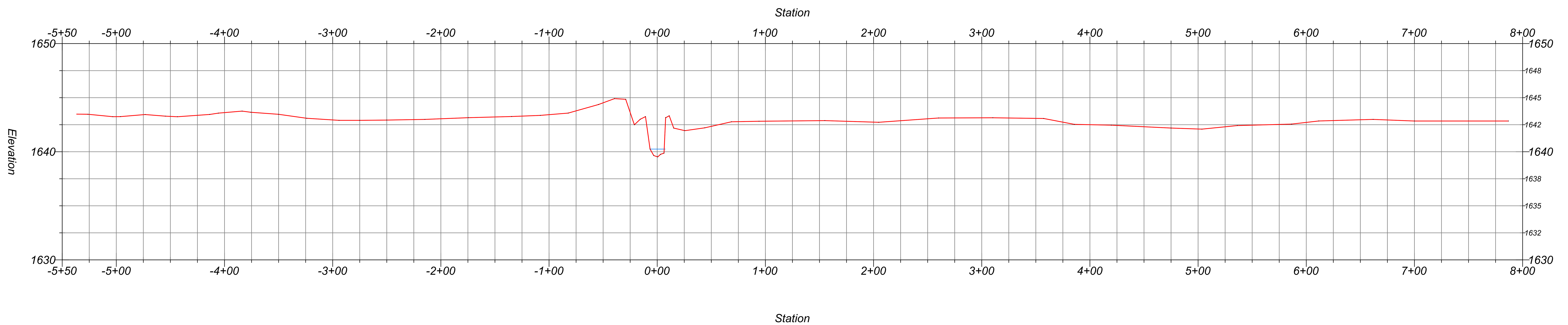
Chewelah X3 (2+33.90) PROFILE



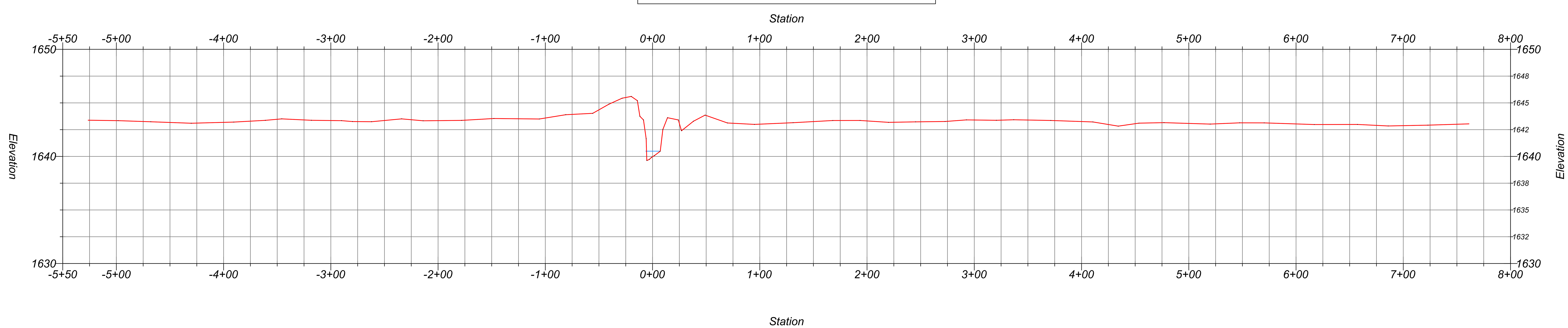
Chewelah X2 (1+70.81) PROFILE

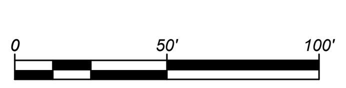


Chewelah X4 (3+86.06) PROFILE

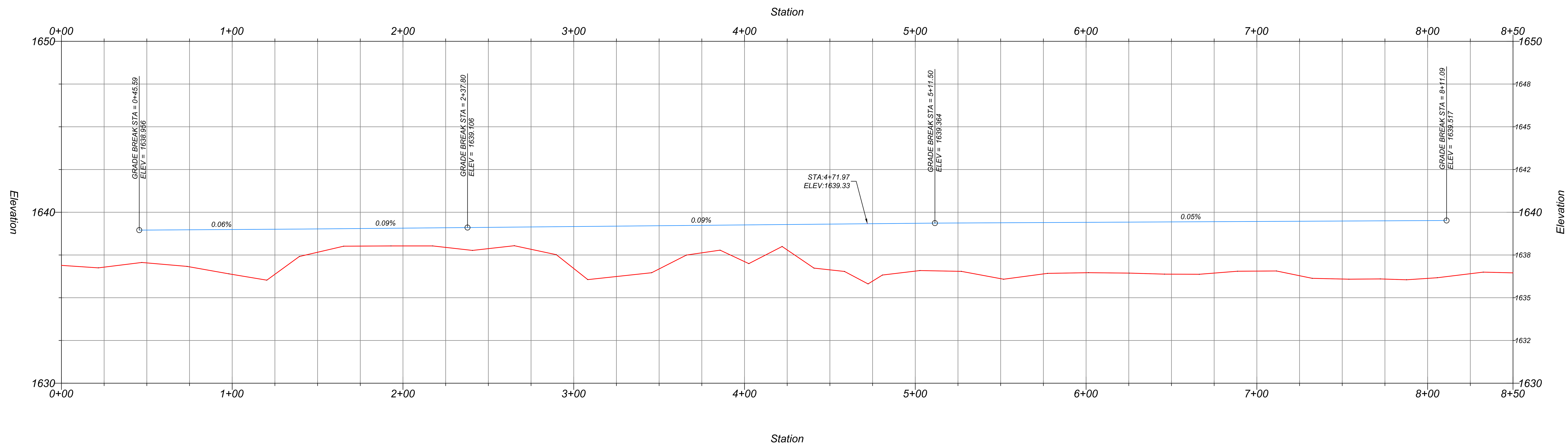


Chewelah X5 (5+04.92) PROFILE

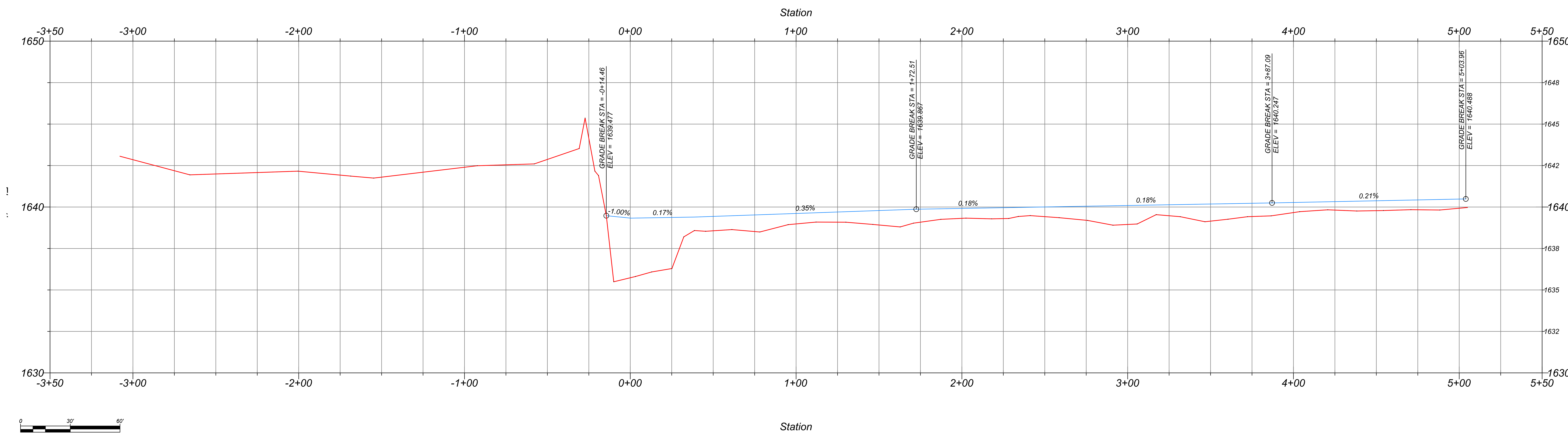




Colville River CL PROFILE



Chewelah Creek CL PROFILE



ATTACHMENT 2

WETLAND DELINEATION REPORT

Wetland Delineation And Categorization

Portions of Parcels 2599800, 2599700 2600300 & 2600500
Section 23, T. 32 N. R. 40 E.W.M.
Confluence of Chewelah Creek and Colville River.

PREPARED BY:

Jim Gleaton

Williamson Consulting, 270 S. Main, Colville, WA

September, 2019

TABLE OF CONTENTS

At your request, I completed an on-site wetland delineation and categorization on portions of Parcels 2599800, 2599700, 2600300 and 2600500 in Section 23 T.32 N. R. 40 E.W.M., in Stevens County. The Wetlands were delineated using wetland identification protocols identified in the 1987 Corps of Engineer Wetland Delineation Manual (Regional Supplement -- Western Mountains, Valleys, and Coast Region (Version 2.0) adopted by Stevens County and Washington State in March of 2011.

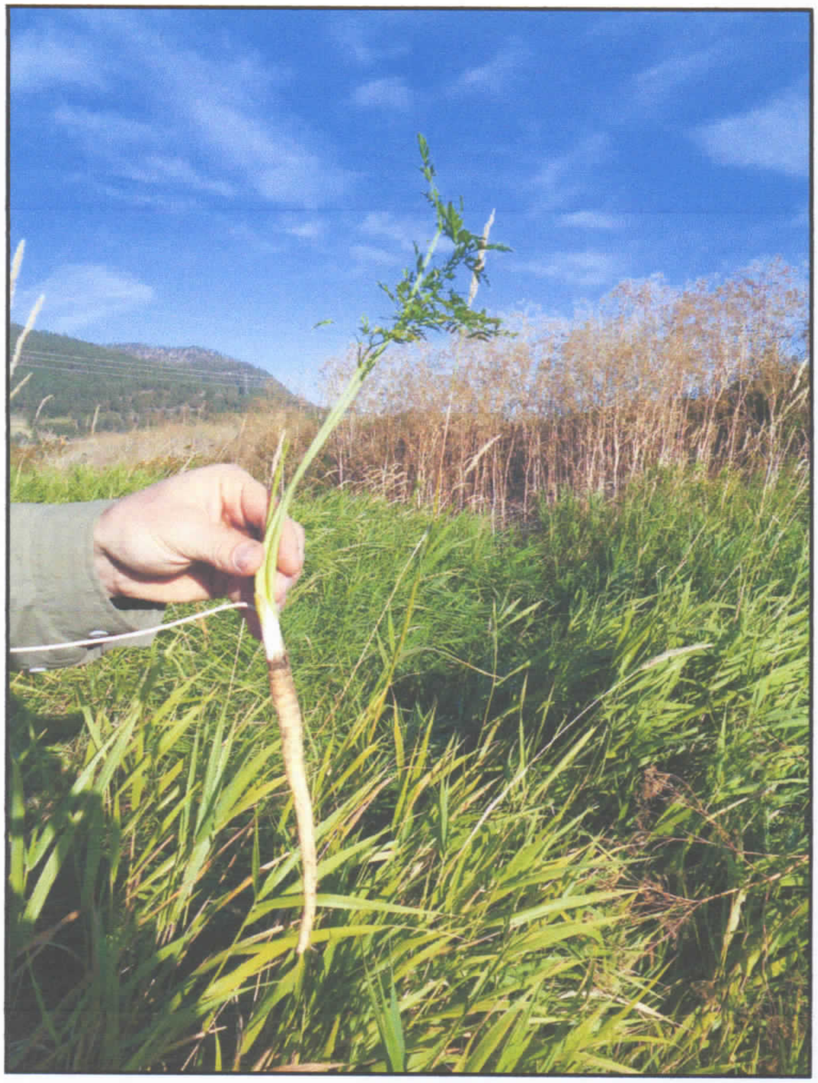
The wetland were Categorized using Ecology's Eastern Washington Wetland Rating System (Jan. 2015). These are Category II "Riverine" wetlands (see Maps). Stevens County's Critical Areas Ordinance requires a 150 buffer from the delineated wetland boundary. Normally the wetlands associated with the Colville River are "Slope Wetlands" however, at the confluence of Chewelah Creek and the Colville River there are several sand bars in the Colville River Channel. Because the proposed project is mostly downstream of that confluence and these sand bars are between the Ordinary High Water Marks of the Colville River, I decided to use the "Riverine" wetland rating worksheets to rank this wetland.

Chewelah Creek and the Colville River are both Type 1 waters of the state, they both have a 150 buffer in Stevens County.

Sand bar just downstream of the confluence of the two streams.

The National Wetland Inventory Map prepared by the U.S. Fish and Wildlife Service, shows these areas as PEM1Ad, which means they are listed as a drained phase wetland because of the dredging of the Colville River which has altered the natural hydrology, lowering it 3 to 5 feet during a large part of the growing season. The USDA Natural Resources Conservation Service maps these soils as Bossburg Muck, which are dark surface and mottles are present in the profile. These mottles reflect a seasonal high water table, but remain after the hydrology was modified. I relied on the existing plant community to determine the presence of absence of the wetland. There is not sufficient evidence to call the cropped portion of the area a non–wetland. Where there was sufficient FACU plants, I mapped those areas as Upland. I have included aerial photography (Google Earth), dating back to 2003 that I used to help me understand the cropping history, and changes in hydrology where visible.

A large pile of "spoils" (material excavated from the area below the confluence) is shown on the base map as an Upland site. This is an area of non-native sandy gravel material, that has mostly FACU plants on it. There is also a large patch of what looks to me like Poison Hemlock (Conium maculatum). It has been sprayed with a herbicide to try kill it but there is a lot of young plants coming in the understory. If this actually is Poison Hemlock, it is very poisonous and contact with the roots or sap should be avoided. I would recommend that the Stevens County Weed Board be contacted to confirm the identity of this plant. I hope I am wrong but better safe than sorry.

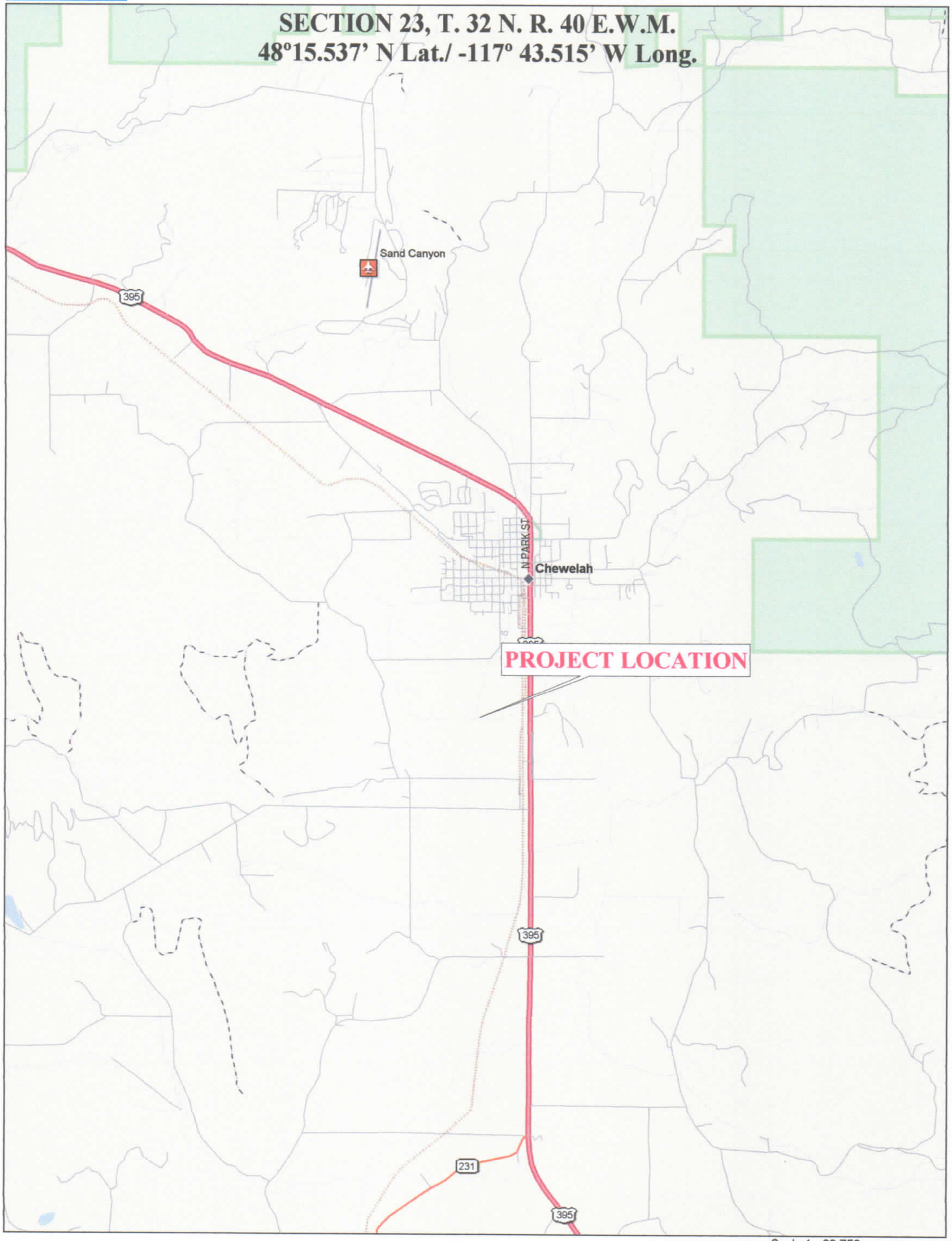


Note dead plants in background, this is a young plant pulled from the understory of the sprayed area.

Jim Gluton

LOCATION MAP

Street Atlas USA® 2006



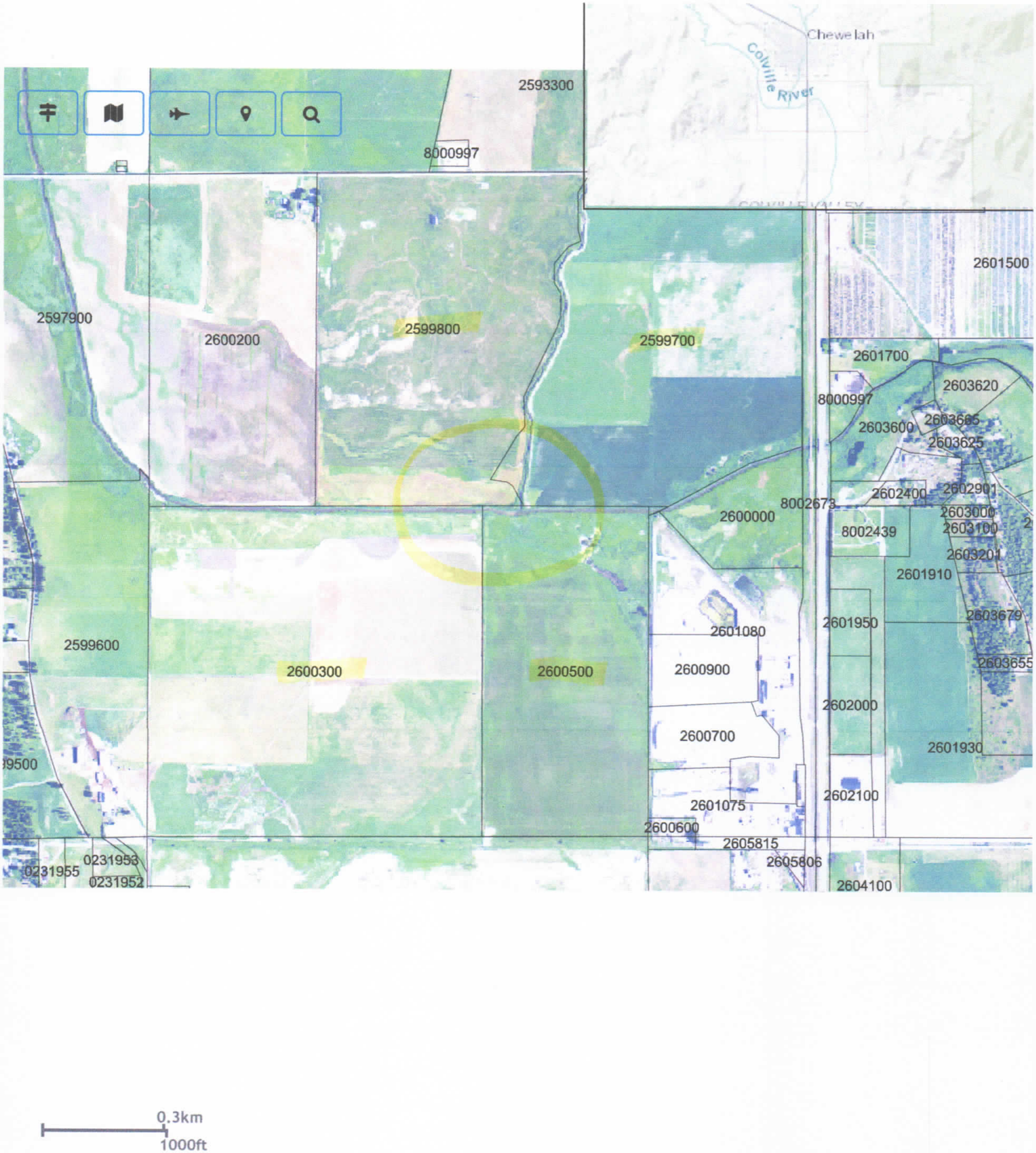
Data use subject to license.

TN
MN (14.2°E)

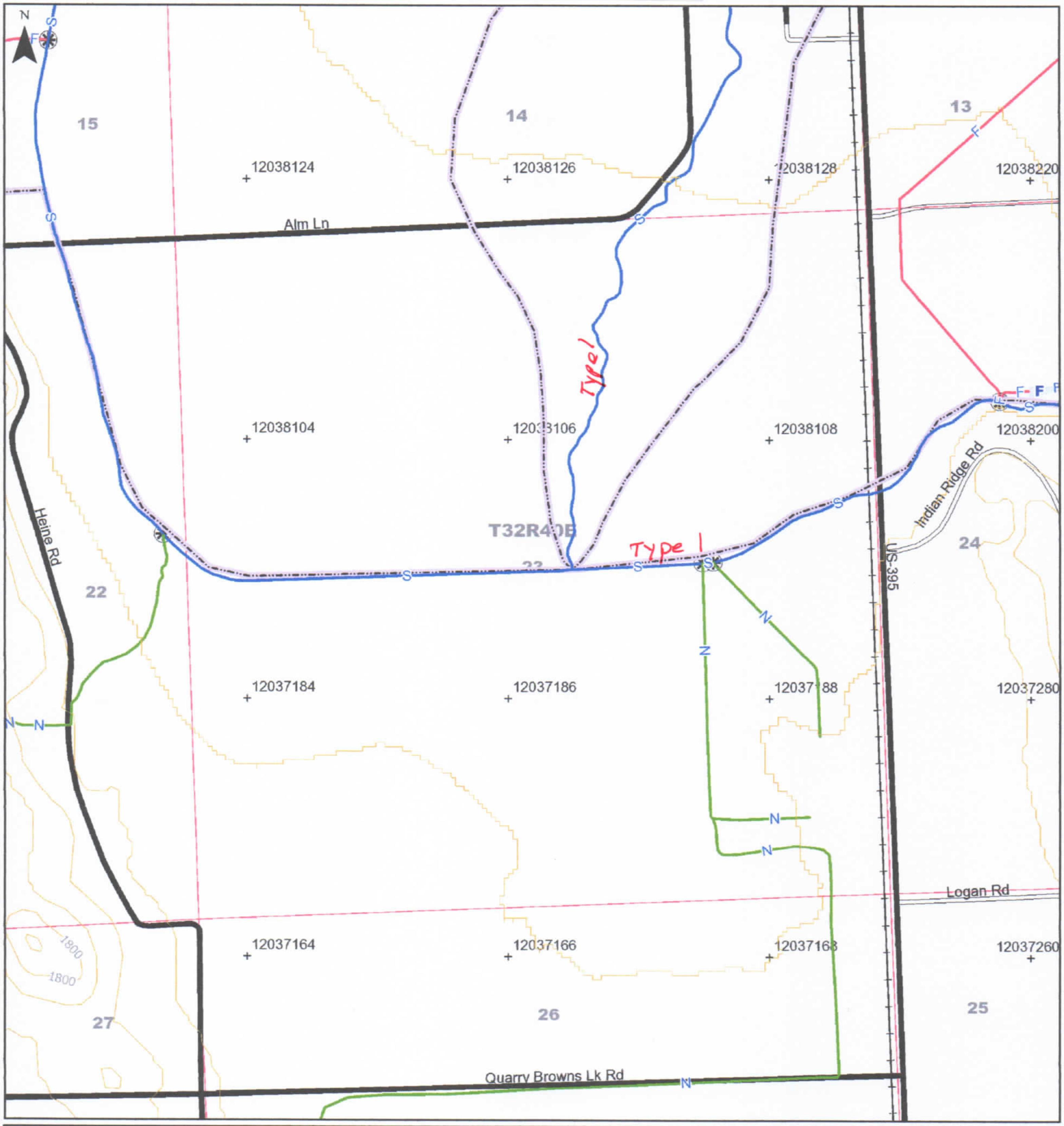
Scale 1 : 68,750

1" = 1.09 mi

Data Zoom 11-5


Chewelah
Colville River
2593300
8000997
2601500
2597900
2600200
2599800
2599700
2601700
2603620
8000997
2603665
2603600
2603625
2602400
2602901
8002673
2600000
2603000
2603100
8002439
2603201
2601910
2603679
2601950
2601080
2599600
2600300
2600500
2600900
2603655
2602000
2600700
2601930
39500
2602100
2601075
2600600
2605815
2605806
0231953
0231955
0231952
2604100
0.3km
1000ft

WATERTYPE MAP



Map Symbols

Harvest Boundary
Road Construction
Stream
RMZ / WMZ Buffers
Rock Pit
Landing
Waste Area
Clumped WRTS/GRTS
Existing Structure

Additional Information

Legal Description

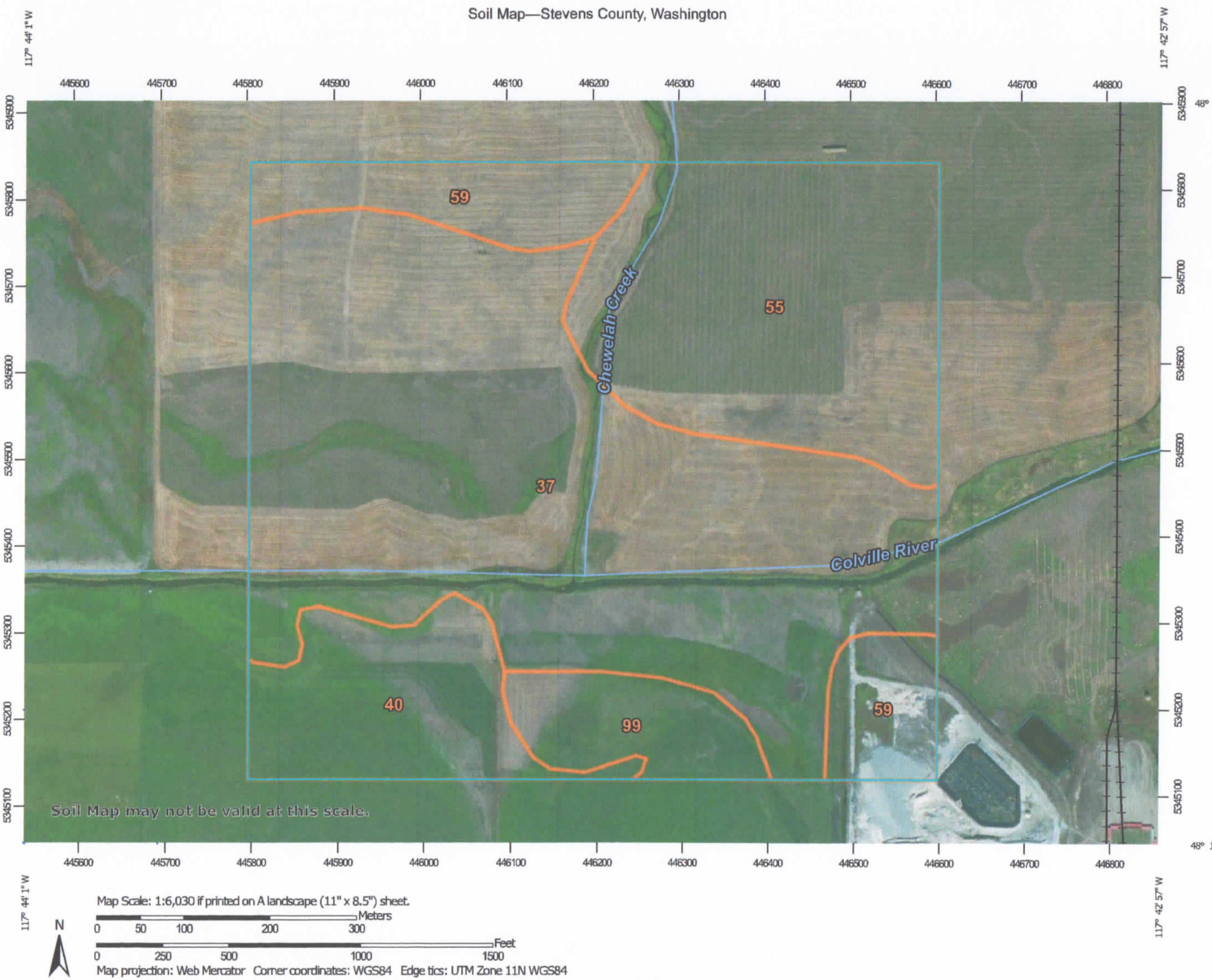
S26 T32.0N R40.0E, S13 T32.0N R40.0E
S14 T32.0N R40.0E, S27 T32.0N R40.0E
S22 T32.0N R40.0E, S25 T32.0N R40.0E
S15 T32.0N R40.0E, S24 T32.0N R40.0E
S23 T32.0N R40.0E

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

0 0.25 Miles

Date: 9/20/2019 Time: 1:06:09 PM

Soil Map—Stevens County, Washington



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Stevens County, Washington
Survey Area Data: Version 16, Sep 10, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 5, 2015—Sep 19, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
37	Bossburg muck	74.4	52.6%
40	Bridgeson silt loam, drained	14.1	9.9%
55	Chewelah fine sandy loam	32.4	22.9%
59	Colville silt loam, drained	13.3	9.4%
99	Hodgson silt loam, 0 to 3 percent slopes	7.4	5.2%
Totals for Area of Interest		**141.6**	**100.0%**

U.S. Fish and Wildlife Service

National Wetlands Inventory

Wetlands

September 3, 2019

Wetlands

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

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

WETLANDS AND DEEPWATER HABITATS CLASSIFICATION

SYSTEM L-LACUSTRINE

SUBSYSTEM 1 – LIMNETIC | 2 – LITORAL

	1 – LIMNETIC				2 – LITORAL						
CLASS	RM – ROCK BOTTOM	UB – UNCONSOLIDATED BOTTOM	AB – AQUATIC BED	OW – OPEN WATER UNKNOWN BOTTOM	RM – ROCK BOTTOM	UB – UNCONSOLIDATED BOTTOM	AB – AQUATIC BED	RS – ROCKY SHORE	US – UNCONSOLIDATED SHORE	EM – EMERGENT	OW – OPEN WATER UNKNOWN BOTTOM
SUBCLASS	1 BEDROCK 2 RUBBLE	1 COBBLE-GRAVEL 2 SAND 3 MUD 4 ORGANIC	1 ALGAL 2 AQUATIC MOSS 3 ROOTED VASCULAR 4 FLOATING VASCULAR 5 UNKOWN SUBMERGENT 6 UKNOWN SURFACE		1 BEDROCK 2 RUBBLE	1 COBBLE-GRAVEL 2 SAND 3 MUD 4 ORGANIC	1 ALGAL 2 AQUATIC MOSS 3 ROOTED VASCULAR 4 FLOATING VASCULAR 5 UNKOWN SUBMERGENT 6 UKNOWN SURFACE	1 BEDROCK 2 RUBBLE	1 COBBLE-GRAVEL 2 SAND 3 MUD 4 ORGANIC 5 VEGETATED	2 NONPERSISTENT	

SYSTEM P - PALUSTRINE

CLASS	RM – ROCK BOTTOM	UB – UNCONSOLIDATED BOTTOM	AB – AQUATIC BED	UN – UNCONSOLIDATED SHORE	ML - MOSSES LICHENS	EM – EMERGENT	SS – SCRUB/SHRUB	FO – FORESTED	OW – OPEN WATER UNKNOWN BOTTOM
SUBCLASS	1 BEDROCK 2 RUBBLE	1 COBBLE-GRAVEL 2 SAND 3 MUD 4 ORGANIC	1 ALGAL 2 AQUATIC MOSS 3 ROOTED VASCULAR 4 FLOATING VASCULAR 5 UNKOWN SUBMERGENT 6 UNKNOWN SURFACE	1 COBBLE-GRAVEL 2 SAND 3 MUD 4 ORGANIC	1 MOSSES 2 LICHENS	1 PERSISTENT 2 NONPERSISTENT	1 BROAD-LEAVED DECIDUOUS 2 NEEDLE-LEAVED DECIDUOUS 3 BROAD-LEAVED EVERGREEN 4 NEEDLE-LEAVED 5 DEAD 6 DECIDUOUS 7 EVERGREEN	1 BROAD-LEAVED DECIDUOUS 2 NEEDLE-LEAVED DECIDUOUS 3 BROAD-LEAVED EVERGREEN 4 NEEDLE-LEAVED EVERGREEN 5 DEAD 6 DECIDUOUS 7 EVERGREEN	

MODIFIERS

In order to more adequately describe the wetland and deepwater habitats one or more of the water regime, chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

WATER REGIME		WATER CHEMESTRY		SOIL	SPECIAL MODIFIERS	
NON-TIDAL		**Inland Salinity**	**pH Modifiers for All Fresh Water**			
A Temporarily Flooded B Saturated C Seasonally Flooded D Seasonally Flooded, Well-Drained E Seasonally Flooded, Saturated F Semi-permanently Exposed G Intermittently Exposed	H Permanently Flooded J Intermittently Flooded K Artificially Flooded U Unknown	7 Hypersaline 8 Eusaline 9 Misosaline 0 Fresh	a Acid t Circumneutral i Alkaline	g Organic n Mineral	b. Beaver d. Partially drained f. Farmed	h. Dike/Impound k. Sand/Rock r. Artificial substrate s. Spoil x. Excavated z. None

WETLAND DOCUMENTATION RECORD
GENERAL SITE INFORMATION

Land owner: Cheiwelah Creek Project County/State Stevens WA
Date: 9/3/19
Field Investigator: Jim Gleston
Legal Description: Parcel 2599800 2599700 Section: 23 T. 32 N. R. 40 E.
GPS Coordinates: N 48° 15. 537 W -117° 43. 515
Elevation: Notes:

Site map attached showing location, Base line(s), transect location(s) and plot locations.

GEOMORPHIC DATA

1. DEPRESSIONAL

1. VERNAL POOL	2. BOG	3. POTHOLE	4. SIZE (ac)
5. DEPTH (ft)	6. OUTLET ? [ ] Y [ ] N	OTHER:	

2. RIVERINE

Stream Name:	Stream Flow (cfs)	Average Land Slope (%)
Colville River	7500 cfs	1%

3. FRINGE

1. Estuarine	2. Lacustrine	3. Average Width (ft)

4. SLOPE

Average Land Slope (%)	Concentrated Flow?	Surface Water?

Antecedent Moisture Conditions

1. Prior Month Rainfall (in) .8	2. Normal (in) .66	3. Station Name: Colville
4. Prior Week Rainfall (in) 0	5. Normal (in) .17	6. Current Weather (sunny, rain)

Soil information:

Soil Mapping Unit No.(s) Chewelah, Colville Bossburg

Transects required

Baseline length: 800 Ft. <25 miles to 1 mile [ ] 1 mile to 2 miles [ ] 2 miles to 4 miles [ ]	Transects: 1 or 2 [ ] 3 [X] 5 [ ] 8 [ ]	Notes: (If modified number of transects explain) 3 - Transect

Wetland >5 Acres [X] Y [ ] N

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Parcels 2599800 & 2599700 City/County: Stevens Sampling Date: 9/3/19

Applicant/Owner: Stevens County State: WA Sampling Point: 1

Investigator(s): Jim Gleaton Section, Township, Range: 23-32-40

Landform (hillslope, terrace, etc.): Valley Bottom Local relief (concave, convex, none): Concave Slope (%): 1%

Subregion (LRR): E Lat: 48°15.561 Long: -117°43.646' Datum: GPS

Soil Map Unit Name: 37 - Bossburg Muck NWI classification: Pem/Ad

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ____

Are Vegetation ____, Soil ____, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓ No ____	Is the Sampled Area within a Wetland?	Yes ✓ No ____
Hydric Soil Present?	Yes ✓ No ____		
Wetland Hydrology Present?	Yes ✓ No ____		

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
		= Total Cover	
Sapling/Shrub Stratum (Plot size: ____)			
1.			
2.			
3.			
4.			
5.			
		= Total Cover	
Herb Stratum (Plot size: 10x10)			
1. Phalaris arundinacea	55	Y	Facw
2. Carex Stipata	10	N	OBL
3. Matricaria matricarioides	15	N	Facu
4. Cirsium arvense	20	Y	Fac
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	100	= Total Cover	
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
		= Total Cover	
% Bare Ground in Herb Stratum ____			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	10	x 1 = 10
FACW species	55	x 2 = 110
FAC species	20	x 3 = 60
FACU species	15	x 4 = 60
UPL species		x 5 =
Column Totals:	100 (A)	240 (B)

Prevalence Index = B/A = 2.4

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✓ 2 - Dominance Test is >50%
- ✓ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ____

Remarks:

SOIL Bossburg Muck

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.) Sampling Point: 1

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR2/1							
8-18	10YR 3/2		7.5YR4/4	<2	C	M	Muck	
18-20+	5Y4/1		7.5YR 4/4	<2	C	M	silt loam	
							silt loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- __ Histosol (A1)
- ✓ Histic Epipedon (A2)
- __ Black Histic (A3)
- __ Hydrogen Sulfide (A4)
- __ Depleted Below Dark Surface (A11)
- __ Thick Dark Surface (A12)
- __ Sandy Mucky Mineral (S1)
- __ Sandy Gleyed Matrix (S4)
- __ Sandy Redox (S5)
- __ Stripped Matrix (S6)
- __ Loamy Mucky Mineral (F1) (except MLRA 1)
- __ Loamy Gleyed Matrix (F2)
- __ Depleted Matrix (F3)
- ✓ Redox Dark Surface (F6)
- __ Depleted Dark Surface (F7)
- __ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- __ 2 cm Muck (A10)
- __ Red Parent Material (TF2)
- __ Very Shallow Dark Surface (TF12)
- __ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ____

Depth (inches): ____

Hydric Soil Present? Yes ✓ No ____

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- __ Surface Water (A1)
- ✓ High Water Table (A2)
- __ Saturation (A3)
- __ Water Marks (B1)
- __ Sediment Deposits (B2)
- __ Drift Deposits (B3)
- __ Algal Mat or Crust (B4)
- __ Iron Deposits (B5)
- __ Surface Soil Cracks (B6)
- __ Inundation Visible on Aerial Imagery (B7)
- __ Sparsely Vegetated Concave Surface (B8)
- __ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- __ Salt Crust (B11)
- __ Aquatic Invertebrates (B13)
- __ Hydrogen Sulfide Odor (C1)
- __ Oxidized Rhizospheres along Living Roots (C3)
- ✓ Presence of Reduced Iron (C4)
- __ Recent Iron Reduction in Tilled Soils (C6)
- __ Stunted or Stressed Plants (D1) (LRR A)
- __ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- __ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- __ Drainage Patterns (B10)
- __ Dry-Season Water Table (C2)
- ✓ Saturation Visible on Aerial Imagery (C9)
- __ Geomorphic Position (D2)
- __ Shallow Aquitard (D3)
- __ FAC-Neutral Test (D5)
- __ Raised Ant Mounds (D6) (LRR A)
- __ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ____ No ✓ Depth (inches): ____

Water Table Present? Yes ✓ No ____ Depth (inches): 22'

Saturation Present? (includes capillary fringe) Yes ✓ No ____ Depth (inches): 18-20"

Wetland Hydrology Present? Yes ✓ No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Parcels 2599800 & 2599700 City/County: Stevens Sampling Date: 9/3/19
Applicant/Owner: Stevens County State: WA Sampling Point: 2
Investigator(s): Jim Gleaton Section, Township, Range: 23-32-40
Landform (hillslope, terrace, etc.): Valley Bottom Local relief (concave, convex, none): Convex Slope (%): 4%
Subregion (LRR): E Lat: 48° 15.540' Long: -117° 43.643 Datum: GPS
Soil Map Unit Name: 87- Bossburg Muck NWI classification: Pem1Ad
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)
Are Vegetation ____, Soil ____, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ____
Are Vegetation ____, Soil ____, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ✓ No ____		Is the Sampled Area within a Wetland? Yes ✓ No ____
Hydric Soil Present? Yes ✓ No ____		
Wetland Hydrology Present? Yes ✓ No ____		

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 10x10)			
1. Phalaris arundinacea	100	Y	Facw
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	= Total Cover		
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
	= Total Cover		
% Bare Ground in Herb Stratum ____			

Remarks:

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)
Total Number of Dominant Species Across All Strata: 1 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species	100	x 2 = 200
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	100 (A)	200 (B)

Prevalence Index = B/A = 2.0

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✓ 2 - Dominance Test is >50%
- ✓ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ____

SOIL Bossburg Muck

Sampling Point: 2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR2/1						Muck	
8-18	10YR 2/2		7.5YR4/4	<2	C	M	silt loam	
18-20+	2Y 4/1		7.5YR 4/4	<2	C	M	silt loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ✓ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) (except MLRA 1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ✓ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ✓ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ✓ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) (LRR A)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ✓ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) (LRR A)
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ___

Water Table Present? Yes ✓ No ___ Depth (inches): 22'

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 18-20"

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Parcels 2599800 & 2599700 City/County: Stevens Sampling Date: 9/3/19

Applicant/Owner: Stevens County State: WA Sampling Point: 3

Investigator(s): Jim Gleaton Section, Township, Range: 23-32-40

Landform (hillslope, terrace, etc.): Valley Bottom Local relief (concave, convex, none): Concave Slope (%): 1%

Subregion (LRR): E Lat: 48°15.526 Long: -117°43.648 Datum: GPS

Soil Map Unit Name: 40 - Bridgeson Silt loam (drained) NWI classification: Pem1Ad

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ___

Are Vegetation ___, Soil ___, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___	No ✓
Hydric Soil Present?	Yes ___	No ✓
Wetland Hydrology Present?	Yes ___	No ✓

Is the Sampled Area within a Wetland? Yes ___ No ✓

Remarks:

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: ___)			
1.			
2.			
3.			
4.			
= Total Cover			
Sapling/Shrub Stratum (Plot size: —)			
1.			
2.			
3.			
4.			
5.			
= Total Cover			
Herb Stratum (Plot size: 10X10)			
1. Dactylis glomerata	50	Y	Facu
2. Bromus intermis	20	Y	Fac
3. Solidago canadensis	10	N	Facu
4. Sisymbrium altissimum	10	N	Facu
5. Lactuca serriola	10	N	Facu
6.			
7.			
8.			
9.			
10.			
11.			
= Total Cover	100		
Woody Vine Stratum (Plot size: ___)			
1.			
2.			
= Total Cover			

% Bare Ground in Herb Stratum ___

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: .5 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species	20	x 3 = 60
FACU species	80	x 4 = 320
UPL species		x 5 =
Column Totals:	100 (A)	380 (B)

Prevalence Index = B/A = 3.8

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ___ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ___ No ✓

Remarks:

SOIL Bridgeson Silt loam (drained)

Sampling Point: 2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-10	10YR2/1							
10-12	10YR4/1						silt loam	
12-20"	10YR5/1		10YR2/3	<2	C	M	silt loam	
			"	"	"	"	silty clay loam.	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) (except MLRA 1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ___ No ✓

Remarks: This is a raised area near the River a drained phase of this mapping unit

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) (LRR A)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) (LRR A)
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ______

Water Table Present? Yes ___ No ✓ Depth (inches): >24'

Saturation Present? (includes capillary fringe) Yes ___ No ✓ Depth (inches): "

Wetland Hydrology Present? Yes ___ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Parcels 2599800 & 2599700 City/County: Stevens Sampling Date: 9/3/19

Applicant/Owner: Stevens County State: WA Sampling Point: 4

Investigator(s): Jim Gleston Section, Township, Range: 23-32-40

Landform (hillslope, terrace, etc.): Valley Bottom Local relief (concave, convex, none): Concave Slope (%): 1%

Subregion (LRR): E Lat: 48°15.516 Long: -117°43.653 Datum: GPS

Soil Map Unit Name: 37 Dossberg Muds NWI classification: Pem/Ad

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ____

Are Vegetation ____, Soil ____, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ✓ No ____		Is the Sampled Area within a Wetland? Yes ✓ No ____
Hydric Soil Present? Yes ✓ No ____		
Wetland Hydrology Present? Yes ✓ No ____		

Remarks:

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: ____)			
1.			
2.			
3.			
4.			
		= Total Cover	
Sapling/Shrub Stratum (Plot size: —)			
1.			
2.			
3.			
4.			
5.			
		= Total Cover	
Herb Stratum (Plot size: 10X10)			
1. Phalaris arundinacea	30	Y	Facw
2. Bromus inermis	20	Y	Fac
3. Alopecurus pratensis	15	N	Fac
4. Elymus repens	35	Y	Fac-
5.			
6.			
7.			
8.			
9.			
10.			
11.			
		= Total Cover	
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
		= Total Cover	

% Bare Ground in Herb Stratum ____

Remarks:

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species	30	x 2 = 60
FAC species	70	x 3 = 210
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	100 (A)	270 (B)

Prevalence Index = B/A = 2.7

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✓ 2 - Dominance Test is >50%
- ✓ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ____

SOIL Bossburg Muck

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.) Sampling Point: 4

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR2/1						Muck	
8-18	10YR 2/2		7.5YR4/4	<2	C	M	silt loam	
18-20+	2Y4/1		7.5YR4/4	<2	C	M	silt loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ✓ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) (except MLRA 1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ✓ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ✓ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ✓ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) (LRR A)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ✓ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) (LRR A)
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ___

Water Table Present? Yes ✓ No ___ Depth (inches): 22'

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 18-20"

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Parcels 2599800 & 2599700 City/County: Stevens Sampling Date: 9/3/19

Applicant/Owner: Stevens County State: WA Sampling Point: 5

Investigator(s): Jim Gleaton Section, Township, Range: 23 - 32 - 40

Landform (hillslope, terrace, etc.): Valley Bottom Local relief (concave, convex, none): Concave Slope (%): 1%

Subregion (LRR): E Lat: 48° 15.563 Long: -117° 43.578 Datum: GPS

Soil Map Unit Name: Bossburg Muck NWI classification: PemlAd

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ____

Are Vegetation ____, Soil ____, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ✓ No ____		Is the Sampled Area within a Wetland? Yes ✓ No ____
Hydric Soil Present? Yes ✓ No ____		
Wetland Hydrology Present? Yes ✓ No ____		

Remarks:

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: —)			
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: —)			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 10X10)			
1. Cirsium arvense	20	Y	Fac
2. Phalaris arundinacea	60	Y	Facw
3. Matricaria Matricarioides	20	Y	Facu
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: .6 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species	60	x 2 = 120
FAC species	20	x 3 = 60
FACU species	20	x 4 = 80
UPL species		x 5 =
Column Totals:	100 (A)	260 (B)

Prevalence Index = B/A = 2.6

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✓ 2 - Dominance Test is >50%
- ✓ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ____

Remarks:

SOIL Bossburg Muck

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.) Sampling Point: 5

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR2/1							
8-18	10YR 3/2		7.5YR4/4	<2	C	M	muck	
18-20+	2Y4/1		7.5YR 4/4	<2	C	M	silt loam	
							silt loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ✓ Histosol (A1)
- ✓ Histic Epipedon (A2)
- __ Black Histic (A3)
- __ Hydrogen Sulfide (A4)
- __ Depleted Below Dark Surface (A11)
- __ Thick Dark Surface (A12)
- __ Sandy Mucky Mineral (S1)
- __ Sandy Gleyed Matrix (S4)
- __ Sandy Redox (S5)
- __ Stripped Matrix (S6)
- __ Loamy Mucky Mineral (F1) (except MLRA 1)
- __ Loamy Gleyed Matrix (F2)
- __ Depleted Matrix (F3)
- ✓ Redox Dark Surface (F6)
- __ Depleted Dark Surface (F7)
- __ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- __ 2 cm Muck (A10)
- __ Red Parent Material (TF2)
- __ Very Shallow Dark Surface (TF12)
- __ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ____

Depth (inches): ____

Hydric Soil Present? Yes ✓ No ____

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- __ Surface Water (A1)
- ✓ High Water Table (A2)
- __ Saturation (A3)
- __ Water Marks (B1)
- __ Sediment Deposits (B2)
- __ Drift Deposits (B3)
- __ Algal Mat or Crust (B4)
- __ Iron Deposits (B5)
- __ Surface Soil Cracks (B6)
- __ Inundation Visible on Aerial Imagery (B7)
- __ Sparsely Vegetated Concave Surface (B8)
- __ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- __ Salt Crust (B11)
- __ Aquatic Invertebrates (B13)
- __ Hydrogen Sulfide Odor (C1)
- __ Oxidized Rhizospheres along Living Roots (C3)
- ✓ Presence of Reduced Iron (C4)
- __ Recent Iron Reduction in Tilled Soils (C6)
- __ Stunted or Stressed Plants (D1) (LRR A)
- __ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- __ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- __ Drainage Patterns (B10)
- __ Dry-Season Water Table (C2)
- ✓ Saturation Visible on Aerial Imagery (C9)
- __ Geomorphic Position (D2)
- __ Shallow Aquitard (D3)
- __ FAC-Neutral Test (D5)
- __ Raised Ant Mounds (D6) (LRR A)
- __ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ____ No ✓ Depth (inches): ____

Water Table Present? Yes ✓ No ____ Depth (inches): 22"

Saturation Present? (includes capillary fringe) Yes ✓ No ____ Depth (inches): 18-20"

Wetland Hydrology Present? Yes ✓ No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Parcels 2599800 & 2599700 City/County: Stevens Sampling Date: 9/3/19

Applicant/Owner: Stevens County State: WA Sampling Point: 6

Investigator(s): Jim Gleaton Section, Township, Range: 23-32-40

Landform (hillslope, terrace, etc.): Valley Bottom Local relief (concave, convex, none): Convex Slope (%): 10%

Subregion (LRR): E Lat: 48°15.556 Long: -117°43.578 Datum: GPS

Soil Map Unit Name: Gravel Spoils from Channel Clearing NWI classification: —

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ___

Are Vegetation ___, Soil ___, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ___ No ✓		
Hydric Soil Present? Yes ___ No ✓	Is the Sampled Area within a Wetland?	Yes ___ No ✓
Wetland Hydrology Present? Yes ___ No ✓		

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: —)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
		= Total Cover	
Sapling/Shrub Stratum (Plot size: 10x10)			
1. Symphoricarpos albus	30	Y	Facu
2.			
3.			
4.			
5.			
	30	= Total Cover	
Herb Stratum (Plot size: 10x10)			
1. Sisymbrium altissimum	10	N	Facu
2. Lactuca striola	20	Y	Facu
3. Agastache urticifolia	10	N	Facu
4. Conium maculatum ?	30	Y	Fac
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	70	= Total Cover	
Woody Vine Stratum (Plot size: ___)			
1.			
2.			
		= Total Cover	

% Bare Ground in Herb Stratum ___

Remarks:

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: .3 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species	30	x 3 = 90
FACU species	70	x 4 = 280
UPL species		x 5 =
Column Totals:	100 (A)	370 (B)

Prevalence Index = B/A = 3.7

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ 5 - Wetland Non-Vascular Plants[1]

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ___ No ✓

SOIL Sandy gravel Spoils from Channel Cleaning Sampling Point: 6

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-20	10YR4/3						gravelly Sandy loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- __ Histosol (A1)
- __ Histic Epipedon (A2)
- __ Black Histic (A3)
- __ Hydrogen Sulfide (A4)
- __ Depleted Below Dark Surface (A11)
- __ Thick Dark Surface (A12)
- __ Sandy Mucky Mineral (S1)
- __ Sandy Gleyed Matrix (S4)
- __ Sandy Redox (S5)
- __ Stripped Matrix (S6)
- __ Loamy Mucky Mineral (F1) (except MLRA 1)
- __ Loamy Gleyed Matrix (F2)
- __ Depleted Matrix (F3)
- __ Redox Dark Surface (F6)
- __ Depleted Dark Surface (F7)
- __ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- __ 2 cm Muck (A10)
- __ Red Parent Material (TF2)
- __ Very Shallow Dark Surface (TF12)
- __ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ____

Depth (inches): ____

Hydric Soil Present? Yes ____ No ✓

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- __ Surface Water (A1)
- __ High Water Table (A2)
- __ Saturation (A3)
- __ Water Marks (B1)
- __ Sediment Deposits (B2)
- __ Drift Deposits (B3)
- __ Algal Mat or Crust (B4)
- __ Iron Deposits (B5)
- __ Surface Soil Cracks (B6)
- __ Inundation Visible on Aerial Imagery (B7)
- __ Sparsely Vegetated Concave Surface (B8)
- __ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- __ Salt Crust (B11)
- __ Aquatic Invertebrates (B13)
- __ Hydrogen Sulfide Odor (C1)
- __ Oxidized Rhizospheres along Living Roots (C3)
- __ Presence of Reduced Iron (C4)
- __ Recent Iron Reduction in Tilled Soils (C6)
- __ Stunted or Stressed Plants (D1) (LRR A)
- __ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- __ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- __ Drainage Patterns (B10)
- __ Dry-Season Water Table (C2)
- __ Saturation Visible on Aerial Imagery (C9)
- __ Geomorphic Position (D2)
- __ Shallow Aquitard (D3)
- __ FAC-Neutral Test (D5)
- __ Raised Ant Mounds (D6) (LRR A)
- __ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ____ No ✓ Depth (inches): ____

Water Table Present? Yes ____ No ✓ Depth (inches): ____

Saturation Present? (includes capillary fringe) Yes ____ No ✓ Depth (inches): ____

Wetland Hydrology Present? Yes ____ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Parcels 2599800 & 2599700 City/County: Stevens Sampling Date: 9/3/19

Applicant/Owner: Stevens County State: WA Sampling Point: 7

Investigator(s): Jim Gleaton Section, Township, Range: 23 – 32 – 40

Landform (hillslope, terrace, etc.): Valley Bottom Local relief (concave, convex, none): Concave Slope (%): 7%

Subregion (LRR): E Lat: 48°15.543 Long: –117°43.583 Datum: GPS

Soil Map Unit Name: Bossburg Muck NWI classification: Pem1Ad

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ____

Are Vegetation ____, Soil ____, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ✓ No ____	Is the Sampled Area within a Wetland?	Yes ✓ No ____
Hydric Soil Present? Yes ✓ No ____		
Wetland Hydrology Present? Yes ✓ No ____		

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: —)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	____ = Total Cover		
Sapling/Shrub Stratum (Plot size: —)			
1.			
2.			
3.			
4.			
5.			
	____ = Total Cover		
Herb Stratum (Plot size: 10X10)			
1. Dipsacus sylvestris	10	N	Fac
2. Phalaris arundinacea	90	Y	Facw
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____

Remarks:

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species	90	x 2 = 180
FAC species	10	x 3 = 30
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	100 (A)	210 (B)

Prevalence Index = B/A = 2.1

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✓ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ____

SOIL Bossburg Muck

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.) Sampling Point: 7

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR 2/1						Muck	
8-18	10YR 2/2		7.5YR 4/4	<2	C	M	silt loam	
18-20+	2.5Y 4/1		7.5YR 4/4	<2	C	M	silt loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ✓ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) (except MLRA 1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ✓ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ✓ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ✓ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) (LRR A)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ✓ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) (LRR A)
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ___

Water Table Present? Yes ✓ No ___ Depth (inches): 22"

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 18-20"

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Parcels 2599800 & 2599700 City/County: Stevens Sampling Date: 9/3/19

Applicant/Owner: Stevens County State: WA Sampling Point: 8

Investigator(s): Jim Gleaton Section, Township, Range: 23-32-40

Landform (hillslope, terrace, etc.): Valley Bottom Local relief (concave, convex, none): Concave Slope (%): 4%

Subregion (LRR): E Lat: 48°15.527' Long: -117°43.585 Datum: GPS

Soil Map Unit Name: Bossburg Muck NWI classification: ______

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ___

Are Vegetation ___, Soil ___, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓ No ___	Is the Sampled Area within a Wetland? Yes ✓ No ___
Hydric Soil Present?	Yes ✓ No ___	
Wetland Hydrology Present?	Yes ✓ No ___	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ___)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	___ = Total Cover		
Sapling/Shrub Stratum (Plot size: ___)			
1.			
2.			
3.			
4.			
5.			
	___ = Total Cover		
Herb Stratum (Plot size: 10x10)			
1. Amaranthus retroflexus	20	Y	Facu
2. Chenopodium album	10	N	Facu
3. Phalaris arundinacea	20	Y	Facw
4. Cirsium arvense	20	Y	Fac
5. Polygonum aviculare	20	Y	Fac
6.			
7.			
8.			
9.			
10.			
11.			
	___ = Total Cover		
Woody Vine Stratum (Plot size: ___)			
1.			
2.			
	___ = Total Cover		

% Bare Ground in Herb Stratum 10%

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: .75 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species	x 1 =	
FACW species 20	x 2 =	40
FAC species 40	x 3 =	120
FACU species 30	x 4 =	120
UPL species	x 5 =	
Column Totals: 90 (A)		280 (B)

Prevalence Index = B/A = 3.1

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✓ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ___

Remarks:

SOIL Bossburg Muck

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.) Sampling Point: 8

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR2/1						Muck	
8-18	10YR 2/2		7.5YR4/4	<2	C	M	silt loam	
18-20+	5Y 4/1		7.5YR 4/4	<2	C	M	silt loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ✓ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) (except MLRA 1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ✓ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ✓ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ✓ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) (LRR A)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ✓ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) (LRR A)
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ______

Water Table Present? Yes ✓ No ___ Depth (inches): 22'

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 18-20"

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Parcels 2599800 & 2599700 City/County: Stevens Sampling Date: 9/3/19

Applicant/Owner: Stevens County State: WA Sampling Point: 9

Investigator(s): Jim Gleaton Section, Township, Range: 23 – 32 – 40

Landform (hillslope, terrace, etc.): Valley Bottom Local relief (concave, convex, none): Concave Slope (%): 1%

Subregion (LRR): E Lat: 48° 15.553 Long: –117° 43.505 Datum: GPS

Soil Map Unit Name: Bossburg Muck NWI classification: Pem 1Ad

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ____

Are Vegetation ____, Soil ____, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓ No ____	Is the Sampled Area within a Wetland? Yes ✓ No ____
Hydric Soil Present?	Yes ✓ No ____	
Wetland Hydrology Present?	Yes ✓ No ____	

Remarks:

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: —)			
1.			
2.			
3.			
4.			
		= Total Cover	
Sapling/Shrub Stratum (Plot size: —)			
1.			
2.			
3.			
4.			
5.			
		= Total Cover	
Herb Stratum (Plot size: 10X10)			
1. Phalaris arundinacea	90	Y	Facw
2. Verbascum thapsus	10	N	Facu
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	100	= Total Cover	
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
		= Total Cover	

% Bare Ground in Herb Stratum ____

Remarks:

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species	90	x 2 = 180
FAC species		x 3 =
FACU species	10	x 4 = 40
UPL species		x 5 =
Column Totals:	100 (A)	220 (B)

Prevalence Index = B/A = 2.2

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✓ 2 - Dominance Test is >50%
- ✓ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ____

SOIL Bossburg Muck

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.) Sampling Point: 9

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR2/1							
8-18	10YR 2/2		7.5YR4/4	<2	C	M	muck	
18-20+	5Y 4/1		7.5YR 4/4	<2	C	M	silt loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ✓ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) (except MLRA 1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ✓ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ✓ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ✓ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) (LRR A)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ✓ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) (LRR A)
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ______

Water Table Present? Yes ✓ No ___ Depth (inches): 22'

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 18-20"

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Parcels 2599800 & 2599700 City/County: Stevens Sampling Date: 9/3/19

Applicant/Owner: Stevens County State: WA Sampling Point: 10

Investigator(s): Jim Gleaton Section, Township, Range: 23 – 32 – 40

Landform (hillslope, terrace, etc.): Valley Bottom Local relief (concave, convex, none): Concave Slope (%): 2%

Subregion (LRR): E Lat: 48°15.543 Long: –117°43.508 Datum: GPS

Soil Map Unit Name: Bossberg Muck NWI classification: PemlAd.

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ____

Are Vegetation ____, Soil ____, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓ No ____	Is the Sampled Area within a Wetland? Yes ✓ No ____
Hydric Soil Present?	Yes ✓ No ____	
Wetland Hydrology Present?	Yes ✓ No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: —)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: —)			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: 10x10)			
1. Matricaria matricariodes	15	N	Facu
2. Phalaris arundinacea	75	Y	Facw
3. Dipsacus sylvestris	10	N	Fac
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species	75	x 2 = 150
FAC species	10	x 3 = 30
FACU species	15	x 4 = 60
UPL species		x 5 =
Column Totals:	100 (A)	240 (B)

Prevalence Index = B/A = 2.4

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✓ 2 - Dominance Test is >50%
- ✓ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ____

Remarks:

SOIL Bossburg Muck

Sampling Point: 10

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR2/1						muck	
8-18	10YR 3/2		7.5YR4/4	<2	C	M	silt loam	
18-20+	5Y 4/1		7.5YR 4/4	<2	C	M	silt loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ✓ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) (except MLRA 1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ✓ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ✓ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ✓ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) (LRR A)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ✓ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) (LRR A)
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ______

Water Table Present? Yes ✓ No ___ Depth (inches): 22'

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 18-20"

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Parcels 2599800 & 2599700 City/County: Stevens Sampling Date: 9/3/19

Applicant/Owner: Stevens County State: WA Sampling Point: 11

Investigator(s): Jim Gleaton Section, Township, Range: 23-32-40

Landform (hillslope, terrace, etc.): Valley Bottom Local relief (concave, convex, none): Concave Slope (%): 1%

Subregion (LRR): E Lat: 48° 15.532 Long: -117°43.505 Datum: GPS

Soil Map Unit Name: Bossburg Muck NWI classification: PEM1C

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ___

Are Vegetation ___, Soil ___, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓ No ___	Is the Sampled Area within a Wetland? Yes ✓ No ___
Hydric Soil Present?	Yes ✓ No ___	
Wetland Hydrology Present?	Yes ✓ No ___	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ___)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: ___)			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: ___)			
1. Cirsium arvense	30	Y	FAC
2. Phalaris arundinacea	30	Y	FACW
3. Polygonum aviculare	20	Y	FAC
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	= Total Cover		
Woody Vine Stratum (Plot size: ___)			
1.			
2.			
	= Total Cover		
% Bare Ground in Herb Stratum 20			

Remarks:

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: ___ (A)

Total Number of Dominant Species Across All Strata: ___ (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ___ (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species	30	x 2 = 60
FAC species	50	x 3 = 150
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	80 (A)	210 (B)

Prevalence Index = B/A = 2.7

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

✓ 2 - Dominance Test is >50%

✓ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ 5 - Wetland Non-Vascular Plants[1]

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ___

SOIL Bossburg Muck

Sampling Point: 11

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR2/1						muck	
8-18	10YR 3/2		7.5YR4/4	<2	C	M	silt loam	
18-20+	2Y4/1		7.5YR 4/4	<2	C	M	silt loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ✓ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) (except MLRA 1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ✓ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ✓ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ✓ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) (LRR A)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ✓ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) (LRR A)
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ______

Water Table Present? Yes ✓ No ___ Depth (inches): 22'

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 18-20"

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

RATING SUMMARY – Eastern Washington

Name of wetland (or ID #): Chewelah Creek Project Date of site visit: 9/3/2019

Rated by Jim Gleaton Trained by Ecology? ■ Yes ■ No Date of training 2011

HGM Class used for rating Riverine Wetland has multiple HGM classes? ■ Yes ■ No

NOTE: Form is not complete with out the figures requested (*figures can be combined*).
Source of base aerial photo/map Google Earth

OVERALL WETLAND CATEGORY II (based on functions ■ or special characteristics ■)

1. Category of wetland based on FUNCTIONS

____ **Category I** - Total score = 22 - 27
X **Category II** - Total score = 19 - 21
____ **Category III** - Total score = 16 - 18
____ **Category IV** - Total score = 9 - 15

FUNCTION	Improving Water Quality	Hydrologic	Habitat	
	List appropriate rating (H, M, L)			
Site Potential	L	M	M	
Landscape Potential	M	M	H	
Value	H	H	M	**Total**
Score Based on Ratings	6	7	7	20

Score for each function based on three ratings (*order of ratings is not important*)

9 = H, H, H
8 = H, H, M
7 = H, H, L
7 = H, M, M
6 = H, M, L
6 = M, M, M
5 = H, L, L
5 = M, M, L
4 = M, L, L
3 = L, L, L

2. Category based on SPECIAL CHARACTERISTICS of wetland

CHARACTERISTIC	Category
Vernal Pools	
Alkali	
Wetland of High Conservation Value	
Bog and Calcareous Fens	
Old Growth or Mature Forest - slow growing	
Aspen Forest	
Old Growth or Mature Forest - fast growing	
Floodplain forest	
None of the above	X

Maps and Figures required to answer questions correctly for Eastern Washing

Depressional Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes and classes of emergents	D 1.3, H 1.1, H 1.5	
Hydroperiods (including area of open water for H 1.3)	D 1.4, H 1.2, H 1.3	
Location of outlet (*can be added to map of hydroperiods*)	D 1.1, D 4.1	
Boundary of area within 150 ft of the wetland (*can be added to another figure*	D 2.2, D 5.2	
Map of the contributing basin	D 5.3	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website	D 3.1, D 3.2	
Screen capture of list of TMDLs for WRIA in which wetland is found (website)	D 3.3	

Riverine Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes and classes of emergents	H 1.1, H 1.5	1
Hydroperiods	H 1.2, H 1.3	3
Ponded depressions	R 1.1	1
Boundary of area within 150 ft of the wetland (*can be added to another figure*	R 2.4	1
Map of the contributing basin	R 2.2, R 2.3, R 5.2	4
Plant cover of trees, shrubs, and herbaceous plants	R 1.2, R 4.2	1
Width of wetland vs. width of stream (*can be added to another figure*)	R 4.1	3
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	2
Screen capture of map of 303(d) listed waters in basin (from Ecology website	R 3.1	3
Screen capture of list of TMDLs for WRIA in which wetland is found (website)	R 3.2, R 3.3	3

Lake Fringe Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes and classes of emergents	L 1.1, L 4.1, H 1.1, H 1.5	
Plant cover of trees, shrubs, and herbaceous plants	L 1.2	
Boundary of area within 150 ft of the wetland (*can be added to another figure*	L 2.2	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website	L 3.1, L 3.2	
Screen capture of list of TMDLs for WRIA in which wetland is found (website)	L 3.3	

Slope Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes and classes of emergents	H 1.1, H 1.5	
Hydroperiods	H 1.2, H 1.3	
Plant cover of **dense** trees, shrubs, and herbaceous plants	S 1.3	
Plant cover of **dense, rigid** trees, shrubs, and herbaceous plants (*can be added to figure above*)	S 4.1	
Boundary of area within 150 ft of the wetland (*can be added to another figure*	S 2.1, S 5.1	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website	S 3.1, S 3.2	
Screen capture of list of TMDLs for WRIA in which wetland is found (website)	S 3.3	

HGM Classification of Wetland in Eastern Washington

For questions 1 - 4, the criteria described must apply to the entire unit being rated.

If the hydrologic criteria listed in each question do not apply to the entire unit being rated, you probably have a unit with multiple HGM classes. In this case, identify which hydrologic criteria in questions 1 - 4 apply, and go to Question 5.

1. Does the entire unit **meet both** of the following criteria?
   - The vegetated part of the wetland is on the water side of the Ordinary High Water Mark of a body of permanent open water (without any plants on the surface) that is at least 20 ac (8 ha) in size
   - At least 30% of the open water area is deeper than 10 ft (3 m)

   ■ NO - go to 2 ■ **YES** - The wetland class is **Lake Fringe** (Lacustrine Fringe)

2. Does the entire wetland unit meet all of the following criteria?
   - The wetland is on a slope (*slope can be very gradual*),
   - The water flows through the wetland in one direction (unidirectional) and usually comes from seeps. It may flow subsurface, as sheetflow, or in a swale without distinct banks;
   - The water leaves the wetland **without being impounded**.

   ■ NO - go to 3 ■ **YES** - The wetland class is **Slope**

   NOTE: Surface water does not pond in these type of wetlands except occasionally in very small and shallow depressions or behind hummocks (depressions are usually <3 ft diameter and less than 1 foot deep).

3. Does the entire wetland unit **meet all** of the following criteria?
   - The unit is in a valley, or stream channel, where it gets inundated by overbank flooding from that stream or river;
   - The overbank flooding occurs at least once every 10 years.

   ■ NO - go to 4 ■ **YES** - The wetland class is **Riverine**

   NOTE: The Riverine wetland can contain depressions that are filled with water when the river is not flooding.

4. Is the entire wetland unit in a topographic depression in which water ponds, or is saturated to the surface, at some time during the year. *This means that any outlet, if present, is higher than the interior of the wetland.*

   ■ NO - go to 5 ■ **YES** - The wetland class is **Depressional**

5. Your wetland unit seems to be difficult to classify and probably contains several different HGM classes. For example, seeps at the base of a slope may grade into a riverine floodplain, or a small stream within a Depressional wetland has a zone of flooding along its sides. GO BACK AND IDENTIFY WHICH OF THE HYDROLOGIC REGIMES DESCRIBED IN QUESTIONS 1 - 4 APPLY TO DIFFERENT AREAS IN THE WETLAND UNIT (make a rough sketch to help you decide). Use the following table to identify the appropriate class to use for the rating system if you have several HGM classes present within the wetland unit being scored.

NOTE: Use this table only if the class that is recommended in the second column represents 10% or more of the total area of the wetland unit being rated. If the area of the HGM class listed in column 2 is less than 10% of the unit; classify the wetland using the class that represents more than 90% of the total area.

HGM classes within the wetland unit being rated	HGM Class to use in rating
Slope + Riverine	Riverine
Slope + Depressional	Depressional
Slope + Lake Fringe	Lake Fringe
Depressional + Riverine (the riverine portion is within the boundary of depression)	Depressional
Depressional + Lake Fringe	Depressional
Riverine + Lake Fringe	Riverine

If you are still unable to determine which of the above criteria apply to your wetland, or if you have ***more than 2 HGM classes*** *within a wetland boundary, classify the wetland as Depressional for the rating.*

NOTES and FIELD OBSERVATIONS:
This would be a slope wetland except for the fact that at the mouth of Chewelah Creek there is a sandbar, and there is another small one down stream about 300 - 400 ft. Even though there is a small amount of inter-OHWM sand bars I have decided to rate this as Riverine.

RIVERINE WETLANDS

Water Quality Functions - Indicators that the site functions to improve water quality	Points (only 1 score per box)
R 1.0. Does the site have the potential to improve water quality?	
R 1.1. Area of surface depressions within the Riverine wetland that can trap sediments during a flooding event: Depressions cover > $^1/_3$ area of wetland — points = 6 Depressions cover > $^1/_{10}$ area of wetland — points = 3 Depressions present but cover < $^1/_{10}$ area of wetland — points = 1 No depressions present — points = 0	1
R 1.2. Structure of plants in the wetland (areas with > 90% cover at person height; **not** Cowardin classes): Forest or shrub > $^2/_3$ the area of the wetland — points = 10 ■ Forest or shrub $^1/_3 – ^2/_3$ area of the wetland — points = 5 ■ Ungrazed, herbaceous plants > $^2/_3$ area of wetland — points = 5 Ungrazed herbaceous plants $^1/_3 – ^2/_3$ area of wetland — points = 2 Forest, shrub, and ungrazed herbaceous < $^1/_3$ area of wetland — points = 0	2
Total for R 1 — Add the points in the boxes above	**3**

Rating of Site Potential If score is: ■ **12 - 16 = H** ■ **6 - 11 = M** **0 - 5 = L** *Record the rating on the first page*

R 2.0. Does the landscape have the potential to support the water quality function of the site?	
R 2.1. Is the wetland within an incorporated city or within its UGA? Yes = 2 No = 0	0
R 2.2. Does the contributing basin to the wetland include a UGA or incorporated area? Yes = 1 No = 0	1
R 2.3. Does at least 10% of the contributing basin contain tilled fields, pastures, or forests that have been clearcut within the last 5 years? Yes = 1 No = 0	1
R 2.4. Is > 10% of the area within 150 ft of the wetland in land uses that generate pollutants? Yes = 1 No = 0	0
R 2.5. Are there other sources of pollutants coming into the wetland that are not listed in questions R 2.1 - R 2.4? Sources — Yes = 1 No = 0	0
Total for R 2 — Add the points in the boxes above	**2**

Rating of Landscape Potential If score is ■ **3 - 6 = H** ■ **1 or 2 = M** **0 = L** *Record the rating on the first page*

R 3.0. Is the water quality improvement provided by the site valuable to society?	
R 3.1. Is the wetland along a stream or river that is on the 303(d) list or on a tributary that drains to one within 1 mi? Yes = 1 No = 0	1
R 3.2. Does the river or stream have TMDL limits for nutrients, toxics, or pathogens? Yes = 1 No = 0	0
R 3.3. Has the site been identified in a watershed or local plan as important for maintaining water quality? (*Answer YES if there is a TMDL for the drainage in which the unit is found*). Yes = 2 No = 0	2
Total for R 3 — Add the points in the boxes above	**3**

Rating of Value If score is ■ **2 - 4 = H** ■ **1 = M** ■ **0 = L** *Record the rating on the first page*

RIVERINE WETLANDS

Hydrologic Functions - Indicators that site functions to reduce flooding and stream erosion	Points (only 1 score per box)
R 4.0. Does the site have the potential to reduce flooding and erosion?	
R 4.1. Characteristics of the overbank storage the wetland provides: *Estimate the average width of the wetland perpendicular to the direction of the flow and the width of the stream or river channel (distance between banks). Calculate the ratio: (average width of wetland)/(average width of stream between banks).* If the ratio is more than 2 — points = 10 If the ratio is 1 - 2 — points = 8 If the ratio is ½ - < 1 — points = 4 If the ratio is ¼ - < ½ — points = 2 If the ratio is < ¼ — points = 1	4
R 4.2. Characteristics of plants that slow down water velocities during floods: *Treat large woody debris as forest or shrub. Choose the points appropriate for the best description (polygons need to have > 90% cover at person height. These are NOT Cowardin classes).* Forest or shrub for more than $^2/_3$ the area of the wetland — points = 6 Forest or shrub for > $^1/_3$ area OR emergent plants > $^2/_3$ area — points = 4 Forest or shrub for > $^1/_{10}$ area OR emergent plants > $^1/_3$ area — points = 2 Plants do not meet above criteria — points = 0	4
Total for R 4 — Add the points in the boxes above	**8**

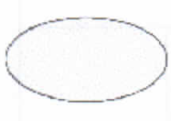
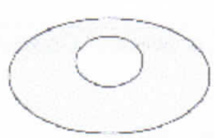
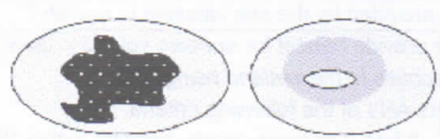
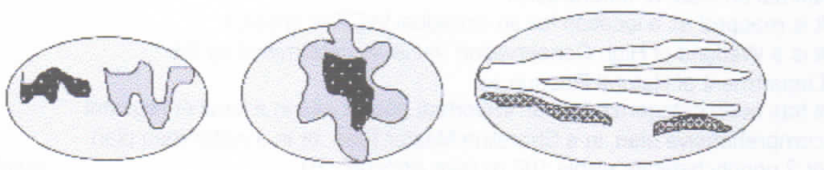
Rating of Site Potential If score is: **12 - 16 = H** **6 - 11 = M** **0 - 5 = L** *Record the rating on the first page*

R 5.0. Does the landscape have the potential to support the hydrologic functions of the site?	
R 5.1. Is the stream or river adjacent to the wetland downcut? Yes = 0 No = 1	0
R 5.2. Does the up-gradient watershed include a UGA or incorporated area? Yes = 1 No = 0	1
R 5.3. Is the up-gradient stream or river controlled by dams? Yes = 0 No = 1	1
Total for R 5 — Add the points in the boxes above	**2**

Rating of Landscape Potential If score is: **3 = H** **1 or 2 = M** **0 = L** *Record the rating on the first page*

R 6.0. Are the hydrologic functions provided by the site valuable to society?	
R 6.1. Distance to the nearest areas downstream that have flooding problems? *Choose the description that best fits the site.* The sub-basin immediately down-gradient of the site has flooding problems that result in damage to human or natural resources — points = 2 Surface flooding problems are in a sub-basin farther down-gradient — points = 1 No flooding problems anywhere downstream — points = 0	2
R 6.2. Has the site been identified as important for flood storage or flood conveyance in a regional flood control plan? Yes = 2 No = 0	0
Total for R 6 — Add the points in the boxes above	**2**

Rating of Value If score is: **2 - 4 = H** **1 = M** **0 = L** *Record the rating on the first page*

These questions apply to wetlands of all HGM classes. **HABITAT FUNCTIONS** - Indicators that site functions to provide important habitat	(only 1 score per box)
H 1.0. Does the wetland have the potential to provide habitat for many species?	
H 1.1. Structure of plant community: *Check the Cowardin vegetation classes present and categories of emergent plants. Size threshold for each category is > = ¼ ac or > = 10% of the wetland if wetland is < 2.5 ac.* ☐ Aquatic bed ■ Emergent plants 0 - 12 in (0-30 cm) high are the highest layer and have > 30% cover — 4 or more checks: points = 3 ■ Emergent plants > 12 - 40 in (> 30-100 cm) high are the highest layer with >30% cover — 3 checks: points = 2 ■ Emergent plants > 40 in (> 100 cm) high are the highest layer with >30% cover — 2 checks: points - 1 ☐ Scrub-shrub (areas where shrubs have > 30% cover) — 1 check: points = 0 ☐ Forested (areas where trees have > 30% cover)	1
H 1.2. Is one of the vegetation types Aquatic Bed? Yes = 1 No = 0	0
H 1.3. Surface water H 1.3.1. Does the wetland have areas of open water (without emergent or shrub plants) over at least ¼ ac **OR** 10% of its area during the March to early June **OR** in August to the end of September? *Answer YES for Lake Fringe wetlands.* ■ Yes = 3 points & go to H 1.4 No = go to H 1.3.2 H 1.3.2. Does the wetland have an intermittent or permanent, and unvegetated stream within its boundaries, or along one side, over at least ¼ ac or 10% of its area? *Answer yes only if H 1.3.1 is No.* ☐ Yes = 3 No = 0	3
H 1.4. Richness of plant species Count the number of plant species in the wetland that cover at least 10 ft^2. *Different patches of the same species can be combined to meet the size threshold. You do not have to name the species. Do not include Eurasian milfoil, reed canarygrass, purple loosestrife, Russian olive, Phragmites, Canadian thistle, yellow-flag iris, and saltcedar (Tamarisk)* # of species 5 Scoring: > 9 species: points = 2 4 - 9 species: points = 1 < 4 species: points = 0	1
H 1.4. Interspersion of habitats Decide from the diagrams below whether interspersion among types of plant structures (described in H 1.1), and unvegetated areas (open water or mudflats) is high, moderate, low, or none. *Use map of Cowardin and emergent plant classes prepared for questions H 1.1 and map of open water from H 1.3. If you have four or more plant classes or three classes and open water, the rating is always high.*  **None** = 0 points  **Low** = 1 point  **Moderate** = 2 points All three diagrams in this row are **HIGH** = 3 points  Riparian braided channels with 2 classes	2

H 1.6. Special habitat features: *Check the habitat features that are present in the wetland. The number of checks is the number of points.* ■ Loose rocks larger than 4 in OR large, downed, woody debris (> 4 in diameter) within the area of surface ponding or in stream. ■ Cattails or bulrushes are present within the wetland. ■ Standing snags (diameter at the bottom > 4 in) in the wetland or within 30 m (100 ft) of the edge. ■ Emergent or shrub vegetation in areas that are permanently inundated/ponded. ■ Stable steep banks of fine material that might be used by beaver or muskrat for denning (> 45 degree slope) OR signs of recent beaver activity ■ Invasive species cover less than 20% in each stratum of vegetation (*canopy, sub-canopy, shrubs, herbaceous, moss/ground cover*)	2
Total for H 1 — Add the points in the boxes above	**9**

Rating of Site Potential If Score is ■ **15 - 18 = H ■ 7 - 14 = M ■ 0 - 6 = L** *Record the rating on the first page*

H 2.0. Does the landscape have the potential to support habitat functions of the site?	
H 2.1 Accessible habitat (only area of habitat abutting wetland). If total accessible habitat is: *Calculate:* 0 % undisturbed habitat + (70 % moderate & low intensity land uses / 2) = 35%	
> $^1/_3$ (33.3%) of 1 km Polygon — points = 3 20 - 33% of 1 km Polygon — points = 2 10 - 19% of 1 km Polygon — points = 1 < 10 % of 1 km Polygon — points = 0	3
H 2.2. Undisturbed habitat in 1 km Polygon around wetland. *Calculate:* 0 % undisturbed habitat + (90 % moderate & low intensity land uses / 2) = 45%	
Undisturbed habitat > 50% of Polygon — points = 3 Undisturbed habitat 10 - 50% and in 1 - 3 patches — points = 2 Undisturbed habitat 10 - 50% and > 3 patches — points = 1 Undisturbed habitat < 10% of 1 km Polygon — points = 0	3
H 2.3 Land use intensity in 1 km Polygon: > 50% of 1 km Polygon is high intensity land use — points = (-2) Does not meet criterion above — points = 0	0
H 2.4. The wetland is in an area where annual rainfall is less than 12 in, and its water regime is not influenced by irrigation practices, dams, or water control structures. *Generally, this means outside boundaries of reclamation areas, irrigation districts, or reservoirs* Yes = 3 No = 0	0
Total for H 2 — Add the points in the boxes above	**6**

Rating of Landscape Potential If Score is ■ **4 - 9 = H ■ 1 - 3 = M ■ < 1 = L** *Record the rating on the first page*

H 3.0. Is the habitat provided by the site valuable to society?	
H 3.1. Does the site provide habitat for species valued in laws, regulations, or policies? *Choose only the highest score that applies to the wetland being rated.* Site meets ANY of the following criteria: — points = 2 ■ It has 3 or more priority habitats within 100 m (see Appendix B) ■ It provides habitat for Threatened or Endangered species (any plant or animal on state or federal lists) ■ It is mapped as a location for an individual WDFW species ■ It is a Wetland of High Conservation Value as determined by the Department of Natural Resources ■ It has been categorized as an important habitat site in a local or regional comprehensive plan, in a Shoreline Master Plan, or in a watershed plan Site has 1 or 2 priority habitats within 100 m (see Appendix B) — points = 1 Site does not meet any of the criteria above — points = 0	1

Rating of Value If Score is ■ **2 = H ■ 1 = M ■ 0 = L** *Record the rating on the first page*

NOTE: A wetland may meet the criteria for more than one set of special characteristics. Record all those that apply. NOTE: All wetlands should also be characterized based on their functions.

Wetland Type	Category
Check off any criteria that apply to the wetland. List the category when the appropriate criteria are met.	
SC 1.0. Vernal Pools Is the wetland **less than 4000 ft^2**, and does it meet at least **two** of the following criteria? ☐ Its only source of water is rainfall or snowmelt from a small contributing basin and has no groundwater input. ☐ Wetland plants are typically present only in the spring; the summer vegetation is typically upland annuals. *If you find perennial, obligate, wetland plants, the wetland is probably NOT a vernal pool.* ☐ The soil in the wetland is shallow [< 1 ft (30 cm) deep] and is underlain by an impermeable layer such as basalt or clay. ☐ Surface water is present for less than 120 days during the wet season. ☐ Yes - Go to **SC 1.1** ☐ No = **Not vernal pool** SC 1.1. Is the vernal pool relatively undisturbed in February and March? ☐ Yes – Go to **SC 1.2** ☐ No = **Not a vernal pool with special characteristics**	
SC 1.2. Is the vernal pool in an area where there are at least 3 separate aquatic resources within 0.5 mi (other wetlands, rivers, lakes etc.)? ☐ Yes = **Category II** ☐ No = **Category III**	
SC 2.0. Alkali wetlands Does the wetland meet **one** of the following criteria? ☐ The wetland has a conductivity > 3.0 mS/cm. ☐ The wetland has a conductivity between 2.0 and 3.0 mS, and more than 50% of the plant cover in the wetland can be classified as "alkali" species (see Table 4 for list of plants found in alkali systems). ☐ If the wetland is dry at the time of your field visit, the central part of the area is covered with a layer of salt. **OR** does the wetland unit meet two of the following three sub-criteria? ☐ Salt encrustations around more than 75% of the edge of the wetland ☐ More than ¾ of the plant cover consists of species listed on Table 4 ☐ A pH above 9.0. All alkali wetlands have a high pH, but please note that some freshwater wetlands may also have a high pH. Thus, pH alone is not a good indicator of alkali wetlands. ☐ Yes = **Category I** ☐ No = **Not an alkali wetland**	
SC 3.0. Wetlands of High Conservation Value (WHCV) SC 3.1. Has the WA Department of Natural Resources updated their website to include the list of Wetlands of High Conservation Value? ☐ Yes - Go to **SC 3.2** ☐ No - Go to **SC 3.3** SC 3.2. Is the wetland listed on the WDNR database as a Wetland of High Conservation Value? ☐ Yes = **Category I** ☐ No = **Not WHCV** SC 3.3. Is the wetland in a Section/Township/Range that contains a Natural Heritage wetland? http://www1.dnr.wa.gov/nhp/refdesk/datasearch/wnhpwetlands.pdf ☐ Yes - **Contact WNHP/WDNR and to SC 3.4** ☐ No = **Not WHCV** SC 3.4. Has WDNR identified the wetland within the S/T/R as a Wetland of High Conservation Value and listed it on their website? ☐ Yes = **Category I** ☐ No = **Not WHCV**	

SC 4.0. Bogs and Calcareous Fens *Does the wetland (or any part of the wetland unit) meet both the criteria for soils and vegetation in bogs or calcareous fens? Use the key below to identify if the wetland is a bog or calcareous fen.* ***If you answer yes you will still need to rate the wetland based on its functions.*** SC 4.1. Does an area within the wetland have organic soil horizons (i.e., layers of organic soil), either peats or mucks, that compose 16 in or more of the first 32 in of the soil profile? *See Appendix C for a field key to identify organic soils* ◘ Yes - Go to **SC 4.3** ◘ No - Go to **SC 4.2** SC 4.2. Does an area within the wetland have organic soils, either peats or mucks, that are less than 16 in deep over bedrock or an impermeable hardpan such as clay or volcanic ash, or that are floating on top of a lake or pond? ◘ Yes - Go to **SC 4.3** ■ No = **Is not a bog for rating** SC 4.3. Does an area within the wetland have more than 70% cover of mosses at ground level AND at least 30% of the total plant cover consists of species in Table 5? ◘ Yes = **Category I bog** ◘ No - Go to **SC 4.4** **NOTE:** If you are uncertain about the extent of mosses in the understory, you may substitute that criterion by measuring the pH of the water that seeps into a hole dug at least 16 in deep. If the pH is less than 5.0 and the plant species in Table 5 are present, the wetland is a bog. SC 4.4. Is an area with peats or mucks forested (> 30% cover) with subalpine fir, western red cedar, western hemlock, lodgepole pine, quaking aspen, Engelmann spruce, or western white pine, AND any of the species (or combination of species) listed in Table 5 provide more than 30% of the cover under the canopy? ◘ Yes = **Category I bog** ◘ No - Go to **SC 4.5** SC 4.5. Do the species listed in Table 6 comprise at least 20% of the total plant cover within an area of peats and mucks? ◘ Yes = **Is a Calcareous Fen for purpose of rating** ◘ No - Go to **SC 4.6** SC 4.6. Do the species listed in Table 6 comprise at least 10% of the total plant cover in an area of peats and mucks, AND one of the two following conditions is met: ◘ Marl deposits [calcium carbonate ($CaCO_3$) precipitate] occur on the soil surface or plant stems ◘ The pH of free water is ≥ 6.8 AND electrical conductivity is ≥ 200 uS/cm at multiple locations within the wetland ◘ Yes = **Is a Category I calcareous fen** ◘ No = **Is not a calcareous fen**	
SC 5.0. Forested Wetlands Does the wetland have an area of forest rooted within its boundary that meets **at least one** of the following three criteria? (*Continue only if you have identified that a forested class is present in question H 1.1*) ◘ The wetland is within the 100 year floodplain of a river or stream ◘ Aspen (*Populus tremuloides*) represents at least 20% of the total cover of woody species ◘ There is at least ¼ ac of trees (even in wetlands smaller than 2.5 ac) that are "mature" or "old-growth" according to the definitions for these priority habitats developed by WDFW (*see definitions in question H3.1*) ◘ Yes - Go to **SC 5.1** ◘ No = **Not a forested wetland with special characteristics** SC 5.1. Does the wetland have a forest canopy where more than 50% of the tree species (by cover) are slow growing native trees (*see Table 7*)? ◘ Yes = **Category I** ◘ No - Go to **SC 5.2** SC 5.2. Does the wetland have areas where aspen (*Populus tremuloides*) represents at least 20% of the total cover of woody species? ◘ Yes = **Category I** ◘ No - Go to **SC 5.3** SC 5.3. Does the wetland have at least ¼ acre with a forest canopy where more than 50% of the tree species (by cover) are fast growing species (*see Table 7*)? ◘ Yes = **Category II** ◘ No - Go to **SC 5.4** SC 5.4. Is the forested component of the wetland within the 100 year floodplain of a river or stream? ◘ Yes = **Category II** ◘ No = **Not a forested wetland with special characteristics**	
Category of wetland based on Special Characteristics *Choose the highest rating if wetland falls into several categories* If you answered No for all types, enter "Not Applicable" on Summary Form	

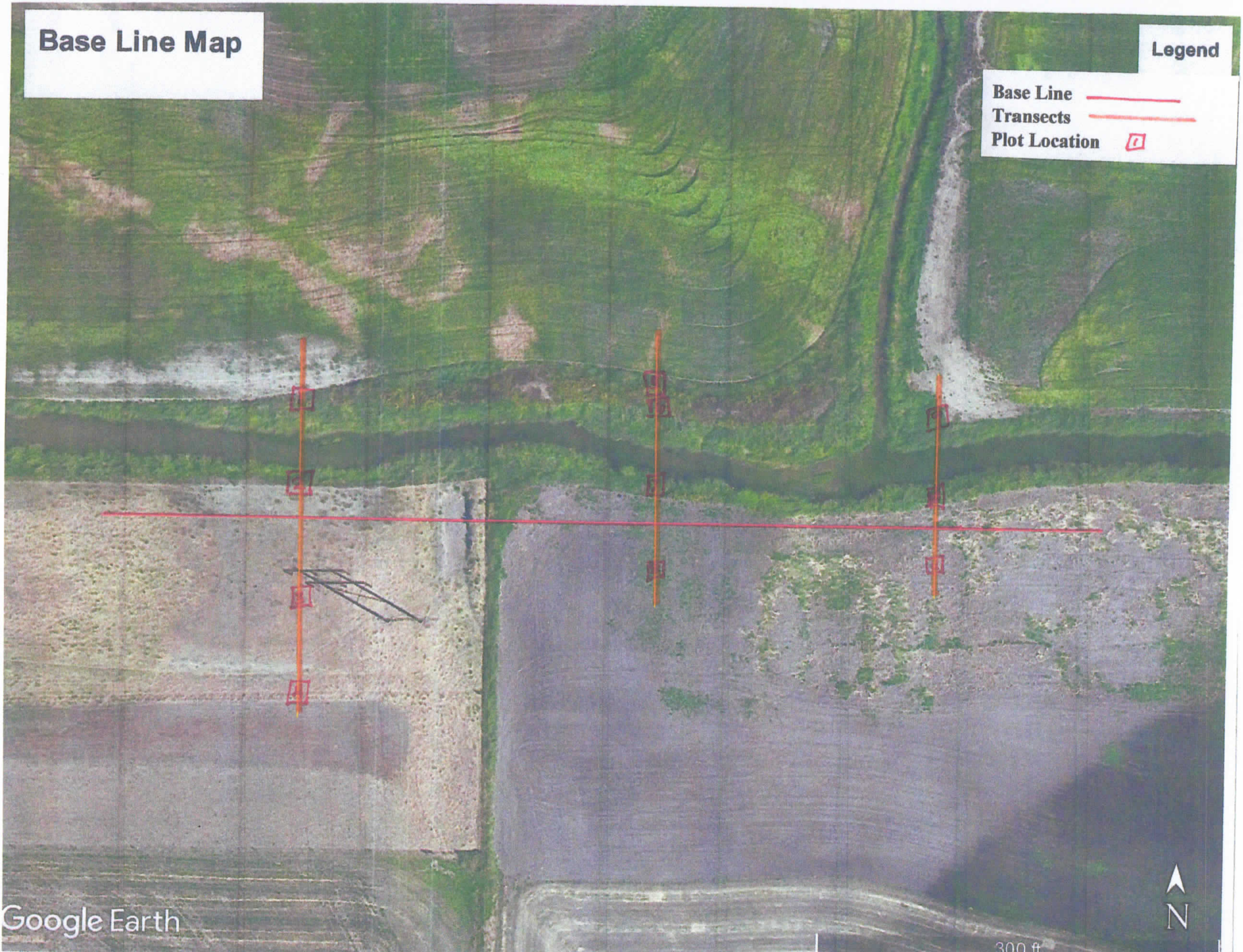
Appendix B: WDFW Priority Habitats in Eastern Washington

Priority habitats listed by WDFW (see complete descriptions of WDFW priority habitats, and the counties in which they can be found, in: Washington Department of Fish and Wildlife. 2008. Priority Habitat and Species List. Olympia, Washington. 177 pp.
http://wdfw.wa.gov/publications/00165/wdfw00165.pdf or access the list from here:
http://wdfw.wa.gov/conservation/phs/list/

Count how many of the following priority habitats are within 330 ft (100 m) of the wetland unit: ***NOTE***: *This question is independent of the land use between the wetland unit and the priority habitat.*

- ☐ **Aspen Stands**: Pure or mixed stands of aspen greater than 1 ac (0.4 ha).
- ☐ **Biodiversity Areas and Corridors**: Areas of habitat that are relatively important to various species of native fish and wildlife (*full descriptions in WDFW PHS report*).
- ☐ **Old-growth/Mature forests**: Old-growth east of Cascade crest – Stands are highly variable in tree species composition and structural characteristics due to the influence of fire, climate, and soils. In general, stands will be >150 years of age, with 10 trees/ac (25 trees/ha) that are > 21 in (53 cm) dbh, and 1-3 snags/ac (2.5-7.5 snags/ha) that are > 12-14 in (30-35 cm) diameter. Downed logs may vary from abundant to absent. Canopies may be single or multi-layered. Evidence of human-caused alterations to the stand will be absent or so slight as to not affect the ecosystem's essential structures and functions. Mature forests – Stands with average diameters exceeding 21 in (53 cm) dbh; crown cover may be less than 100%; decay, decadence, numbers of snags, and quantity of large downed material is generally less than that found in old-growth; 80-200 years old west and 80-160 years old east of the Cascade crest.
- ☐ **Oregon White Oak**: Woodland stands of pure oak or oak/conifer associations where canopy coverage of the oak component is important (*full descriptions in WDFW PHS report p. 158 – see web link above*).
- ☐ **Riparian**: The area adjacent to aquatic systems with flowing water that contains elements of both aquatic and terrestrial ecosystems which mutually influence each other.
- ☐ **Caves**: A naturally occurring cavity, recess, void, or system of interconnected passages under the earth in soils, rock, ice, or other geological formations and is large enough to contain a human.
- ☐ **Cliffs**: Greater than 25 ft (7.6 m) high and occurring below 5000 ft elevation.
- ☐ **Talus**: Homogenous areas of rock rubble ranging in average size 0.5 - 6.5 ft (0.15 - 2.0 m), composed of basalt, andesite, and/or sedimentary rock, including riprap slides and mine tailings. May be associated with cliffs.
- ☐ **Snags and Logs**: Trees are considered snags if they are dead or dying and exhibit sufficient decay characteristics to enable cavity excavation/use by wildlife. Priority snags have a diameter at breast height of > 20 in (51 cm) in western Washington and are > 6.5 ft (2 m) in height. Priority logs are > 12 in (30 cm) in diameter at the largest end, and > 20 ft (6 m) long.
- ☐ **Shrub-steppe**: A nonforested vegetation type consisting of one or more layers of perennial bunchgrasses and a conspicuous but discontinuous layer of shrubs (see Eastside Steppe for sites with little or no shrub cover).
- ☐ **Eastside Steppe**: Nonforested vegetation type dominated by broadleaf herbaceous flora (i.e., forbs), perennial bunchgrasses, or a combination of both. Bluebunch wheatgrass (*Pseudoroegneria spicata*) is often the prevailing cover component along with Idaho fescue (*Festuca idahoensis*), Sandberg bluegrass (*Poa secunda*), rough fescue (*F. campestris*), or needlegrasses (*Achnatherum* spp.).
- ☐ **Juniper Savannah**: All juniper woodlands.

Note: All vegetated wetlands are by definition a priority habitat but are not included in this list because they are addressed elsewhere.


Base Line Map
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BASE LINE: see Baseline Map
PLOT NO. & LOCATION: see Baseline Map
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Site Map
2016
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1000 ft
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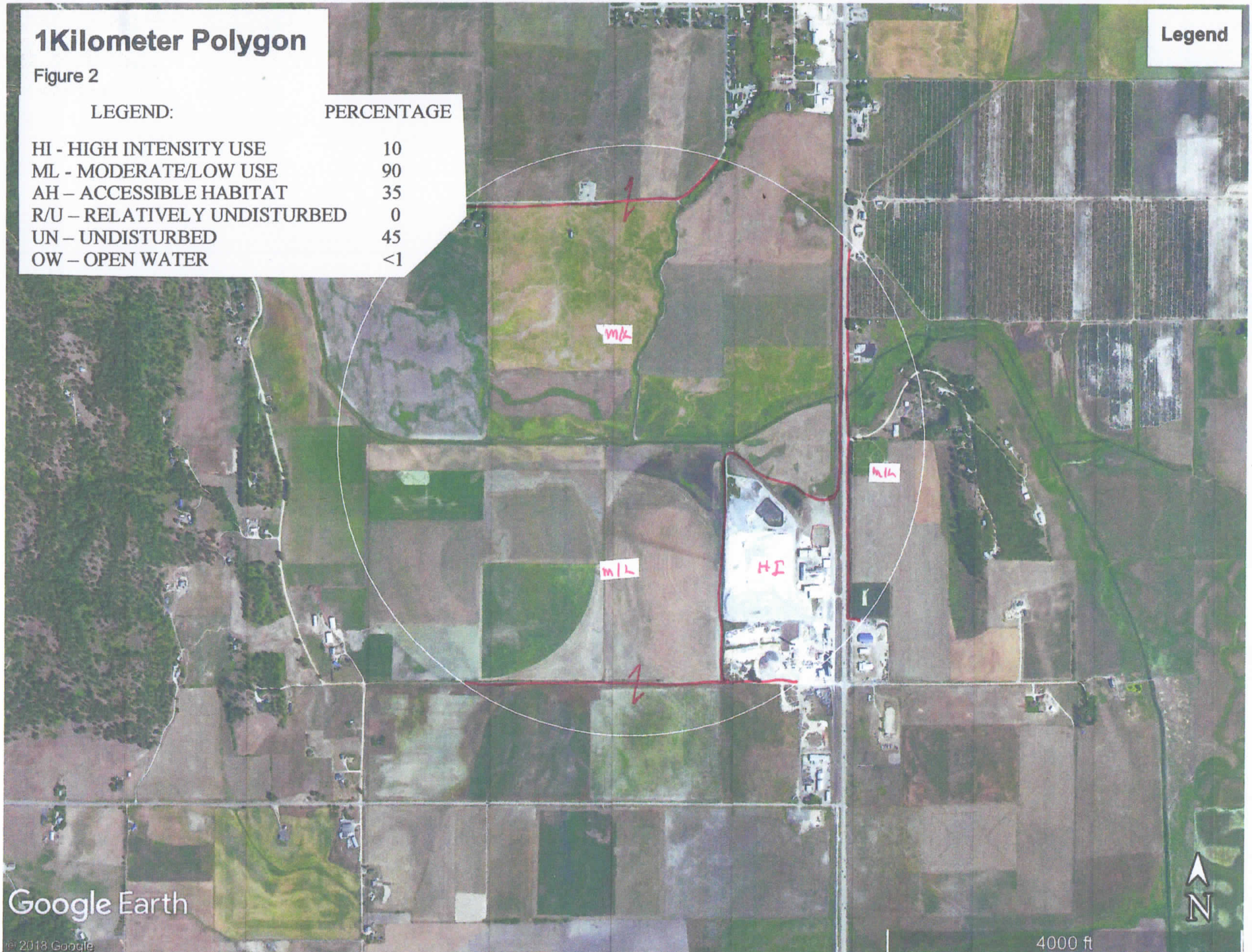
1Kilometer Polygon

Figure 2

LEGEND:	PERCENTAGE
HI - HIGH INTENSITY USE	10
ML - MODERATE/LOW USE	90
AH – ACCESSIBLE HABITAT	35
R/U – RELATIVELY UNDISTURBED	0
UN – UNDISTURBED	45
OW – OPEN WATER	<1



DEPARTMENT OF ECOLOGY State of Washington

Washington State Water Quality Atlas

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Legend | Filter Data | Zoom To | Tools

Add or remove map data

Assessed Waters/Sediment

Water

- Category 5 - 303d
- Category 4C
- Category 4B
- Category 4A
- Category 2
- Category 1

Sediment

- Category 5 - 303d
- Category 4C
- Category 4B

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Assessment | Standards | Outfalls | WQI Projects | WLA Points

Zoom to selection | Export to csv

Find	Listing ID	Assessment Unit ID	Category	Medium
No filter applied, to view records filter data				

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Water Quality Atlas Version: 1.0.0.0

FIGURE 3.

No TMDL set.

HYDRO PERIOD: (Stevens County Soil Survey table 15)

Soil Mapping Unit	Water Table Depth	Season present
37 – Bossburg muck	0 – 1ft.	Feb. – May
40 – Bridgeson silt loam, drained	2 – 4 ft.	Feb. – Jun.
55 – Chewelah fine sandy loam	2 – 4 ft.	Feb. – May
59 – Colville Silt loam, drained	2 – 4 ft.	Feb. – Jun.
99 – Hodgson silt loam	2 – 3 ft	Feb. – April.

R 4.1 Ratio – width of wetland/width of Stream (100/19 = .84)

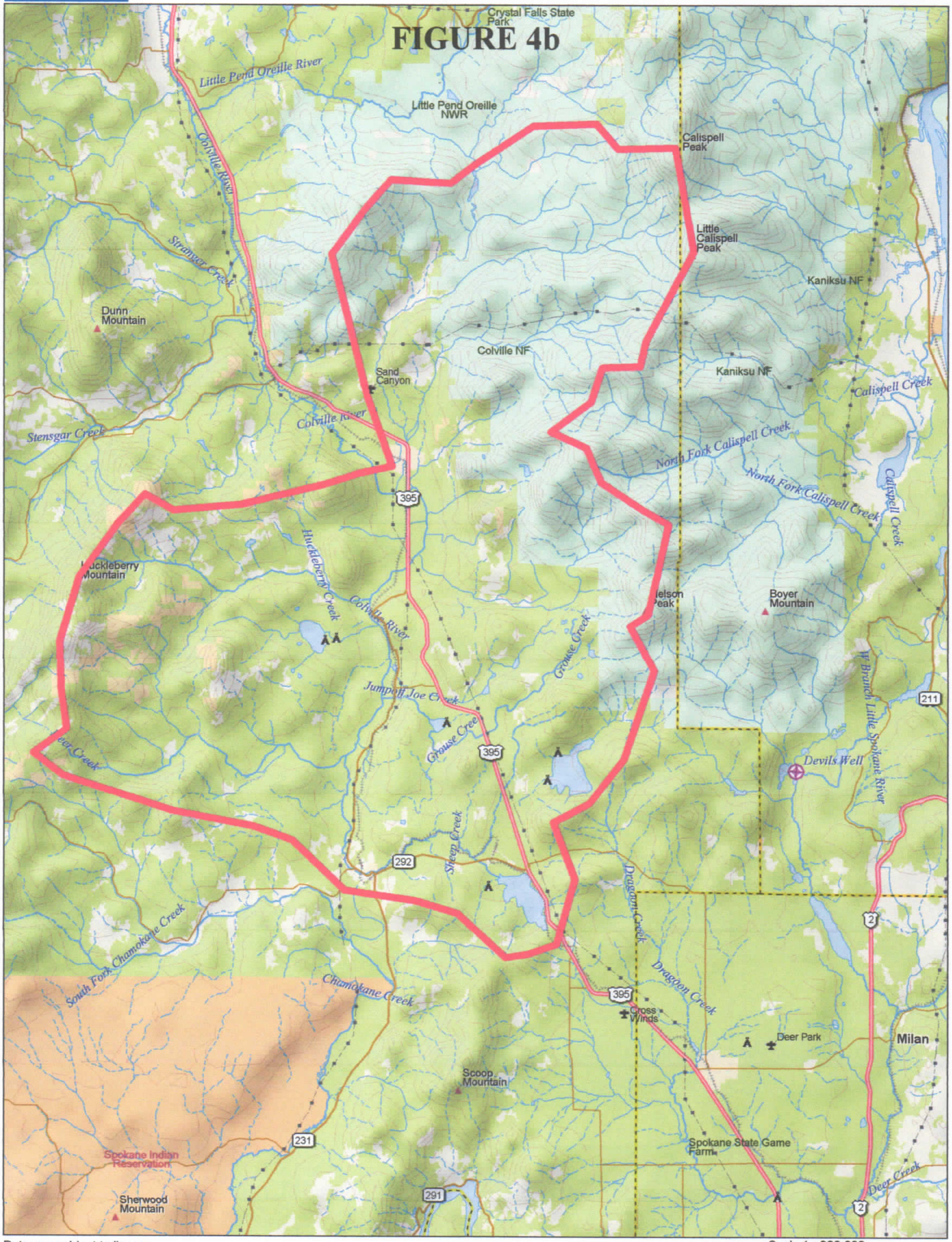
Contributing Basin

Figure 4

DELORME

CONTRIBUTING BASIN

Topo North America™ 10



TN

MN (14.2°E)

Scale 1 : 300,000

1" = 4.73 mi

Data Zoom 9-4

ATTACHMENT 3

ENGINEERING REPORT

Engineer's Report
October 27, 2019

CUNNINGHAM ENGINEERS, INC.
609D Gold Creek Loop, Colville WA 99114
Telephone (509) 684-5036 Cell (509) 680-0058
Email: earthboy2u@gmail.com

TO: Gene St. Godard
P.G., L.Hg., CWRE
WNR Group
P.O. Box 28755
Spokane, Washington 99228

Adam Cares
Stevens County Land Services
260 S. Oak St.
Colville, Washington 99141

Bryce Tolton
Mid-Mountain Surveyors
4 Mid-Mountain Lane
Republic, WA 99166

Engineer's Report Chewelah Creek Stream Improvement
100-year and 25-year Flood Elevation Study for
Confluence of Colville River and Chewelah Creek
S23, T32N, R40E, Stevens County, WA.

JOSEPH LEE CUNNINGHAM
STATE OF WASHINGTON
31293
REGISTERED
PROFESSIONAL ENGINEER

Signed on Oct. 27, 2019

References:
1. WNR Group, Inc. April 17th, 2015 Memo of Conclusions for WRIA 59 Flow Subcommittee
2. September 12, 2019 site inspection with Mid-Mountain Surveyors
3. USGS StreamStat Flood Flow Calculator
4. USGS – Methods for Estimating Flood Magnitudes, Frequency in WA Fact Sheet 016-01

Attached:
1. MathCAD calculation sheets for 100-year flood estimates
2. 19017A-1 Aerial View of Project Site
3. 19017A-2 Cross-Section Location
4. 19017A-3 Flood Control Site Plan
5. 19017A-4 Floodway/Diversion Channel Typical Cross-Section
6. 19017A-5 Diversion Structure - Cross-Section
7. 19017A-6 Colville River- Chewelah Creek Centerline Profiles
8. 19017A-7 Colville River – Cross-Sections X1 & X2
9. 19017A-8 Colville River – Cross-Sections X3, X4 & X5
10. 19017A-9 Chewelah Creek– Cross-Sections X1 & X2
11. 19017A-9 Chewelah Creek– Cross-Sections X1 & X2
12. Cost estimates for channel widening excavations and instream structures per drawings

Dear Mr. St. Godard,
We have completed the Flood Elevation study for the subject area in accordance with references 2 & 3. Mid-Mountain Surveyors surveyed ten sections; perpendicular to Colville River and Chewelah Creek stream channels with five sections for each stream. The capacities of Colville River and Chewelah Creek were evaluated for peak flow during 100-year and 25-year storms. Using information from the above references, the volumes calculated for the 100-year storm were 11,026 cfs for the Colville River and 2757 cfs for Chewelah Creek. For the 25-year storm the volumes were 6469 cfs for the Colville River and 1761 cfs for Chewelah Creek. The cross-sections are numbered facing downstream, progressing upstream and are stationed with 0+00 at centerline with minus stations to the left and positive stations to the right. A preliminary design for the subject stream improvement project on Chewelah Creek and Colville River is also presented.

100-year Flood Depths

Floodways on each stream are proposed to reduce restrictions to flood flow. A cross-section width of **110 feet** for Chewelah Creek determined a flood depth of **2 feet.** This depth allowed flood to remain about **1 ft below** adjacent landforms. A cross-section width of **700 feet** for the Colville River determined a flood depth of **5 feet.** This depth is **1.5 ft above** adjacent landforms.

This posed the question of what combination of cross-section width and flood depth would allow Colville River 100-year flood to pass and stay within adjacent landforms. Hydraulic calculations determined that a floodway width of **1400 feet** and depth of **3.5 feet** would allow flood to remain even with the landforms.

25-year Flood Depths

A floodway cross-section width of **110 feet** for Chewelah Creek was analyzed to have a flood depth of **1.5 feet.** A floodway cross-section width of **700 fee**t for the Colville River determined a flood depth of **3.5 feet.** This floodway width will allow flood flow to remain within the channel landforms.

Estimated Earth Quantities:

The soil materials removed during floodway construction could be used to amend low lying areas in adjacent fields.

1. Chewelah Creek Floodway:
110 ft wide x 2 ft deep x 465 ft long = 102300 cu. ft. = 3789 cu. yds.

2. Colville River Floodway:
700 ft wide x 3.5 deep x 765 ft long = 1874250 cu. ft. = 69417 cu. yds.

3. New Diversion Floodway-Chewelah Creek:
44 ft wide x 2.5 ft deep x 500 ft long = 55000 cu. ft. = 2037 cu. yds.

Notes on the Hydraulic Analysis of Cross Sections

The elevations of the current water levels in each section are indicated. The slope of the water surface between sections was used in the hydraulic calculations. The valley topography at the project site is noted as having very little change. This has the effect of magnifying flood effects once the valley is covered since drainage to the north is restricted by the narrow dredged channel. The existing water surface was used as the reference for slope as the stream bottoms are convoluted with rises and dips due the original dredging activities and the scouring and depositions of from the yearly regimen of spring run-offs.

The Colville River has a drop of **0.56 feet** in the **765 feet** between cross-sections X5 to X1. This gives a slope of an average of 0.00073 (.073%) or about 3.8 ft in 1 mile. Chewelah Creek has a drop of **1.1 feet** in the **466 feet** between cross-sections X5 to X1.This give an average slope of 0.00236 (.236%) or about 12.5 ft in 1 mile. Each cross-section has the proposed floodway profile shown with the present water surface and with the 100- year and 25-year flood depths. The average flood elevation for the **Colville River** is **1644 feet** for **100-year** flood and **1642.5 fee**t for **25-yea**r flood. The average flood elevation for **Chewelah Creek** is **1641.5 feet** for **100-year** flood and **1640 feet** for **25-year** flood. This indicates that during any flood event, a **backwater** effect of up to **2.5 feet** from the Colville River into Chewelah Creek occurs due the topography of the two streams. A 1644 foot contour line on valley maps in the vicinity of the confluence would give an accurate indication of the extent of a 100-year flood event. This very large width indicates that the valley is very flat and flow is likely restricted further downstream.

Discussion of Analysis Method

100-year and 25-year stream flow data was taken from USGS Streamstat program. Models of the 110 foot floodway, the 700 foot floodway and the 1400 foot floodway were analyzed using MathCAD and the hydraulic equation:

$$Q = \frac{1.486}{n} \times A \times R^{2/3} \times S^{1/2}$$

Where: Q = flow cfs, A = area sq. ft., R = hydraulic radius
S=slope, n = Manning Coefficient

Permit Requirements:

The HPA permit process will be used, and is generalized to include County, State Fish and Wildlife, Ecology, and Army Corps of Engineers permitting requirements.

Recommendations for future study to define a Sustainable Meander Corridor (SMC):

This project was reviewed with the Stevens County Planning Department and project stakeholders who farm the adjacent fields. These land owners indicated that crop rotations are done on a 3 to 10 year basis, and they proposed that a 10-year sized floodway would be an acceptable accommodation for them and would allow more land to remain in cultivation.

This criteria is compatible with the SMC methodology, since this method does not supplant or replace the Channel Migration Zone (CMZ) wherever action is not taken to limit channel migration outside of the SMC boundary, and does not ignore the 100-yr flood zone, both of which extend beyond the SMC. This SMC delineation *defines the minimum* sustainable meander corridor with that the river system needs.

It is recommended that the 700 ft wide floodway proposed in this report to contain the 25-Year flood event should be analyzed for a narrower 10-yr floodway excavated down to a determined 2-year flow surface elevation where the river bottom could meander within this floodway creating a new sustainable meander corridor (SMC). Hydraulic analysis could also be done to compare this 10-yr with 25-yr flood flows. This SMC study should be conducted along the Colville River from the Hwy 395 crossing up to the bridge on Schmidlekofer Road.

A section of the Colville River located downstream of Little Pend Oreille River confluence has been evaluated for an SMC whose width was determined to vary from 531 feet wide at the upstream end, to 665 feet wide at downstream end of this reach. By comparison, the river section downstream of Chewelah Creek would likely be a narrower SMC because it is transporting much less water. However, the average river slope along this portion of the valley would also be a governing factor.

Benefits of a Sustainable Meander Corridor (SMC):
If an SMC study is conducted and then implemented, natural revegetation and channel migration processes could resume with most flooding occurring within the corridor below adjacent field elevations for significant agricultural benefit. A new SMC would greatly reduce flood durations and related mass wasting damage to the valley farm land, for significantly reduced durations of field saturation for increased field productivity, and would provide a defendable line between fields and the new sustainable riparian zone. Maturing trees, shaded water, natural erosion processes without mass wasting, would provide significant habitat improvements for significant ecological benefits as well.

Cost Estimates:
Attached to this report are the cost estimates for the two options described in the drawings.

700' wide Floodway Option: 700 feet wide, excavated to sandbar / point bar elevation (approximate surface elevation of the 2-yr flow), would generate 480,000 cu yds per river mile, for a rough construction cost estimate of $1,810,000 per river mile.

400' wide SMC Option: Assuming a Sustainable Meander Corridor 400 feet wide, excavated to sandbar / point bar elevation (approximate surface elevation of the 2-yr flow), would generate 280,000 cu yds per river mile, for a rough construction cost estimate of $1,090,000 per river mile to create an SMC. Channel surveys, hydraulic analysis and stream engineering costs would be approximately $7,500 per river mile.

Cost estimates for the Final Engineering the Chewelah Creek instream structures and Diversion Floodway is estimated to be $7,000 and would be used for both options.

Liability Limitations and Closing Remarks:
This report describes a preliminary design and is not a final design. Our limitations of liability are only for the analysis presented, and not for installation of any stream structures or excavations based on this engineer's report. Thank you for this opportunity to be of service. Please call us if you have any questions.

Prepared by;

Robert L. Cunningham, Jr, PE
509-680-1286
CUNNINGHAM ENGINEERS, INC.
609D Gold Creek Loop, Colville WA 99114

Concurrence:

Joseph L. Cunningham, P.E.
509-680-0058

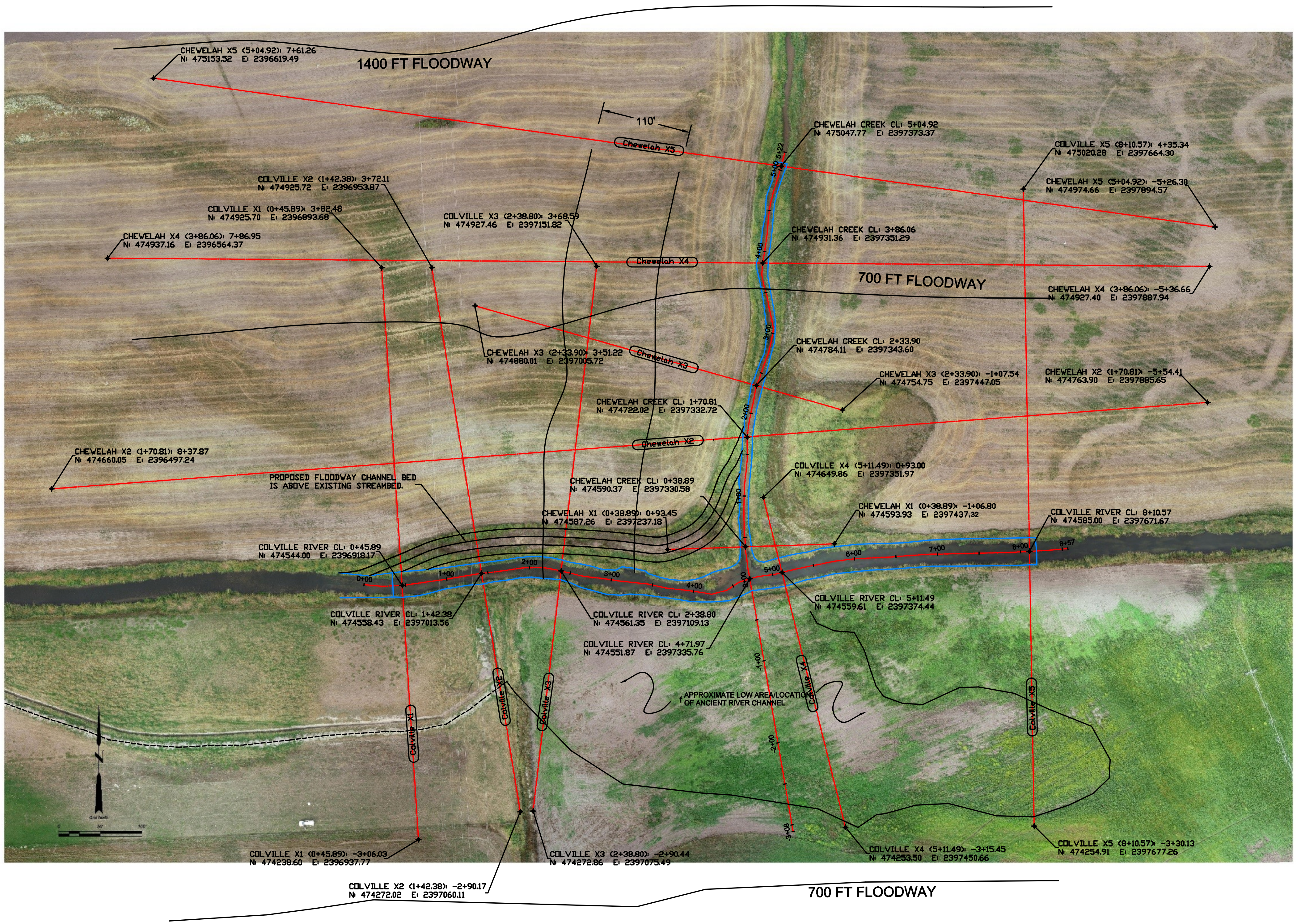
cc: file 19017

Task 8 - - Project Cost Estimate for Chewelah Creek Stream Improvement at Confluence of Colville River and Chewelah Creek

10/27/2019

Sub-Task	Task Description	Quantity	Units	Rate	Sub-Task Subtotal		
1	**Excavation along Chewelah Creek:** Equipment: Belly Scraper 110 ft W x 2 ft DP x 465 ft L = 102300 cu. ft. = 3789 cu yds.	3800	cu yds	$2.00	$7,600.00		
2	**Excavation For New Diversion Floodway-Chewelah Creek:** 44 ft W x 2.5 ft DPx 500 ft L = 55000 cu. ft. = 2037 cu. yds.	2100	cu yds	$1.75	$3,675.00		
3	**Dewatering:** Construct Diversion Dam structure, 10x5x200 diversion channel (or gravity pipe system) to transport water past instream work area(s) and Backfill when completed.	1	each	$550.00	$550.00		
		400	cu yds	$3.00	$1,200.00		
		400	cu yds	$4.00	$1,600.00		
4	**In stream structures-Chewelah Creek: (**Streambarbs)	8	each	$1,500.00	$12,000.00		
5	**In stream structures-Chewelah Creek:** (Grade Control Weir)	660	sq ft	$70.00	$46,200.00		
6	**Excavation along Colville River (700 ft wide Floodway):** 700 ft W x 3.5 DP x 765 ft L = 1874250 cu. ft. = 69417 cu. yds.	70000	cu yds	$2.00	$140,000.00	Cu Yds per River Mile:	480000
7	**Placing Soil Fill Amendment:** Equipment: Belly Scraper (Fill in low areas under cultivation)	70000	cu yds	$1.75	$122,500.00	*** Cost per River Mile:**	**$1,810,000.00**
						*** Cost per Lineal Foot:**	**$343.00**
8	**Engineering:** Instream Structures, Floodway Entrance, Exit	1	each	$7,000.00	$7,000.00		
9	**Permitting:** --Hydraulic Permit Application	1	**each**	$8,000.00	$8,000.00		
10				**Sub Total:**	$350,325.00		
11		**15% Contingency:**			$52,548.75		
12		**10% Construction Management:**			$35,032.50		
13		**5% Program**			$17,516.25		
14		**TOTAL:**			**$455,000.00**		
	References: SCCD Cost List -- WA_EQIP_12262013 Stevens Co Cost List 2016 *(Modified for larger equipment and larger economy of scale for work)*					* Does not include Creek Structures, Planting, 15% Contingency, 10% Construction Management or 5% Program Costs. Intended only for comparisons between options.	
15	**Aerial and Channel Surveys, Hydraulic Analysis and Stream Engineering for SMC Alternate Option:**	1.00	mile	$7,500.00	$7,500.00	NOTE: Additional Mile(s) will reduce the cost per mile for Survey and Engineering.	
16	**ALTERNATE OPTION: SMC Excavation along Colville River** --400 ft wide Sustainable Meander Corridor (SMC) **4**00 ft W x 3.5 DP x 765 ft L = 1071000 cu. ft. = 39,700 cu. yds.	40000	cu yds	$2.00	$80,000.00	Cu Yds per River Mile:	280000
17	**Placing Soil Fill Amendment (SMC ALTERNATE):** (Fill in low areas under cultivation)	40000	cu yds	$1.75	$70,000.00	*** Cost per River Mile:**	**$1,090,000.00**
						*** Cost per Lineal Foot:**	**$206.00**

NOTE: Conducting the SMC study and excavating a Sustainable Meander Corridor (SMC) will effectively repair the river's Riparian Zone from the impact of clearing trees and vegetation from streambanks and dredging, with the benefit of reduced flood impact to adjacent farm fields.



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PROJECT:

FLOOD CONTROL SYSTEM FOR
CHEWELAH CREEK CONFLUENCE
WITH THE COLVILLE RIVER

SPONSOR:

WNR GROUP
P.O. BOX 28755
SPOKANE, WA 99228
509-935-9395

PREPARED BY:

CUNNINGHAM ENGINEERS, INC
609D GOLD CREEK LOOP
COLVILLE, WA 99114
(509) 684-5036

0 50 100 200 300 400 500

SCALE:

1400 FT FLOODWAY

JOSEPH LEE CUNNINGHAM
STATE OF WASHINGTON
31283
REGISTERED
PROFESSIONAL ENGINEER
09/29/2019

DAY	MONTH	YEAR	NO.	REVISION RECORD	BY	CK	ZONE
23	SEP	19	00	ORIGINAL DRAWING	RC	JC	

PROJECT:

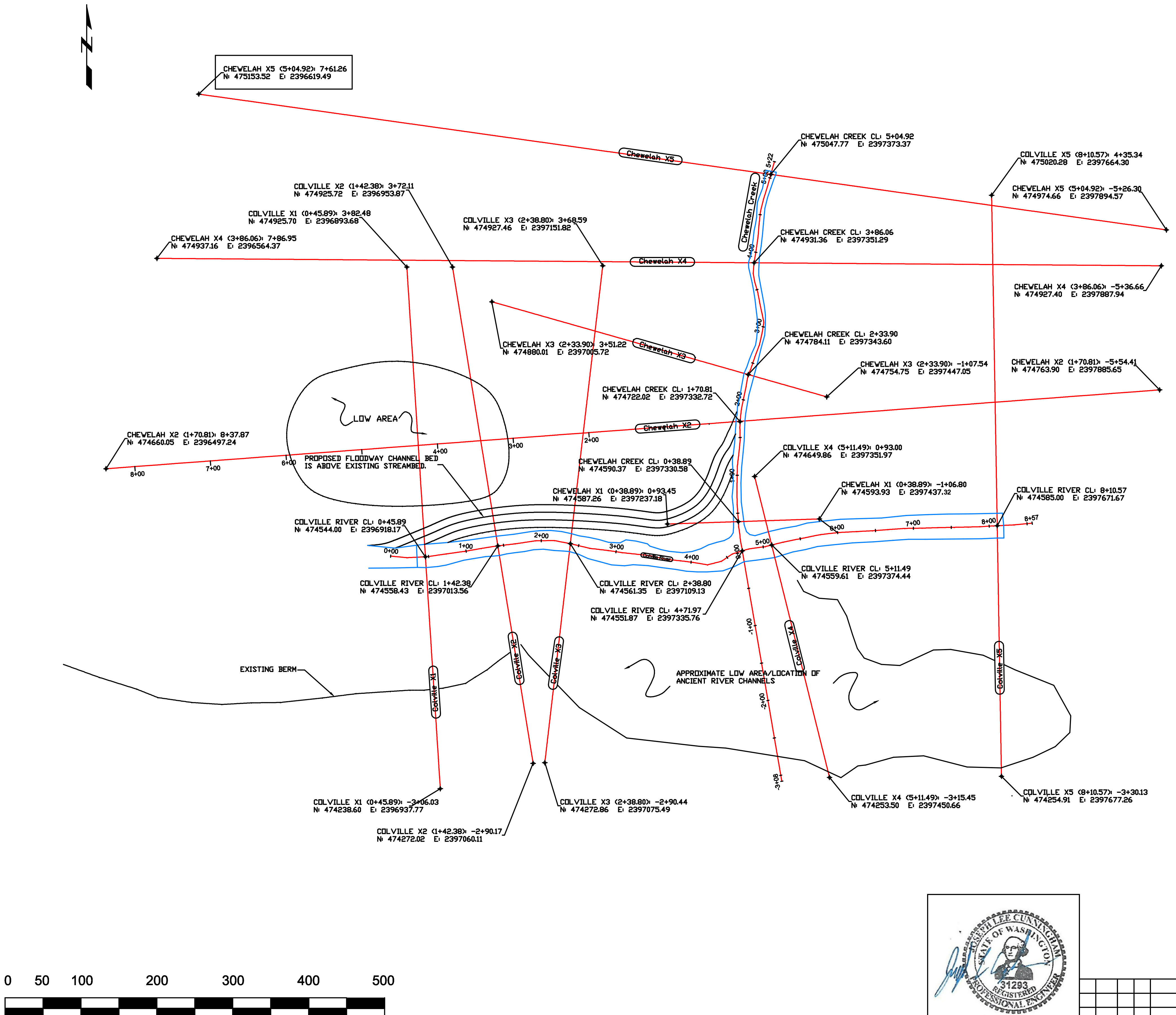
CHEWELAH CREEK-COLVILLE RIVER
FLOOD CONTROL
AERIAL VIEW OF PROJECT SITE

CUNNINGHAM ENGINEERS, INC.
609D GOLD CREEK LOOP, COLVILLE, WA
509-684-5036

DESIGNED J. L. CUNNINGHAM
DRAWN RLC
CHECKED JLC
APPROVED JLC

DRAWING NUMBER
19017A-1

1 OF 10



PROJECT:
FLOOD CONTROL SYSTEM FOR
CHEWELAH CREEK CONFLUENCE
WITH THE COLVILLE RIVER

SPONSOR:
WNR GROUP
P.O. BOX 28755
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509-935-9395

PREPARED BY:
CUNNINGHAM ENGINEERS, INC
609D GOLD CREEK LOOP
COLVILLE, WA 99114
(509) 684-5036

STATE OF WASHINGTON — JOSEPH LEE CUNNINGHAM — 31283 — REGISTERED PROFESSIONAL ENGINEER

09/29/2019

DAY	MONTH	YEAR	NO.	REVISION RECORD	DR	CK	ZONE
23	SEP	19	00	ORIGINAL DRAWING	RC	JC	

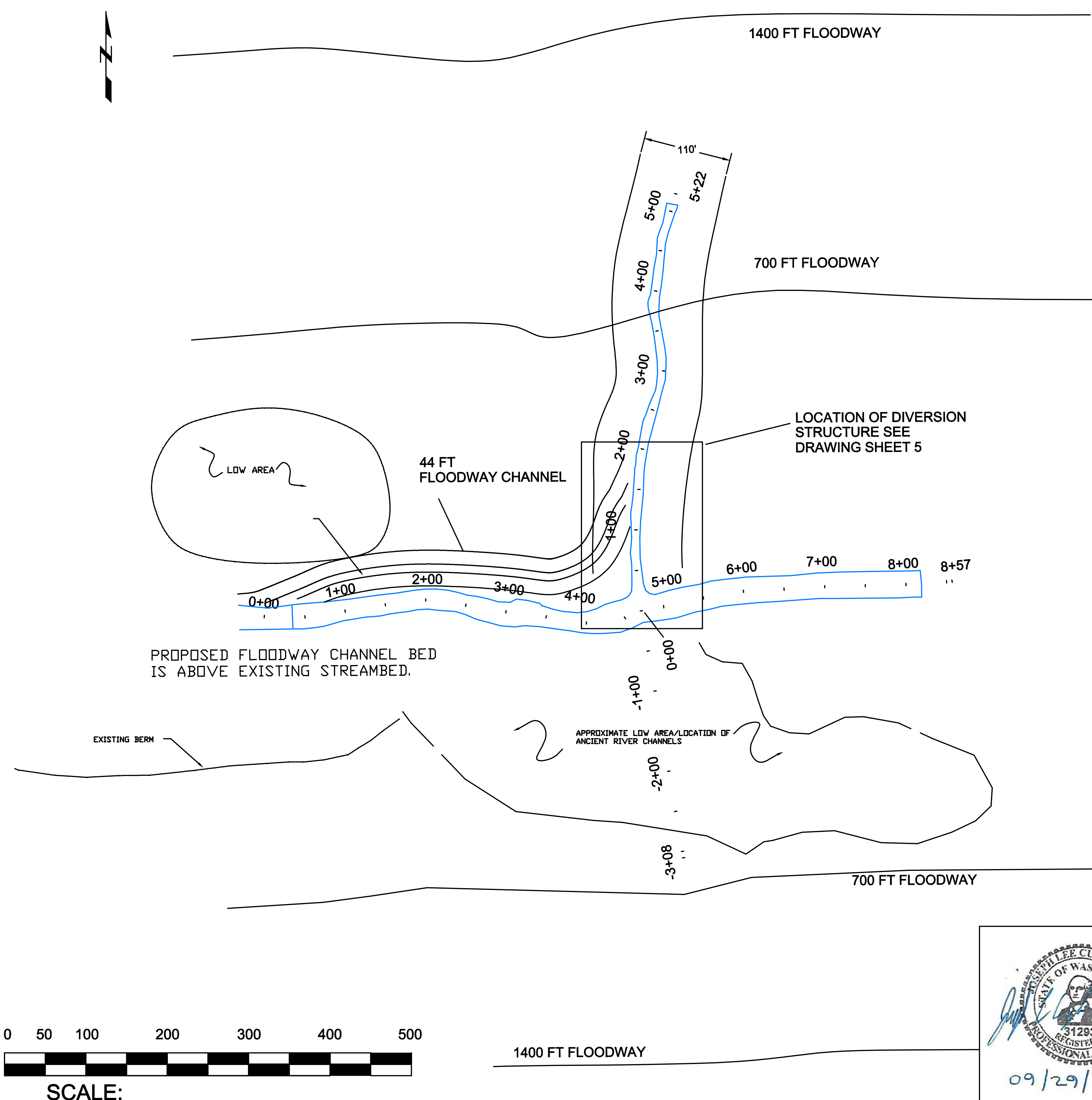
PROJECT:
CHEWELAH CREEK-COLVILLE RIVER
FLOOD CONTROL
CROSS-SECTION LOCATIONS

CUNNINGHAM ENGINEERS, INC.
609D GOLD CREEK LOOP, COLVILLE, WA
509-684-5036

DESIGNED J.L. CUNNINGHAM
DRAWN RLC
CHECKED JLC
APPROVED JLC

DRAWING NUMBER
19017A-2

2 OF 10



1. VALLEY TOPOGRAPHY:
VALLEY FLOOR SHOWS EVIDENCE OF BEING FORMED BY SEDIMENT DEPOSIT IN A MODIFIED ALLUVIAL FAN ACROSS THE VALLEY WHICH RESULTS IN GROUND THAT SLOPES AWAY FROM THE MAIN CHANNEL OF CHEWELAH CREEK. ORIGINAL STREAM LIKELY HAD SEVERAL CHANNELS PRIOR TO CONSTRUCTION OF ROADWAYS AND THE CLEARING OF FARM LAND.

2. CURRENT CONDITIONS:
HISTORICAL STREAM DREDGING HAS RESULTED IN AN UNNATURALLY NARROW MEANDER CORRIDOR WITH SIDE BERMS OF LARGELY UNCONSOLIDATED SEDIMENTARY MATERIAL WHICH IS HIGHLY SUSCEPTIBLE TO BREAKOUTS DURING FLOOD CONDITIONS. MEANDER CORRIDOR WIDTH MUST BE INCREASED ACCORDING TO A MORE DETAILED ANALYSIS OF FLOOD FLOW HYDRODYNAMICS AND THE NATURAL STREAM CHANNEL MORPHOLOGY BASED ON THE VALLEY FLOOR SEDIMENTS, AGRICULTURAL ACTIVITIES AND VEGETATION ALONG SEVERAL MILES OF RIVER REACH.

3. SUMMARY OF PROPOSED FLOOD CONTROL SYSTEM AND STREAM RESTORATION:
INSTALL ONE DIVERSION STRUCTURE TO DIVERT WATER INTO NEW FLOODWAY CHANNEL. (ALONG THE EDGE OF FIELD WEST OF CHEWELAH CREEK AND ALONG NORTH SIDE OF COLVILLE RIVER APPROXIMATELY AS SHOWN.) EXCAVATED MATERIAL MAY BE PLACED ON LOW AREAS OF ADJACENT FIELDS.

4. FLOOD MANAGEMENT OPERATIONS:
THISN FLOODWAY CHANNEL MUST BE CONSIDERED AS A CIVIL STRUCTURES FOR FLOOD CONTROL. ACCESS AND CLEANOUT OPERATIONS SHOULD BE PRE-APPROVED AS NEEDED WITH RENEWABLE PERMITS WITH GOVERNING AGENCIES AFTER EACH SIGNIFICANT FLOOD EVENT AND MUST BE COORDINATED WITH PROPERTY OWNERS.

5. PURPOSE OF NEW FLOODWAY CHANNEL:
IN ADDITION TO REDUCING IMPACT OF FLOOD CONDITIONS IN THE VALLEY, THE NEW FLOODWAY CHANNEL WILL ALLOW THE LOWER SECTION OF CHEWELAH CREEK TO FLOW FROM ITS TOPOGRAPHY THE WAY IT USED TO BEFORE DEVELOPMENT OF THE VALLEY OCCURRED. THIS SIDE CHANNEL REDUCES FLOOD VOLUME IN THE MAIN CHANNEL BELOW BRANCHING STRUCTURE WITH LOWERED RATE OF AGGRADATION OF THE STREAMBED WHILE ALLOWING FULL SUMMER FLOW VOLUME TO REMAIN IN THE EXISTING CHANNEL. FOR FLOOD CONTROL TREATMENT TO BE EFFECTIVE, FLOODWAY CONSTRUCTION SHOULD EXTEND APPROXIMATELY 11,000 FEET TO MATCH MEANDER CORRIDOR WEST OF SCHMIDLEKOFER ROAD. 100-YEAR FLOOD FLOW IS 11,322 CFS AT THIS LOCATION.

6. EXPECTED PERFORMANCE:
THE PROPOSED COLVILLE RIVER FLOODWAY CHANNEL WILL BE SUBJECT TO CHANNEL MIGRATION PRESSURE AS THE RIVER RE-ESTABLISES ITS MEANDER CORRIDOR.

7. RECOMMENDED FURTHER STUDY
A STUDY OF THE REACH OF RIVER EXTENDING TO SCHMIDLEKOFER ROAD IS RECOMMENDED TO DETERMINE THE MINIMUM SUSTAINABLE MEANDER CORRIDOR WIDTH NEEDED FOR THE RIVER WHICH WILL SIGNIFICANTLY REDUCE IMPACT OF FLOODING ON ADJACENT FIELDS.

JOSEPH LEE CUNNINGHAM
STATE OF WASHINGTON
31293
REGISTERED PROFESSIONAL ENGINEER
09/29/2019

DAY	MONTH	YEAR	NO.	REVISION RECORD	DR	CK	ZONE
23	SEP	19	00	ORIGINAL DRAWING	RC	JC	

PROJECT:

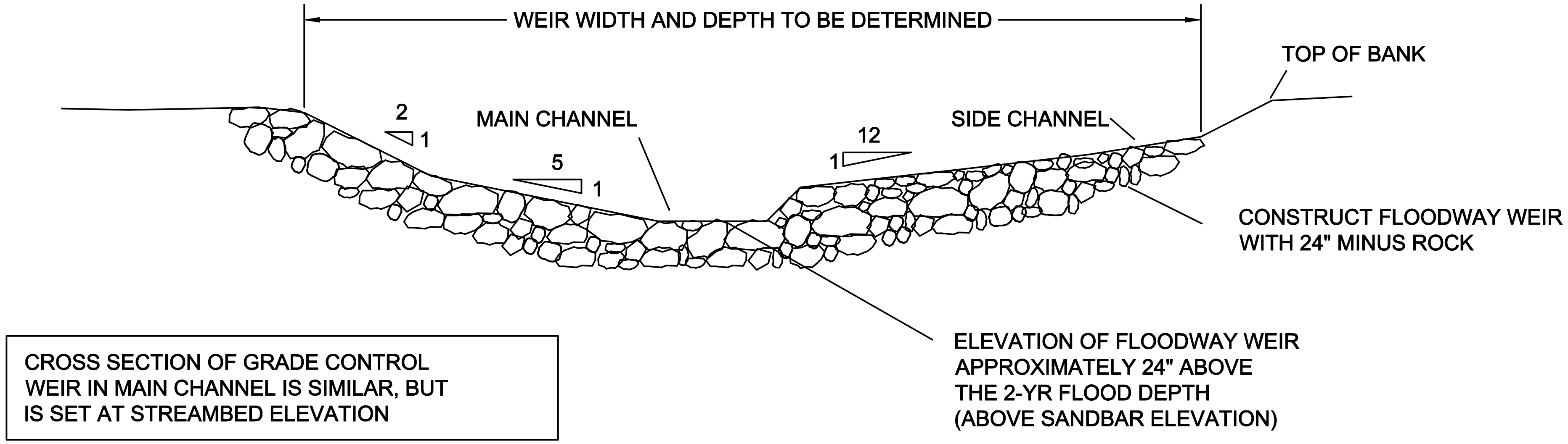
CHEWELAH CREEK-COLVILLE RIVER FLOOD CONTROL - SITE PLAN

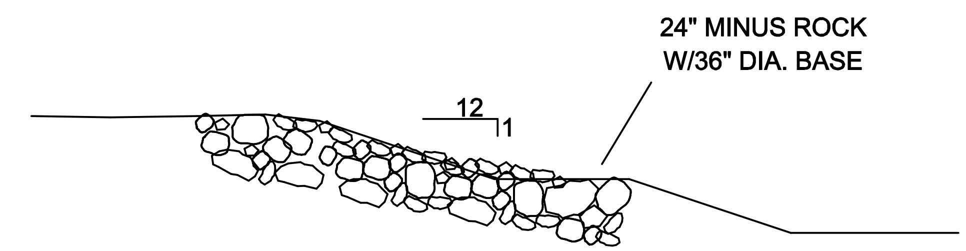
CUNNINGHAM ENGINEERS, INC.
609D GOLD CREEK LOOP, COLVILLE, WA
509-684-5036

DESIGNED J.L. CUNNINGHAM
DRAWN RLC
CHECKED JLC
APPROVED JLC

DRAWING NUMBER
19017A-3

3 OF 10

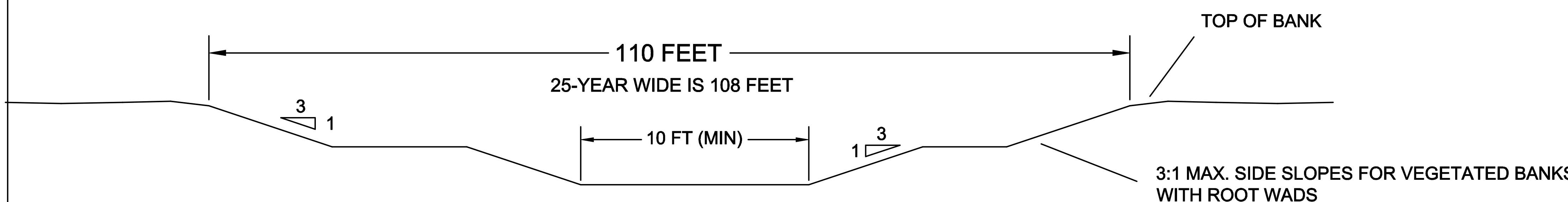




CONCEPTUAL FLOODWAY WEIR STRUCTURE

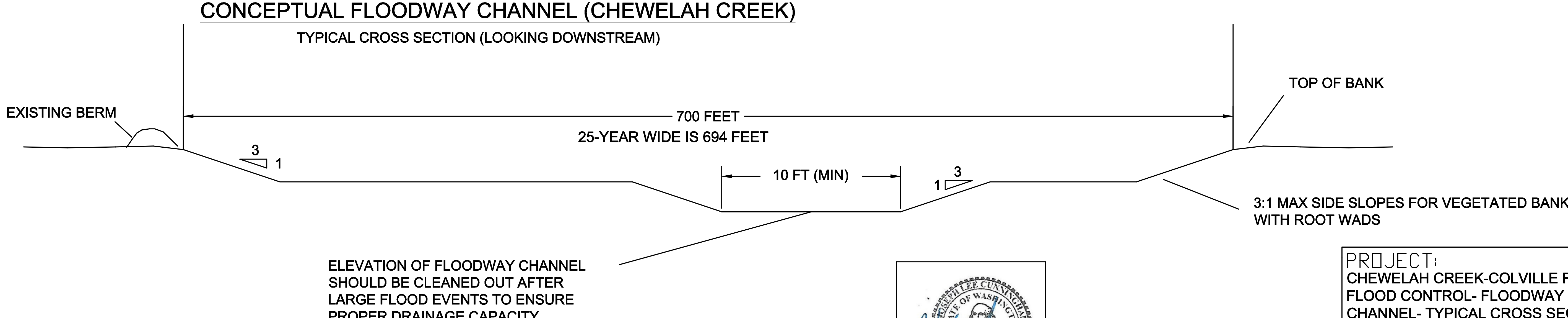
TYPICAL CROSS SECTION

STREAMBARB CONSTRUCTION



CONCEPTUAL FLOODWAY CHANNEL (CHEWELAH CREEK)

TYPICAL CROSS SECTION (LOOKING DOWNSTREAM)



CONCEPTUAL FLOODWAY CHANNEL (COLVILLE RIVER)

TYPICAL CROSS SECTION (LOOKING DOWNSTREAM)

JOSEPH LEE CUNNINGHAM
STATE OF WASHINGTON
31293
REGISTERED PROFESSIONAL ENGINEER
09/29/2019

DAY	MONTH	YEAR	NO.	REVISION RECORD	DR	CK	ZONE
23	SEP	19	00	ORIGINAL DRAWING	RC	JC	

PROJECT:
CHEWELAH CREEK-COLVILLE RIVER
FLOOD CONTROL- FLOODWAY DIVERSION/
CHANNEL- TYPICAL CROSS SECTION FOR
100-YEAR FLOOD

CUNNINGHAM ENGINEERS, INC.
609D GOLD CREEK LOOP, COLVILLE, WA
509-684-5036

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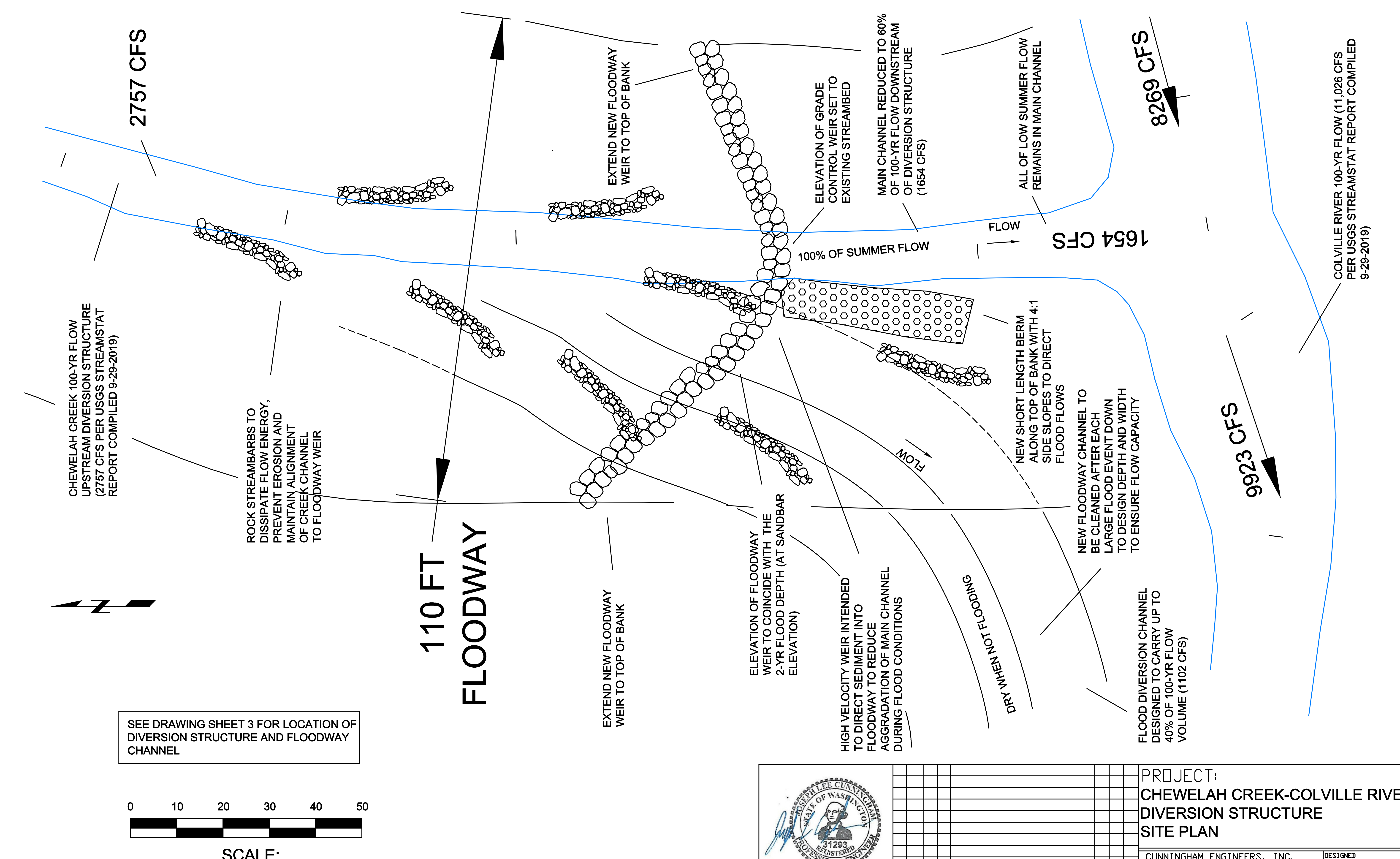
DRAWN RLC
CHECKED JLC
APPROVED JLC

DRAWING NUMBER
19017A-4

4 OF 10



SEE DRAWING SHEET 3 FOR LOCATION OF DIVERSION STRUCTURE AND FLOODWAY CHANNEL

JOSEPH LEE CUNNINGHAM
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31293
REGISTERED PROFESSIONAL ENGINEER
09/29/2019

DAY	MONTH	YEAR	NO.	REVISION RECORD	DR	CK	ZONE
26	SEP	19	00	ORIGINAL DRAWING	RC	JC	

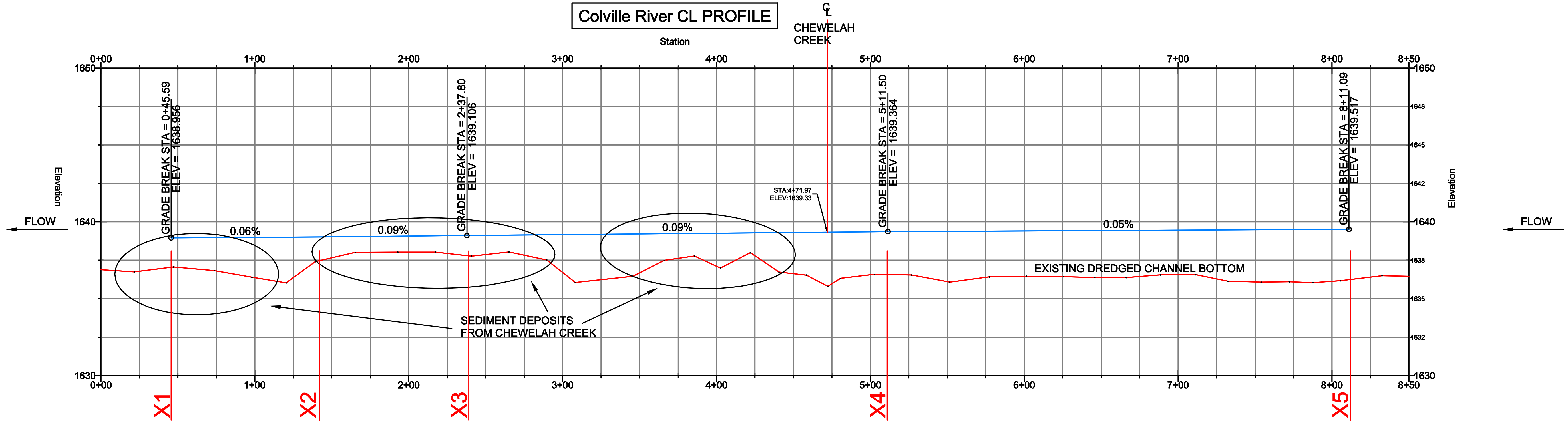
PROJECT:
CHEWELAH CREEK-COLVILLE RIVER DIVERSION STRUCTURE SITE PLAN

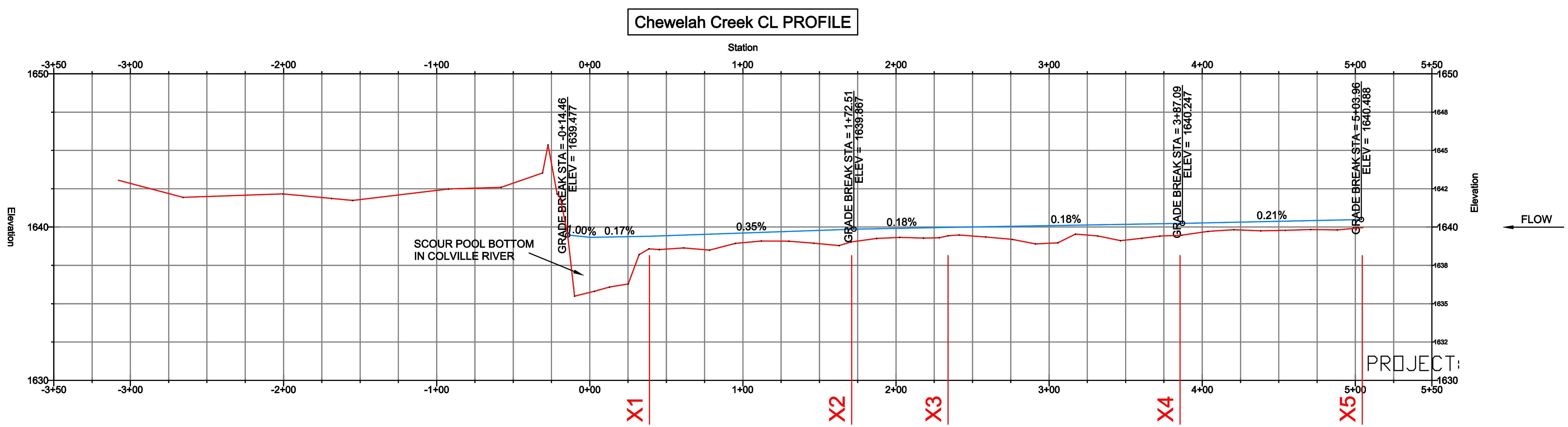
CUNNINGHAM ENGINEERS, INC.
609D GOLD CREEK LOOP, COLVILLE, WA
509-684-5036

DESIGNED J.L. CUNNINGHAM
DRAWN RLC
CHECKED JLC
APPROVED JLC

DRAWING NUMBER 19017A-5

5 OF 10





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SCALE:

09/29/2019

DAY	MONTH	YEAR	NO.	REVISION RECORD	BY	CK	ZONE
23	SEP	19	00	ORIGINAL DRAWING	RC	JC	

PROJECT:

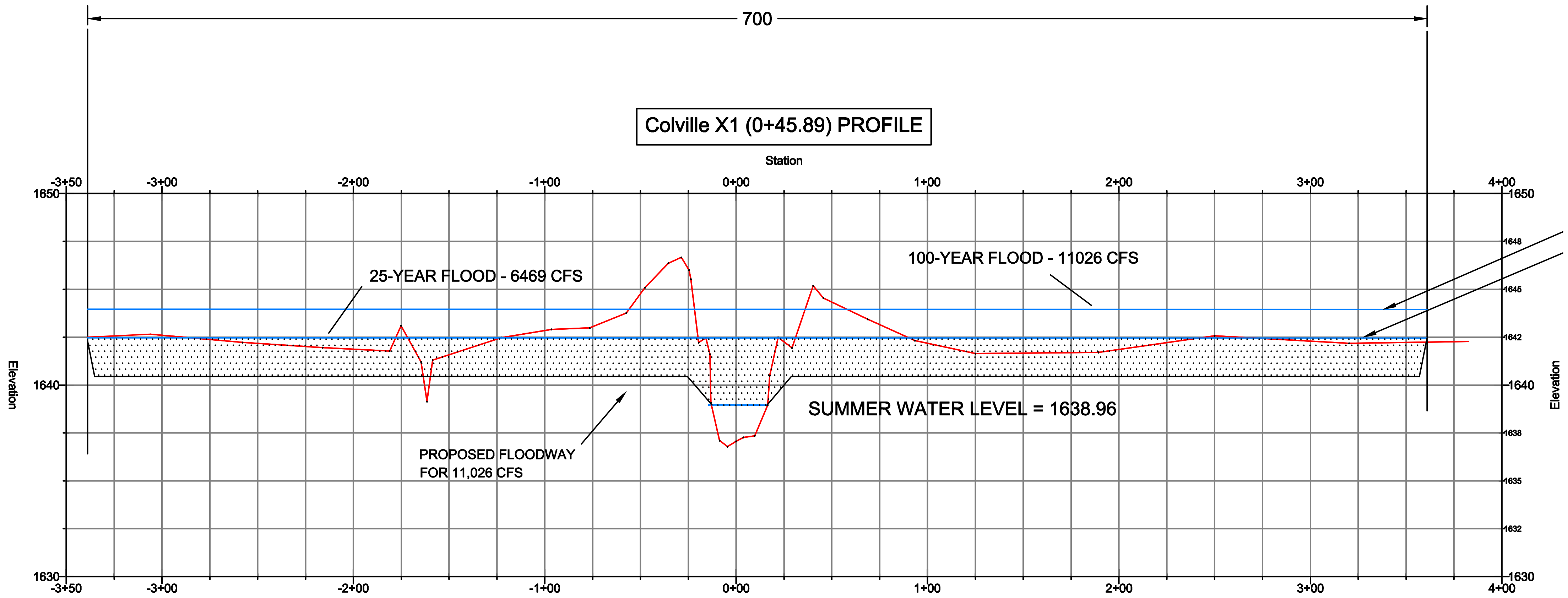
CHEWELAH CREEK-COLVILLE RIVER FLOOD CONTROL - CENTERLINE PROFILES

CUNNINGHAM ENGINEERS, INC.
6090 GOLD CREEK LOOP, COLVILLE, WA
509-684-5036

DESIGNED J.L. CUNNINGHAM
DRAWN RLC
CHECKED JLC
APPROVED JLC

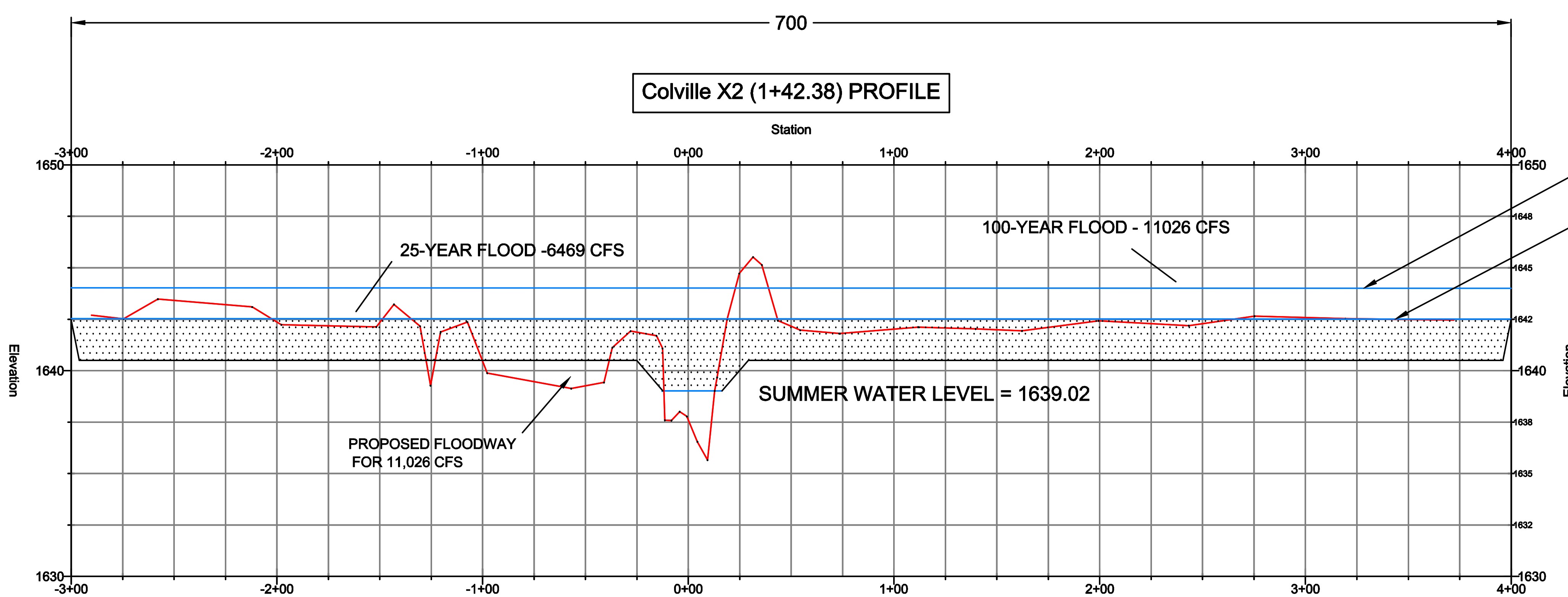
DRAWING NUMBER 19017A-6

6 OF 10

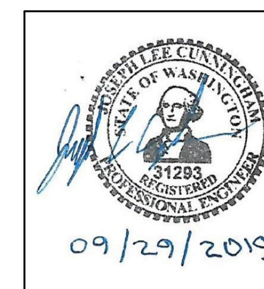


5 FT DEPTH @ 700 FT WIDTH
3.5 FT DEPTH @ 1400 FT WIDTH
(3.5 FT DEPTH FOR 25-YEAR FLOOD)

PROPOSED FLOODWAY X-SECTIONS SHOWN ARE BASED ON TOPOGRAPHY. ACTUAL SIZE AND LOCATIONS OF FLOODWAYS TO BE DETERMINED WITH ADJACENT LAND OWNERS. FLOODWAYS ARE LESS DEEP THAN COLVILLE RIVER.



5 FT DEPTH @ 700 FT WIDTH
3.5 FT DEPTH @ 1400 FT WIDTH
(3.5 FT DEPTH & 700 FT WIDTH
FOR 25-YEAR FLOOD)



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SCALE:

PROJECT:

COLVILLE RIVER FLOOD CONTROL
CROSS SECTIONS X1 & X2

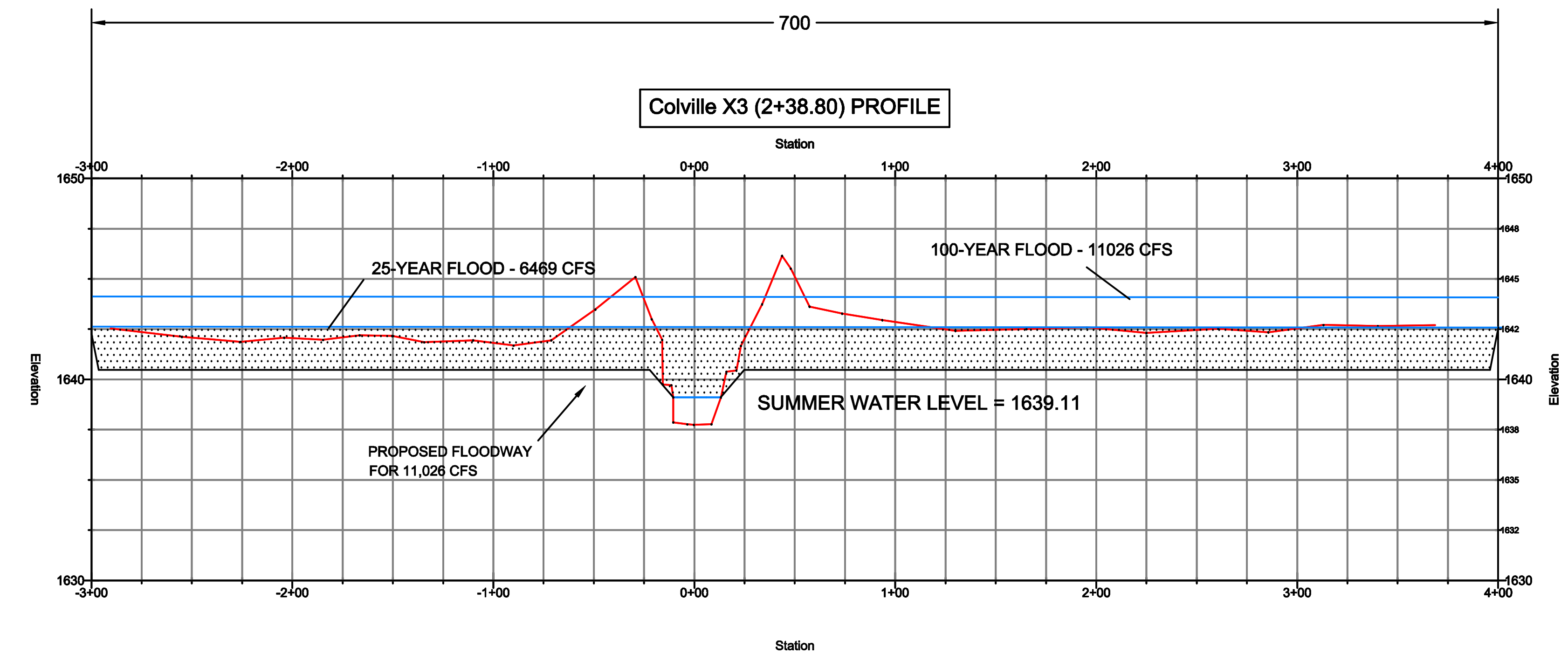
23	SEP	19	00	ORIGINAL DRAWING	RC	JC		
DAY	MONTH	YEAR	NO.	REVISION RECORD	BR	CK	ZONE	

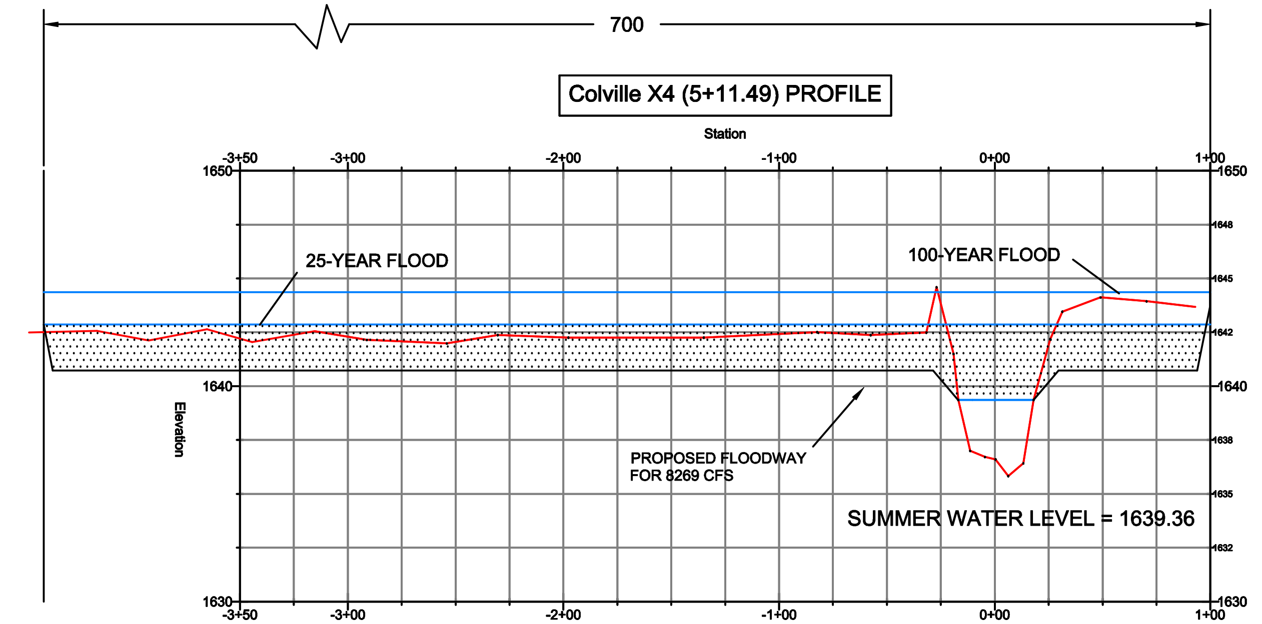
CUNNINGHAM ENGINEERS, INC.
609D GOLD CREEK LOOP, COLVILLE, WA
509-684-5036

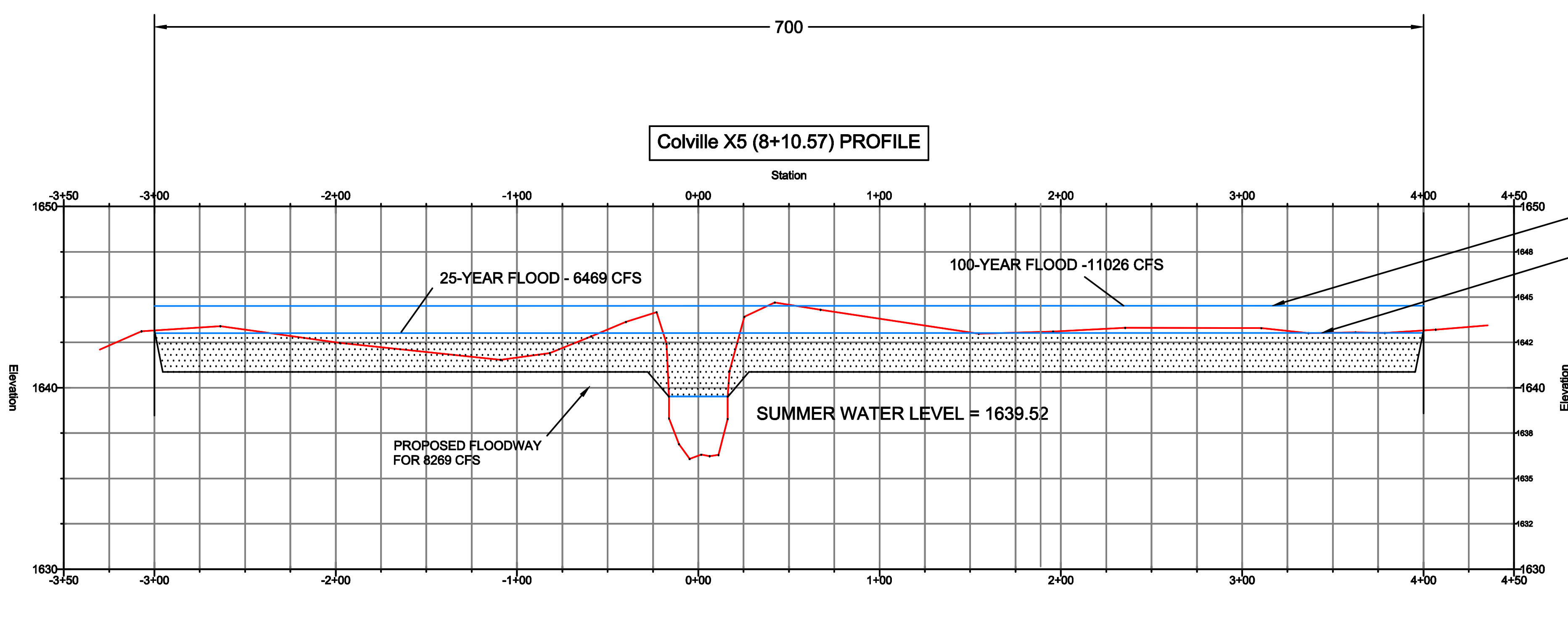
DESIGNED J.L. CUNNINGHAM
DRAWN RLC
CHECKED JLC
APPROVED JLC

DRAWING NUMBER
19017A-7

7 OF 10



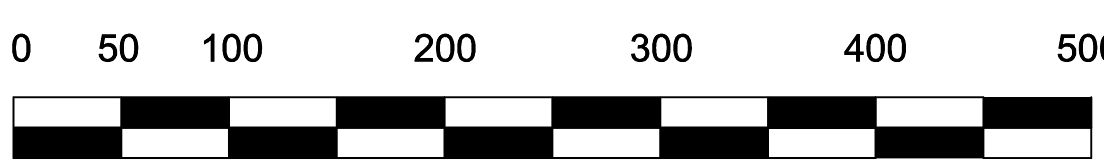




5 FT DEPTH @ 700 FT WIDTH
3.5 FT DEPTH @ 1400 FT WIDTH
(3.5 FT DEPTH & 700 FT WIDTH
FOR 25-YEAR FLOOD)

TYPICAL

PROPOSED FLOODWAY X-SECTIONS SHOWN ARE BASED ON TOPOGRAPHY. ACTUAL SIZE AND LOCATIONS OF FLOODWAYS TO BE DETERMINED WITH ADJACENT LAND OWNERS. FLOODWAYS ARE LESS DEEP THAN COLVILLE RIVER.



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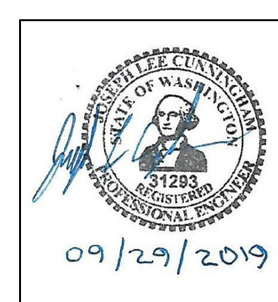


DAY	MONTH	YEAR	NO.	REVISION RECORD	DR	CK	ZONE
23	SEP	19	00	ORIGINAL DRAWING	RC	JC	

PROJECT:

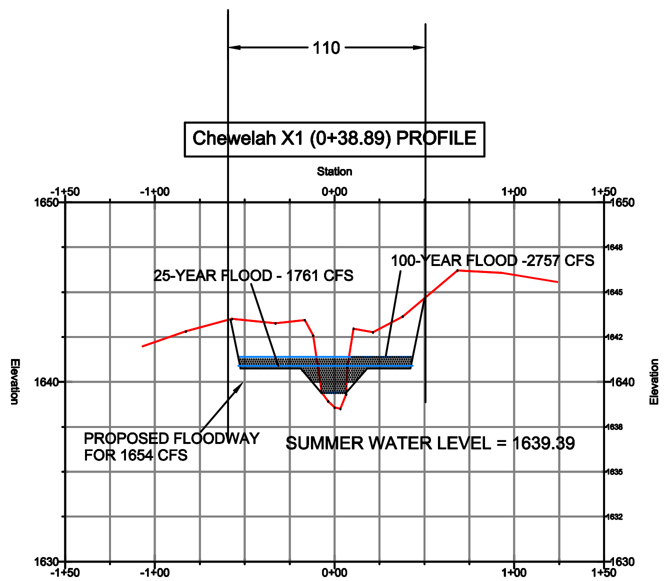
COLVILLE RIVER FLOOD CONTROL
CROSS SECTIONS X3, X4 & X5

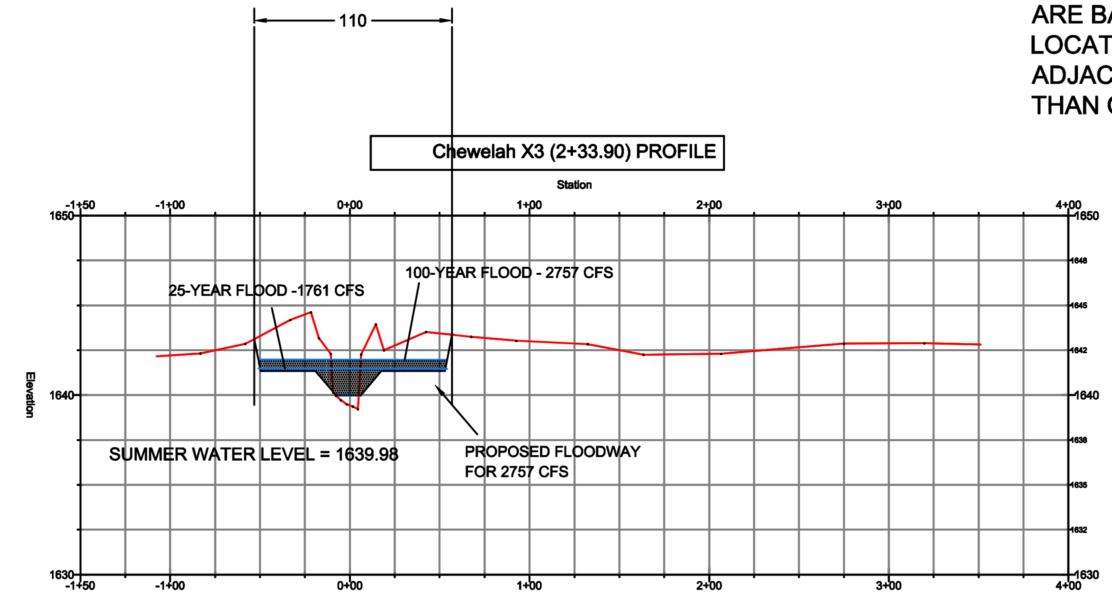
CUNNINGHAM ENGINEERS, INC.
609D GOLD CREEK LOOP, COLVILLE, WA
509-684-5036

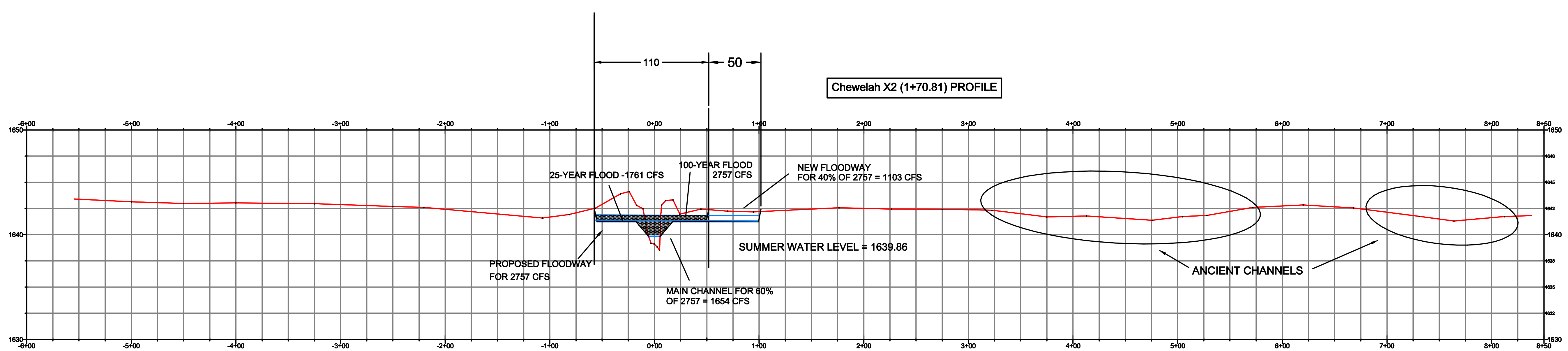
DRAWING NUMBER
19017A-8
8 OF 9

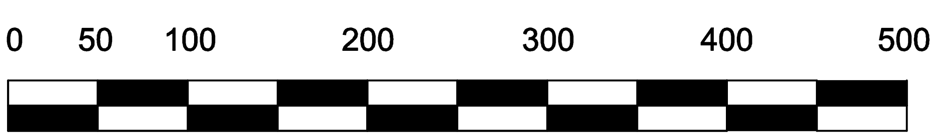
DESIGNED J.L. CUNNINGHAM
DRAWN RLC
CHECKED JLC
APPROVED JLC

PROPOSED FLOODWAY X-SECTIONS SHOWN ARE BASED ON TOPOGRAPHY. ACTUAL SIZE AND LOCATIONS OF FLOODWAYS TO BE DETERMINED WITH ADJACENT LAND OWNERS. FLOODWAYS ARE LESS DEEP THAN CHEWELAH CREEK









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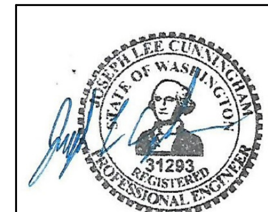


09/29/2019

DAY	MONTH	YEAR	NO.	REVISION RECORD	DR	CK	ZONE
23	SEP	19	00	ORIGINAL DRAWING	RC	JC	

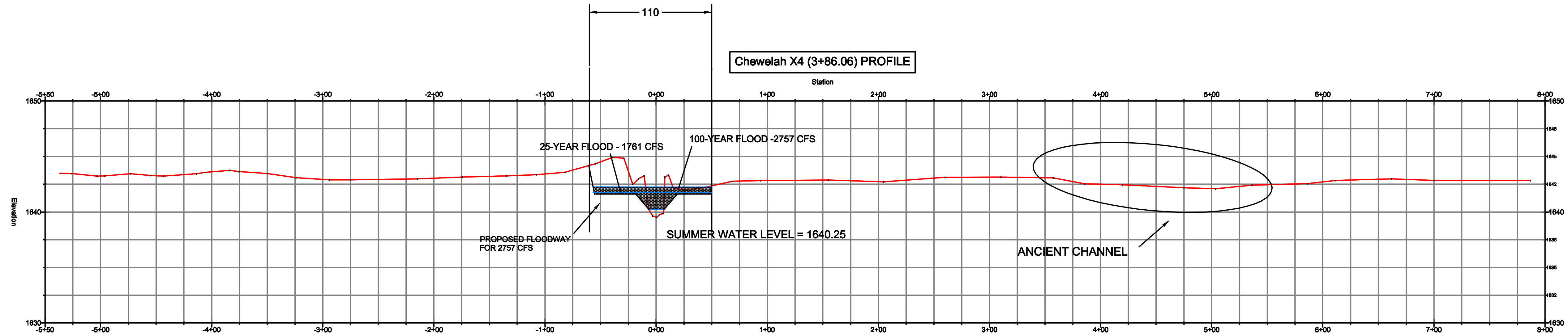
PROJECT:

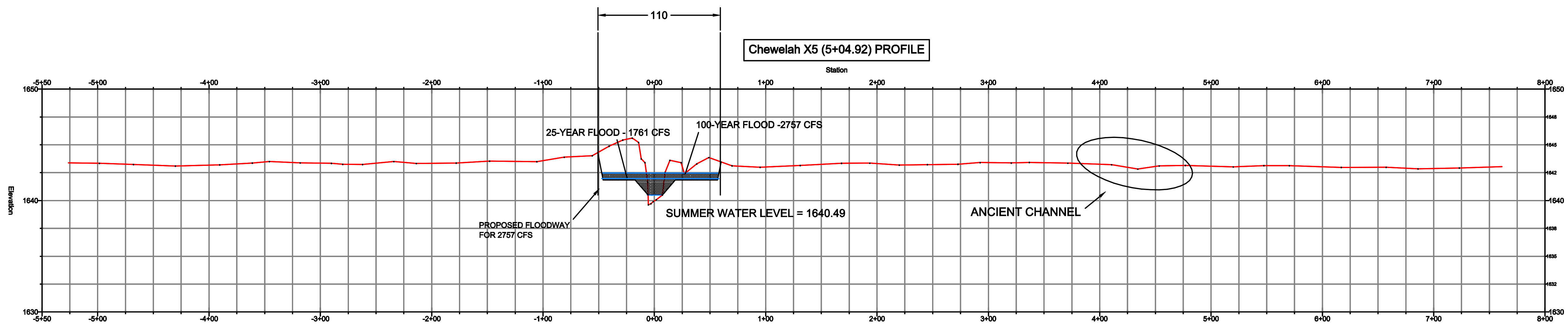
CHEWELAH CREEK FLOOD CONTROL
CROSS SECTIONS X1, X2, & X3

CUNNINGHAM ENGINEERS, INC.
609D GOLD CREEK LOOP, COLVILLE, WA
509-684-5036

DRAWING NUMBER
19017A-9
9 OF 10

DESIGNED J. L. CUNNINGHAM
DRAWN RLC
CHECKED JLC
APPROVED JLC





PROPOSED FLOODWAY X-SECTIONS SHOWN ARE BASED ON TOPOGRAPHY. ACTUAL SIZE AND LOCATIONS OF FLOODWAYS TO BE DETERMINED WITH ADJACENT LAND OWNERS. FLOODWAYS ARE LESS DEEP THAN CHEWELAH CREEK

0 50 100 200 300 400 500

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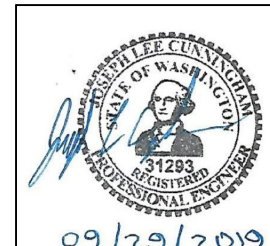

DAY	MONTH	YEAR	NO.	REVISION RECORD	DR	CK	ZONE
23	SEP	19	00	ORIGINAL DRAWING	RC	JC	

PROJECT:

CHEWELAH CREEK FLOOD CONTROL
CROSS SECTIONS X4 & X5

CUNNINGHAM ENGINEERS, INC.
609D GOLD CREEK LOOP, COLVILLE, WA
509-684-5036

DESIGNED J.L. CUNNINGHAM
DRAWN RLC
CHECKED JLC
APPROVED JLC

DRAWING NUMBER
19017A-10 10 OF 10

APPENDIX E

WRIA 59 FEASIBILITY PROJECT – TECHNCIAL MEMORANDUM ON REIDEL CREEK INFILTRATION PROJECT FEASIBILITY

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Cell: 509-953-9395
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TECHNICAL MEMORANDUM

To: **WRIA 59 Watershed Management Partnership (WMP), WRIA 59 Water Resources Management Board (Board) and Stevens County Land Services Planning Department**

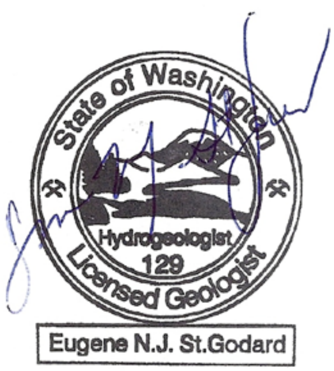
From: **Eugene N.J. St.Godard, P.G., L.Hg., CWRE**
Principal Hydrogeologist/Owner
Water & Natural Resource Group, Inc.

Date: **October 31, 2019**

Project No. **045-007-09 – WRIA 59 RCW 90.94 Feasibility Studies**

Subject: **Technical Memorandum on Reidel Creek Infiltration Project Feasibility**

SIGNATURES: This Technical Memorandum and Hydrogeological interpretations were made by Eugene N.J. St.Godard, a licensed geologist/hydrogeologist (L.Hg. #129) in the State of Washington.



Date Signed: - October 31, 2019

1.0 INTRODUCTION

Over the past two years, in response to the adoption of RCW 90.94.020, Stevens County, in conjunction with the WRIA 59 Watershed Management Partnership (WMP) and WRIA 59 Water Resource Management Board (Board) is developing an Addendum to the Watershed Plan to evaluate the impact of future domestic permit-exempt wells within WRIA 59. In May 2019, the WRIA 59 Board completed its assessment on estimating future domestic well impacts in each of the subbasins within the WRIA (WNR Group, May 31, 2019), and subsequently prioritized the basins according to consumptive use impacts. As a result of this analysis, numerous projects were developed within priority subbasins which could off-set the future estimated domestic consumptive use, and result in a Net Ecological Benefit (NEB) to the watershed (Figure 1). These projects were ranked high or medium in order to prioritize the potential future development of the project within the WRIA 59 Watershed Plan Addendum. This addendum will supplement the most recently approved WRIA 59 Watershed Plan completed in 2007 (Golder, 2007) and Detailed Implementation Plan (Golder, 2006).

The Board developed a conceptual project within Reidel Creek, a tributary to Haller Creek, that could off-set the estimated consumptive use of future domestic exempt wells. The project is identified as Project #7 within the WRIA 59 Boards developed list of proposed projects. The Board's estimate of potential future domestic well consumptive use was estimated at 30.8 acre-feet through 2038 for the Haller Creek subbasin (WNR Group, May 2019). The proposed project is situated just above the confluence of Reidel Creek and Haller Creek in the southern part of the Haller Creek subbasin (Figure 2). It is located on Washington State Department of Natural Resource (DNR) property in the W½ NW¼ Section 19, T.34N., R.39E.W.M. (Figure 3).

2.0 CONCEPTUAL PROJECT AND SCOPE

Figure 4 presents the preliminary conceptual model for development of an infiltration project within the Reidel Creek drainage. This project was developed in consultation with representatives of the DNR, and was outlined as a potential priority project during the WRIA 59 Watershed Plan Addendum development. The proposed project would pump water from the creek and would convey the water into infiltration trenches in the old gravel pit. Water would then naturally infiltrate into the substrate and eventually return to base flow in Haller creek during low flow periods.

In July 2019, Ecology notified the WRIA 59 Board that potential funding may be available to conduct Feasibility Studies on potential priority projects within the watershed. After consultation with the WRIA 59 Board, a request was submitted to Ecology to conduct a feasibility project on the Reidel Creek Infiltration Project. This initial feasibility screening project was recommended to determine if hydrogeologic conditions beneath the gravel pit are conducive to the proposed project which would flatten the hydrograph some and capture the excessive runoff. Funding was approved in late July 2019 to conduct the following at the Reidel Creek project:

1) Conduct a drone survey of the site to develop a topographic map which could be used for a conceptual design at the site. The survey will be conducted with a drone to produce a 2-foot topographic contour map;
2) Dill two exploratory holes at the site to decipher geologic conditions and install piezometers if groundwater is encountered. Tasks to include collecting soil samples and logging the geologic conditions.
3) Conduct a percolation test to estimate hydraulic conductivity of the soils at the site;
4) Developed preliminary engineering design and cost estimates to develop a project at the site.

3.0 SITE FEASIBILITY ASSESMENT

The Water & Natural Resource (WNR) Group, Inc. was retained by Stevens County, on behalf of the WRIA 59 Board, to conduct a hydrogeologic investigation of the Reidel Creek property. Tasks completed for this analysis included:

1) Contracting a licensed surveyor to develop a topographic map of the project area utilizing a drone;
2) Contracting a drilling company and overseeing the completion of two exploratory wells; and
3) Completing a percolation test to estimate the hydraulic continuity of the subsurface soils.

3.1 Topographic Survey

Mid-Mountain Survey of Republic, Washington was retained to develop a topographic map of the site. Measurement methods used for surveying on the project included Conventional Total Stations, RTK GPS, and UAV photogrammetry. Each site uses the Washington State Plane North (NAD83/11) coordinate system, with elevations derived from NAVD88. This Reidel Creek Infiltration Project's control was established by post processing static GPS data with the NGS OPUS processing service.

UAV photogrammetry included setting photo targets / ground control points (GCPs) at the site and surveying them with RTK GPS. Then a multirotor UAV was flown between 200 and 300 feet above ground level (AGL) to capture approximately 1200, 20-megapixel, digital photos of the sites. The photos and GCPs where then processed to produce orthophotos (aerial photos) and digital surface models (DSM), which provides an elevation for each pixel of the orthophoto. Finally, the orthophoto and DSM were used to extract ground points and break lines to create a topographic surface and contour lines suitable for civil engineering design.

The Reidel Creek Infiltration project consisted of producing topographic surveys of approximately 20 acres, with 1-foot contour intervals, and surveying creek profiles and cross-sections that fell outside the boundary of the topographic survey. Additionally, elevations and locations of the exploratory wells were surveyed at the site. Figure 5 presents an aerial photo of the site as developed from the drone survey, with the associated 1-foot contours shown. Surveyor maps, surveyed stream profiles, and cross-sections are attached to this Memorandum as Attachment 1.

3.2 Subsurface Exploration

The WNR Group retained Fogle Drilling of Colville, Washington to complete the drilling and well installation tasks for the feasibility analysis. The field exploration program conducted for this study consisted of advancing two air rotary borings to depths of 55 feet (RC-1) and 50 feet (RC-2) below the existing site grade. Both borings were completed to install monitoring wells. Locations of the explorations are presented on Figure 3. These locations were measured in the field using a handheld Garmin GPS unit to record latitude and longitude. Upon completion of the well installation, an Ecology Well I.D. tag was placed on each of the wells: BMH-599 for RC-1, and BMH-600 for RC-2.

Prior to initiating field drilling activities, Fogle Drilling submitted the required Notice of Intent permits with the Washington State Department of Ecology. The borings were drilled on August 20 and 21, 2019. Two borings were advanced utilizing a 6-inch inside diameter steel casing with a ReichDrill T-650WII truck mounted drill. Borings were advanced using a 925 cfm @ 350 psi compressor mounted on the rig. During the drilling process, samples were generally obtained at 5 feet depth intervals. Soil samples were obtained using a screened collection tool, collecting the cuttings from the air effluent which discharges the cuttings from the annulus of the drill hole. The borings were continuously observed and logged by an experienced licensed geologist from our firm.

Soils encountered in RC-1, which is located in the southern area of the gravel pit, primarily consisted of varying amounts of Medium-coarse Sands with fine-sands and gravels. A well sorted gravel interval was encountered from 20 to 25 feet below grade. The remaining soil column primarily consisted of the medium-coarse Sand. A geologic log of the soils inspected by the site geologist is included in Figure 6. These soils have a high permeable. Groundwater was encountered at a depth of approximately 50 feet bgs at the time of drilling. Drilling was terminated at a depth of 55.3 feet below grade within the saturated medium-coarse Sand of the valley unconfined aquifer.

Soils encountered in RC-2, which is located in the northern area of the gravel pit, primarily consisted of medium-coarse Sands with some gravel to the full depths explored of 50 feet. Groundwater was encountered at a depth of approximately 47 feet at time of drilling. A geologic log of the soils inspected by the site geologist in RC-2 is included in Figure 7.

Utilizing the Washington State DNR Geologic Maps (1991), and geologic map was developed for the area of the site and is presented in Figure 8. As shown on Figure 8, the unconsolidated sediments (Qs) are located in the Reidel Creek drainage. Near the mouth of Reidel Creek, the creek appears to be incised over some Ordovician metasedimentary bedrock. This may act to restrict groundwater flow through the outlet of Reidel Creek to the Haller Creek drainage. As shown on the geologic map in Figure 7, the unconsolidated sands and gravels are mapped to the east of the project site, all the way to the Haller Creek drainage. This may be the preferred direction of groundwater flow in the area. As a result of this, diversion of water from Reidel Creek, which is losing to the aquifer at the site, to recharge the aquifer at the site may then flow in an easterly direction towards the Haller Creek drainage.

3.3 Groundwater Well Installation

The two borings were completed for the purpose of installing site piezometers (monitoring wells). The air rotary exploration was advanced into the substrate until the desired depth was achieved. Schedule 40 PVC well casing was installed inside the steel casing, with blank casing to approximately the ground surface followed by 10 feet of screen (with 0.020 slots) in wells RC-1 and RC-2. Well RC-1 was installed with 10 feet of 0.020 slot screen from 44.5 to 54.5 feet below the ground surface, with the remainder of the well consisting of blank casing. Well RC-2 was installed with 10 feet of 0.020 slot screen from 39.8 to 49.8 feet below the ground surface, with the remainder of the well consisting of blank casing. The steel casing was then filled periodically with a select sand filter pack and slowly withdrawn to allow the sand to surround the well screen and fill the annulus of the boring to approximately two to three feet above the top of the well screen. A seal consisting of bentonite was then placed in the hole to a depth approximately 2 feet below the ground surface. A cement seal was then placed above the bentonite seal flush with the existing site grade. Each well was completed by installing a locking cap in the top of the blank PVC pipe and cementing in a flush mounted steel well monument.

A summary of the construction details of the two piezometers are presented in Figures 6 and 7. After installation, the well was developed using a PVC bailer. At the end of development, the initial estimate of yield from the aquifer was that it appeared to be capable of yielding greater than 50 gpm. The top of casing elevation of the two piezometers was surveyed in by Mid-Mountain surveyors and is summarized in Table 1. Several depths to water measurements were collected after the well was surveyed and are presented on Figures 6 and 7.

TABLE 1: WELL SURVEY DATA

		NAVD88 Elevation		*State Plane (WA83-NF)*		*WGS84*	
Site	*Well Name*	*PVC (Top)*	*Concrete*	*Northing (Y)*	*Easting (X)*	*Latitude*	*Longitude*
Reidel Creek	RC-1	**2104.64**	2104.70	535,849.72	2,339,573.31	48°25'59.18271" N	117°57'09.74864" W
Reidel Creek	RC-2	**2101.43**	2101.55	535,968.63	2,339,392.02	48°26'00.42225" N	117°57'12.36915" W

3.4 Groundwater Data Collection – Relationship to Reidel Creek

After installation of the piezometer at the project site on August 20 and 21, an additional groundwater water level measurement was collected on September 4, 2019. Table 2 summarizes the measurements collected, and the associated groundwater surface elevation. This measurement was collected to determine a relative relationship of the groundwater table to the creek within the Reidel Creek drainage.

TABLE 2: SUMMARY OF GROUNDWATER MEASUREMENTS

Well	Date	Casing Elevation	DTW	GWE
RC-1	9/4/2019	2104.64	49.62	2055.02
RC-2	9/4/2019	2101.43	46.10	2055.33
Diversion		Surveyed Creek Elevation		2089.50
Reidel Creek		Approximate Creek Elevation Southwest of Site		2070.00

Direction of groundwater flow is difficult to predict without three elevation points. This feasibility analysis installed two piezometers at the site. As shown in Table 2, the groundwater beneath the gravel pit is relatively flat with a slight gradient to the south or southeast. In general, the aquifer is located at an approximate elevation of 2055 feet amsl. As shown on Table 2, the proposed diversion point located northwest of the site was surveyed in at an elevation of 2089.5 feet amsl. The creek traverses the gravel pit west of Reidel Creek Road, and at a point located southwest of RC-1 (that area near the southern extent of the gravel pit), the creek is at an approximate elevation of 2070 feet amsl. If creek elevations are compared to the groundwater elevation, it appears to show that the creek is losing water to the aquifer (creek water elevations are higher in elevation than groundwater). For reference, the approximate elevation of the creek water at the confluence of Riedel and Haller Creek is approximately 2050 feet amsl.

3.5 Percolation Testing of Subsurface Soils

In order to test soil conditions at the site, a percolation test was conducted. This test included the installation of a 6-inch diameter, 5-foot-long pipe, buried to a depth of three feet below grade. The pipe was installed in a trench excavation, and placed on top of undisturbed soils, then backfilled. Soil in the trench was compacted with the small excavator to assure a good seal with the bottom annulus of the pipe to the native soils.

The percolation pipe was installed 20 feet north of RC-1 (see Figure 9). On September 4, 2019 the WNR Group retained Fogle Drilling and their Ford L8000 2500-gallon water truck (with pump) to conduct a percolation test at the site. An in-line flow meter was installed to the effluent hose and the starting reading of 422374 gallons was recorded. The meter also measured flow in gpm, which was recorded periodically during the test.

Throughout the test, groundwater measurements were collected in RC-1 to monitor if the injected water would mound the groundwater table. Prior to conducting the test, the depth to groundwater was recorded at 49.62 feet below top of casing. The groundwater elevation did not change throughout the period of the percolation test.

Prior to conducting the test, approximately 250 gallons of water from the water truck was discharged to the pipe in order to saturate the soils.

The test was initiated at a flow rate of 12 gpm. After 4-minutes, no water was accumulating in bottom of the 6-inch pipe, so the flow rate was increased to 20 gpm. At this rate, there appeared to be a slight accumalation of water in the bottom of the pipe. This rate was maintained until 40 minutes, at which time the rate was increased again to 25 gpm. After 60 minutes, the 6-inch pipe was still not filling with water and the substrate soils had no problems infiltrating the water at this rate.

At 60-minutes, the test was adjusted to monitor the infiltration rate under a steady state condition (maintaining the same water level in the 6-inch percolation pipe. The flow rate was increased to 36 gpm, at which time the pipe began to fill up. Once the pipe was filled to a mark within the pipe, the flow was adjusted to approximately 28 gpm to maintain that water level. This flow rate was maintained to the termination of the test at 90 minutes. Depth to water in RC-1 was also continuously monitored during the test. No rise or drop in groundwater elevation occurred in RC-1 during the duration of the test.

As shown in Table 3, the subsurface soils at the Reidel Creek gravel pit appear to be capable of infiltrating 28 gpm under saturated conditions. At the cessation of pumping at 90 minutes, the water level in the percolation pipe was monitored to determine how long the 5-foot water column in the 6-inch pipe would percolate into the subsurface (falling head test). The 5-foot water column in the pipe (approximately 5.11 gallons) infiltrated into the subsurface soils in 14.5 seconds. The pipe was refilled with water for a second time, and once again infiltrated into the substrate in 14.5 seconds (0.35 gallons per second).

Table 3: Summary of Percolation Test Data

Time since Test Started (min)	GPM in Perc Pipe	DTW (ft) in RC-1 from TOC
0	0	49.62
2	12	49.62
4	12	49.62
6	20	49.62
10	20	49.62
15	20	49.62
20	24	49.62
25	20	49.62
30	22	49.62
40	25	49.62
45	23	49.62
55	24	49.62
60	36	49.62
62	28	49.62
63	26	49.62
65	26	49.62
70	27	49.62
75	28	49.62
80	28	49.62
90	28	49.62

4.0 GEOLOGIC/HYDROGEOLOGIC CONCEPTUAL MODEL

The WNR Group reviewed the Washington Division of Geology and Earth Resources geologic map for northeastern Washington (1991). The geologic map revealed that the subject site is underlain by Pleistocene Age glacial and alluvial sands and gravel deposited over bedrock in the Reidel Creek area. Bedrock in the highlands above the valley floors consists of Ordovician Age metasedimentary (shale/slate) rocks and Ordovician/Carboniferous age dolomites. Figure 8 presents a geologic map of the project site area.

Data was reviewed of aquifer characteristics on well logs in the vicinity of the Site. Only one well log is located within one-mile of the site. Based on geologic exploratory results at the site, the Reidel Creek valley appears to be filled with sands and gravels associated with glacial and alluvial deposits which can yield high amounts of water. Groundwater in the shallow unconfined aquifer beneath the site was found at depths of approximately 50 feet below grade at the site, and appears to have yields greater than 50 gpm.

Groundwater is inferred to be recharged in the highlands of Reidel Creek by snow pack melt and precipitation and flows through the shallow unconfined aquifers and directly through the surface waters of Riedel Creek. Near the gravel pit site, the creek appears to be losing surface water to the unconfined aquifer. The surface water in the creek and the shallow aquifer appears to be restricted at the mouth of Reidel Creek due to near surface bedrock. Groundwater flow beneath the site appears flow from beneath the Reidel Creek drainage at the site, then flows in an easterly direction, where it eventually reenters Haller Creek in the northern area of Section 19 where bedrock appears to be incised by Haller Creek (see Figure 8). This would effectively cause groundwater towards the ground surface, causing Haller Creek to be a gaining reach (groundwater recharging surface water).

As shown on the geologic map in Figure 8, it can be inferred that the shallow aquifer is generally flowing in an easterly direction, from the Reidel Creek drainage to the Haller Creek drainage, and does not necessarily follow the same direction in the lower portion of the drainage as Reidel Creek, northwest to southeast. The shallow unconfined aquifer appears to be in direct hydraulic connection with the creeks, with the lower portions of Reidel Creek losing water to the aquifer, then the aquifer recharging Haller Creek in the southern portion of Section 18.

In order for the project to effectively retime the groundwater recharge during low flow periods in Haller Creek, a conceptual estimate of groundwater flow was developed. It is inferred that infiltrated surface water at the project site can percolate to the substrate to the groundwater table within hours-days. The groundwater table beneath the site appears to be generally flat. Travel distance in the groundwater prior to re-entering the lower portion of Reidel Creek is approximately 200 feet. If the groundwater is flowing to Haller Creek, the distance is estimated at 750 to 1000 feet.

Groundwater velocity was then calculated by utilizing the Darcy formula as shown below:

$V=(k*i)/n$

Where:
V = velocity in feet/day (ft/day)
K = hydraulic conductivity (ft/day)
i = hydraulic gradient (ft/ft)
n = effective porosity (percent)

Assuming an average effective porosity of 25 percent and a K value of 84 feet per day (average value of Upper Aquifer in WRIA 59 from Ely and Kahle, 2004) or 100 feet per day (ft/day) (low value from Driscoll, 1986 for sand and gravel), a groundwater gradient of 0.01 (estimated from site piezometers), a groundwater velocity of approximately 4 ft/day is estimated. This would result in an estimated travel time in the groundwater from the infiltration trench to Reidel Creek of approximately 50 days, and from the infiltration trenches to Haller Creek of 180 days. These are preliminary estimates, and should be further refined with additional data.

5.0 DESIGN OF PROPOSED MITIGATION PROJECT

The WNR Group retained Cunningham Engineers of Colville, Washington to assist the preliminary design of a diversion and infiltration mitigation project. The proposed project would divert a minimum of 31 acre-feet each year from Reidel Creek to infiltrate into the shallow aquifer. The recharged aquifer would then convey the water to the southeast where it would eventually recharge Haller Creek. The preliminary engineering design for the Reidel Creek Infiltration Project is included in this Memorandum as Attachment 2.

The following is a summary of the proposed project for the Reidel Creek gravel pit:

- Water will be diverted from Reidel Creek by a bank of six to eight-foot-deep stilling wells located approximately 300-feet northwest of the infiltration trench;
- The system is designed for a daily flow of 86,400 gallons per day at a rate of 80 gpm;
- Diversion pumps are to run 9 hours per day for a total operation time of 3 months (from mid March through mid May);
- The pump system is designed if increased flows from 80 gpm to 160 gpm are needed;
- A maximum of 83-acre feet could be diverted if the period of operation is increased to 4 months with a daily run time of 18 hours.

The Reidel Creek infiltration project site hydrogeologic conditions are amenable to an infiltration project. The primary limitation at the site will be the available water and flow conditions at the diversion point. The system could be designed to divert up to the maximum available water.

6.0 NEB INTERPRETATION

There is no requirement in RCW 90.94 that the proposed mitigation strategy for the domestic exempt consumptive use be offset all the impacts in time and in place at the same location of the domestic well. Mitigation strategies are focused towards a subbasin and or basin wide mitigation strategy that offsets the consumptive use at the watershed gauge. For NEB evaluation purposes, the closer in place and time of the mitigation strategies, to the proposed future domestic well use, the better ecological benefit is observed in the subbasin.

As shown in the Technical Memorandum for estimating future domestic groundwater consumptive use (WNR Group, 2019), the Haller Creek subbasin will require approximately 30.8 acre-feet of mitigation per year at the end of the 20-year planning period (2038). As discussed in the consumptive use memo, it appears the majority of the impacts will occur in the lower portions of Haller Creek, with the majority of the upper portions of the basin being public lands, and not likely to develop.

From 2007 through 2014, the WRIA 59 planning unit collected stream flow data within the subbasins throughout the watershed. This previous stream flow study completed by the WRIA 59 planning unit (WNR Group, April 17, 2015) showed that over eight years of monitoring of Haller Creek (2007 – 2014) showed that in general, flows above the agreed upon flow were present from December through June. This is also the time period when domestic well use is at its lowest. In addition, the proposed period to divert available waters for this mitigation project is in the latter half of this time period. Therefore, the proposed mitigation project to divert spring melt waters and infiltrate for base flow back to the creek during low flow periods is a feasible alternative.

The proposed project in Reidel Creek is designed to capture excess flow during the spring run-off, infiltrate the excess water to the groundwater, which will eventually travel as return flow to Reidel and Haller Creeks during low flow conditions. The proposed project is designed to cause minimal impacts to the watershed during the diversion period. Recharge to the creeks during the low flow summer and fall months will enhance the fluvial environment by increasing stream flows with cooler groundwater. This will act as an enhancement of fish habitat in the Haller Creek drainage.

The system is designed to mitigate, at a minimum, the estimated 31 acre-feet of consumptive use in the basin. This quantity of water would be diverted and retimed to base flow to re-enter Haller creek from June through September. If the diverted water is attenuated out over the delayed retimed baseflow return time frame of 90-120 days, a benefit of 0.13 (31 AF over 4 months) to 0.17 (31 AF over 3 months) would be seen in Haller Creek. In summary, the proposed project appears to be a Net Ecological Benefit (NEB) to the watershed.

7.0 CONCLUSIONS AND FINDINGS

The WNR Group has developed this Technical Memo to present the data collected from the Reidel Creek Infiltration Project Feasibility Analysis, a project developed by the WRIA 59 planning unit in the Haller Creek subbasin for the WRIA 59 RCW 90.94 domestic well consumptive use assessment. The feasibility study has developed the following findings:

- Based on review of historic creek flow data, it is inferred that there will be sufficient excess flow during the spring months for the proposed infiltration project;
- An estimated 31 acre-feet per year of consumptive use from permit exempt water sources will potentially be needed through 2038;
- Exploration borings at the site have identified the Reidel Creek gravel pit site is underlain by medium-coarse Sands;
- Groundwater was encountered at depths of approximately 50 feet below existing site grade;
- Unsaturated soils were capable of infiltrating up to 28 gpm;
- Surface water in Reidel Creek is proposed to be diverted from a bank of six to eight-foot-deep stilling wells located approximately 300-feet northwest of the infiltration trench;
- The proposed system is designed for a daily flow of 86,400 gallons per day at a rate of 80 gpm;
- Diversion pumps are to run 9 hours per day for a total operation time of 3 months (from mid March through mid May);
- The pump system is designed if increased flows from 80 gpm to 160 gpm are needed;
- A maximum of 83-acre feet could be diverted if the period of operation is increased to 4 months with a daily run time of 18 hours;
- The proposed project is a NEB to the watershed and will enhance stream flows during low flow periods of the year.

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Golder Associates, March 31, 2006, WRIA 59 – Colville River Watershed Detailed Implementation Plan. Report submitted to Colville River Watershed Planning Unit Team.

Kahle, S.C., Longpré, C.I., Smith, R.R., Sumioka, S.S., Watkins, A.M., and Kresch, D.L., 2003, Water resources of the ground-water system in the unconsolidated deposits of the Colville River Watershed, Stevens County, Washington: U.S. Geological Survey Water-Resources Investigations Report 03-4128, 76 p.

Stevens County Assessor, 2019, property database - http://propertysearch.trueautomation.com/PropertyAccess/

Washington State Department of Natural Resources (DNR), 2019, unpublished communication and development of Land Use License (LUL) for conducting Feasibility Projects.

Water & Natural Resource Group & Mentor Law Group, June 17, 2015, WRIA 59 Colville River Basin Water Bank Feasibility Study; prepared for Stevens County Planning Department and WRIA 59 WMP.

Water & Natural Resource Group, Inc., May 31, 2019, Technical memorandum on Estimation of Future Build-out and Consumptive Use Relative to Domestic Exempt Groundwater Supply Wells; prepared for Stevens County Planning Department and WRIA 59 WMP.

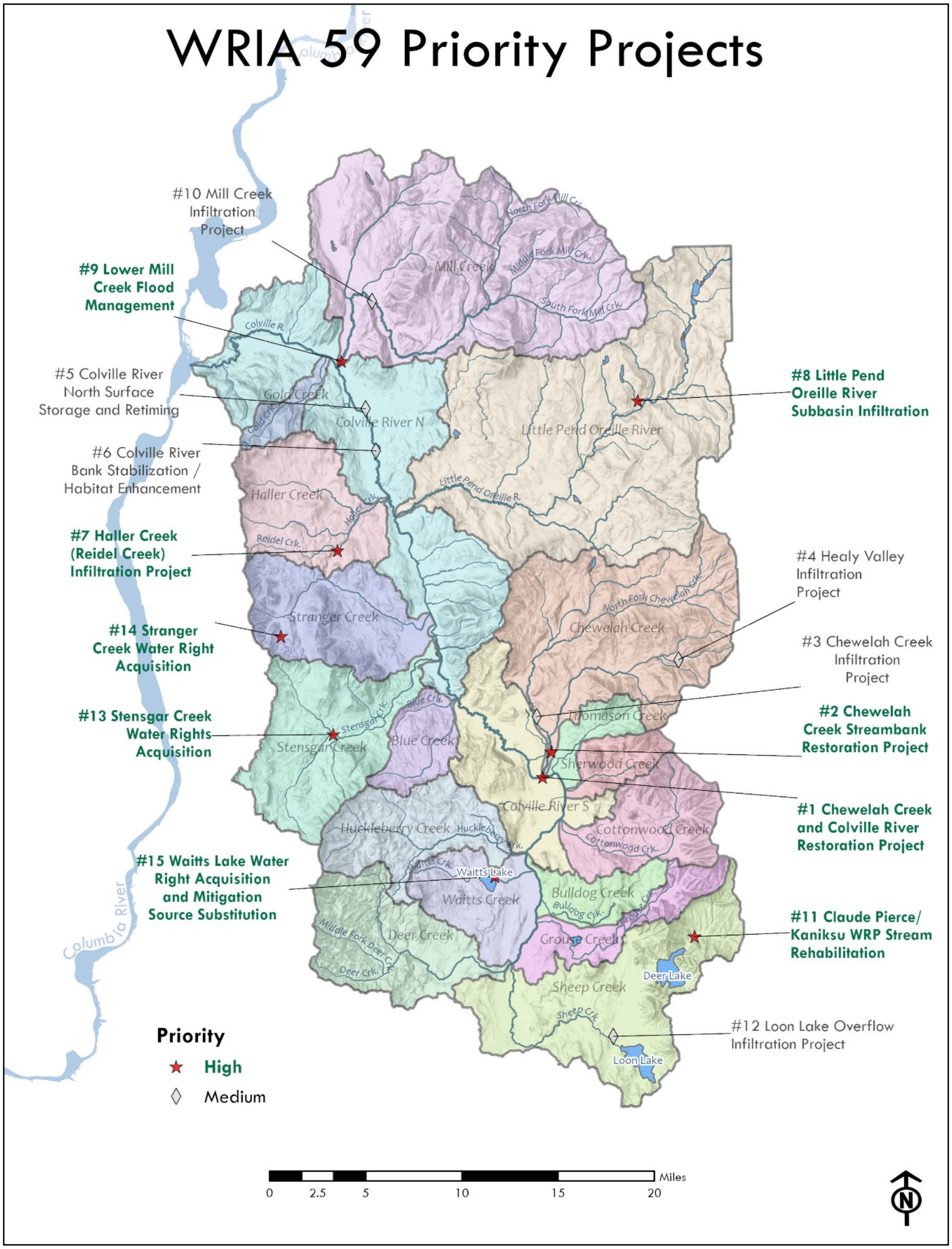


Figure 1: Map showing location of WRIA 59 Subbasins and location of high and medium ranked RCW 90.94 mitigation projects.

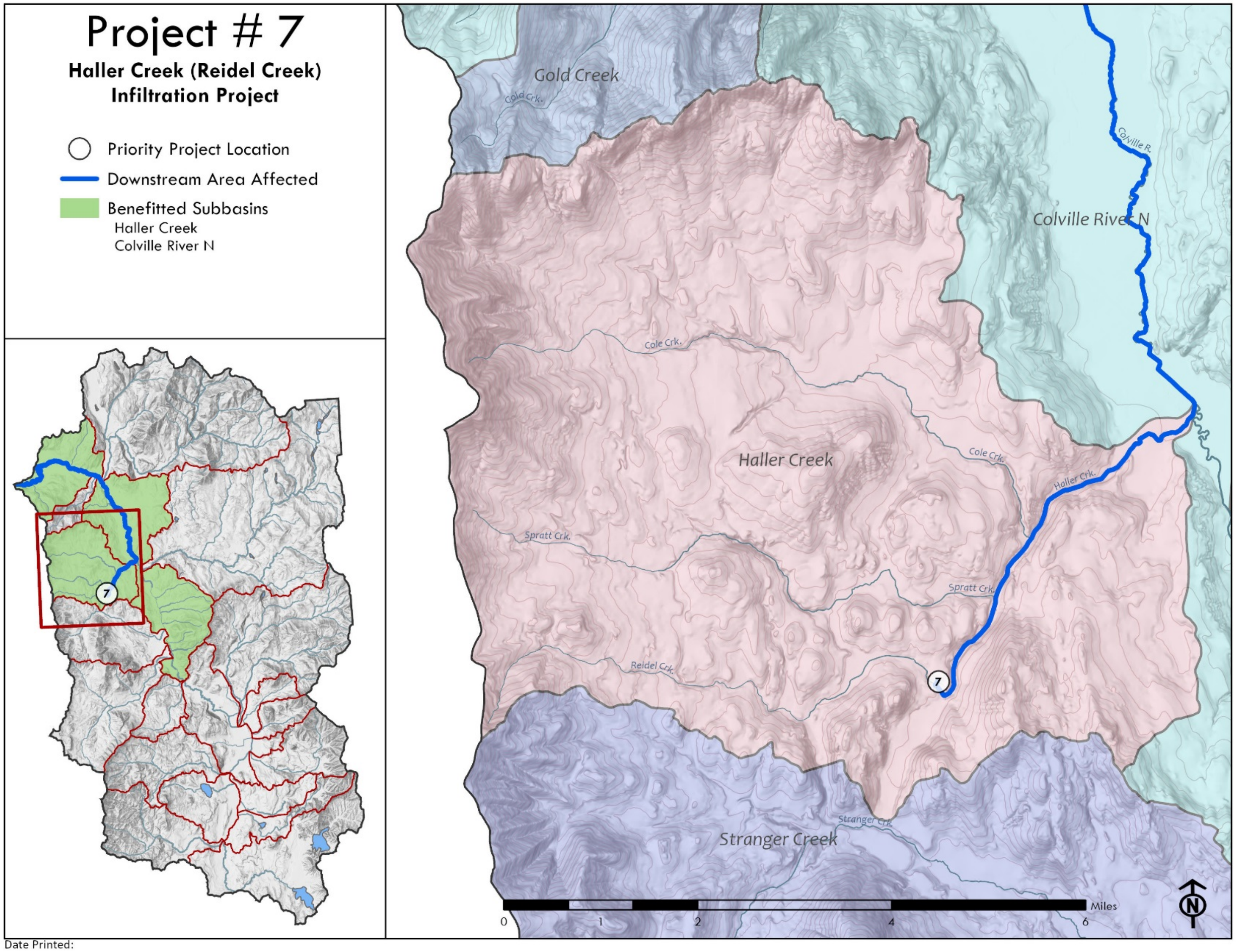


Figure 2: Location of Reidel Creek Infiltration Project in Haller Creek Subbasin.

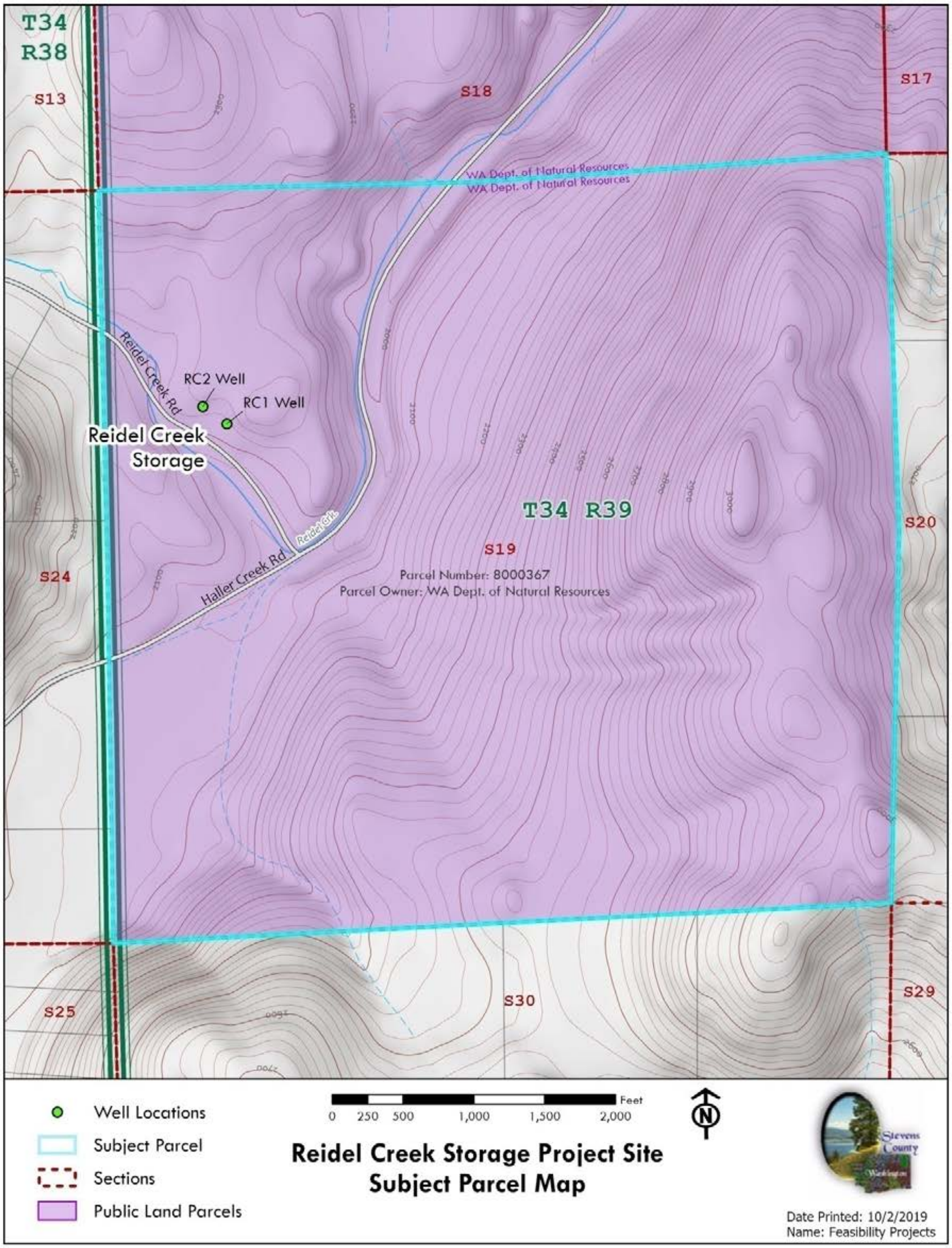


Figure 3: Parcel Ownership Map for Reidel Creek Infiltration Project (Stevens County Assessor, 2019).

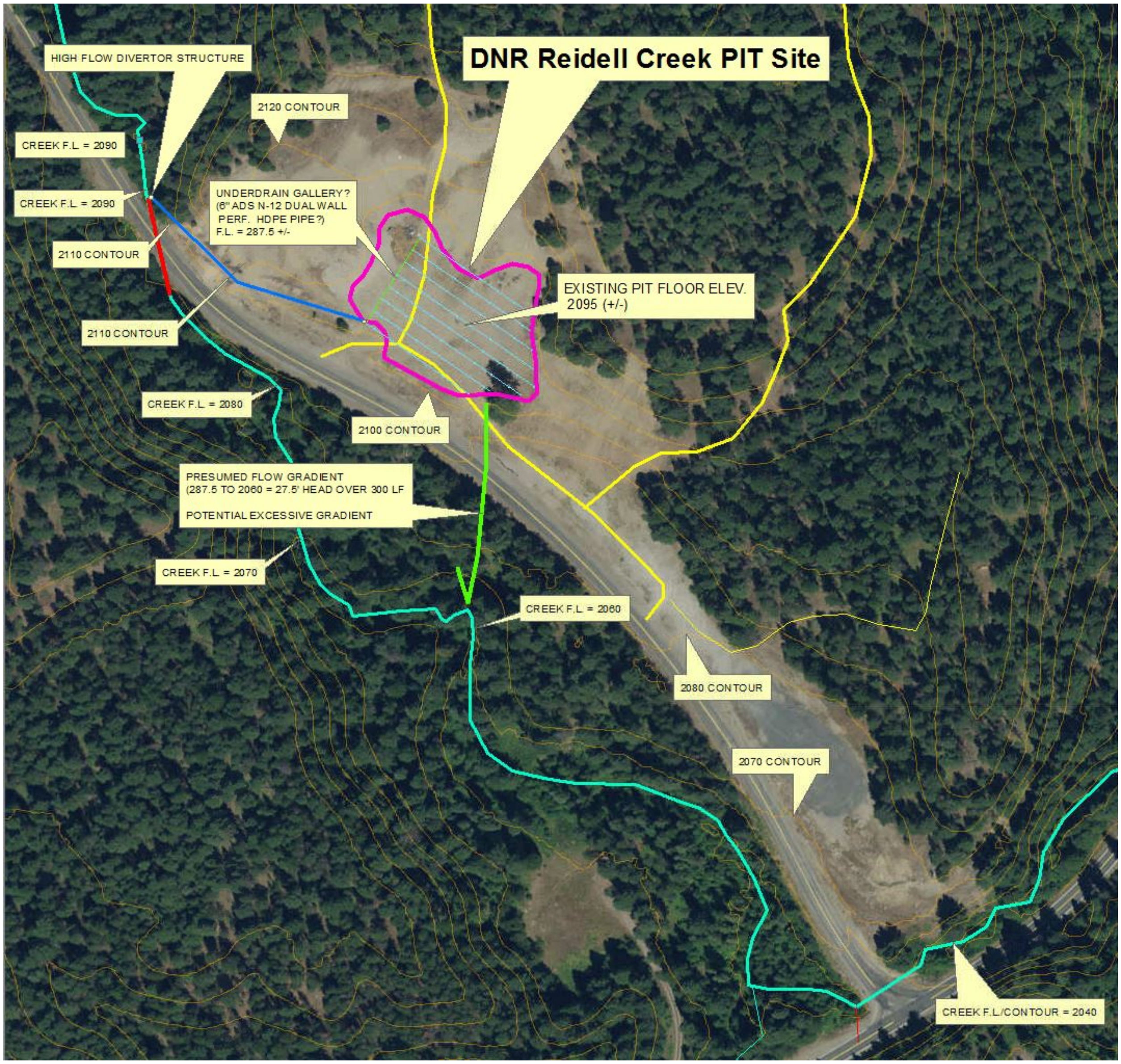


Figure 4: Conceptual Project Development for the Reidel Creek Infiltration Project as Developed with the DNR (from unpublished DNR, 2019 LUL application).

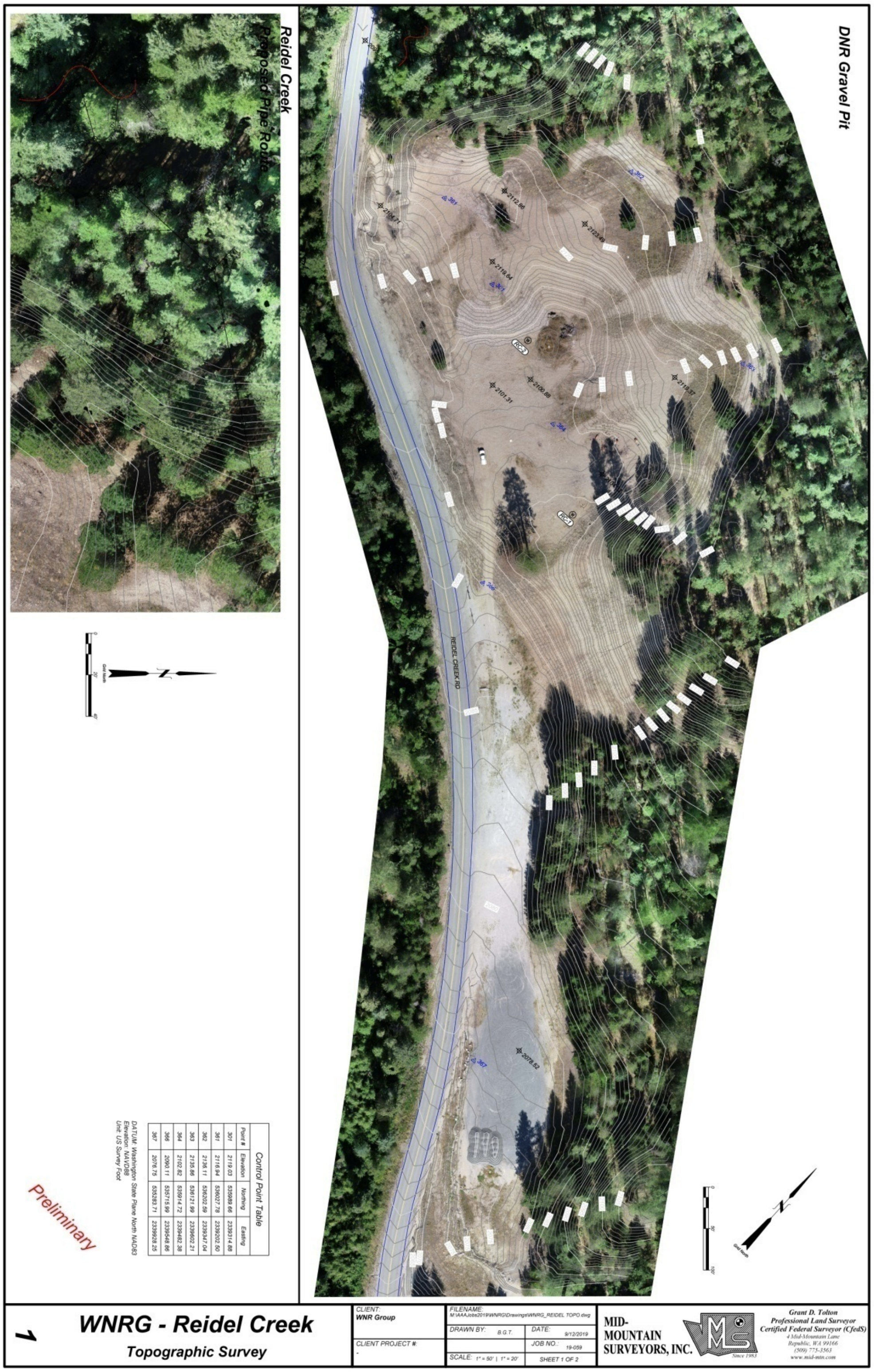


Figure 5: Aerial Photograph with 1-foot Contours for the Reidel Creek Site.

Well Number: BMH-599 (RC-1)
Project: WRIA 59 - Reidel Creek Feasibility
Date Completed: 08/20/2019
Logged by: St.Godard w/ WNR Group
Location: Reidel Creek Road, Stevens County, WA
Total Depth: 55.3 feet below grade
Legal: W1/2-NW Sec. 19, T34N, R39E.W.M.
Water Depth: 50 feet bgs - ATD
50.13 ft below TOC 8/21/19
49.62 ft below TOC 9/04/19
GPS: N48.43313, W-117.95272

Ground Surface
8-inch steel flush monument w/ locking cap

	Very Dense, gray, dry, coarse Gravel with sand (0-5')	2-ft concrete seal (0-2')
5-feet	Very Dense, grayish brown, dry to moist Gravel with coarse sand and silt, trace of fine-sand (5-9')	
10-feet	Dense, brown/dark gray, dry, very coarse Sand with some gravel and fine sand (9-15')	Stabilizer at 10 ft. Bentonite seal (2-42')
15-feet	Dense, brown, dry to damp, medium-coarse Sand with some gravel (15-20')	2-inch PVC blank well casing (0-44.5')
20-feet	Dense, light brown, damp, Gravel with coarse sand, some fine-med sand (20-25')	Stabilizer at 20 ft.
25-feet	Dense, brown, damp, medium Sand with some gravel, trace silt (25-43')	
30-feet		Stabilizer at 30 ft.

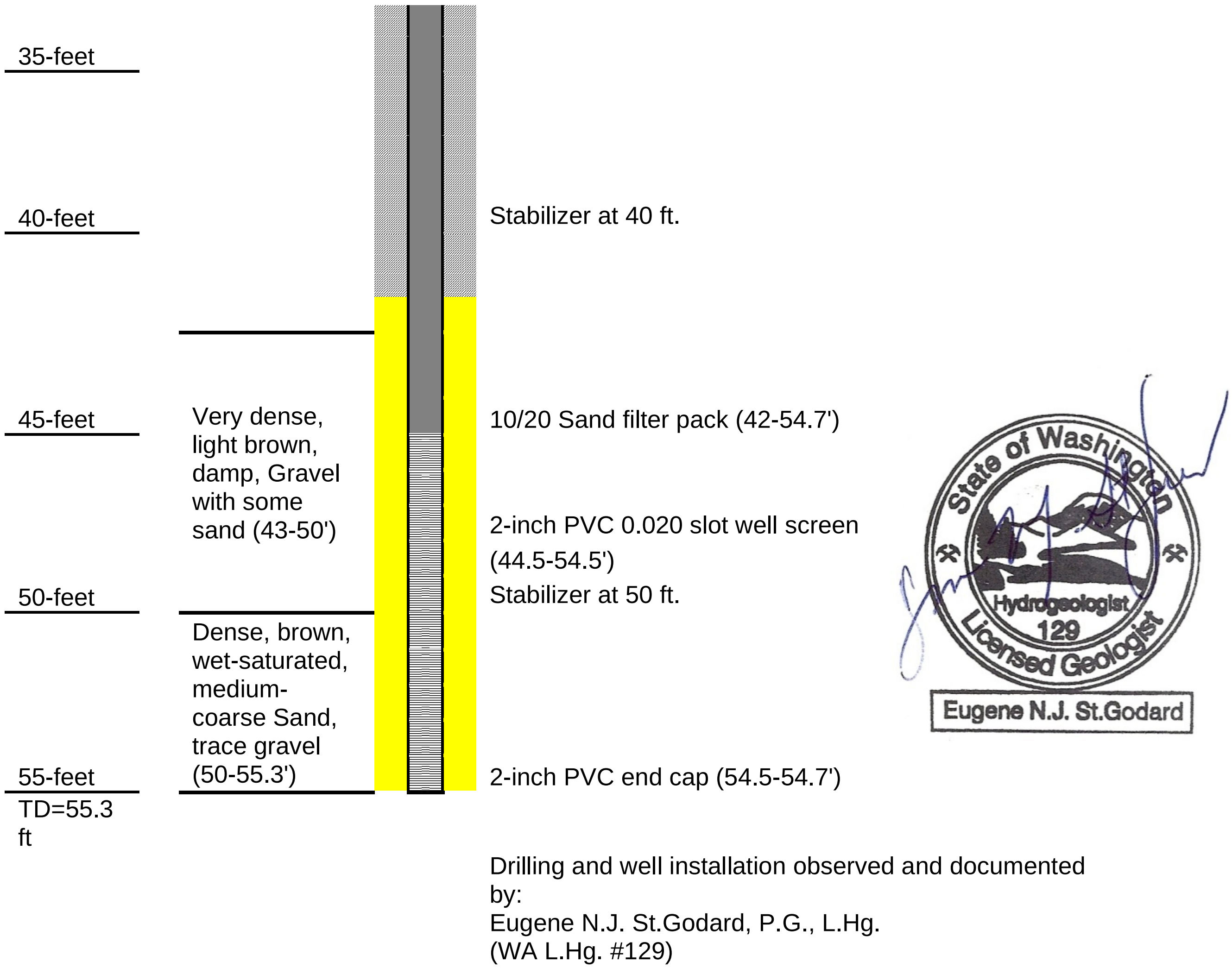


Figure 6: Geologic Well Log and Piezometer Construction Details for RC-1.

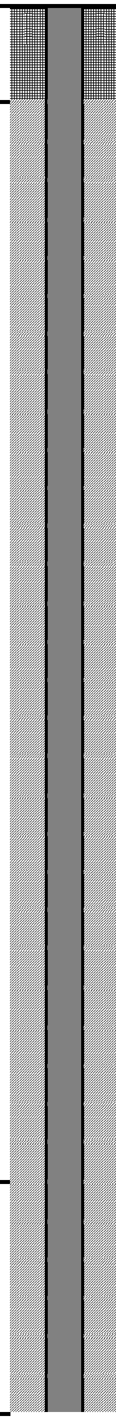
Well Number: BMH-600 (RC-2)
Date Completed: 08/21/2019
Logged by: St.Godard w/ WNR Group
Total Depth: 50.0 feet below grade
Water Depth: 47 feet bgs - ATD
46.60 ft below TOC 8/21/19
46.10 ft below TOC 9/04/19

Project: WRIA 59 - Reidel Creek Feasibility

Location: Reidel Creek Road, Stevens County, WA
Legal: W1/2-NW Sec. 19, T34N, R39E.W.M.
GPS: N48.43347, W-117.95341

Ground Surface

8-inch steel flush monument w/ locking cap



Very Dense, gray, dry, coarse Gravel-FILL (0-1.5')

2-ft concrete seal (0-2')

5-feet

10-feet

Bentonite seal (2-37')

15-feet

Dense, brown, damp, Medium-coarse Sand with gravel, trace silt (1.5-30')

2-inch PVC blank well casing (0-40')

20-feet

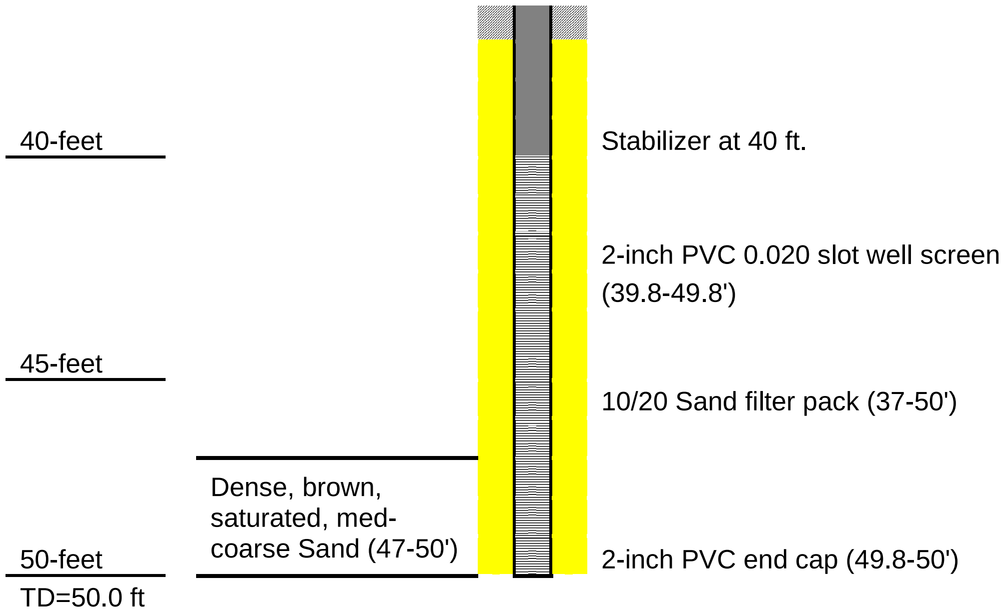
Stabilizer at 20 ft.

25-feet

30-feet

Dense, brown, damp medium Sand with trace coarse sand, trace gravel (30-47')

35-feet



Drilling and well installation observed and documented by Eugene N.J. St.Godard, P.G., L.Hg.
(WA L.Hg. #129)

Figure 7: Geologic Well Log and Piezometer Construction Details for RC-2.

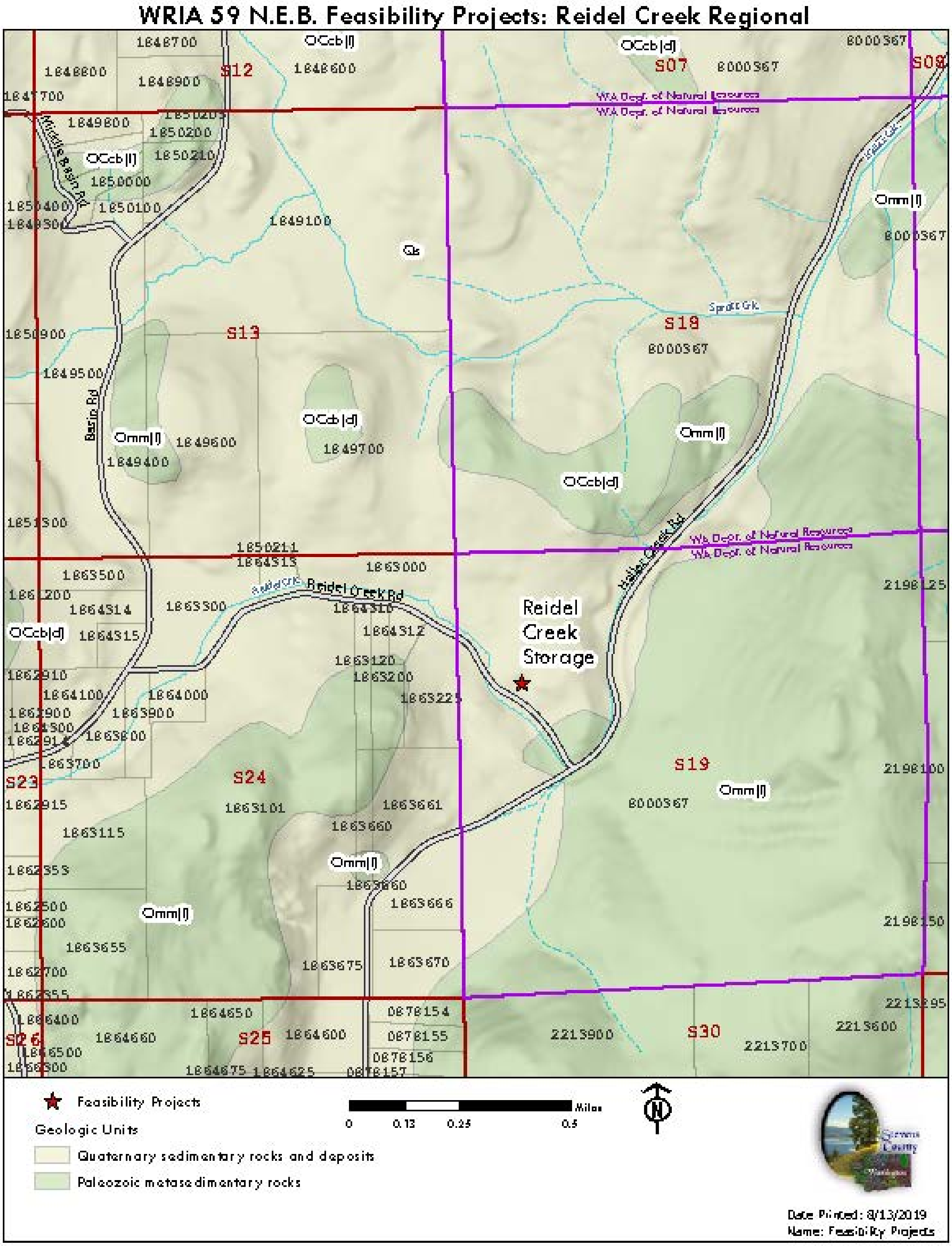


Figure 8: Geologic Map of the Reidel Creek Area. Qs = Quarternary Age Valley Fill Material (sands and gravels), Omm(l) & OCcb(d) = Ordivician metasedimentary rocks (shales and dolomites).

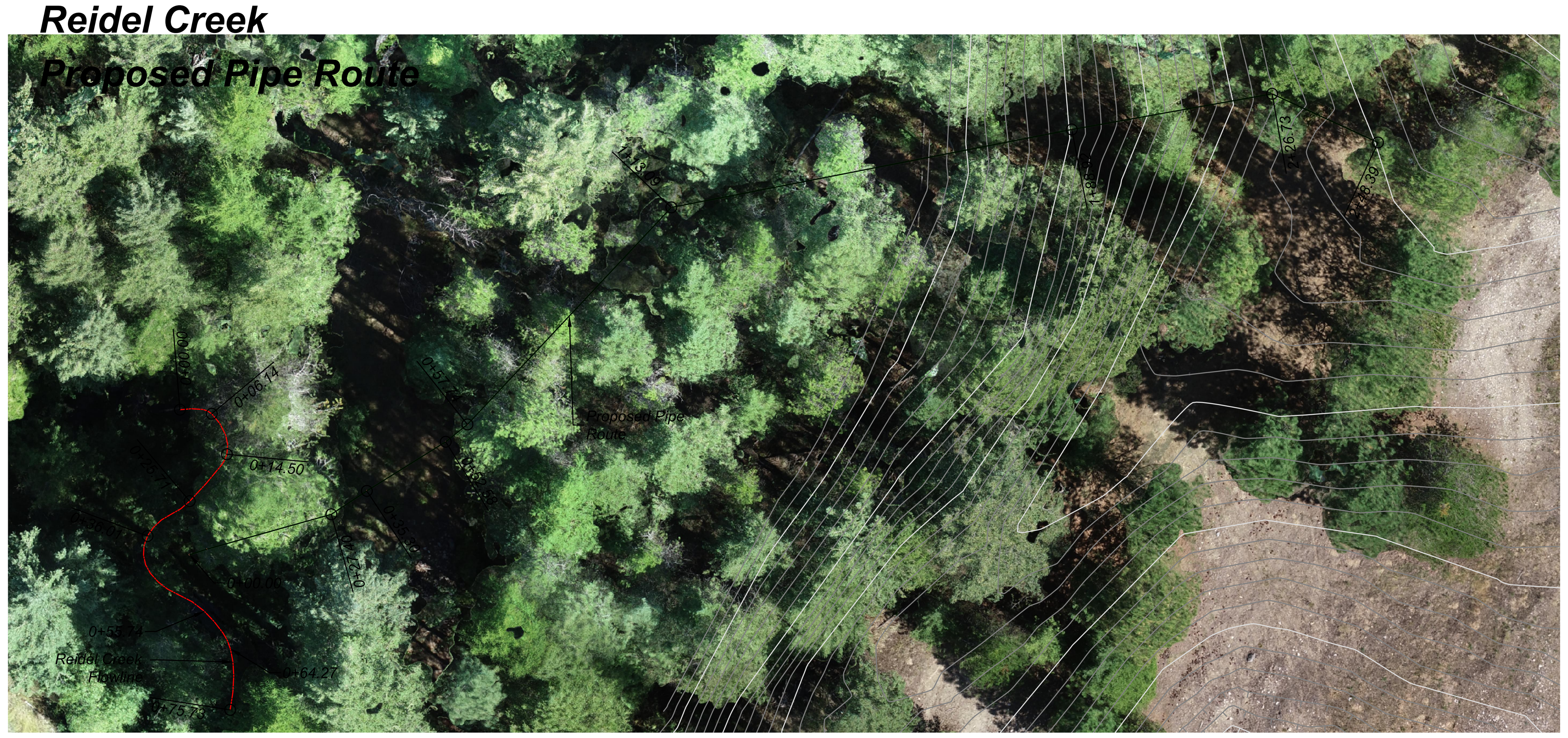
Figure 9: Photo of Percolation testing set-up at Reidel Creek site. Percolation pipe 20-feet from RC-1.

ATTACHMENT 1

SURVEYOR MAPS

DNR Gravel Pit

Reidel Creek
Proposed Pipe Route



Grid North
0 20' 40'

Control Point Table			
Point #	Elevation	Northing	Easting
301	2119.03	535989.66	2339314.88
361	2116.94	536027.78	2339202.50
362	2136.11	536202.59	2339347.04
363	2135.86	536121.99	2339602.21
364	2102.82	535914.72	2339482.38
366	2090.11	535715.99	2339548.86
367	2076.75	535283.71	2339928.25

DATUM: Washington State Plane North NAD83
Elevation: NAVD88
Unit: US Survey Foot

Preliminary

Grant D. Tolton
Professional Land Surveyor
Certified Federal Surveyor (CfedS)
4 Mid-Mountain Lane
Republic, WA 99166
(509) 775-3563
www.mid-mtn.com

MID-MOUNTAIN SURVEYORS, INC.
Since 1983

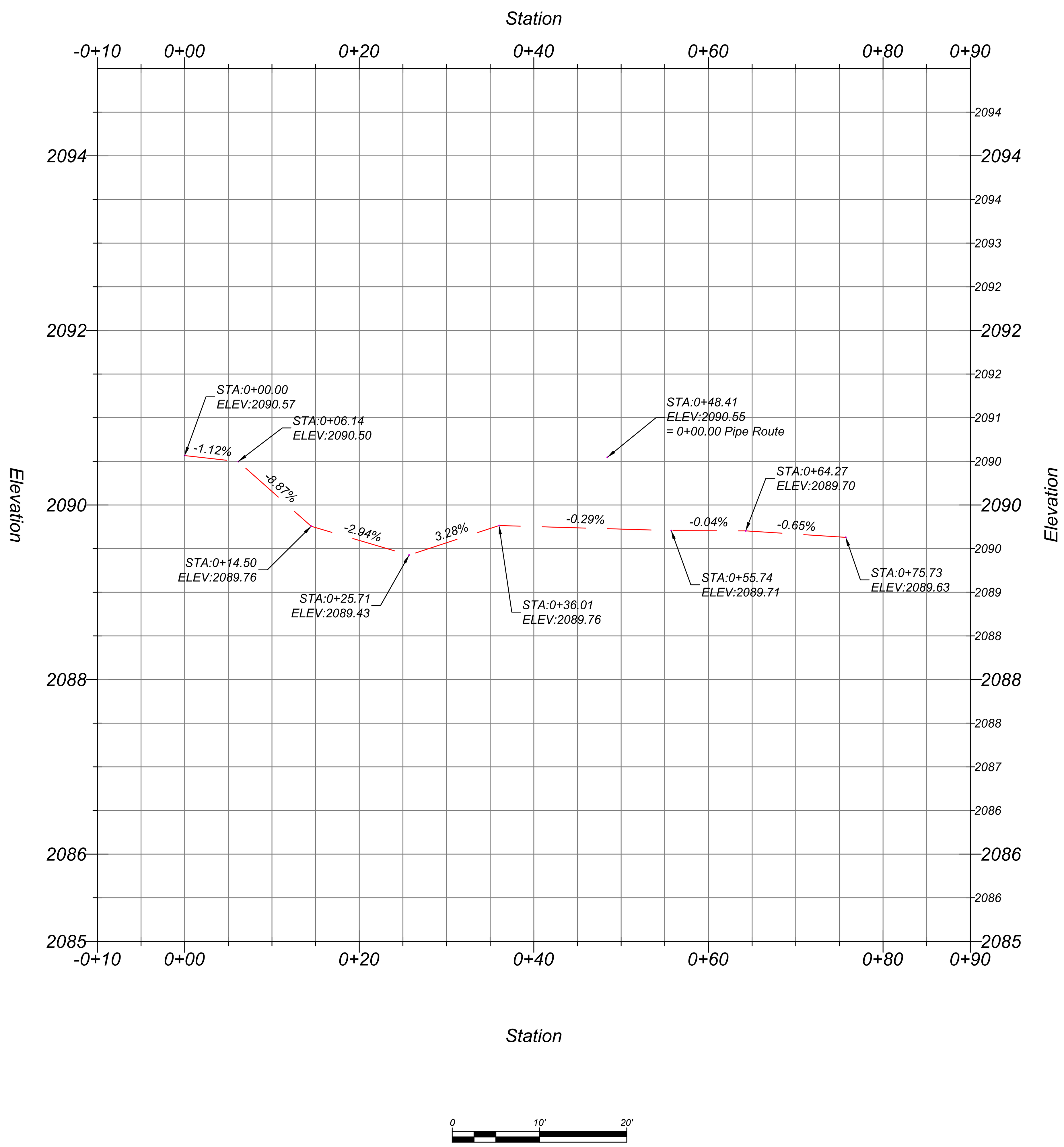
FILENAME: M:\AAAJobs2019\WNRG\Drawings\WNRG_REIDEL TOPO.dwg
DRAWN BY: B.G.T.
DATE: 9/12/2019
JOB NO.: 19-059
SCALE: 1" = 50' | 1" = 20'
SHEET 1 OF 2

CLIENT: **WNR Group**
CLIENT PROJECT #: -

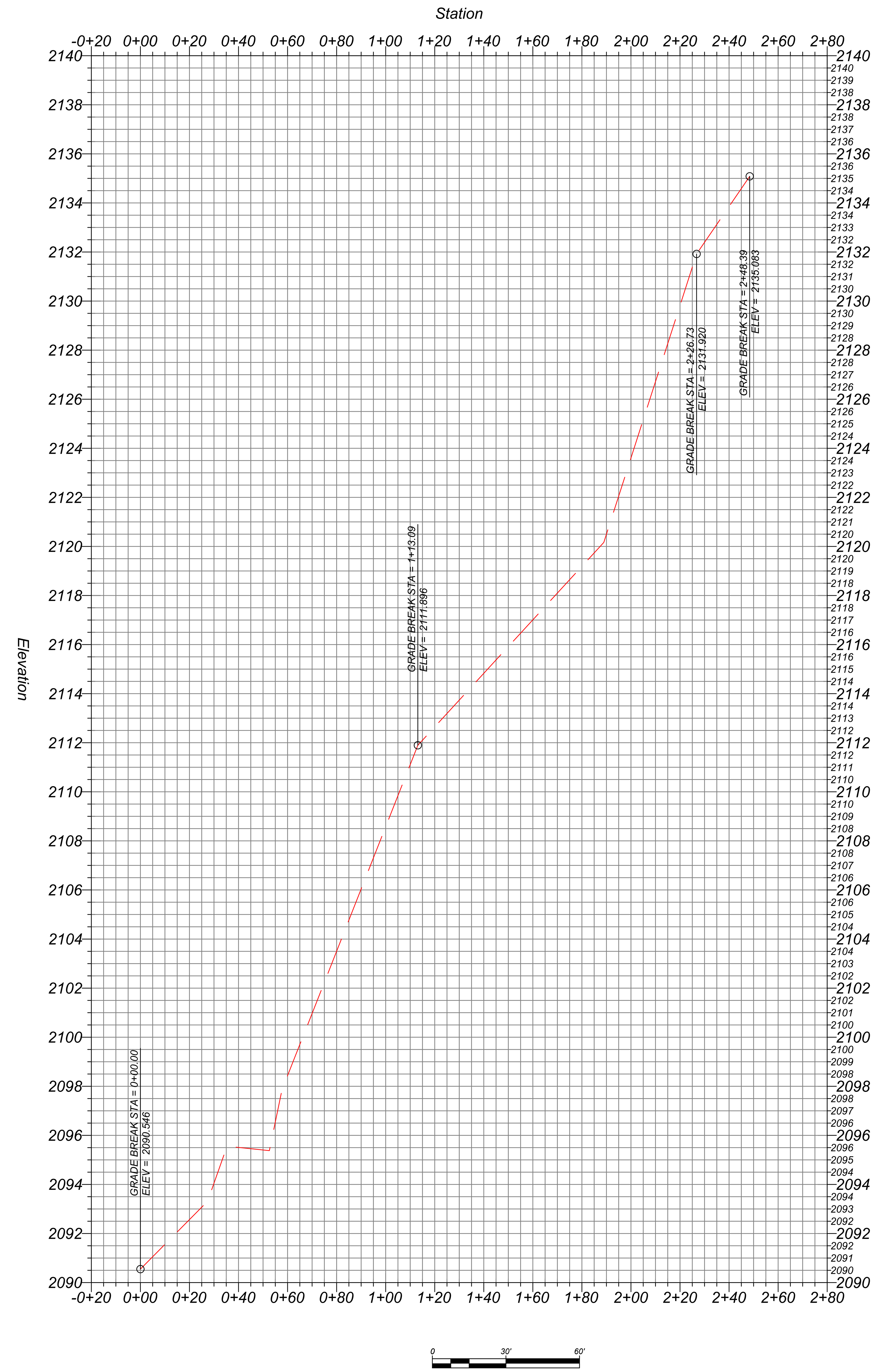
WNRG - Reidel Creek
Topographic Survey

1

Reidel Creek Profile



Proposed Pipe Route Profile



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DRAWN BY: B.G.T.	DATE: 9/12/2019
CHECKED BY:	JOB NO.: 19-059
SCALE: -	SHEET 2 OF 2

CLIENT:
WNR Group

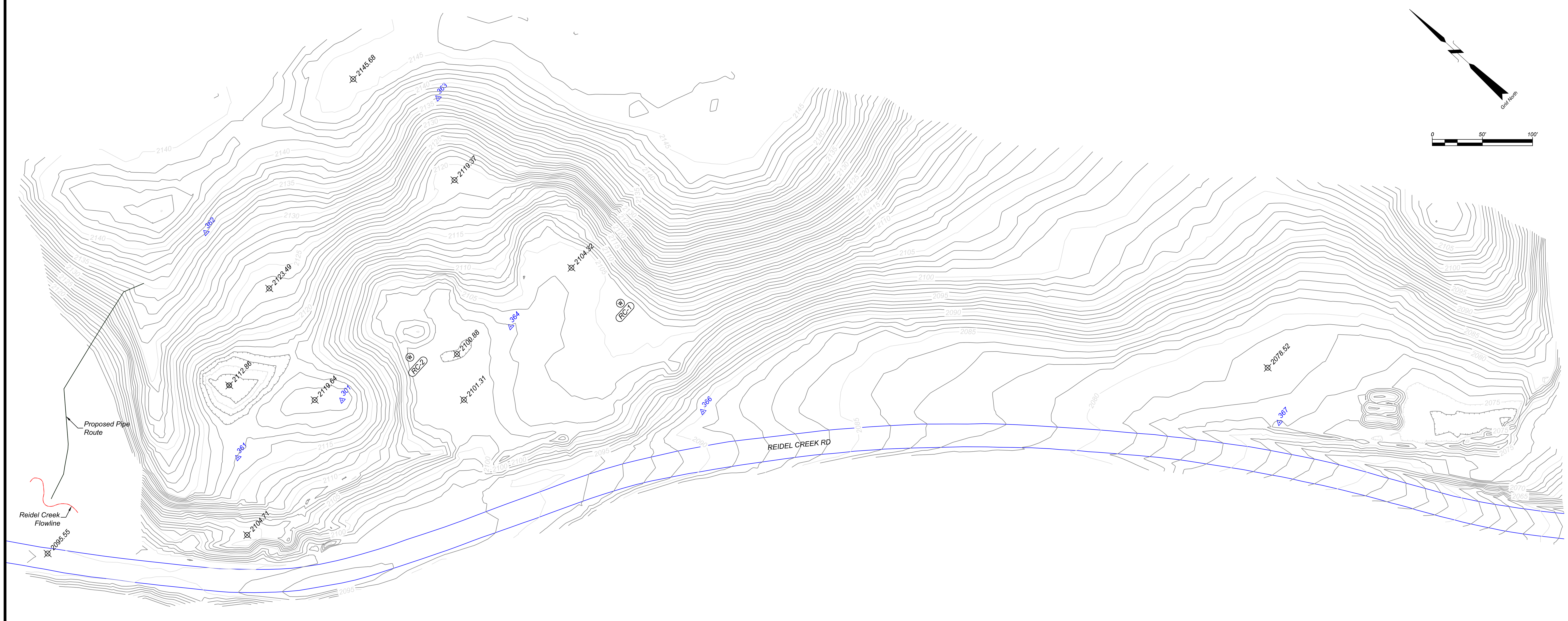
CLIENT PROJECT #:
-

WNRG - Reidel Creek

Topographic Survey

2

DNR Gravel Pit



Reidel Creek
Proposed Pipe Route

Control Point Table

Point #	Elevation	Northing	Easting
301	2119.03	535989.66	2339314.88
361	2116.94	536027.78	2339202.50
362	2136.11	536202.59	2339347.04
363	2135.86	536121.99	2339602.21
364	2102.82	535914.72	2339482.38
366	2090.11	535715.99	2339548.86
367	2076.75	535283.71	2339928.25

DATUM: Washington State Plane North NAD83
Elevation: NAVD88
Unit: US Survey Foot

Preliminary

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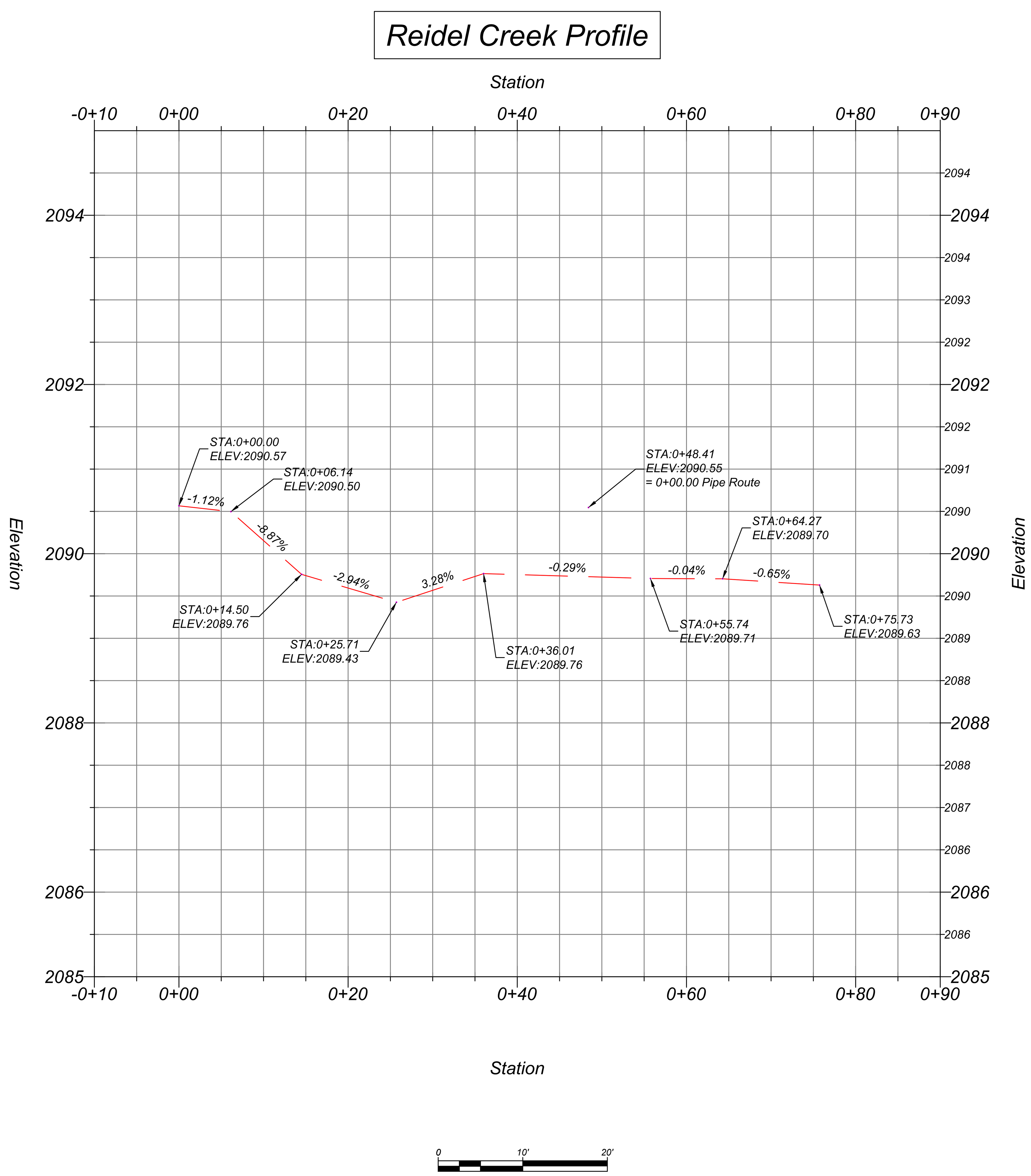
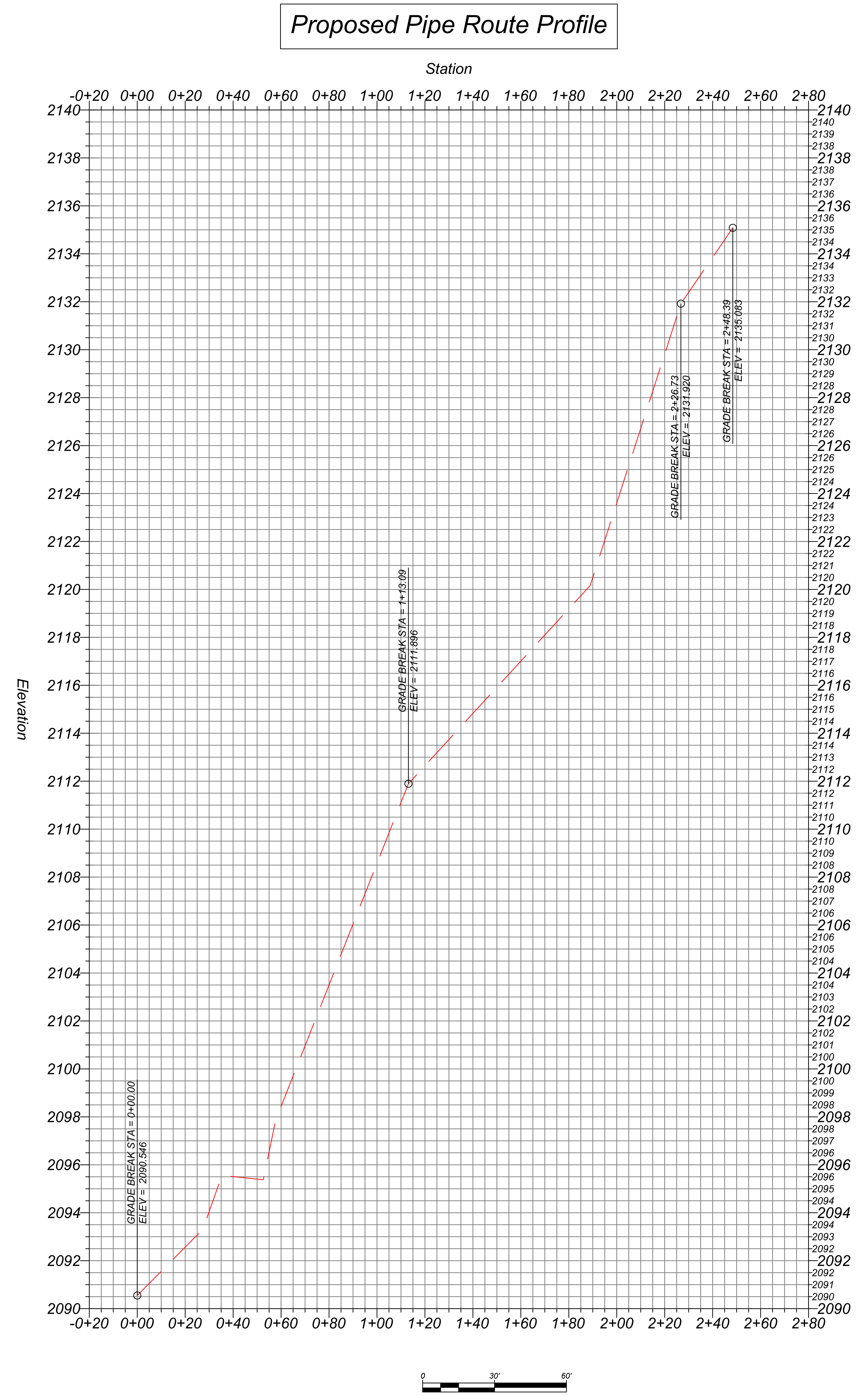
DATE: 9/12/2019
JOB NO.: 19-059
SCALE: 1" = 50' | 1" = 20'
SHEET 1 OF 2

CLIENT: **WNR Group**
CLIENT PROJECT #: -

WNRG - Reidel Creek
Topographic Survey

1





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DRAWN BY: B.G.T.	DATE: 9/12/2019
CHECKED BY:	JOB NO.: 19-059
SCALE: -	SHEET 2 OF 2

CLIENT: **WNR Group**

CLIENT PROJECT #: -

WNRG - Reidel Creek

Topographic Survey

2

ATTACHMENT 2

ENGINEERING REPORT

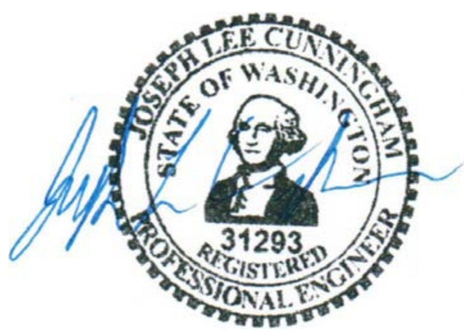
ENGINEER'S REPORT FOR
REIDEL CREEK INFILTRATION SYSTEM
DESIGN, OPERATIONS & MAINTENANCE

Site Location: Reidel Creek Road, 1600 ft north of Haller Creek Rd.
Parcel Number:
Owned by: Washington Department of Natural Resources

Reference:
WNR Group, Inc. April 17th, 2015 Memo of Conclusions for WRIA 59 Flow Subcommittee

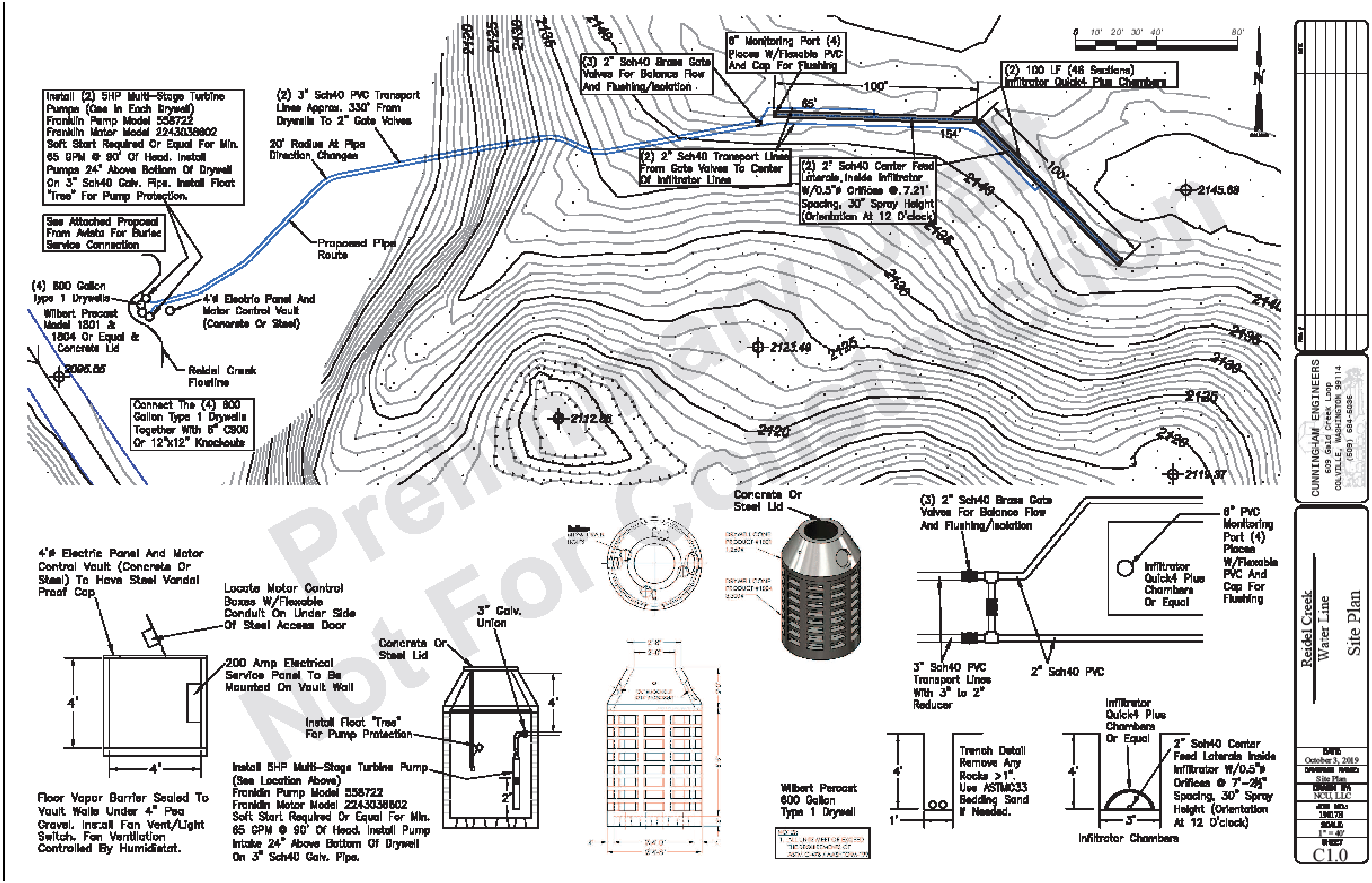
Prepared by: **October 2019**

CUNNINGHAM ENGINEERS, INC.
609D Gold Creek Loop, Colville WA 99114
Telephone (509) 684-5036 Cell (509) 680-0058
Email: earthboy2u@gmail.com



Signed on Oct. 27, 2019

INSTALLER
TBD



Install (2) 5HP Multi-Stage Turbine Pumps (One In Each Drywell) Franklin Pump Model 558722 Franklin Motor Model 2243038602 Soft Start Required Or Equal For Min. 65 GPM @ 90' Of Head. Install Pumps 24" Above Bottom Of Drywell On 3" Sch40 Galv. Pipe. Install Float "Tree" For Pump Protection.
See Attached Proposal From Avista For Buried Service Connection
(4) 800 Gallon Type 1 Drywells Wilbert Precast Model 1801 & 1804 Or Equal & Concrete Lid
4'Ø Electric Panel And Motor Control Vault (Concrete Or Steel)
Reidel Creek Flowline
Connect The (4) 800 Gallon Type 1 Drywells Together With 6" C900 Or 12"x12" Knockouts
(2) 3" Sch40 PVC Transport Lines Approx. 330' From Drywells To 2" Gate Valves
20' Radius At Pipe Direction Changes
Proposed Pipe Route
(3) 2" Sch40 Brass Gate Valves For Balance Flow And Flushing/Isolation
6" Monitoring Port (4) Places W/Flexible PVC And Cap For Flushing
(2) 100 LF (46 Sections) Infiltrator Quick4 Plus Chambers
(2) 2" Sch40 Transport Lines From Gate Valves To Center Of Infiltrator Lines
(2) 2" Sch40 Center Feed Laterals, Inside Infiltrator W/0.5"Ø Orifices @ 7.21' Spacing, 30" Spray Height (Orientation At 12 O'clock)
100'
65'
154'
N
0 10' 20' 30' 40' 80'
2145.69
2123.49
2112.86
2119.37
2095.55
4'Ø Electric Panel And Motor Control Vault (Concrete Or Steel) To Have Steel Vandal Proof Cap
Locate Motor Control Boxes W/Flexible Conduit On Under Side Of Steel Access Door
200 Amp Electrical Service Panel To Be Mounted On Vault Wall
Floor Vapor Barrier Sealed To Vault Walls Under 4" Pea Gravel. Install Fan Vent/Light Switch. Fan Ventilation Controlled By Humidistat.
Concrete Or Steel Lid
3" Galv. Union
Install Float "Tree" For Pump Protection
Install 5HP Multi-Stage Turbine Pump (See Location Above) Franklin Pump Model 558722 Franklin Motor Model 2243038602 Soft Start Required Or Equal For Min. 65 GPM @ 90' Of Head. Install Pump Intake 24" Above Bottom Of Drywell On 3" Sch40 Galv. Pipe.
Wilbert Precast 800 Gallon Type 1 Drywell
(3) 2" Sch40 Brass Gate Valves For Balance Flow And Flushing/Isolation
6" PVC Monitoring Port (4) Places W/Flexible PVC And Cap For Flushing
Infiltrator Quick4 Plus Chambers Or Equal
3" Sch40 PVC Transport Lines With 3" to 2" Reducer
2" Sch40 PVC
Trench Detail Remove Any Rocks >1". Use ASTMC33 Bedding Sand If Needed.
2" Sch40 Center Feed Laterals Inside Infiltrator W/0.5"Ø Orifices @ 7'-2½" Spacing, 30" Spray Height (Orientation At 12 O'clock)
Infiltrator Chambers
Preliminary Draft Not For Construction
CUNNINGHAM ENGINEERS
609 Gold Creek Loop
COLVILLE, WASHINGTON 99114
(509) 684-5086
Reidel Creek
Water Line
Site Plan
October 3, 2019
NCU, LLC
1" = 40'
C1.0

SECTION 1.0 SYSTEM DESCRIPTION

1.1 GENERAL BACKGROUND

The proposed system will be used to for ground water recharge and increase creek flows during periods of low flow. The new system consists of (4) stilling wells located along Reidel Creek, with (2) 5 hp pumps controlled by floats and a control panel, serving 600 sq ft of infiltration bed. Graveless chambers, large orifice dia used to reduce or eliminate sediment failures, which are most common in drainrock bed systems.

1.2 WATER SUPPLY

The water is supplied by a bank of 6 ft – 8 ft deep stilling wells located approximately 300' northwest of infiltration bed. A new power utility line will be needed to serve the pump station where shown. The system is designed for a daily flow of 86,400 gal per day at 80 gpm, with pump runtimes of 9 hrs per day per pump to allow for pump rest times, which is best practice to prolong pump life. Total operation time is 3 months, from mid March through mid May, for 31 acre-ft of water storage to mitigate consumptive use as determined by the WIRA 59 Flow Subcommittee technical analysis.

1.3 UTILITY POWER AND COST ESTIMATE

Avista is currently considering two options for extending electric power to the project. If an easement can be obtained across a private parcel, they will extend power about 850 ft from the line serving the residence just north of the project. If this option is not possible, then utilities will be extended approximately 1600 ft from Haller Creek Road, for an estimated cost of $40.000. (See Cost Estimate on following page.)

1.4 REQUIRED PERMITS

HPA permit is required for the streamside work. Ecology determined an Underground Injection Control permit is required for infiltration systems. Contact Mary Shaleen-Hansen UIC Program Coordinator 360-407-6143. Electrical Permit are required from LNI, and Water Rights Permit from Ecology will be applied for per RCW 90.03.

1.5 RECEIVING SOIL GEOLOGY, INFILTRATION SYSTEM

Soil characteristics from two test wells located near the infiltration area consist of sand, gravel and cobbles, and were evaluated for infiltration rates. The bottom of infiltration trench is to be level (+/- ½") and not less than 48" deep. The two laterals are graveless chambers, and lay in trenches at least 3' wide and 100' long. Each lateral is center fed from a 2" feeder, where flows are divided equally for each lateral. The orifice size and spacing was determined based on the high infiltration rate, suspended particle size, and low maintenance requirements.

1.6 FUTURE SYSTEM EXPANSION

The infiltration rate of the receiving soil as determined by the hydrologist is much higher than what can be supplied by Reidel Creek. Future expansion of system can be done by simply increasing the water supply to the infiltration bed. The pumps can handle increased flows from 80 gpm to 160 gpm by adjusting the balance and flow valves for increased flowrate. Increased pump runtimes of 18 hrs each, will still provide adequate rest times. If period of operation is increased from 3 to 4 months at this increased pump rate, then up to 83 acre-ft of mitigation water could be available from existing system without upgrading any components of the proposed system.

SECTION 2.0 SYSTEM OPERATION AND CONTROLS

2.1 OVERVIEW OF SYSTEM OPERATION

Water from Reidel Creek is pumped from the stilling wells and controlled by a pump panel with timed on / off periods for the two pumps. Pump operation also depends on a set of float switches mounted to adjustable collars on the float tree.

CONTROLL PANEL SETTING FOR PUMP RUN TIME :_________________________

SET BY: ____DATE: ____________

2.2 GRAVELESS CHAMBERS

Graveless chambers can be used where conventional drain rock is not practical to use, as in this case for better water distribution and larger orifice sizing and increased spacing.
However graveless chambers are susceptible to two different failure modes, which must be addressed for successful operation and continued infiltration performance. The following discussion is based on supplier information and recommendations.

The first failure mode primarily affects performance. A discussion with the Infiltrator™ representative revealed that loose silt, fine sand and other unstructured soils can be washed into the chambers when large doses are delivered which can rinse these soils into the chamber through the louvers on each side of the chamber. This can be mitigated by placing Typar or similar fabric over the louvers, with no detrimental effect on the Infiltrator™ system performance. Infiltration beds located in soils with significant adhesion or structure may not need the fabric. There is not detrimental effect of using fabric, but it may be an unnecessary cost for systems located in theses particular soils.

The second failure mode is caused by rodent activity inside the chambers. This only occurs if burrowing rodents are active in the immediate area of the infiltration beds. Our site visit indicated that there were no indications of burrows or other rodent activity in the area of infiltration. This is likely due to the very coarse cobble rock, sand and gravel comprising the infiltration soils. For finer textured soils, during periods of little or no infiltration, rodent activity inside unprotected chambers can gradually fill the entire void space with soil. This is normal defensive and territorial behavior for gophers and possibly other burrowing rodents. When they discover an underground void space, they will try to fill this void with soil to barricade their own burrow systems.

Rodents are much less likely to work inside chambers where active infiltration is occurring. Placing a wire screen or wire mesh under graveless chambers offers effective protection and is highly recommended for fine textured soils. Because the cost of system replacement for soil packed chambers is high, this floor screen is always recommended. This screen could be omitted if the system owner specifically requests the screen not be installed.

By requesting this screen to be omitted, the system owner also agrees to accept full liabilities for drainfield failure cause by any subsequent rodent activity, and agrees to take full responsibility for system replacement***. NOTE: It is the contractor's responsibility to interpret specific on site***

conditions such as surface evidence of rodent activity in the drainfield area, and consider how long the finished system will be dormant before full

time usage, and the potential for future periods of dormancy. The contractor can use the following recommendations for screening these systems. The system owner(s) should check the selected option below to indicate the as-built status of screen for actual system and sign and date below, giving their concurrence.

_____No protective screen: Not usually recommended. However, with systems placed where no visible rodent activity is present, or systems that would have full time infiltration could be okay. OR install 6” of 2” to 4” cobbles across entire bottom of drainfield before installing Infiltrator chambers.
_____5/8" galvanized 20 gauge chicken wire: For delayed operations up to 3 year period, changing to full time infiltration after that time. IMPORTANT NOTE: The galvanized wire will lose the zinc coating over time and permit complete corrosion of the chicken wire during usage. Periods of inactivity after this occurs could allow rodent activity inside the chambers leading to possible failure.

_____Stainless steel #2 screen (1/2" x 1/2" mesh, any gauge): For delayed and periodic operating conditions, including extended periods of inactivity after full time usage has begun.

Owner signature: ______________________________ Date: ___________

SECTION 3.0 MAINTENANCE AND PERFORMANCE MONITORING

This infiltration system requires periodic inspection and maintenance by the system owner or owner’s agent. This maintenance is the responsibility of the owner, but may be performed by more qualified service providers. In addition to the following maintenance descriptions and schedules, there may be additional requirements defined as the project matures.

3.1 STILLING WELLS

1. **Before use,** the stilling wells must be inspected for structural integrity, proper baffles, screen, adequate ground water inflow, and adequate sizing for its present use**.** Risers and lids must be above grade and secure.

2. **Just before first season of operation and then yearly:** the stilling wells should be inspected for excessive sediment accumulation. The sediment should be removed if deposit exceeds 12 inches in depth or surface skimmed if floating materials exceed 1 inch thick. All stilling well chambers should be inspected.

3. **Just before first season of operation and then yearly:** Check and clean pump screen. Check the float switches for proper activation. Check for unrestricted float movement. Verify that float cords cannot interfere with float operations.

4. **Just before first season of operation and then yearly:** System checks shall include float settings for runtime, and dose volume (Record rate of drawdown in inches for a 10 minute time interval).

   a) Verify that the high water alarm (if present) works by lifting the top float up. Verify that the low water level alarm works by pushing the bottom float down.

   b) Be sure water level is above “timer off float” level and turn each pump on manually by flipping the switch in the control panel to “manual” selection. Watch the water level inside the screened vault as each pump is running for about 30 seconds. Return the switch to “auto” selection. If the water level in each screened pump vault drops very quickly and does not return back to the liquid level in the stilling well quickly then the pump screen is clogged and must be cleaned.
   c) If the control panel has an elapsed time meter (ETM) or a cycle counter (CT), read and record these values and record the date taken. ETM’s and CT’s are valuable troubleshooting data if problems occur in the system.
   d) Verify that Control Panel is set correctly per field setting design record written on page 1 of this manual.
   e) Compare with as built performance data and flush laterals. Flushing laterals will improve performance to be similar to recorded data. Check pumps for burnout, and cycling.

3.2 INFILTRATOR BEDS

1. **The infiltration bed system should be inspected prior to the first season of operation, and once per year thereafter**. Surface of bed area shall be inspected semi-annually at same frequency as listed above. Look for damage to inspection ports or missing caps, improper use such as poor maintenance, or excessive weed growth, which may indicate surfacing of water (ponding).

   a) Ponding of water at bottom of inspection ports – Temporary ponding may occur at the end of a dose, but should dissipate before the next dose occurs. If ponding is still present at the end of the pump off cycle, this may indicate that system is being overloaded beyond the daily design volume, or that excess sediment has accumulated, or the gate valves have become unbalanced and are discharging too much water to one lateral. Verify balance by opening monitoring ports and dosing the system. Compare port inspections for both laterals and check for larger or smaller flow into one laterals. If water levels in laterals appear unequal, check balancing valves.
   b) Lack of grass sod – re-seed if needed. Temporary or infrequent vehicular or livestock traffic is allowed over the infiltration area.
   c) For graveless chamber systems, periodic inspection of bottom screen integrity should be done, and check for evidence of soil clogging from rodent activity.

3.3 DO’S AND DON’TS FOR SYSTEM OWNER

The following is a partial list of things to do and things avoid doing in managing the infiltration system for long system life and reduce the risk of system failures.

DO:

1. Perform required periodic maintenance tasks and operation checks for the system.
2. Keep accurate records of all maintenance and service calls. The results will be valuable if system problems develop. Make sure that whoever services the system keeps a complete record of their actions and all system records are kept with this manual.
3. Determine the level of sediment or floating materials in the stilling wells as described in this manual and remove as needed. Flush the laterals annually or as suggested by installer.
4. Protect the ground over the infiltration area from cover by structures, paving, or impervious material. Protect this area from concentrated surface drainage, soil compaction by vehicular traffic and livestock, and soil removal or grade alterations.

DON'T:

1. Don't use or introduce any other substance or liquids into the stilling wells other than stream water.
2. Don't replace or repair any system component without submitting a permit application to the Department of Ecology.
3. Don't accidentally dig up underground utility or gas lines. Before digging call the local "One Call" number to have underground utilities marked.
4. Don't enter the stilling wells. Any work should be done from the outside. Carbon dioxide is odorless and the lack of oxygen down there can be fatal.

SECTION 4.0 EMERGENCY PLAN AND SYSTEM TROUBLESHOOTING

In the event of system malfunction or failure, refer to the following check list and refer to section 3.0 for any special procedures. Also see contact information on next page.

Maintenance issues:

Improper use such as hydraulic overloading and poor maintenance, may be indicated by surfacing effluent (ponding) or excessive weed growth.

1) **Surface ponding of water inside inspection ports –** This indicates that balancing valves have been misadjusted resulting in discharging too much effluent through one lateral of infiltration system
2) **Lack of grass sod –** re-seed if needed. Limited or infrequent vehicular or livestock traffic is allowed over the infiltration backfill area.
3) **Soil Blockage (graveless chambers only):** (Indicated by inspecting ports)

   Solution: Find where rodents are getting into system, screen bottom of trenches under the chambers, or install 6" of 2" drainrock across entire bottom of drainfield.

   Contact: Dept. of Ecology before proceeding with repair, and contact system installer or Septic System installer for assistance if needed.

Malfunction:

1) **Frequent short duration high water alarms (daily or almost everyday):**
   Cause: Top floats are set too close together
   Solution: Re-position floats to correct settings per figure 5.
   Cause: Pump vault screen clogged
   Solution: Clean screened vault. Check out pump screen for blockage.
   Contact: Owner, Or a Septic System Service.

3) **Continuous high water alarm:**
   Cause: Pumps fail to operate.
   Solution: Check pump circuit breakers, and pump power.
   Cause: High alarm float set too high or malfunctioning.
   Solution: Check top float, Adjust or replace if needed. **Contact:** Owner, or present occupants. System Installer, or Electrical Contractor.

4) **Continuous low level alarm:**
   Cause: redundant off float set too high or malfunctioning.
   Solution: Check bottom float, Adjust or replace if needed.
   Cause: Pump “On” float hung up or malfunctioning.
   Solution: Check float, Adjust or replace if needed.
   Contact: System Installer, or Electrical Contractor.

5) **Pump won't shut off**:
   Solution: Check Pump “On” and "Redundant OFF" floats
   Contact: Septic System Installer

CONTACT INFORMATION:

System Failure: Surfacing sewage at septic tank, pipeline, drainfield or components:
CONTACT: Northeast Tri-County Health District. Colville, (509) 684-2262
Solution: Determine causes, obtain permit to commence repairs by a certified installer.

For general troubleshooting contact Cunningham Engineers: 609 Gold Creek Loop
Colville, WA 99114
(509) 684-5036

SYSTEM INSTALLER

For problems concerning Septic System Installation: ______________________________

____

(Name, phone, address) ______________________________

____

ELECTRICAL CONTRACTOR

For Electrical installation / control panel concerns: ______________________________

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(Name, phone, address) ______________________________

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FOR SPECIFIED EQUIPTMENT CONTACTS SEE DRAWINGS

Task 9 - Reidel Creek Infiltration - Project Cost Estimate

For Doubled Pair of Stilling Wells with Dual Pumps to Bottomless Chamber Infiltration System 10/27/2019

Sub-Task	Task Description	Material, Equipment, Fuel and Labor:	Quantity	Units	Rate	Line Total	Sub-Task Subtotal
1	**Equipment Transport and Rental:** (Transport Labor Included for Mobilize and Demobilize) Equipment Setup, Demobilization, and Rental	Mobilize/Demobilize	5.00	each	$800.00	$4,000.00	
		Dump Truck + Fuel	4.00	weeks	$1,350.00	$5,400.00	
		Large Excavator + Fuel	4.00	weeks	$2,700.00	$10,800.00	
		Backhoe + Fuel	4.00	weeks	$1,117.00	$4,468.00	
		Shoring Box	1.00	weeks	$1,600.00	$1,600.00	
		Medium Dozer + Fuel	1.00	weeks	$1,900.00	$1,900.00	$28,168.00
2	**Dewatering:** Construct Catchment Dam, Install Pump and Piping past excavation area	Misc. Materials for Dam	1.00	each	$550.00	$550.00	
		(2) Trash Pumps + Fuel	1.00	week	$720.00	$720.00	
		Piping	1.00	week	$210.00	$210.00	
		Labor	16.00	hours	$85.00	$1,360.00	$2,840.00
3	**Excavation Near Creek:** Installing (4) Stilling Wells and (1) Electric Vault with Custom Steel Lid	Stilling Wells	4.00	each	$1,500.00	$6,000.00	
		Electric Vault	1.00	each	$1,000.00	$1,000.00	
		Custom Steel Vault Lid	1.00	each	$2,500.00	$2,500.00	
		Labor	40.00	hours	$85.00	$3,400.00	$12,900.00
4	**Avista Utility Power -- Service Extension:** 3000 feet extension, plus 300 feet digging through rock contingency	Pro-rated Materials, Labor	3000.00	L.F.	$10.10	$30,300.00	
		Rock Contingency	300.00	L.F.	$11.24	$3,372.00	
		Rock Contingency -- Equip	2.00	day	$2,200.00	$4,400.00	
		Flaggers	16.00	hours	$120.00	$1,920.00	$39,992.00
5	**Extraction Pump Installation:** Power Panel, Pump Control Panel and Floats	Electrician	1.00	lump sum	$8,000.00	$8,000.00	
		Pumps, Relays and Motors	2.00	each	$3,450.00	$6,900.00	
		Dehumidifier	1.00	each	$2,000.00	$2,000.00	
		Pump Panel, Floats	1.00	each	$2,500.00	$2,500.00	
		Labor	27.00	hours	$85.00	$2,295.00	$21,695.00
6	**Excavation and Installation for Infiltration Field:** Installing 200 linear feet of gravelless chambers, plumbing and backfilled with backfill sorted through contractor supplied grizzley bars	Gravelless Chambers	200.00	L.F.	$9.00	$1,800.00	
		Pipe	1060.00	L.F.	$3.00	$3,180.00	
		Cleanout/Monitoring Ports	4.00	each	$200.00	$800.00	
		Infiltration Field Valves	5.00	each	$60.00	$300.00	
		Labor	108.00	hours	$85.00	$9,180.00	$15,260.00
7	**Permitting:** Water Rights, Ecology (Per RCW 90.03), Electrical Permit	Labor/Fees	1.00	each	$25,000.00	$25,000.00	
8	**Contractor's Administrative**	Labor	6.00	hours	$85.00	$510.00	$510.00
				Subtotal:		$146,365.00	$121,365.00 (checking)
9				**15% Contingency:**		$21,954.75	
10				**10% Construction**		$14,636.50	
11				**5% Program**		$7,318.25	
12				**TOTAL:**		$190,000.00	

13 **References:**

Stevens County Cost List

Quote from Avista, Electrician, Installation Contractor (Time/Materials estimate)

Northeast WA LWG 2008 EQIP Payment Schedule (Adjusted for inflation at 3%/yr)

Capacity: 31 Acre-Ft Cost/Acre-Ft: $6,100.00

NOTE: Cost/Acre-Ft limited only by supply, 62 Acre-Ft Max Capacity with existing equipment would result in one-half this Cost/Acre-Ft