

LITTLE SPOKANE (WRIA 55) WATERSHED PLAN ADDENDUM

Prepared for:
WRIA 55 Planning Unit (Lead Agency-Spokane County)

Project No. 180249 • July 2, 2020 DRAFT





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Acronyms

afy	acre-feet per year
amsl	above mean sea level
Aspect	Aspect Consulting, LLC
BDAs	beaver dam analogues
cfs	cubic feet per second
DNR	Washington State Department of Natural Resources
Ecology	Washington State Department of Ecology
ESSB	Engrossed Substitute Senate Bill
FFFPP	Family Forest Fish Passage Program
GIS	geographic information systems
GMA	Growth Management Act
gpm	gallons per minute
INLC	Inland Northwest Land Conservancy
LSR	Little Spokane River
MAR	managed aquifer recharge
NEB	net ecological benefit
OFM	Office of Financial Management
PALS	Post Assisted Log Structures
PHs	Priority Habitats and Species
PSA	Purchase and Sale Agreement
RCW	Revised Code of Washington
ROE	Reports of Examination
SCD	Spokane Conservation District
SVRP	Spokane Valley-Rathdrum Prairie
TWRP	Trust Water Right Program
WAC	Washington Administrative Code
WAUs	Watershed Administrative Units
WIG	Washington Irrigation Guide
WRIA	Water Resource Inventory Area
WWD	Whitworth Water District
WDFW	Washington State Department of Fish and Wildlife

Executive Summary

The passage of Engrossed Substitute Senate Bill (ESSB) 6091, as codified by RCW 90.94, requires that an update to the existing Watershed Plan for Water Resource Inventory Area (WRIA) 55, the Little Spokane Watershed, be approved by the Washington Department of Ecology (Ecology) by February 1, 2021. WRIA 55 has an instream flow rule in place governed by WAC 173-555 that includes it in the RCW 90.94 process. For watersheds with existing instream flow rules and existing watershed plans, including WRIA 55, ESSB 6091 and RCW 90.94 allows for new exempt wells to continue to be authorized by counties through their building permit process while a watershed plan update is developed to address future exempt well use and associated streamflow restoration projects.

Section 202(4)(c) of ESSB 6091 states:

“Prior to adoption of the updated watershed plan, the department must determine that actions identified in the watershed plan, after accounting for new projected uses of water over the subsequent twenty years, will result in a net ecological benefit to instream resources within the water resource inventory area.”

Previous watershed planning in WRIA 55 was conducted in combination with WRIA 57 (Middle Spokane River). The watershed plan for WRIs 55/57 was adopted in 2006. This addendum to the watershed plan (Plan Addendum) has been prepared to meet the requirements of ESSB 6091 and RCW 90.94, and to demonstrate that an appropriate set of offset projects has been developed to substantially offset new projected uses of exempt wells over the required 20-year horizon, thereby resulting in a Net Ecological Benefit (NEB).

Preparation of this Plan Addendum has been completed through a collaborative effort with the WRIA 55 Initiating Governments and Planning Unit members. The process was supported by convening the WRIA 55 Planning Unit to review technical tasks and memorandums, policy decisions, and this Plan Addendum.

The NEB evaluation presented in this Plan Addendum concludes that:

- The combined water balance at the WRIA scale from proposed offset projects indicates a basinwide surplus of 1,908 afy relative to the estimated 20-year permit-exempt well demand, exceeding water offset requirements for WRIA 55 required by RCW 90.94. This surplus provides reasonable assurance that permit exempt demand will be offset in WRIA 55. If some offset projects are not developed due to funding constraints or other issues, a subset of projects can still provide sufficient water offset to meet projected demand.
- Most subbasins have sufficient water offset projects identified to meet or exceed projected 20-year subbasin permit-exempt well demand, with the exception of two subbasins. Many of the subbasins have non-water offset projects proposed,

including the two subbasins with offset water deficits. The non-water offset projects support the attainment of NEB.

- The projects are realistic, consist of project types regularly funded by state and federal funding programs, and have a solid scientific foundation.
- Key agencies and stakeholders with experience in implementing projects have proposed offset projects for inclusion in this Plan Addendum for WRIA 55, including Spokane County, Spokane Conservation District, Pend Oreille Conservation District, The Lands Council, The Inland Northwest Land Conservancy, Spokane Tribe of Indians, and Washington Department of Fish and Wildlife.
- A water right acquisition project was funded in 2019 from the Streamflow Restoration Grant Program. Spokane County currently holds 283.4 afy in the Little Spokane water bank, and five applications were submitted for Streamflow Restoration Grant Program funding in 2020 which demonstrates a commitment to implementing the Plan Addendum.
- Water offset and non-water offset projects are distributed throughout WRIA 55 including in the upper portions of the basin providing instream flow benefits to significant river miles in the tributaries and mainstem.
- The WRIA 55 Planning Unit has reached concurrence that this Plan Addendum demonstrates that the combined components of the plan do achieve NEB.

1 Introduction

The passage of Engrossed Substitute Senate Bill (ESSB) 6091, as codified by RCW 90.94, requires that an update to the existing Watershed Plan for Water Resource Inventory Area (WRIA) 55, the Little Spokane Watershed, be approved by the Washington Department of Ecology (Ecology) by February 1, 2021. Passage of the law followed the 2016 *Whatcom County v. Hirst, Futurewise, et al.* Washington State Supreme Court Decision (the “Hirst decision”). The Hirst decision placed the burden on counties to address legal availability of water for exempt wells as part of the building permit approval and planning process. WRIA 55 has an instream flow rule in place governed by WAC 173-555 that incorporates the watershed into the RCW 90.94 process.

For watersheds with existing instream flow rules and existing watershed plans, including WRIA 55, ESSB 6091 and RCW 90.94 allows for new exempt wells to continue to be authorized by counties through their building permit process while a watershed plan update is developed to address future exempt well use and associated streamflow restoration projects.

1.1 Overview of Plan Addendum Requirements

ESSB 6091 includes the following language (excerpted here) relevant to updating the WRIA 55 Watershed Plan:

- In Section 202(2) “the department shall work with the initiating governments and the planning units described in chapter 90.82 RCW to review existing watershed plans to identify the potential impacts of exempt well use, identify evidence-based conservation measures, and identify projects to improve watershed health”
- In Section 202(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. Watershed plan recommendations may include, but are not limited to, acquiring senior water rights, water 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.”
- In Section 202(4)(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 Section 202(4)(c) “Prior to adoption of the updated watershed plan, the department must determine that actions identified in the watershed plan, after accounting for new projected uses of water over the subsequent twenty years, will result in a net ecological benefit to instream resources within the water resource inventory area.”

WRIA 55 is included in a combined WRIA55/57 watershed plan that was adopted in 2006. Ecology issued a Streamflow Restoration Policy and Interpretive Statement on July 31, 2019, which stated:

“A complete update of all the elements of the original watershed management plan is not required for WRIs planning under RCW 90.94.020. The requirement to update an existing watershed management plan applies specifically to the objectives of the Streamflow Restoration legislation.”

In addition to the requirements set forth in ESSB 6091 and the Streamflow Restoration Policy and Interpretative statement, Ecology developed Guidance for Determining Net Ecological Benefit (GUID-2094, Ecology, 2019). This guidance includes these minimum planning requirements:

- Utilization of clear and systematic logic
- Delineation of subbasins
- Estimation of new consumptive water uses
- Evaluation of impacts from new consumptive water use
- Description and evaluation of projects and actions for their offset potential

1.2 Planning Unit Participation and Coordination

Spokane County Environmental Services is serving as the lead agency for this process. The WRIA 55 Initiating Governments for the watershed planning process are Spokane County, Stevens County, Pend Oreille County, the City of Spokane, and Whitworth Water District. The process was supported by convening the WRIA 55 Planning Unit to review technical tasks and memorandums, policy decisions, and this Plan Addendum. Aspect Consulting, LLC (Aspect) has been contracted by Spokane County to facilitate planning unit meetings, conduct supporting technical tasks, and prepare the Watershed Plan Addendum (Plan Addendum).

In November 2018, the first meeting of the WRIA 55 Planning Unit was convened to begin the process of updating the WRIA 55 Watershed Plan through this Plan Addendum. Since that time, eight total Planning Unit meetings were held, along with two technical workshops in support of the collaborative process involved in preparing this Plan Addendum.

Planning Unit Meeting agendas and meeting minutes are available on the Spokane County's website (<https://www.spokanecounty.org/3843/WRIA-55-Watershed-Plan-Update>).

Table 1 below presents a list of Planning Unit members and participation. All of the organizations listed were invited to participate; however, some chose not to as indicated in the table.

Table 1. WRIA 55 Planning Unit Members

Organization	Initiating Government	Planning Unit Member	Participation
Spokane County	X	X	Yes
Stevens County	X	X	Yes
Pend Oreille County	X	X	Yes
Whitworth Water District	X	X	Yes
City of Spokane	X	X	Yes
Kalispel Tribe of Indians		X	Yes
Spokane Tribe of Indians		X	Yes
Colville Tribe		X	Yes
City of Deer Park		X	Yes
Stevens County PUD		X	Yes
Spokane County Water District #3		X	Yes
Diamond Lake Sewer and Water District		X	No
Spokane Regional Health District		X	Yes
Spokane Conservation District		X	Yes
Stevens County Conservation District		X	Yes
Pend Oreille County Conservation District		X	Yes
Department of Ecology		X	Yes
Washington Department of Fish and Wildlife		X	Yes
Spokane County Farm Bureau		X	Yes
Stevens County Farm Bureau		X	Yes
Eloika Lake Association		X	Yes
Spokane Association of Realtors		X	Yes
Spokane Home Builders		X	Yes
Friends of the Little Spokane Valley		X	Yes
League of Women Voters		X	Yes
The Lands Council		X	Yes
Center for Environmental Law and Policy		X	Yes
Futurewise		X	Yes
Trout Unlimited		X	Yes
Citizens Alliance for Property Rights		X	No
Spokane Riverkeeper		X	Yes

Organization	Initiating Government	Planning Unit Member	Participation
Responsible Growth Northeast Washington		X	Yes
Spokane County Cattlemen’s Association		X	Yes
Stevens County Cattlemen’s Association		X	No

1.3 Plan Approval

Ecology Policy 2094 Streamflow Restoration Policy and Interpretative Statement states that the approval procedure identified under RCW 90.82.130, the statute that the original WRIA 55/57 Plan was adopted under, is not specifically required under RCW 90.94.020. The Initiating Governments entered into a Memorandum of Agreement (MOA) (Appendix A) in June 2018 to guide the development and approval of the Plan Addendum including the following provisions:

5.0 Process:

- 5.1 The planning process entails a collaboration between the initiating governments and stakeholders identified in Attachment “A” actively participating in the planning unit. A facilitator may be contracted to assist in implementing a congenial consensus-building methodology to ensure participant interests and concerns are considered in the development of a fact-based WRIA 55 Watershed Plan Update.
- 5.2 All decisions or actions other than approval of the WRIA 55 Watershed Plan Update not resolved during the planning process specified in 5.1 shall require a motion and a majority vote of the initiating governments. Only the designated representative of an initiating government may call for a decision or action by motion.
- 5.3 Approval of the WRIA 55 Watershed Plan Update shall require a super majority vote (2/3) of the initiating governments.

The MOA and approval process were presented at the first and second Planning Unit meetings. During this planning process all participant interests and concerns were considered, and the Initiating Governments voted on to approve this Plan Addendum.

2 Background

This section provides references to previous watershed planning in WRIA 55, the physical setting of the watershed, and habitat conditions to provide context for the offset projects presented in this Plan Addendum.

2.1 Previous Watershed Planning in WRIA 55

Section 202(2) of ESSB 6091 requires a review of the existing watershed plan for WRIA 55:

“the department shall work with the initiating governments and the planning units described in chapter 90.82 RCW to review existing watershed plans to identify the potential impacts of exempt well use, identify evidence-based conservation measures, and identify projects to improve watershed health”

Previous watershed planning in WRIA 55 was conducted in combination with WRIA 57 (Middle Spokane River). The Watershed Plan (Little Spokane River and Middle Spokane River Planning Unit, 2005) for WRIsAs 55/57 was adopted in 2006, and the Detailed Implementation Plan (WRIA 55/57 Watershed Implementation Team, 2008) was approved in 2008 for WRIsAs 55/57.

Ecology issued initial policy interpretations on ESSB 6091 in March 2018, including its interpretation that the requirement to review existing watershed plans is a procedural step to help inform the participants in the planning process in their endeavor to update the watershed plan as directed under Section 202(4)(a). Ecology noted it does not interpret the new law to necessitate a comprehensive review of the entire watershed plan. As stated in Section 202(4)(a) the purpose of the review is to identify references to:

- The potential impacts of exempt well use
- Evidence-based conservation measures
- Projects to improve watershed health

This required review is documented in a Technical Memorandum presented in Appendix B of this Plan Addendum. The findings of the watershed plan review were discussed with the WRIA 55 Planning Unit in a February 20, 2019 meeting.

2.2 Physical Setting of WRIA 55

The Little Spokane River Basin encompasses 679 square miles along the eastern border of Washington including areas in Spokane, Pend Oreille and Stevens Counties (Figure 1). Elevations in the watershed range from more than 5,300 feet above mean sea level (amsl) in the north and east sides of the basin to approximately 1,540 feet amsl at the junction of the Little Spokane River and Spokane River.

The Little Spokane River Basin can be broadly split into two regions; the Columbia Plateau region, and the Northern Rocky Mountains region. Broad and relatively flat topographic features with deeply incised river drainages characterize the Columbia Plateau region of the southern portion of the basin. Steep-sided canyons and relatively straight river courses characterize the Rocky Mountains region to the north. Evergreen

forests are the primary land cover in the mountainous areas to the north and east. Agricultural lands are interspersed throughout the watershed, but the majority are found on the south and west sides of the watershed. The remaining portions of the watershed are composed of urban areas, rangeland, wetlands and barren land (Golder, 2003).

2.2.1 Climate and Hydrology

The climate of the Little Spokane River Basin is generally warm and dry in the summer and cool and moist in the winter. Large variations in climate occur across the watershed from a sub humid mountain climate in the north to semiarid in the south. Annual precipitation also varies spatially within the basin and temporally throughout the year. There is significantly more precipitation in the upper elevation areas in the north eastern portion of the basin, and during the winter and spring months. On average, precipitation during July, August, and September is less than 2 inches.

The Little Spokane River Basin is largely a snowmelt driven system. Significant snowpack accumulates mostly in the eastern and northern portions of the basin at relatively high elevations. Up to 60 percent of the total precipitation falls as snow during the winter months over the higher elevations in the watershed. Snowmelt along with spring precipitation produces a large spring runoff. Tributary streams with steep slopes in the headwaters rapidly convey the surface runoff and then experience low summer flows, causing seasonal distribution problems. The main stem of the Little Spokane River also conveys the significant runoff, but during summer months has a sustained base flow derived from groundwater. Summer and early fall are the periods when the instream flows established by WAC 173-555 are often not met in the mainstem of the Little Spokane River, and there are also numerous tributary closures in place during this time.

2.2.2 Hydrogeology

Hydrogeology within the Little Spokane River Basin can be divided into two important components: the Spokane Valley-Rathdrum Prairie (SVRP) aquifer and Little Spokane River aquifers. The SVRP aquifer is a prolific aquifer that is interconnected with the Spokane River and the lower portion of the Little Spokane River, below the Dartford gage. It is governed under WAC 173-557, and is not associated with the planning requirement for WRIA 55 in RCW 90.94.

The hydrogeology of WRIA 55 is varied and complex. Groundwater in the basin is principally found in four hydrogeologic units:

- Upper Sand and Gravel Unit – This unit is composed mostly of sand and gravel and occurs on about 32 percent of the surface area of the watershed. This unit receives recharge from precipitation and snow melt during the winter and spring, and provides base flow to surface water during the summer and fall. This unit is capable of producing significant quantities of water.
- Columbia River Basalt Unit – This unit is comprised of the basalt formations and sedimentary interbeds. Groundwater occurs in the joints, vesicles, fractures and sedimentary interbeds. The largest occurrence of this unit is found in the middle portion of the watershed in the Deer Park area, where much of the agriculture in the watershed is located.

- Bedrock Unit – This unit underlies the entire basin and occurs at land surface on approximately 44 percent of the basin’s surface area. It is comprised of granite, quartzite, schist and gneiss. This unit produces quantities of water suitable for domestic use where fractures can be found.
- Lower Sand and Gravel Unit – This unit is comprised of localized sand and gravel aquifers found beneath low permeability confining layers. This unit can produce significant quantities of water and hosts some large municipal production wells in the southern portion of the watershed.

These hydrogeologic units are commonly heterogeneous and locally discontinuous. Groundwater movement in WRIA 55 generally mimics the surface-water drainage pattern of the basin, moving from the topographically high tributary-basin areas toward the topographically lower valley floors (Kahle et al, 2013).

Spokane County previously received a grant from the Bureau of Reclamation’s Drought Resiliency grant program to develop modeling tools to identify and quantify projects aimed at enhancing streamflows. Through that project, a transient integrated surface and groundwater model was developed for WRIA 55 by EarthFX, a consulting group specializing in groundwater modeling, using the USGS modeling package GSFLOW (WEST, Earthfx, 2018). This model provides a tool for ongoing watershed management in WRIA 55 and was employed to conduct analysis of managed aquifer recharge (MAR) projects as part of preparing this Plan Addendum.

2.3 Habitat Considerations

The Little Spokane River watershed, or WRIA 55, supports a variety fish species with redband trout being particularly important. Redband trout is a subspecies of rainbow trout and those within the Little Spokane River are included in the upper Columbia River Basin geographic population group. Redband trout habitat is distributed throughout the Little Spokane River mainstem and the tributaries of Dartford, Deadman, Little Deep, Deer, Dragon, Buck, and Otter Creeks (Western Native Trout Initiative, 2010).

Spokane County has prepared a summary of current aquatic habitat conditions to support the Net Ecological Benefit (NEB) evaluation. That report reviews existing information on habitat conditions, both basin wide and by specific subbasin, including the intrinsic potential of stream reaches to support redband trout and steelhead. It provides figures showing:

- Distribution of redband trout
- Known areas of poor riparian habitat
- Identified fish passage barriers
- Intrinsic potential habitat for steelhead/redband trout
- Potential wetland restoration sites
- Intrinsic potential habitat for chinook

This report is incorporated into the Plan Addendum as Appendix C for reference.

3 Projected Exempt Well Demand

Section 202 of ESSB 6091, which is applicable to WRIA 55, contains several provisions regarding how updated watershed plans are to offset or account for projected water use.

Specifically, Section 202(4)(b) states, in part:

“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.”

In March 2018, Ecology issued Recommendations for Water Use Estimates (Ecology, 2018) for ESSB 6091 that provides guidance on evaluation of future exempt well demand. Key excerpts from this document include:

- Timeframe:** To evaluate and offset potential consumptive impacts from permit-exempt domestic wells, a timeframe over which new domestic¹ use will be considered must be designated. Since a “subsequent twenty years” is referenced throughout other sections of ESSB 6091 (such as sections 202(4)(c), Ecology interprets the timeframe for 202(4)(b) ... to be the next **twenty years**. In its *Interim Guidance for Determining Net Ecological Benefit*², Ecology further clarified that this 20-year planning horizon begins on the date ESSB 6091 was signed into law – January 19, 2018.
- Scope of “water use”:** Ecology interprets all projected water use referenced in sections 202(4)(c)...to refer to only **consumptive permit-exempt domestic groundwater water use** (as opposed to water use associated with municipalities, or permit exempt use for commercial and industrial purposes for example).
- Consumptive use:** Water Resources Program Policy 1020 (1991) states, “Consumptive water use causes diminishment of the source at the point of appropriation,” and that, “Diminishment is defined as to make smaller or less in quantity, quality, rate of flow, or availability.” This guidance document is focused on estimating only quantity diminishment, so for the purposes described here, consumptive water use is considered water that is evaporated, transpired, consumed by humans, or otherwise removed from an immediate water environment due to the use of permit-exempt domestic wells.
- Subbasins:** ESSB 6091 is written in the context of WRIA-wide mitigation, so Ecology interprets the words “same basin or tributary” to refer to subareas or subbasins as opposed to entire WRIsAs. For the purposes of this document, the

¹ Ecology’s *ESSB 6091-Streamflow Restoration Initial Policy Interpretations* defines domestic use as “indoor and outdoor uses for a household (including watering of a lawn and noncommercial garden).”

<https://fortress.wa.gov/ecy/publications/documents/1811008.pdf>

² <https://fortress.wa.gov/ecy/publications/documents/1811009.pdf>

term “subbasin” is equivalent to the words “same basin or tributary” as used in sections 202(4)(b).

The NEB Guidance includes two components for the evaluation of permit exempt demand:

- Development of an estimate of new consumptive water use, and
- Evaluation of impacts from new consumptive use.

3.1 Estimate of New Consumptive Use

The evaluation of exempt well demand in WRIA 55 conducted as part of preparing this Plan Addendum is discussed in detail in Appendix D. It includes an evaluation of future exempt well demand on a subbasin level and on a 20-year horizon within WRIA 55 that meets the requirements of ESSB 6091.

Figure 1 presents a map of WRIA 55 delineating the subbasins used in the evaluation, which are the Washington Department of Natural Resources (DNR) Watershed Administrative Units (WAUs) and are consistent with subbasin boundaries used in previous watershed planning and management, with the exception of the Dartford subbasin. This subbasin includes areas that drain to Dartford Creek, the Spokane Valley Rathdrum Prairie aquifer, and the mainstem of the Little Spokane. To address those complexities the following approach was utilized:

1. Demand projected to occur in the area governed by WAC 173-557 (Instream flow rule for the Spokane River and Spokane Valley Rathdrum Prairie aquifer) was removed from the analysis. Permit-exempt wells in this area are regulated separately, and Ecology has established a water bank to mitigate for new uses.
2. Demand from exempt wells in the Dartford subbasin that do not impact Dartford Creek, and those that impact the mainstem Little Spokane River were separated. The change results in the addition of a Mainstem Little Spokane River subbasin to the DNR WAUs.

WRIA 55 extends into Spokane, Stevens, and Pend Oreille Counties. All three counties have conducted analysis and worked cooperatively together to develop estimates of future residential permits in WRIA 55 outside of areas with public water service to support the development of the exempt well demand estimates. Prior to conducting the exempt well demand analysis described in detail in Appendix D, staff from Spokane, Stevens, and Pend Oreille Counties, Aspect, and Ecology discussed potential approaches with consideration of Ecology’s Recommendations for Water Use Estimates for ESSB 6091.

The 20-year WRIA 55 exempt well demand estimate that forms the basis for the NEB analysis and required water offset totals was developed and refined through several iterations and distribution of draft memorandums to the Planning Unit.

The first scenario presented to the planning unit was based on the Office of Financial Management (OFM) medium growth estimates for Spokane County, and historical growth rates in Stevens County and Pend Oreille County. The OFM medium estimate for

Spokane County was utilized for consistency with Growth Management Act (GMA) planning. These estimates were lower than historical growth rates. Some Planning Unit members were concerned that this estimate was too low. To accommodate those concerns and to provide reasonable assurance that enough water offset is developed over the planning horizon, the historical growth rate was utilized for Spokane County, which results in 40 percent more single-family residences than the OFM projections. Table 2 presents the number of single-family residences projected over the planning horizon, including the estimate based on OFM and historical growth rates for Spokane County.

Table 2. Projected Growth in Single-Family Residences

	Spokane County (OFM)	Spokane County (Historical)	Stevens County	Pend Oreille County
Dartford Creek	93	131		
Mainstem LSR	124	174		
Dragoon Creek	281	395	179	
Deadman-Peone Creek	319	448		
Beaver Creek	155	218	65	
Otter Creek	156	219		194
West Branch	67	94	2	138
Little Spokane/Deer Creek	261	366		
Little Deep Creek	98	137		
Total	1554	2182	246	332

In addition to utilizing a higher growth rate in Spokane County, Planning Unit members were concerned that potential impacts from climate change may require additional offset. To address this concern, 10 percent additional consumptive use was added to the exempt well demand based on modeling analysis of climate change impacts. Table 3 illustrates the increase in demand from including the climate change contingency, which is the demand scenario approved by the Planning Unit at its March 5, 2020 meeting for inclusion in this Plan Addendum.

See Appendix D for additional details on this analysis, including the climate change analysis. The final estimate of new consumptive water use is 2,353.69 acre-feet per year (afy) or 3.25 cubic feet per second (cfs).

Table 3. Total Projected Combined Indoor/Outdoor Consumptive Use in WRIA 55, 20-Year Planning Horizon (with Climate Change 10 percent Contingency Factor)

WRIA 55 Subbasins	Without Climate Change Contingency Factor		With Climate Change Contingency Factor	
	Projected Consumptive Use (afy)	Projected Consumptive Use (cfs)	Projected Consumptive Use (afy)	Projected Consumptive Use (cfs)
Dartford Creek	124.91	0.17	137.40	0.19
Mainstem	165.91	0.23	182.51	0.25
Dragoon Creek	456.05	0.63	501.65	0.69
Deadman-Peone Creek	483.31	0.67	531.64	0.73
Beaver Creek	217.47	0.30	239.22	0.33
Otter Creek	298.04	0.41	327.84	0.45
West Branch	86.53	0.12	95.18	0.13
Little Spokane/Deer Creek	240.03	0.33	264.03	0.36
Little Deep Creek	67.48	0.09	74.22	0.10
TOTAL	2139.72	2.95	2353.69	3.25

3.2 Evaluation of Impacts from New Consumptive Use

New development is expected to be distributed throughout each subbasin and not concentrated in any specific location as is common with development supplied by public water supplies. Wells associated with permit exempt development will be completed in all hydrogeologic units present in WRIA 55 at various depths. While water use and pumping associated with residential development has a seasonal increase during the summer months, this impact will be attenuated by the distance from surface water both laterally and vertically. The distribution of wells and attenuation of changes in pumping rates creates an impact of equal magnitude throughout the year, or a steady state impact.

While impacts are steady state, they represent the greatest percentage of surface flow during the low flow periods of late summer and early fall. Consistent with this impact, several water offset projects are included in this Plan Addendum that focus on providing the greatest benefit during low flow periods.

This approach to assessing impacts from new consumptive use is consistent with Ecology's interpretation provided in Appendix B of GUID-2094: *Final Guidance for Determining Net Ecological Benefit* (Ecology, 2019)

“The conclusion of this appendix is that in most instances pumping impacts associated with new permit-exempt domestic withdrawals will be quite small, well dispersed, and nearly steady-state with respect to streams. Also, in general it will not be possible and is unnecessary to evaluate the impacts of pumping at individual locations. Planning groups can assume the impacts from new permit-exempt domestic withdrawals over the planning horizon will be steady-state.”

4 Identified Offset Projects

This section of the Plan Addendum provides descriptions of identified water and non-water offset projects in support of the required NEB evaluation presented in Section 6.

4.1 Development of Project Proposals

Project proposals were developed through evaluation of studies and projects done during the development and implementation of the WRIA 55/57 Watershed Plan (Little Spokane River and Middle Spokane River Planning Unit, 2005), and Detailed Implementation Plan (WRIA 55/57 Watershed Implementation Team, 2008), projects funded by Watershed Planning implementation grants, development of the Little Spokane Water Bank, and the development and use of the Little Spokane integrated ground and surface water model. Additional technical assessment was conducted during the development of the Plan Addendum. Based on this information Spokane County and Aspect identified water offset project proposals.

On December 10, 2019, Aspect submitted a request to WRIA 55 Planning Unit participants to submit water and non-water offset project proposals for the Planning Unit's consideration. The request included a form for providing specific information regarding the proposals. Projects received through this solicitation are summarized in this section, along with water offset projects identified and investigated by Spokane County and Aspect as described above. The solicitation forms submitted by WRIA 55 Planning Unit participants are provided in Appendix H. Streamflow Restoration Grant applications were submitted in April 2020 for five WRIA 55 projects. The project summaries and scope of work from each grant application is also provided in Appendix H.

4.2 Considerations for Implementing Proposed Offset Projects

Ecology's GUID-2094: *Final Guidance for Determining Net Ecological Benefit*, states that the Plan Addendum must include an assessment of the likelihood that project and action benefits will occur and recommends an assessment of possible barriers to implementation. The following factors were suggested for planning groups to consider:

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

- Connections to existing projects and actions, such as land use regulations
- The role of adaptive management in plan implementation

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

4.3 Categories of Proposed Offset Projects

This section summarizes identified water and non-water offset projects in support of establishing NEB for WRIA 55. The summary is provided based on the following categories of projects:

4.3.1 Identified Water Offset Projects

- Water right purchases – Placing valid water rights into Ecology’s Trust Water Rights Program (TWRP) and the associated cessation of use provides direct instream flow benefits and mitigation for exempt well use. This includes prospective purchases and purchases already completed by Spokane County in support of the Little Spokane Water Bank.
- Managed aquifer recharge (MAR) projects identified through modeling/geographic information systems (GIS) investigations – MAR projects involve the capture of surface water and infiltration to groundwater, when water is physically and legally available. Successful MAR projects result in streamflow benefits during critical low streamflow periods.
- MAR projects with preliminary design status – Field investigations were conducted at three potential MAR sites identified through modeling/GIS investigations, and two MAR project sites now have preliminary design work completed and site access secured.
- Surface water storage projects – Surface water storage projects involve the retention of surface water when water is physically and legally available, for later release during critical low streamflow periods.
- Water supply source exchange – This involves using alternative sources for water supply that lessen or eliminate impacts at the original water source location, providing streamflow benefits to adjacent surface water bodies from cessation of use at the former source location.

4.3.2 Identified Non-Water Offset (Habitat Projects)

- Fish barrier removal – These projects involve replacing or modifying culverts to remove barriers to fish passage, thereby increasing available accessible habitat.
- Floodplain restoration – Restoration can include reconnecting side channels and other modifications to stream channel morphology, levee modifications, and enhancement of associated riparian vegetation.

- Habitat restoration/enhancement – Habitat restoration projects can include enhancing riparian vegetation, placing woody debris, gravel augmentation, and other activities that improve habitat.
- Land acquisition – These projects include acquisition (or easements) that protect land from future development and allow preservation and restoration of upland and riparian habitat to preserve and enhance the aquatic environment.

4.3.3 Identified Opportunistic Projects

- Seeking new opportunities for water right purchases
- Future identification of culvert/fish barrier projects
- Future landowner interest in habitat restoration projects

4.4 Summary of Proposed Offset Projects

A summary of water and non-water offset projects reviewed and approved by the WRIA 55 Planning Unit for inclusion in the Plan Addendum is presented in this section. Figure 2 shows the location of the offset projects along with established subbasin boundaries for reference. The projects below are provided with reference numbers that are shown on Figure 2, with the exception of projects that are basinwide.

4.4.1 Water Offset Projects

Water Right Purchases – Proposed by Spokane County

Several water rights have been identified for potential purchase in WRIA 55 based on seller interest. As noted previously, placing valid water rights into the Ecology’s TWRP and the associated cessation of use provides direct instream flow benefits and offset for permit-exempt well use in perpetuity.

During the development of the Little Spokane Water Bank, Spokane County conducted an extensive search for water rights available for acquisition in WRIA 55. Spokane County purchased two water rights which are now in the Little Spokane Water Bank. Five additional water rights were identified but not acquired for the water bank. Spokane County submitted an application for a Streamflow Restoration Grant in 2019 to acquire water rights with WRIA 55. The funding was awarded, but it was determined that a direct purchase by Ecology for the benefit of water offset in WRIA 55 was the best administrative approach. Ecology has contracted with Aspect to facilitate the acquisition of water rights detailed in Streamflow Restoration Grant WRSRP-2019-SCUWRS-00006.

Ecology recently approved a Purchase and Sale Agreement (PSA) template for these purchases, and Aspect is moving forward on working with interested sellers to obtain executed PSAs. Following this work and in coordination with Ecology, Aspect will support required preparation of Reports of Examination (ROEs) for the water right transfers to trust.

Provided that agreements are reached with potential sellers of the water rights, these projects are considered technically feasible. Ecology is providing funding for these

purchases and logistical support. No operation and maintenance expenses are associated with water right purchases placed in trust.

Spokane County has ownership of two water rights (CG3-24214(A), G3-20511C) currently in the TWRP that it purchased for the Little Spokane Water Bank. These are included in the water right purchase summary section below. The water bank offsets new permit exempt use in the same way as other water offset projects, but includes one additional step, the issuance of a mitigation certificate. Once a mitigation certificate is issued it is permanently dedicated to offsetting water use for a new permit exempt use. Accounting for the use of mitigation certificates for RCW 90.94 offset could be done in one of two ways: 1) remove the number of homes that could be supported by the water bank from the projected demand, or 2) add the quantity of water currently available in the water bank to the offset total in the same way as other water rights. This plan incorporates the second approach.

It is understood by Spokane County that many new permit exempt well users would not purchase mitigation certificates if there is a lower cost option available, i.e. payment of the \$500 fee required under RCW 90.94. However, there are instances where the water bank provides a unique solution to water availability for permit exempt well development that may be preferable. For example, Spokane County recently updated its mitigation ordinance to allow for a process to use mitigation certificates in rural developments that require more water than is allowed by the permit exemption (i.e., to address issues raised by the findings of *Ecology v Campbell & Gwinn*)³. The County is currently working through the process identified in the mitigation ordinance for an 80-lot development in the Beaver Creek subbasin. This development is at the density of one home per ten acres), consistent with the categories of properties that were incorporated into the demand estimate. Developments of this type would not induce additional development not already considered in the demand estimate. Mitigation certificates will only be issued that will offset water for homes that would have otherwise required RCW 90.94 offset, as the intent of the water bank has always been to support rural exempt well mitigation in WRIA 55.

The water bank also provides a tool for ongoing plan implementation. For example, if there is a deficit in the comparison between new permit exempt demand and actual implemented water offset projects, and there is available water in the water bank, the County can seek funding to permanently transfer to Ecology portions of available water bank quantities into trust for supporting RCW 90.94 offset totals.

The following water right purchases are being pursued at this time:

G3-23099C (G3-CV2-SP52) (Project 1)

Description on Water Right Certificate: 120 gallons per minute (gpm), 78 afy from May 1 to Sept 30, irrigation of 36 acres

Expected Total Water Savings/Streamflow Benefits: The point of withdrawal for G3-23099C is located in the Little Spokane/Deer Creek subbasin. The water duty assigned is less than that required for irrigation of 36 acres with pasture/turf per the

³ <https://caselaw.findlaw.com/wa-supreme-court/1329095.html>

Washington Irrigation Guide (WIG). Given this, all of the 78 afy are assumed to be consumptive. Use of irrigation rights over multiple seasons generally result in a year-round, dampened impact to the groundwater flow regime at greater distances away from the point of withdrawal. Cessation of use of this groundwater right is expected to provide 78 afy of benefit to instream flows in the Little Spokane/Deer Creek subbasin and the Little Spokane River.

G3-*02228CWRIS (Project 2)

Description on Water Right Certificate: 300 gpm, 180 afy, for irrigation of 60 acres

Expected Total Water Savings/Streamflow Benefits: The point of withdrawal for G3-*02228CWRIS is located in the Beaver Creek subbasin of WRIA 55. The Beaver Creek subbasin includes the upper reaches of Dragoon Creek. Review of water use indicates that approximately 40 acres, rather than 60 acres, are currently being irrigated. Based on irrigation of 40 acres with alfalfa, consumptive use is estimated to be approximately 100 afy per the WIG. Cessation of use of this groundwater right is expected to provide 100 afy of benefit to instream flows in Dragoon Creek (in both the Beaver Creek and Dragoon Creek subbasins) and the Little Spokane River.

G3-*01844CWRIS (Project 3)

Description on Water Right Certificate: 600 gpm, 160 afy, for irrigation of 40 acres

Expected Total Water Savings/Streamflow Benefits: The point of withdrawal for G3-*01844CWRIS is located near the confluence of Dragoon Creek and the mainstem of the Little Spokane River. Based on irrigation of 40 acres with alfalfa, consumptive use is estimated to be approximately 100 afy per the WIG. Cessation of use of this groundwater right is expected to provide 100 afy of benefit to instream flows in Dragoon Creek and the Little Spokane River.

S3-*12724CWRIS (Project 4)

Description on Water Right Certificate: 0.15 cfs, 50 afy, for irrigation of 20 acres

Expected Total Water Savings/Streamflow Benefits: The point of diversion for S3-*12724CWRIS is located near the confluence of Dragoon Creek and the mainstem of the Little Spokane River and is authorized for diversion from an unnamed stream. Based on irrigation of 20 acres with alfalfa, consumptive use is estimated to be approximately 50 afy per the WIG, the full authorization of the water right. Cessation of use of this water right is expected to provide 50 afy of benefit to instream flows in Dragoon Creek and the Little Spokane River.

S3-*06812CWRIS (Project 5)

Description on Water Right Certificate: 0.15 cfs, 50 afy, for irrigation of 20 acres

Expected Total Water Savings/Streamflow Benefits: The point of diversion for S3-*06812CWRIS is located on Dragoon Creek and is authorized for diversion from an unnamed stream. Based on a review of irrigation and discussions with the owner, it appears that up to 20 acres were irrigated. Consumptive use is estimated to be approximately 50 afy. Cessation of use of this water right is expected to provide 50 afy of benefit to instream flows in Dragoon Creek and the Little Spokane River.

CG3-24214(A) – (Project 6)

This water right is owned by Spokane County and is currently held in the TWRP for instream flow mitigation purposes in support of rural residential development. It was purchased by the County as part of developing the Little Spokane Water Bank. Ecology accepted 255.4 afy into the TWRP for mitigation.

Expected Total Water Savings/Streamflow Benefits: The point of diversion for CG3-24214(A) was located in the Beaver Creek subbasin prior to cessation of its use. Based on a suitability map associated the Trust Water Right Agreement for this water right, it provides 255.4 afy of benefit to flows in Dragoon Creek (in both the Beaver Creek and Dragoon Creek subbasins) and the Little Spokane River.

G3-20511C (Project 7)

This water right is owned by Spokane County and is currently held in the TWRP for instream flow mitigation purposes in support of rural residential development. It was purchased by the County as part of developing the Little Spokane Water Bank. Ecology accepted 28 afy into the TWRP for mitigation.

Expected Total Water Savings/Streamflow Benefits: The point of diversion for G3-20511C was located in the Dragoon Creek subbasin prior to cessation of its use. Based on a suitability map associated the Trust Water Right Agreement for this water right, it provides 28 afy of benefit to flows in Dragoon Creek and the Little Spokane River.

MAR Projects with Modeling/GIS Investigations – Proposed by Spokane County

Project Cost: MAR project cost estimates through design, permitting, and implementation are expected to be approximately \$650,000 per project. Operation and maintenance costs are expected to be approximately \$22,500 per year per site.

As noted previously, MAR projects involve the capture of surface water and infiltration to groundwater, when water is physically and legally available, with successful MAR projects resulting in streamflow benefits during critical low streamflow periods. It is assumed that implemented MAR projects would be operated in perpetuity to address mitigation requirements. MAR has been shown to be technically feasible at other locations, provided that subsurface conditions, water availability and quality, and site access are suitable. Ecology supports the use of MAR projects for mitigation.

Selection of potential MAR sites included a site optimization analysis incorporating use of a previously developed transient integrated surface and groundwater model developed for WRIA 55 by EarthFX, a consulting group specializing in groundwater modeling, using the USGS modeling package GSFLOW⁴. Model results were combined with GIS analysis to evaluate potentially suitable MAR locations within WRIA 55. The investigation was documented in a memorandum distributed to the WRIA 55 Planning Unit in December 2019 and included in this Plan Addendum

⁴ <http://www.spokanewatersheds.org/wria-55-57-current-projects>

(Appendix E). MAR projects were simulated in the model with the following conditions:

- One cfs was diverted to the proposed project location and recharged over the period March, April, and May.
- Streamflow was calculated at a nearby downstream location from the recharge site.
- Modeling was done over the period 2002-2017 which included various hydrologic conditions including the 2015 drought. This modeling period provides a robust evaluation of longer-term response of groundwater discharge to surface water as a result of aquifer recharge.

Eighteen sites were investigated for potential MAR projects as documented in the optimization memorandum referenced above. Of these, nine sites show modeled instream flow benefits, with 180 afy per year of benefit estimated from each of the suitable sites for a total of 1,620 afy in combined water offsets. In some subbasins, multiple sites were investigated. In that case, the selected site also has a subbasin site number or other clarifying reference designated. Please refer to Figure 2 for the distribution of the following sites:

- Milan Road/Bear Creek (Little Spokane/Deer Creek subbasin – Project 8): This site was selected for field investigations and preliminary design work, as discussed in the following section. Successful implementation of a MAR project at this site would benefit instream flows in Bear Creek and the mainstem of the Little Spokane River below their confluence.
- Dry Creek, Site 1 (Otter Creek subbasin – Project 9): This site was also selected for field investigations and preliminary design work, as discussed in the following section. Successful implementation of a MAR project at this site would benefit instream flows in Dry Creek and the mainstem of the Little Spokane River below their confluence.
- Otter Creek, Site 3 (Otter Creek subbasin – Project 10): Successful implementation of an MAR project at this site would benefit instream flows in Otter Creek and the mainstem of the Little Spokane River below their confluence.
- County Park/Last Chance Road (West Branch subbasin – Project 11): Successful implementation of a MAR project at this site would benefit instream flows in the West Branch and the mainstem of the Little Spokane River below their confluence.
- Little Deep Creek, Site 1 (Little Deep Creek subbasin – Project 12): Successful implementation of a MAR project at this site would benefit instream flows in Little Deep Creek and the mainstem of the Little Spokane River below their confluence.
- Deadman Creek, Site 1 (Deadman Creek/Peone Creek subbasin – Project 13): Successful implementation of a MAR project at this site would benefit instream

flows in Deadman Creek and the mainstem of the Little Spokane River below their confluence.

- Dry Creek, Site 2 (Otter Creek subbasin – Project 14): Successful implementation of a MAR project at this site would benefit instream flows in Dry Creek and the mainstem of the Little Spokane River below their confluence.
- Dragoon DNR (Dragoon Creek subbasin – Project 15): Successful implementation of a MAR project at this site would benefit instream flows in Dragoon Creek and the mainstem of the Little Spokane River below their confluence.
- Bear Creek (Little Spokane/Deer Creek subbasin – Project 16): Successful implementation of a MAR project at this site would benefit instream flows in Bear Creek and the mainstem of the Little Spokane River below their confluence.
- Deadman Creek, Site 2 (Deadman Creek/Peone Creek subbasin – Project 17): Successful implementation of a MAR project at this site would benefit instream flows in Deadman Creek and the mainstem of the Little Spokane River below their confluence.

MAR Projects in Preliminary Design Status – Proposed by Spokane County

Project Cost: Detailed MAR project cost estimates through design, permitting, and implementation are under development and are expected to be approximately \$650,000 per project. Operation and maintenance costs are expected to be approximately \$22,500 per year per site.

The two sites discussed in this section have been included in the water offset totals noted above. Field investigations were conducted at three potential MAR sites to support an evaluation of project feasibility and preliminary design work, as described in the Technical Memorandum provided in Appendix F. Field investigations began with infiltration testing, which indicated that one of the sites, the Feryn Conservation Area-Deadman Creek, had infiltration rates too low to feasibly implement surface infiltration. Given this determination, that site is not included in the MAR project list presented in this section.

Sites at Milan Road/Bear Creek (Project 7) and on Dry Creek, Site 1 (Project 8) both appear to be feasible for implementation of MAR projects based on infiltration rates, availability of source water during the higher streamflow months, groundwater and surface water quality analysis, engineering considerations, and site access. A technical memorandum summarizing preliminary engineering design work, permitting and water quality considerations, and capital and operation and maintenance cost estimates for each site was completed in June 2020, and is provided in Appendix G. Spokane County filed an application in March 2020 for a Streamflow Restoration Grant to implement the MAR project at Milan Road/Bear Creek (Appendix H).

Surface Water Storage – Eloika Lake Project – Proposed by Spokane County (Project 18)

Project Cost: Permitting and design: \$600,000; wetland restoration: \$1.8 million to \$3.7 million; outlet control structure: \$100,000 to \$300,000. Operation and maintenance costs are dependent on final design.

One surface water storage project, at Eloika Lake in the West Brach subbasin, has been identified that has significant potential to provide water offsets for WRIA 55. Studies completed to date indicated that approximately 1,400 acre-feet of water can be stored for release during low flow periods while still operating within the natural range of lake levels experienced each year. This would be achieved through design and construction of an outlet control structure capable of maintaining higher lake levels for a longer period each summer, resulting in significant late summer instream flow augmentation. The project would also support habitat restoration by restoring 100 acres of wetlands at the south end of the lake.

Through previous watershed planning funding, there was significant investigation into the feasibility of a water storage and wetland restoration project on Eloika Lake. In April 2009, PBS&J, (2009a) completed a surface water storage investigation in WRIA 55 and identified Eloika Lake as a potentially feasible surface water storage opportunity and recommended further investigation.

In June of 2009, PBS&J, (2009b) completed the Eloika Lake In-Depth Surface Water Storage and Wetland Restoration Feasibility study, which concluded that constructing a water control structure for Eloika Lake was a viable option for creating downstream flow benefits. PBS&J also conducted public outreach that indicated most landowners seemed to understand that the project was a benefit to the watershed and lake as well as to them individually. The project has remained on hold for several years due to lack of a funding source. Recent analysis by Spokane County and its consultants confirm that the project could provide approximately 1,400 afy of mitigation benefit.

This project is expected to be technically feasible, given studies conducted to date. Spokane County has conducted preliminary landowner outreach and has indications that the project will be supported. Spokane County filed an application in March 2020 for a Streamflow Restoration Grant to conduct site investigations, evaluate potential impacts to water quality and fish passage, stakeholder outreach, engineering design work through final design, and associated permitting work for this water offset project (Appendix H).

Source Exchange – Whitworth Water District System 8 Water Right Transfer – Proposed by Whitworth Water District (Project 19)

Project Cost: Total project costs are estimated at \$5,772,148.85. Whitworth Water District (WWD) has applied for a grant of \$1,143,898.80 from the Streamflow Restoration Grant Program and plans to fund the balance of the project with bonds and other grant funding. Costs include additional hydrogeologic modeling, design and construction, and acquisition of mitigation. WWD proposes to absorb all future operation and maintenance costs of the project into its normal system operations.

Project Overview: WWD utilizes water from both the SVRP aquifer and Little Spokane River aquifers (LSR aquifers). WWD wells within the LSR aquifers are in hydraulic

continuity with the Little Spokane River. Reduction of withdrawals from WWD's LSR aquifer wells will benefit instream flows. A new water right can be issued from the SVRP aquifer provided that there is mitigation for any impacts to Spokane River flows. WWD's proposed project seeks a new mitigated water right permit to withdraw up to 400 afy from the SVRP aquifer in exchange for donating the equivalent amount of water rights to the TWRP from the LSR watershed that predate the Instream Flow Rule and mitigating impacts to Spokane River flows. Water provided by the new mitigated SVRP water right will be conveyed to locations that are currently served by water from LSR aquifer wells.

This project includes additional modeling to assess the spatial extent of instream flow benefits, design and construction of additional conveyance infrastructure necessary to deliver SVRP water to locations currently served by water from LSR aquifers, and acquisition of a water right to provide mitigation for the new SVRP water right. All of the components of this project are feasible. WWD has consulted with Ecology regarding the issuance of a new mitigated water right from the SVRP aquifer and has tentatively identified a water right for acquisition that can serve as mitigation. WWD has identified necessary infrastructure improvements and is ready to move to design and construction. WWD filed an application in April 2020 for a Streamflow Restoration Grant to obtain funding for evaluation and implementation of this water offset project (Appendix H).

4.4.2 Non-Water Offset Projects

Fish Barrier Removal – Deer Creek Fish Barrier Removal Project – Proposed by Spokane Conservation District (Project 20)

Project Cost: Project development, design, and construction estimated to be \$124,750. Operation and maintenance costs are expected to be negligible.

The Spokane Conservation District (SCD) proposes replacing a stream crossing located on Deer Creek that has been evaluated and classified as a zero-percent passable fish barrier. The existing culvert is over-sloped and undersized, causing an impoundment upstream of the crossing and excessive velocities through the culvert. The barrier blocks salmonid migration to more than 9 miles of spawning and rearing habitat upstream of the crossing location. The upstream and downstream salmonid habitat are classified as excellent, with the exception of some local stream bank erosion and heavy siltation.

The proposed fish passage restoration approach for this site incorporates replacement of the existing culvert with a pre-fabricated steel bridge superstructure set on pre-cast concrete abutments, with pre-cast concrete end-wall closures and a gravel driving surface. The project is considered feasible, as it is similar to several other State-funded fish passage restoration projects that have been completed by the SCD within this subbasin through the Family Forest Fish Passage Program (FFFPP). This stream crossing is located one parcel downstream from a recently funded State of Washington Fish Barrier Removal Project #09-1708, scheduled for correction in the Fall of 2020, through the FFFPP. The project has a willing landowner and experienced project management/design/installation team as a proponent. The project is expected to have immediate impacts to restoring natural stream function and link with other work that is planned or has already been completed in this subbasin.

Floodplain Restoration – Dartford Creek Floodplain Restoration Project – Proposed by Spokane Conservation District (Project 21)

Project Cost: Project development, design, and construction estimated to be \$60,000. Operation and maintenance costs are expected to be negligible.

This project is intended to reconnect the floodplain, correct a fish barrier, and reestablish instream vegetation and habitat on Dartford Creek. The project is part of a multi-year phased approach to restore habitat in this area, which is adjacent to a no-till farm field. At the proposed location, the creek has a headcut with a 5-foot drop, with disconnected upstream and downstream reaches and fish populations. Phase one of the restoration, which involved planting the upland habitat and installing a 50-foot-long riparian forest buffer, was completed in 2019.

The proposed project would be the second and final phase of restoration. The objectives of the project would be to reconnect the floodplain to the creek, installing five 1-foot drops with a step system of weirs and pools, augmented by plantings and large woody debris. This work would remove the fish barrier at the head cut and reconnect the reaches. The streambanks will be pulled back from vertical to a more appropriate 1:1 ratio, with the instream habitat improved by installing vegetation within the riparian zone. A cultural resource survey was completed during phase one, and there are no concerns for the project location. Additionally, this streamside restoration is part of a larger land management effort taking place on this property. The upland agricultural practices were converted in recent years to a direct seed operation to improve soil health and decrease soil erosion. The project has a willing landowner and experienced project management/design/installation team as a proponent.

Habitat Restoration/Enhancement – Dartford Creek Habitat Restoration Project – Proposed by Spokane Conservation District (Project 22)

Project Cost: Project development, design, and construction estimated to be \$17,000. Operation and maintenance costs are expected to be negligible.

The proposed project includes 320 feet of stream habitat restoration on Dartford Creek. This project proposal is downstream from a recent 2019 SCD riparian project that implemented a 50-foot riparian buffer. The completion of these two projects will reconnect 700 feet of habitat at these sites. This project would install a 50-foot-long riparian buffer, utilizing native species found in an analogous forest 500 feet upstream. In addition to the buffer installation, a series of Post Assisted Log Structures (PALS) will be installed to improve habitat, induce sinuosity, and increase turbulence, which will lead to an increase in dissolved oxygen content. The streamside restoration is part of a larger land management effort taking place on this property. The upland agricultural practices were converted in recent years to a direct seed operation to improve soil health and decrease soil erosion in this generally steep topography. The project has a willing landowner and experienced project management/design/installation team as a proponent.

Habitat Restoration/Enhancement – Little Spokane Riparian Habitat Restoration Project – Proposed by Spokane Conservation District (Project 23)

Project Cost: Project development, design, and construction estimated to be \$12,000. Operation and maintenance costs are expected to be limited to \$1,000.

This project will restore the riparian and upland bank habitat on a 200-foot bank of the Little Spokane River near the Riverside community. The reach currently has limited biodiversity, with only grass and weeds present, and little shading or habitat for fish and wildlife. A restoration plan will be developed and implemented to riparian and upland vegetation and filter the runoff from the homesite adjacent to the river. This reach has been identified as having poor to fair ecological conditions.

Planting along the reach will provide valuable fish and wildlife habitat. Planting will extend from the edge of the stream channel out 50 feet and more where possible. This will improve the water quality, decrease runoff, provide stabilization and improve habitat of the reach. The project has a willing landowner and experienced project management/design/installation team as a proponent.

Habitat Restoration/Enhancement – Westover Habitat Restoration Project – Proposed by Pend Oreille Conservation District (Project 24)

Project Cost: Project development, design, and construction estimated to be \$46,250. Operation and maintenance costs are expected to be negligible.

The Pend Oreille Conservation District proposes to place large woody debris in a reach of the Little Spokane River near its headwaters, in addition to restoring riparian vegetation on the streambanks. The project would improve habitat and function of approximately 0.5 miles of the mainstem. The project would address concerns regarding inadequate streamflow velocities due to previous channel straightening that have led to excessive streambed siltation, and would address a lack of diverse riparian vegetation and shading that result in warmer river water temperatures. The project is feasible, and has a willing landowner and the support of the Pend Oreille Conservation District.

Habitat Restoration/Enhancement – Cygiel Habitat Restoration Project – Proposed by Pend Oreille Conservation District (Project 25)

Project Cost: Project development, design, and construction estimated to be \$46,250. Operation and maintenance costs are expected to be negligible.

The Pend Oreille Conservation District proposes to install 850 feet of livestock fencing along a reach of the Little Spokane River near its headwaters, in addition to restoring riparian vegetation on the streambanks on 3+ acres. The project would improve habitat and function of approximately 0.5 miles of the mainstem. The project would address concerns of riparian degradation due to livestock access, and address a lack of diverse riparian vegetation. The project is feasible, and has a willing landowner and the support of the Pend Oreille Conservation District.

Habitat Restoration/Enhancement – Stockton Streamflow Restoration Project – Proposed by Pend Oreille Conservation District (Project 26)

Project Cost: Project development, design, and construction estimated to be \$37,500. Operation and maintenance costs are expected to be negligible.

The Pend Oreille Conservation District proposes to place large woody debris in a 2,200-foot reach of the Little Spokane River, in addition to restoring riparian vegetation on the streambanks. The project would improve habitat and function of approximately 0.5 miles of the mainstem. The project would address a lack of diverse riparian vegetation and shading that result in warmer river water temperatures.

Habitat Restoration/Enhancement – WRIA 55 Fish Barrier Assessment and Prioritization Project – Proposed by Washington Department of Fish and Wildlife (WDFW) (Basinwide Project)

Project Cost: Project development, design, and construction estimated to be \$333,000. Operation and maintenance costs would not be incurred by the study.

Minimal work has been done to date to identify and assess stream crossing structures and fish passage barriers within the WRIA 55. Although data collected from the various entities and managed by WDFW show that there are 84 known barriers within WRIA 55, there are large gaps in the fish passage data. The goal of this project is to inventory all areas of WRIA 55 that have not been previously surveyed and prioritize for removal/replacement. This information would serve as a basis for prioritizing and obtaining funding for future fish barrier removal projects.

All stream crossings associated with roads (both closed and open roads) and trails on fish bearing streams within WRIA 55 will be recorded and evaluated. Open roads would be surveyed using a vehicle, closed roads and trails on foot. Streams and segments of streams will be determined to be “fish bearing” if they meet any of the following criteria:

- Have an ordinary high-water width of >3 feet and a stream gradient <20 percent
- Are identified as “fish bearing” by WDFW’s Priority Habitats and Species (PHS) or other fish distribution database
- Are identified as Type F by DNR
- Have documented salmonid use determined by visual observation, electrofishing, or verification by local biologists

GIS analysis would be used to estimate potential habitat gain for each barrier utilizing natural barrier data and the sources listed above to determine extent of fish bearing habitat. After the data is prioritized and the top 5 barriers are known, WDFW would compose 25 percent design criteria for these barriers. This data will support addition of new, opportunistic barrier removal projects to the offset project list for WRIA 55, as fish passage barrier correction has an immediate positive affect on access to habitat through the potential miles of stream opened to fish passage.

This work is expected to be a collaborative effort between many potential stakeholders to include; Spokane County, SCD, DNR, Stevens County, Pend Oreille County, State Parks, Spokane Tribe of Indians and private landowners.

Habitat Restoration/Enhancement – Little Spokane Watershed Habitat Evaluation and Restoration – Proposed by Spokane Tribe Fisheries and Water Resources Division (Basinwide Project)

Project Cost: Project development, habitat evaluation and documentation are estimated to be \$400,000. Construction of habitat restoration projects is estimated to be \$500,000. Monitoring of completed restoration projects is estimated to be \$50,000.

Many of the previous habitat assessments in WRIA 55 have been largely qualitative, relying on expert opinion and modeling exercises as a means to characterize instream habitats and their quality relative to supporting native fish populations. The WRIA 55 and 57 Watershed Management Plan adopted in 2006 states in section III.A.01 d.

“Recommend a study on the Little Spokane River tributaries on optimizing habitat for the target species and linking the preferred flows on the tributaries to flows at the control points”. Since that time a comprehensive evaluation of the watershed and specific actions to correcting limiting factors have not been identified.

This project would conduct stream habitat monitoring and evaluation on the Little Spokane River and its tributaries to identify areas where instream and off-channel habitat can be restored, implement necessary restoration actions, then provide follow-up monitoring after restoration has been completed to document the change in condition. Restoration actions to be implemented would be consistent with current best management practices that have demonstrated improvements to water quality, water quantity, and landscape processes. These actions may include improving fish passage, reconnecting floodplain habitats and historic channels, riparian restoration, or improvements to upland habitats. Benefits from these wide-ranging habitat restoration actions have been demonstrated to improve water quality and quantity, while also increasing habitat complexity and the species that rely on these varying environments. Given the land ownership and access constraints within the watershed, partnerships with private landowners would need to be developed beforehand.

Habitat Restoration/Enhancement – Beaver Dam Analogue Project on Deadman Creek – Proposed by The Lands Council (Project 27)

Project Cost: Project development, design, and construction estimated to be \$25,000. Operation and maintenance costs are expected to be limited to \$1,500 for the first two years to support riparian plant establishment.

The Deadman Creek/Peone Creek subbasin is a priority watershed for habitat restoration for both the WRIA 55 Watershed Plan Update given limited opportunities for direct water offset projects. It is also a priority region for restoration for the Little Spokane River TMDL Update. The Lands Council proposes to install beaver dam analogues (BDAs) in the creek to trap sediment, slow the flow, and improve habitat. In addition to the BDAs, the proposal involves planting the riparian area with a mix of willow cuttings and potted native trees. While no landowner agreements are in place, a property owner has expressed interest in the project and offered support to conduct outreach to build support with neighboring property owners. The placement and design of the BDAs would be done with help from Ecology and installed by The Lands Council. The project is considered feasible provided that landowner access agreements can be secured.

Habitat Protection – Waikiki Springs Habitat Preservation Project – Proposed by The Inland Northwest Land Conservancy and Spokane Tribe of Indians (Project 28)

Project Cost: The land associated with this potential acquisition is currently listed for sale at \$1,600,000. Project costs for a potential second phase of work for habitat restoration have not been quantified. Operation and maintenance costs would not be directly associated with the land acquisition but would be assessed if fish habitat restoration and reintroduction occur at a later date.

Inland Northwest Land Conservancy (INLC) and the Spokane Tribe of Indians (Spokane Tribe) propose creating a new nature preserve along the north shore of the Little Spokane River between the WDFW Fish Hatchery and Dartford, WA. Their mutual goal is to conserve the undeveloped floodplain (95 acres) and over 1,700 feet of shoreline along the Little Spokane River for future salmon reintroduction activities, habitat protection, and facilitation of public access. The proposed nature preserve is adjacent to a relatively intact high functioning riparian habitat immediately adjacent to major North Spokane neighborhoods such as Fairwood I and Fairwood II, which contain over a thousand homes. Protecting this property and preserving the value it provides is considered highly important by INLC and the Spokane Tribe for maintaining the ecology of the area.

Purchase of the property is considered feasible if funding is obtained prior to it being purchased by other potential buyers. It has the support from the land conservancy expertise of INLC, a regional land trust that has successfully protected over 21,000 acres and over 41 miles of shoreline. The Spokane Tribe brings expertise from its Division of Fisheries and Water Resources to accelerate the future goal of reintroducing native anadromous species historically found in the waters of the Little Spokane River. The Spokane Tribe’s previous analyses determined there are significant amounts of high-quality habitat in the proposed project area.

4.4.3 Opportunistic Projects

Opportunistic project pursuits are proposed for inclusion in this Plan Addendum to provide for ongoing consideration of new project opportunities. These pursuits can be linked with increases or decreases in actual versus currently estimated new exempt well demand, which would potentially shift appropriate offset project needs. Three key types of opportunistic projects are included in this Plan Addendum:

- Seeking new opportunities for water right purchases. While several potential water right sellers have been identified in WRIA 55, more water right owners may express interest in selling water rights in the future.
- Future identification of culvert/fish barrier projects. A comprehensive study of fish barriers in WRIA 55 has not been conducted. Future work, such as that proposed by WDFW, could support identification of key fish barriers to focus on for removal or modification.
- Future landowner interest in habitat restoration projects. Members of the Planning Unit, including conservation districts, the Lands Council, and the Spokane Tribe have noted that habitat restoration projects are often opportunistic in nature based on the timing of landowner interest.

5 Plan Implementation

Implementation of this Plan Addendum will be achieved through the efforts of multiple Planning Unit member organizations in the watershed. The offset projects are the core of this Plan Addendum, and they will be implemented by the entities that have proposed them. A total of 4,262 afy of water offset projects have been proposed. Spokane County's projects total 3,862 afy, and Whitworth Water District's project is 400 afy. Non-water offset projects were proposed by the Spokane Conservation District, Pend Oreille Conservation District, The Lands Council, The Inland Northwest Land Conservancy, Spokane Tribe of Indians, and Washington Department of Fish and Wildlife. Each of the project proponents will further develop the project proposals provided in this Plan Addendum, secure funding, construct the project, and operate and maintain the project.

5.1 Funding

ESSB 6091 authorized \$300 million in capital funds to be dispersed between 2018 to 2033 for the following uses:

- Implement watershed restoration and enhancement projects developed under RCW 90.94.020 and 90.94.030; and to
- Collect data and complete studies necessary to develop, implement, and evaluate watershed restoration and enhancement projects.

In 2019, Ecology adopted a rule to establish process and criteria for prioritizing and approving funding applications. Chapter 173-566 WAC. Under Ecology's rule, projects located in watersheds planning under RCW 90.94.020, like the WRIA 55, and included in watershed plans adopted under RCW 90.94.020 will be given "added priority", (WAC 173-566-150). The projects identified for this Plan Addendum were evaluated based on a collaborative approach of the Planning Unit. The entities that have proposed projects contained in this Plan Addendum have a long history of successfully implementing similar projects. The Planning Unit recognizes there is an active, knowledgeable base of local entities to implement projects. As each project is funded, implementation of that project will include funding to ensure long-term success and consistency with other water resource protection measures. In addition to the Streamflow Restoration Grant program there are other applicable state and federal grant programs, including:

- Bureau of Reclamations WaterSmart Programs (e.g. Drought Resiliency, Water Efficiency, and Water Market programs)
- Ecology Office of Columbia River grant program
- Ecology Water Quality Program grants
- Various habitat restoration grant programs

The funding mechanisms established through ESSB 6091 did not, however, address ongoing implementation of this Plan Addendum. Ecology has indicated that under the current statutory framework for streamflow restoration, state funding will not be available to support ongoing implementation and offset project operations and maintenance. The WRIA 55 Planning Unit considers it a priority to petition the Washington State Legislature to provide ongoing funding for plan implementation and for operation and maintenance of offset projects, in addition to capital funding of projects. In the absence of state funding for this purpose, each project proponent would need to develop a funding source for operation and maintenance of their offset projects.

5.2 Monitoring and Management

Monitoring and managing of the projects identified in this Addendum will be completed through ongoing cooperative efforts from various groups, which may include the Initiating Governments and Planning Unit members that have proposed projects within this Plan Addendum. Some or all of these groups will need to identify funding sources to continue this work.

Each WRIA 55 County will continue to account for permit-exempt domestic groundwater withdrawals. Monitoring actual versus projected new domestic exempt well locations and the rates being established, will enable groups to adaptively manage the implementation of this Addendum to ensure ongoing funding requests for priority projects align with changing impacts/needs. The Planning Unit's estimate is that there will approximately be, on average, an additional 138 new domestic users relying on permit-exempt groundwater withdrawals annually. Each WRIA 55 County will continue to track each new building permit relying on a permit-exempt domestic groundwater withdrawal and geolocate the parcel in its GIS system. Review will be consistent with the recommendations for projects in this Plan Addendum.

5.3 Policy Decisions

RCW 90.94.020(4)(d) notes that the watershed plan may include:

- Recommendations for modification to fees established under this subsection
- Standards for water use quantities that are less than authorized under RCW 90.44.050 or more or less than authorized under subsection (5) of this section for withdrawals exempt from permitting
- Specific conservation requirements for new water users to be adopted by local or state permitting authorities
- Other approaches to manage water resources for a water resource inventory area or portions thereof

At the March 5, 2020 meeting, the Planning Unit reached concurrence that no recommendations under RCW 90.94.020(4)(d) should be recommended or included in this Plan Addendum.

6 Net Ecological Benefit Evaluation

This concluding section of the Plan Addendum provides an evaluation of NEB for WRIA 55 following Ecology’s GUID-2094: *Final Guidance for Determining Net Ecological Benefit* (Ecology, 2019). Key factors and considerations for the NEB Evaluation include:

- Evaluation of impacts from new consumptive water use associated with exempt wells. Section 5 of this Plan Addendum reviewed the conclusions of the exempt well demand analysis, with details on the analysis approach presented in a Technical Memorandum in Appendix D.
- Descriptions and evaluations of offset projects incorporated into the Plan Addendum. Section 6 of this Plan Addendum provided a summary of the set of proposed water and non-water offset projects, with additional details provided in Appendices D through G.
- Comparison of the water offset projects incorporated into the Plan Addendum to demand estimates for the entire watershed⁵ and on a subbasin basis.
- Review of projects and actions, including non-water offset projects, that provide the additional benefits to instream resources beyond those necessary to offset the impacts from new consumptive water use within the WRIA boundary.
- Addressing the ability to implement the Plan Addendum and associated offset projects.
- Concurrence from the WRIA 55 Planning Unit that the combined components of the Plan Addendum achieve NEB.

6.1 Demand Estimate Incorporated into the NEB Evaluation

The following Table 4 presents the 20-year WRIA 55 exempt well demand estimate that forms the basis for the NEB analysis and required water offset totals. This estimate was developed and refined through several iterations and distribution of draft memorandums to the Planning Unit, with the final scenario approved by the Planning Unit at its March 5, 2020 meeting. The first scenario presented to the planning unit was based on the OFM medium growth estimates for Spokane County, and historical growth rates in Stevens County and Pend Oreille County. The OFM medium estimate for Spokane County was utilized for consistency with Growth Management Act planning. These estimates were

⁵Ecology GUID-2094 notes that the NEB evaluation “*should describe the projected impacts and any offsets within each of the subbasins. Because all impacts at a minimum must be offset at the WRIA level, the evaluation should determine if the plan has succeeded in offsetting the impacts at the WRIA level. This means there may be instances where the amount of offsets provided in certain subbasins will be more or less than the projected new consumptive water use there. This is acceptable because the offsets are provided within the WRIA and in sufficient quantities.*”

lower than historical growth rates. Some Planning Unit members were concerned that this estimate was too low. To accommodate those concerns and to provide reasonable assurance that enough water offset is developed over the planning horizon, the historical growth rate was utilized for Spokane County. In addition to utilizing a higher growth rate in Spokane County, Planning Unit members were concerned that potential impacts from climate change may require additional offset, therefore, based on modeling analysis of climate change impacts 10 percent additional consumptive use was added to the exempt well demand.

Table 4. WRIA 55 Exempt Well Demand

WRIA 55 Subbasins	WRIA 55 Exempt Well Demand	
	Projected Consumptive Use (afy)	Projected Consumptive Use (cfs)
Dartford Creek	137.40	0.19
Mainstem	182.51	0.25
Dragoon Creek	501.65	0.69
Deadman-Peone Creek	531.64	0.73
Beaver Creek	239.22	0.33
Otter Creek	327.84	0.45
West Branch	95.18	0.13
Little Spokane/Deer Creek	264.03	0.36
Little Deep Creek	74.22	0.10
TOTAL	2353.69	3.25

6.2 Offset Project Contributions to Establishing NEB

Section 4 of this Plan Addendum described in detail the list of water and non-water offset projects approved by the Planning Unit for incorporation into this Plan Addendum. This section summarizes a comparison of the water offset projects to the demand estimates for the entire watershed and on a subbasin basis. Table 5 (attached) summarizes the demand and water offset totals.

Ecology’s GUID-2094 requires that NEB evaluation in the watershed plan addendum should describe the projected impacts and any offsets within each of the subbasins. Because all impacts at a minimum must be offset at the WRIA level, the evaluation should determine if the plan has succeeded in offsetting the impacts at the WRIA level. Ecology has acknowledged in GUID-2094 that *“this means there may be instances where the amount of offsets provided in certain subbasins will be more or less than the projected new consumptive water use there, and has stated this is acceptable because the offsets are provided within the WRIA and in sufficient quantities.”*

In order to address the comparison of water offset projects with estimated demand, mitigation quantities associated with the water offset projects described are presented below. In summary, the Planning Unit developed projects with quantities significantly greater than projected demand at the WRIA-level, and in all but two of the subbasins.

The following categories of projects and estimated mitigation quantities are included in the tally:

- Water right purchase G3-23099C (G3-CV2-SP52): 78 afy
 - Benefits Little Spokane/Deer Creek subbasin and Little Spokane River
- Water right purchase G3-*02228CWRIS: 100 afy
 - Benefits Beaver Creek subbasin, Dragoon Creek subbasin, and Little Spokane River
- Water right purchase G3-*01844CWRIS: 100 afy
 - Benefits Dragoon Creek subbasin and Little Spokane River
- Water right purchase S3-*12724CWRIS: 50 afy
 - Benefits Dragoon Creek subbasin and Little Spokane River
- Water right purchase S3-*06812CWRIS: 50 afy
 - Benefits Beaver Creek subbasin, Dragoon Creek subbasin, and Little Spokane River
- Water right purchase (owned by Spokane County) CG3-24214(A): 255.4 afy
 - Benefits Beaver Creek subbasin, Dragoon Creek subbasin, and Little Spokane River
- Water right purchase (owned by Spokane County) G3-20511C: 28 afy
 - Benefits Dragoon Creek subbasin and Little Spokane River
- Milan Road/Bear Creek MAR Project: 180 afy
 - Benefits Little Spokane/Deer Creek subbasin and Little Spokane River
- Dry Creek - Site 1 MAR Project: 180 afy
 - Benefits Otter Creek subbasin and Little Spokane River
- Otter Creek - Site 3 MAR Project: 180 afy
 - Benefits Otter Creek subbasin and Little Spokane River
- County Park/Last Chance Road MAR Project: 180 afy
 - Benefits West Branch subbasin and Little Spokane River
- Little Deep Creek - Site 1 MAR Project: 180 afy
 - Benefits West Branch subbasin and Little Spokane River
- Deadman Creek MAR Project: 180 afy
 - Benefits Deadman Creek/Peone Creek subbasin and Little Spokane River
- Dry Creek - Site 2 MAR Project: 180 afy
 - Benefits Otter Creek subbasin and Little Spokane River

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- Dragoon DNR MAR Project: 180 afy
 - Benefits Dragoon Creek subbasin and Little Spokane River
- Bear Creek MAR Project: 180 afy
 - Benefits Little Spokane/Deer Creek subbasin and Little Spokane River
- Eloika Lake Surface Water Storage: 1,400 afy
 - Benefits Little Spokane River
- Whitworth Water District Source Exchange Project: 400 afy
 - Benefits Little Spokane River

Figure 2 shows the distribution of water offset projects and non-water offset projects, along with accounting by subbasin of the water offsets. All water offset projects combined provide a mitigation benefit of 4,262 afy, compared to the high estimate for basin wide demand of 2,354 afy, indicating that the water offset projects provide more than enough water to offset the estimated exempt well demand at the WRIA level, as required.

Consistent with Ecology’s interpretation provided in Appendix B of GUID-2094: *Final Guidance for Determining Net Ecological Benefit* (Ecology, 2019) it is assumed that the impacts of exempt wells on instream flows will be steady state and well dispersed (i.e., no significant seasonal variations in instream flow impacts occur). In addition, the water offset project list includes projects that are intended to provide instream flow benefits specifically during the summer and early fall, when instream flows are often not met. For example, the Eloika Lake Storage Project and MAR projects are intended to provide instream flow benefits during that time of year. In addition, the surface water right currently authorized during the irrigation season will also provide direct benefits during that season from discontinuing their use.

The combined water balance at the WRIA scale indicates a basin wide surplus of 1,908 afy, supporting attainment of NEB by providing additional benefits to instream resources beyond those necessary to merely offset the anticipated 20-year demand in WRIA 55. This surplus supports flexibility and provides reasonable assurance that permit exempt demand will be offset in WRIA 55. If some offset projects are not developed due to funding constraints or other issues, a subset of projects can still provide sufficient water offset to meet projected demand. Projects implemented in excess of the projected demand provide additional instream benefit and contribute to achieving NEB.

Most of the WRIA 55 subbasins have sufficient offset supplies to meet estimated 20-year permit-exempt well demand, including:

- West Branch subbasin
- Beaver Creek subbasin⁶

⁶ Note that a surplus water offset in the Beaver Creek subbasin was transferred downstream to the Dragoon Creek subbasin in the offset accounting, given that the two subbasins are both part of the overall Dragoon Creek drainage.

- Dragoon Creek subbasin
- Otter Creek subbasin
- Little Spokane/Deer Creek subbasin
- Little Deep Creek subbasin

Two of the WRIA 55 subbasins have deficits in offset supplies, including:

- Deadman Creek/Peone Creek subbasin
- Dartford Creek subbasin

Many of the subbasins have non-water offset projects proposed that were previously presented in this report, including the subbasins with offset water deficits. The non-water offset projects are intended to contribute to achieving NEB and, where applicable, help compensate for subbasin water offset deficits.

Section 4 of this Plan Addendum discussed non-water offset projects incorporated into this NEB evaluation in detail. Please see Figure 2 for reaches identified with habitat restoration needs and Appendix C for a summary of current aquatic habitat conditions. The habitat projects in this Plan Addendum include:

- Deer Creek Fish Barrier Removal Project
 - Benefits habitat restoration in the Little Spokane/Deer Creek subbasin, which includes habitat for redband trout and contains reaches with high intrinsic potential for steelhead and redband trout.
- Dartford Creek Floodplain Restoration Project
 - Benefits habitat restoration in the Dartford Creek subbasin, one of the two subbasins with water offset deficits. Dartford Creek is habitat for redband trout and also contains reaches with high intrinsic potential for steelhead. Portions of Dartford Creek have also been identified as in need of habitat restoration.
- Dartford Creek Habitat Restoration Project
 - Benefits habitat restoration in the Dartford Creek subbasin, one of the two subbasins with water offset deficits. Dartford Creek is currently habitat for redband trout and contains reaches with high intrinsic potential for steelhead. Portions of Dartford Creek have also been identified as in need of habitat restoration.
- Little Spokane Riparian Habitat Restoration Project
 - Benefits the mainstem of the Little Spokane River in an area identified as in need of habitat restoration. This reach of the Little Spokane includes habitat for redband trout and contains reaches with high intrinsic potential for steelhead.
- Westover Habitat Restoration Project

- Benefits habitat restoration in the upper reach of the Little Spokane River, which has been identified as in need of habitat restoration.
- Cygiel Habitat Restoration Project
 - Benefits habitat restoration in the upper reaches of the Little Spokane River. This reach has been identified as in need of habitat restoration.
- WRIA 55 Fish Barrier Assessment and Prioritization Project
 - This is a basinwide project that will support habitat restoration throughout multiple reaches of existing and potential redband trout habitat.
- Little Spokane Watershed Habitat Evaluation and Restoration Project
 - This is a basinwide project that will support habitat restoration throughout multiple reaches of existing and potential redband trout habitat.
- Deadman Creek Beaver Dam Analogue Project
 - Benefits habitat restoration in the Deadman Creek subbasin, one of the two subbasins with water offset deficits. Deadman Creek is habitat for redband trout and also contains reaches with high intrinsic potential for steelhead. Deadman Creek also has significant reaches that have been identified as in need of habitat restoration.
- Waikiki Springs Habitat Preservation Project
 - Benefits habitat restoration in the mainstem of the Little Spokane River. This reach of the Little Spokane includes habitat for redband trout and contains reaches with moderate intrinsic potential for steelhead.

The combination of these ten non-water offset projects, including three in water offset deficit subbasins, and two additional basinwide projects, support attainment of NEB by providing additional benefits to instream resources beyond that necessary to merely offset the anticipated 20-year demand in WRIA 55.

6.3 Plan Addendum Implementation

Section 5 of this Plan Addendum described the approach to plan implementation. The Planning Unit considers it is likely that this plan will be implemented as intended based on the following factors:

- The projects are realistic, consist of project types regularly funded by state and federal funding programs, and have a solid scientific foundation based on the investigations funded through Streamflow Restoration Grants.
- Key agencies and stakeholders with experience in implementing projects have proposed offset projects for inclusion in this Plan Addendum for WRIA 55, including Spokane County, SCD, Pend Oreille Conservation District, The Lands Council, INLC, Spokane Tribe of Indians, and WDFW.
- Several of the proposed projects have progressed past the conceptual stage. The water right acquisitions documented in this Plan Addendum include two rights already purchased by Spokane County and held in trust by Ecology. The

additional water right purchases included in this plan have been vetted and are in the process of securing purchasing agreements and transfers to the TWRP. Two of the proposed MAR projects have had field investigations and preliminary design completed, and one has been put forward for funding in a Streamflow Restoration Grant application by Spokane County. Several other of the projects included in this Plan Addendum have Streamflow Restoration Grant applications pending, including the Eloika Lake Storage Project (Spokane County), the Whitworth Source Exchange Project (Whitworth Water District), the WRIA 55 Barrier Assessment and Prioritization Project (WDFW), and the Deer Creek Fish Barrier Removal Project (Spokane Conservation District).

6.4 Conclusions on Achievement of NEB in WRIA 55

The key conclusions from this NEB evaluation include:

- The combined water balance at the WRIA scale from proposed offset projects indicates a basinwide surplus of 1,908 afy relative to the estimated 20-year permit-exempt well demand, exceeding water offset requirements for WRIA 55 required by RCW 90.94. This surplus supports flexibility through adaptive management and provides reasonable assurance that permit exempt demand will be offset in WRIA 55. If some offset projects are not developed due to funding constraints or other issues, a subset of projects can still provide sufficient water offset to meet projected demand.
- Most subbasins have sufficient water offset projects identified to meet or exceed projected 20-year subbasin permit-exempt well demand. The Deadman Creek/Peone Creek and Dartford Creek subbasins are the exceptions, where deficits of 172 afy and 137 afy are estimated based on the current offset project list.
- Many of the subbasins have non-water offset projects proposed, including the two subbasins with offset water deficits (i.e., Deadman Creek/Peone Creek and Dartford Creek subbasin). The non-water offset projects support the attainment of NEB for these subbasins. The WRIA 55 Planning Unit considers it important to prioritize implementation of non-water habitat projects in these subbasins given the offset water deficits.
- The projects are realistic, consist of project types regularly funded by state and federal funding programs, and have a solid scientific foundation.
- Key agencies and stakeholders with experience in implementing projects have proposed offset projects for inclusion in this Plan Addendum for WRIA 55, including Spokane County, Spokane Conservation District, Pend Oreille Conservation District, The Lands Council, The Inland Northwest Land Conservancy, Spokane Tribe of Indians, and Washington Department of Fish and Wildlife.
- Water offset and non-water offset projects are distributed throughout WRIA 55 including in the upper portions of the basin providing instream flow benefits to significant river miles in the tributaries and mainstem.

- The WRIA 55 Planning Unit has reached concurrence that this Plan Addendum demonstrates that the combined components of the plan do achieve NEB.

References

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Limitations

Work for this project was performed for the WRIA 55 Planning Unit (Client), and this report was prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This report does not represent a legal opinion. No other warranty, expressed or implied, is made.

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TABLES

Table 5. WRIA 55 Offset Project Summary Table

Project No. 180249, WRIA 55, Washington

Projects by Subbasin	Project #	Project Proponent	Project Type	Subbasin Demand	Water Offset
Dartford Creek				137.4	
Dartford Creek Floodplain Restoration Project	21	Spokane Conservation District	Habitat		
Dartford Creek Habitat Restoration Project	22	Spokane Conservation District	Habitat		
Subbasin Surplus/Deficit				-137.4	
LSR Mainstem				182.51	
Whitworth Water District Source Exchange	19	Whitworth Water District	Water Offset		400
Little Spokane Riparian Habitat Restoration Project	23	Spokane Conservation District	Habitat		
Westover Habitat Restoration Project	24	Pend Oreille Conservation District	Habitat		
Cygiel Habitat Restoration Project	25	Pend Oreille Conservation District	Habitat		
Stockton Streamflow Restoration Project	26	Pend Oreille Conservation District	Habitat		
Waikiki Springs Habitat Preservation Project	28	Inland Northwest Land Conservancy	Habitat		
Subbasin Surplus/Deficit				217.49	
Beaver Creek				239.22	
G3-*02228CWRI Aquistion	2	Spokane County	Water Offset		100
CG3-24214(A) (Little Spokane Water Bank	6	Spokane County	Water Offset		255.4
Dragoon Creek				501.65	
Dragoon DNR MAR	15	Spokane County	Water Offset		180
G3-*01844CWRI Aquistion	3	Spokane County	Water Offset		100
S3-*12724CWRI Acquisition	4	Spokane County	Water Offset		50
S3-*06812CWRI Aquistion	5	Spokane County	Water Offset		50
G3-20511C (Little Spokane Water Bank)	8	Spokane County	Water Offset		28
Subbasin Surplus/Deficit¹				22.53	
Deadman-Peone Creek				531.64	
Deadman Creek Site 1 MAR	13	Spokane County	Water Offset		180
Deadman Creek Site 2 MAR	17	Spokane County	Water Offset		180
Beaver Dam Analogue Project on Deadman Creek	27	The Lands Council	Habitat		
Subbasin Surplus/Deficit				-171.64	
Otter Creek				327.84	
Dry Creek Site 1 MAR	9	Spokane County	Water Offset		180
Dry Creek Site 2 MAR	14	Spokane County	Water Offset		180
Otter Creek Site 3 MAR	10	Spokane County	Water Offset		180
Subbasin Surplus/Deficit				212.16	
West Branch				95.18	
Eloika Lake Surface Water Storage	18	Spokane County	Water Offset		1400
County Park/Last Chance Rd MAR	11	Spokane County	Water Offset		180
Subbasin Surplus/Deficit				1484.82	
Little Spokane/Deer Creek				264.03	
Milan Road/Bear Creek MAR	8	Spokane County	Water Offset		180
Bear Creek MAR	16	Spokane County	Water Offset		180
G3-23099C (G3-CV2-SP52) Acquisition	1	Spokane County	Water Offset		78
Deer Creek Fish Barrier Removal Project	20	Spokane Conservation District	Habitat		
Subbasin Surplus/Deficit				173.97	
Little Deep Creek				74.22	
Little Deep Creek Site 1 MAR	12	Spokane County	Water Offset		180
Subbasin Surplus/Deficit				105.78	
Basin Wide Projects					
WRIA 55 Fish Barrier Assessment and Prioritization Project	N/A	Washington Department of Fish and Wildlife	Habitat		
Little Spokane Watershed Habitat Evaluation and Restoration	N/A	Spokane Tribe of Indians	Habitat		
Basinwide Surplus/Deficit				1907.71	

Notes: 1-Beaver Creek flows into Dragoon Creek, and excess mitigation in Beaver Creek benefits Dragoon Creek. Therefore, for the purposes of this table the surplus/deficit is calculated for these subbasins in combination. All values in acre-feet per year.

Aspect Consulting

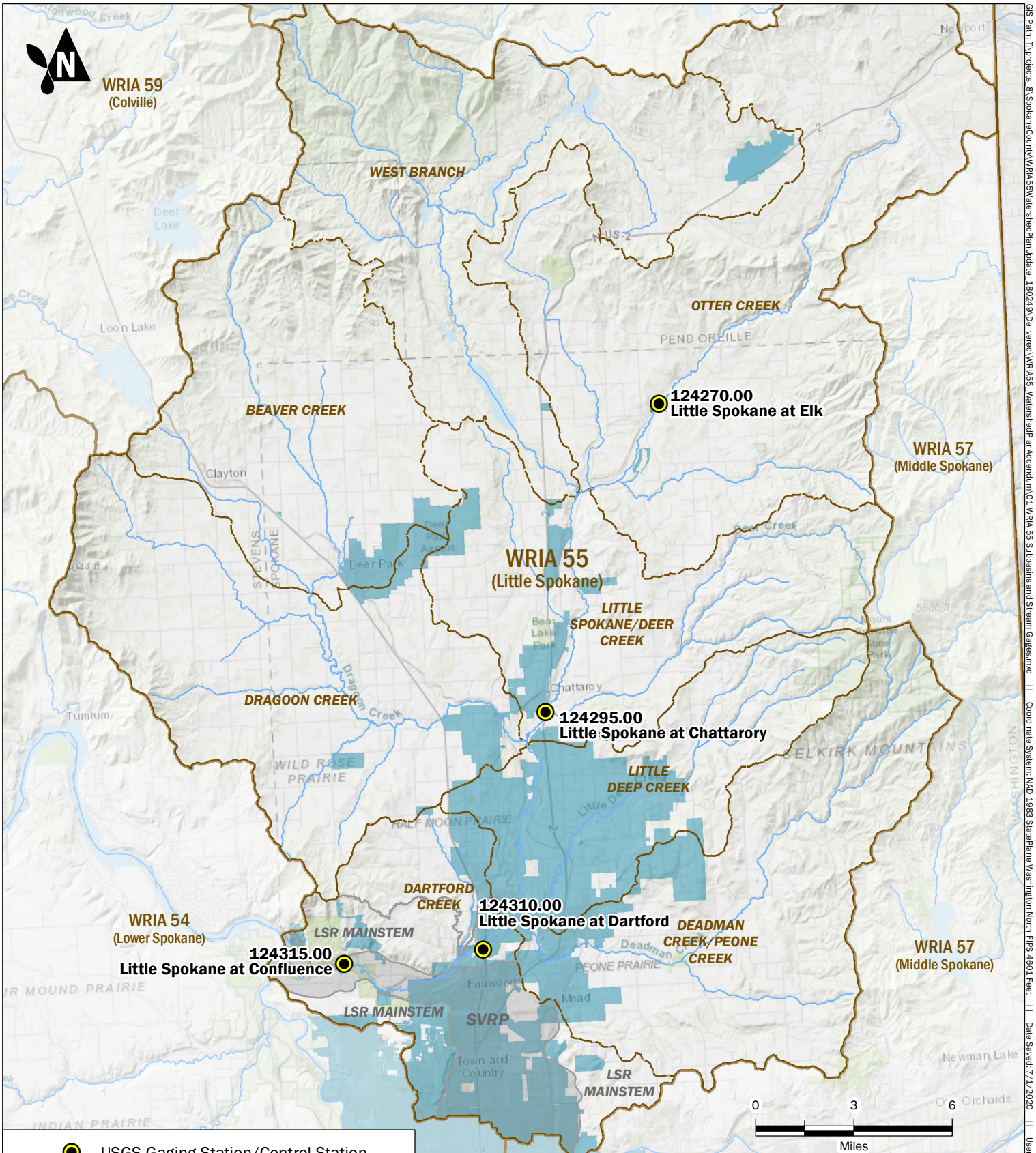
7/2/2020

S:\Little Spokane Watershed Planning 180249\Watershed Plan Addendum\WRIA 55 Plan Addendum Project Summary Table

Table 5

WRIA 55 Plan Addendum

FIGURES



WRIA 59
(Colville)

WEST BRANCH

OTTER CREEK

BEAVER CREEK

124270.00
Little Spokane at Elk

WRIA 57
(Middle Spokane)

WRIA 55
(Little Spokane)

LITTLE SPOKANE/DEER CREEK

DRAGON CREEK

124295.00
Little Spokane at Chattaroy

LITTLE DEEP CREEK

WRIA 54
(Lower Spokane)

DARTFORD CREEK

124310.00
Little Spokane at Dartford

DEADMAN CREEK/PEONE CREEK

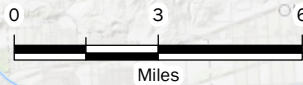
WRIA 57
(Middle Spokane)

124315.00
Little Spokane at Confluence

LSR MAINSTEM

SVRP

LSR MAINSTEM



USGS Gaging Station/Control Station

WRIA Boundary

WRIA 55 Subbasins

Named Watercourse

Public Water System Coverage

Notes:
-WRIA 55 Subbasin Source: Spokane County Water Resources Division of Utilities, 2015

WRIA 55 Subbasins and Stream Gages

Watershed Plan Addendum
Evaluation of Future Exempt Well Demand
ESSB 6091/RCW 90.94 Watershed Plan Update
WRIA 55, Washington

DRAFT

	JUL-2020	BY: CME / RAA	FIGURE NO. 1
	PROJECT NO. 140129	REVISED BY: EAC / SBM	

GIS Path: I:\Projects_8\SpokaneCounty\WRIA55\WatershedPlanUpdate_480291_9\Delivered\WRIA55_WatershedPlanAddendum_Q1\WRIA_55_Subbasins_and_Stream_Gages.mxd || Coordinate System: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet || Date Saved: 7/1/2020 || User: smorenson || Print Date: 7/1/2020

WRIA 55 (Little Spokane)

WRIA 62
(Pend Oreille)

WRIA 59
(Colville)

IDAHO

Total Offset = 4262 afy
Estimated 20-year Demand = 2354 afy
Combined Water Balance at WRIA Scale = 1908 afy

WRIA 55
(Lower Spokane)

Basin Wide Projects
 - Fish Barrier Assessment
 - Seek Additional Water Right Purchases

Water Offset Projects

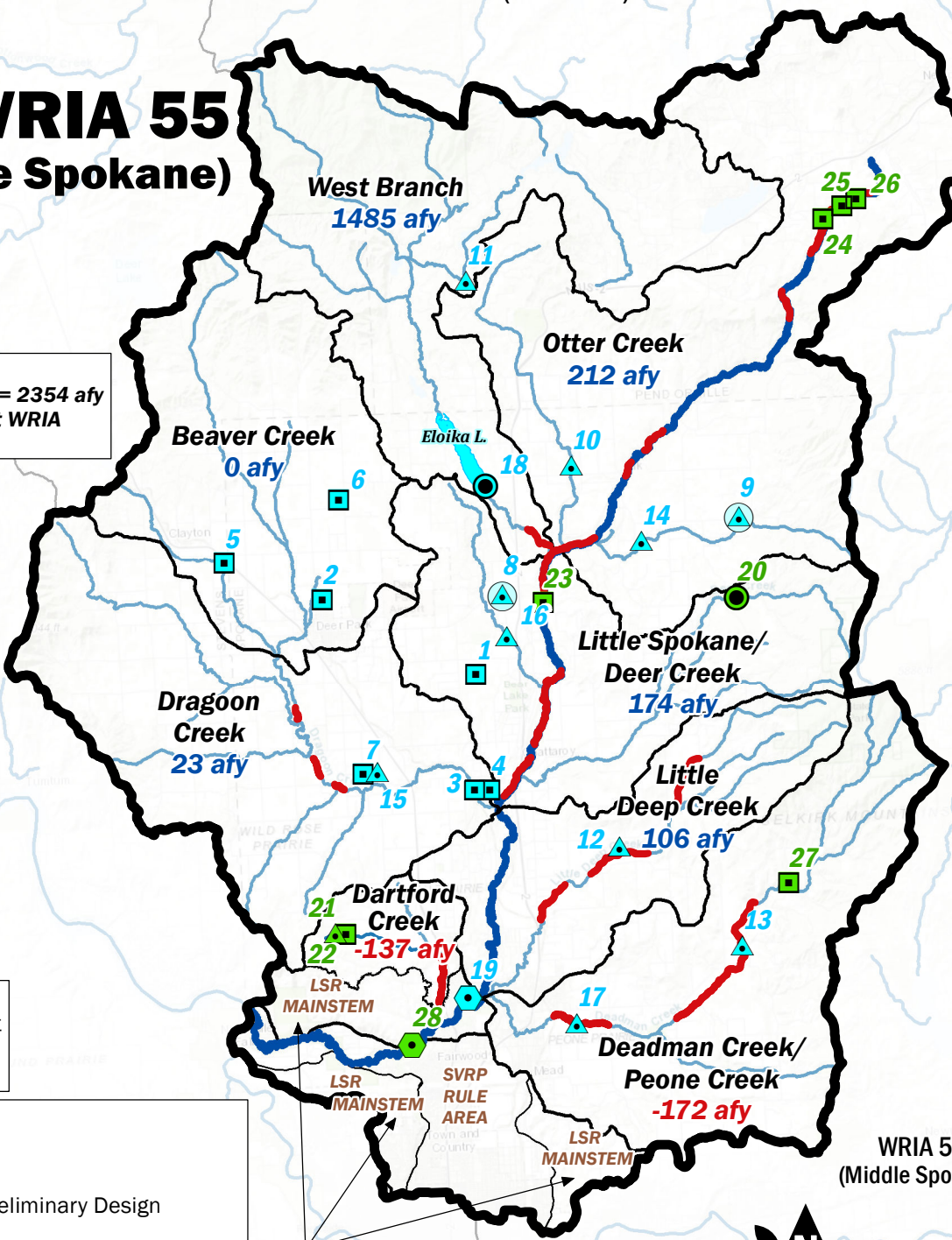
- MAR Project
- MAR Project with Preliminary Design
- Source Exchange
- Storage Project
- Water Right Acquisition

Non-Water Offset Projects

- Floodplain Restoration
- Habitat Restoration/Enhancement
- Habitat Protection
- Fish Barrier Removal
- Identified Habitat Restoration Needs (Priority Areas for Opportunistic Projects)

Subbasin Water Offset Balance
POSITIVE
NEGATIVE

217 afy



Proposed Water and Non-Water Offset Projects and Offset Totals

Watershed Plan Addendum
 Water Offset Technical Memo
 WRIA 55, Washington

DRAFT

	JUL-2020	BY: CME / EAC	FIGURE NO. 2
	PROJECT NO. 180249	REVISED BY: SBM	

APPENDIX A

**MOA: ESSB 6091 Watershed
Plan Update Development
and Approval, WRIA 55**

**MEMORANDUM OF AGREEMENT:
ESSB 6091 WATERSHED PLAN UPDATE DEVELOPMENT AND APPROVAL
WATER RESOURCE INVENTORY AREA 55**

WHEREAS, the Washington Watershed Planning Act, chapter 90.82 RCW, provides a process to develop, adopt, and implement a watershed management plan for Water Resource Inventory Areas (WRIA) in the State of Washington; and

WHEREAS, the Watershed Management Plan, Water Resource Inventory Area 55-Little Spokane River & Water Resource Inventory Area 57-Middle Spokane River (Watershed Plan) was adopted in joint session on January 31, 2006 by the Pend Oreille County Board of Commissioners, Spokane County Board of Commissioners, and the Stevens County Board of Commissioners; and

WHEREAS, Engrossed Substitute Senate Bill 6091 Chapter 1, Laws of 2018 (ESSB 6091) requires (i) each applicant for a domestic building permit of a building necessitating potable water shall provide evidence of an adequate water supply for the intended use of the building located within WRIA 55 which relies on groundwater withdrawal exempt from the permitting requirements of RCW 90.44.050 from a water-well constructed after January 19, 2018, and (ii) must be consistent with Section 202 of ESSB 6091, unless the applicant provides other evidence of an adequate water supply that complies with chapters 90.03 and 90.44 RCW; and

WHEREAS, ESSB 6091 Section 202 (1) states “unless requirements are otherwise specified in the applicable rules adopted under this chapter or under chapter 90.22 or 90.54 RCW, potential impacts on a closed water body and potential impairment to an instream flow are authorized for new domestic groundwater withdrawals exempt from permitting under RCW 90.44.050 through compliance with the requirements established in this section; and

WHEREAS, ESSB 6091 Section 202 requires the WRIA 55 initiating governments, in collaboration with the WRIA 55 planning unit, to update the watershed plan for WRIA 55 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, and at a minimum, include those actions that the planning unit determine necessary to offset potential impacts to instream flows associated with permit-exempt domestic water use; and

WHEREAS, if WRIA 55 watershed plan update as required by ESSB 6091 Section 202 is not adopted by February 1, 2021, the Washington Department of Ecology must adopt rules for WRIA 55 that meet the requirements of ESSB 6091 Section 202; and

WHEREAS, the WRIA 55 initiating governments are Spokane County, Stevens County, Pend Oreille County, the City of Spokane, and Whitworth Water District; and

WHEREAS, chapter 90.82 RCW directs the initiating governments to invite a wide range of water resource interests to be part of a watershed planning unit; and

WHEREAS, the initiating governments entered into a Memorandum of Agreement in 1999 to initiate the development of a watershed plan for WRIA 55 and WRIA 57 that specified the governmental and non-governmental groups invited to be a member of the planning unit; and

WHEREAS, the initiating governments have reviewed the groups invited in 1999 and considered the update requirements imposed under ESSB 6091 and considered which groups best

represent the water resource interests specific to WRIA 55 in 2018, including the Colville Tribe of Indians, Spokane Tribe of Indians and the Kalispel Tribe of Indians, and have invited the governmental and non-governmental groups identified in Attachment “A” to be a member of the WRIA 55 planning unit.

NOW, THEREFORE, the initiating governments for WRIA 55 agree as follows:

1.0 Purpose: It is the purpose of this Agreement to set forth a process through which the parties may develop, adopt, and secure approval of an update to the WRIA 55 portion of the previously approved WRIA 55/57 Watershed Plan, herein referred to as the WRIA 55 Watershed Plan update, to meet the requirements of all applicable sections of ESSB 6091, including Section 202, by February 1, 2021.

2.0 Initiating governments: According to the provisions of RCW 90.82.060, the eligible parties to this Agreement shall be Spokane County, Stevens County, Pend Oreille County, the City of Spokane, and Whitworth Water District.

3.0 Lead Agency: Spokane County will be the lead agency for the purposes of convening the planning unit, and receipt and administration of state funds provided for planning unit facilitation and development and approval of the WRIA 55 Watershed Plan Update. Designation of Spokane County as lead agency does not preclude any eligible entity from receiving funds for project implementation.

4.0 Planning Unit:

4.1 The planning unit is a committee formed by the initiating governments as described in chapter 90.82 RCW. ESSB 6091 requires the initiating governments to collaborate with the planning unit in the development of the WRIA 55 Watershed Plan Update.

4.2 The planning unit is composed of stakeholders, both governmental and non-governmental entities, with a wide range of water resources interests invited by the initiating governments to collaborate on the development of the WRIA 55 Watershed Plan Update. Stakeholders invited to be a member of the planning unit and participate in developing the WRIA 55 Watershed Plan Update are included in Attachment “A”. The initiating governments are participants in the planning unit.

5.0 Process:

5.1 The planning process entails a collaboration between the initiating governments and stakeholders identified in Attachment “A” actively participating in the planning unit. A facilitator may be contracted to assist in implementing a congenial consensus-building methodology to ensure participant interests and concerns are considered in the development of a fact-based WRIA 55 Watershed Plan Update.

5.2 All decisions or actions other than approval of the WRIA 55 Watershed Plan Update not resolved during the planning process specified in 5.1 shall require a motion and a majority vote of the initiating governments. Only the designated representative of an initiating government may call for a decision or action by motion.

5.3 Approval of the WRIA 55 Watershed Plan Update shall require a super majority vote (2/3) of the initiating governments.

- 5.4 Prior to adoption of the updated watershed plan, the watershed plan update will be submitted to the Washington State Department of Ecology for a determination that actions identified in the watershed plan update, after accounting for new projected uses of water over the subsequent twenty years, will result in a net ecological benefit to instream resources within WRIA 55.
- 5.5 The planning unit may adopt operating rules as long as they do not conflict with provisions of this Agreement.
- 5.6 The Initiating Parties are concerned about creating potential inconsistencies between planning documents where the 20-year projection required under ESSB 6091 §202(4)(c) does not coincide with other mandated planning, and agree nothing in this Agreement imposes a duty on the Parties to update other planning documents or prohibits adjusting the planning window to avoid inconsistencies with other required planning.
- 5.7 The planning process shall be subject to the Open Public Meetings Act.

6.0 Funding:

- 6.1 This Agreement does not obligate the initiating governments (agencies) to pay any operating costs for the WRIA 55 Watershed Plan Update. Any such obligation in the future shall require express written agreement.
- 6.2 Spokane County shall be the lead agency for application and management of funding provided by the State of Washington for the development and approval of the WRIA 55 Watershed Plan Update. Budgets allocating the use of watershed planning funds shall be approved by the initiating governments. Grant funds shall be used for staff support and consultant support, including the preparation of technical reports for review by the planning unit and/or technical committees and/or focus groups.
- 6.3 Participation in the planning unit and/or technical committees and/or focus groups by officials and staff of members shall be contributed time and not eligible for reimbursement unless expressly approved by the initiating governments.
- 6.4 This Agreement does not preclude any party from applying for and receiving project funding under ESSB 6091 separate and apart from the planning unit and lead agency.

7.0 Duration:

- 7.1 This Agreement will operate for the duration of the watershed plan update development and approval or until February 1, 2021, whichever occurs first.
- 7.2 Any party to this Agreement shall have the right to withdraw from the planning process at any time. All Parties agree that if any entity withdraws, that entity shall not be deemed a party to any plan or agreement developed, approved, and submitted to Department of Ecology for determination of compliance with chapter 90.82 RCW and ESSB 6091.

8.0 Modification: This Agreement may be modified or amended only by a subsequent written document, signed by representatives of all initiating governments, expressly stating the intention to

amend this Agreement. No amendment or alteration of this Agreement shall arise by implication, course of conduct or change in state law.

9.0 Agreement: The water resource planning process described in this Agreement is intended to result in a WRIA 55 Watershed Plan Update that meets the requirements of ESSB 6091. The Parties agree that participation in the development of WRIA 55 Watershed Plan Update shall not abrogate any member's authority or the reserved rights of any Tribe, except where an obligation has been accepted in writing.

10.0 Miscellaneous

10.1 This Agreement does not create, nor seek to create, a separate legal entity pursuant to RCW 39.34.030.

10.2 The Parties shall be responsible for filing this Agreement as provided for in RCW 39.34.040.

11.0 Effective Date: This Agreement shall become effective and commence upon execution of the Agreement by all parties.

IN WITNESS WHEREOF, we the undersigned have executed this Agreement as of the date as indicated.

SPOKANE COUNTY:

By: _____ Date: _____
Josh Kerns, Chair

STEVENS COUNTY:

By: _____ Date: _____
Wes McCart, Chair

PEND OREILLE COUNTY:

By: _____ Date: _____
Stephen Kiss, Chair

CITY OF SPOKANE:

By: _____ Date: _____
David Condon, Mayor

WHITWORTH WATER DISTRICT:

By: _____ Date: _____
Dennis Brown, Chairman

Attachment A
Planning Unit Stakeholders
WRIA 55 ESSB 6091 Watershed Plan Update

Initiating Governments

- Spokane County
- Stevens County
- Pend Oreille County
- Whitworth Water District
- City of Spokane

The following entities were invited to participate in the WRIA 55 Planning Unit for the ESSB 6091 WRIA 55 Watershed Plan Update.

Units of Government

- Kalispel Tribe of Indians
- Spokane Tribe of Indians
- Colville Tribe
- City of Deer Park
- Stevens County PUD
- Spokane County Water District #3
- Diamond Lake Sewer and Water District
- Spokane Regional Health District
- Spokane Conservation District
- Stevens County Conservation District
- Pend Oreille County Conservation District
- Washington State Agencies

Non-governmental Members

- Spokane County Farm Bureau
- Stevens County Farm Bureau (includes Pend Oreille County)
- Eloika Lake Association
- Spokane Association of Realtors
- Spokane Home Builders
- Friends of the Little Spokane Valley
- League of Women Voters
- The Lands Council
- Center for Environmental Law and Policy
- Futurewise
- Trout Unlimited
- Citizens Alliance for Property Rights
- Spokane County Cattlemen's Association
- Stevens County Cattlemen's Association

amend this Agreement. No amendment or alteration of this Agreement shall arise by implication, course of conduct or change in state law.

9.0 Agreement: The water resource planning process described in this Agreement is intended to result in a WRIA 55 Watershed Plan Update that meets the requirements of ESSB 6091. The Parties agree that participation in the development of WRIA 55 Watershed Plan Update shall not abrogate any member's authority or the reserved rights of any Tribe, except where an obligation has been accepted in writing.

10.0 Miscellaneous

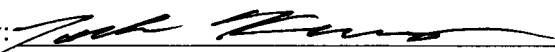
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11.0 Effective Date: This Agreement shall become effective and commence upon execution of the Agreement by all parties.

IN WITNESS WHEREOF, we the undersigned have executed this Agreement as of the date as indicated.

SPOKANE COUNTY:

By:  Date: 6.26.18
Josh Kerns, Chair

STEVENS COUNTY:

By: _____ Date: _____
Wes McCart, Chair

PEND OREILLE COUNTY:

By: _____ Date: _____
Stephen Kiss, Chair

CITY OF SPOKANE:

By: _____ Date: _____
David Condon, Mayor

WHITWORTH WATER DISTRICT:

By: _____ Date: _____
Dennis Brown, Chairman

amend this Agreement. No amendment or alteration of this Agreement shall arise by implication, course of conduct or change in state law.

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IN WITNESS WHEREOF, we the undersigned have executed this Agreement as of the date as indicated.

SPOKANE COUNTY:

By: _____ Date: _____
Josh Kerns, Chair

STEVENS COUNTY:

By:  _____ Date: 7/16/18
Wes McCart, Chair

PEND OREILLE COUNTY:

By: _____ Date: _____
Stephen Kiss, Chair

CITY OF SPOKANE:

By: _____ Date: _____
David Condon, Mayor

WHITWORTH WATER DISTRICT:

By: _____ Date: _____
Dennis Brown, Chairman

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SPOKANE COUNTY:

By: _____ Date: _____
Josh Kerns, Chair

STEVENS COUNTY:

By: _____ Date: _____
Wes McCart, Chair

PEND OREILLE COUNTY:

By: Stephen Kiss _____ Date: June 11, 2018
Stephen Kiss, Chair

CITY OF SPOKANE:

By: _____ Date: _____
David Condon, Mayor

WHITWORTH WATER DISTRICT:

By: _____ Date: _____
Dennis Brown, Chairman

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SPOKANE COUNTY:

By: _____ Date: _____
Josh Kerns, Chair

STEVENS COUNTY:

By: _____ Date: _____
Wes McCart, Chair

PEND OREILLE COUNTY:

By: _____ Date: _____
Stephen Kiss, Chair

CITY OF SPOKANE:

By: David Condon _____ Date: 6/27/18
David Condon, Mayor

WHITWORTH WATER DISTRICT:

By: _____ Date: _____
Dennis Brown, Chairman

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SPOKANE COUNTY:

By: _____ Date: _____
Josh Kerns, Chair

STEVENS COUNTY:

By: _____ Date: _____
Wes McCart, Chair

PEND OREILLE COUNTY:

By: _____ Date: _____
Stephen Kiss, Chair

CITY OF SPOKANE:

By: _____ Date: _____
David Condon, Mayor

WHITWORTH WATER DISTRICT:

By:  Date: 6/21/2018
Dennis Brown, Chairman

APPENDIX B

Review of Existing Watershed Plan and Implementation (Aspect, March 2019)

March 31, 2019

To: Mike Hermanson – Spokane County Environmental Services, Lead Agency
WRIA 55 Planning Unit Members

From: Carl Einberger, LHG, Aspect Consulting, LLC
Dan Haller, PE, Aspect Consulting, LLC

Re: **Review of Existing Watershed Plan and Implementation
ESSB 6091/RCW 90.94 Watershed Plan Update**

Background

The passage of Engrossed Substitute Senate Bill (ESSB) 6091, as codified by RCW 90.94, requires that an update to the existing Watershed Plan for Water Resource Inventory Area (WRIA) 55, the Little Spokane Watershed, be approved by the Washington Department of Ecology (Ecology) by February 1, 2021. Spokane County Environmental Services is serving as the lead agency for this process. The WRIA 55 Initiating Governments for the watershed planning process are Spokane County, Stevens County, Pend Oreille County, the City of Spokane, and Whitworth Water District. The process is supported by convening the WRIA 55 Planning Unit to review technical tasks and memorandums, policy decisions, and the pending watershed plan update. Aspect Consulting, LLC (Aspect) has been contracted by Spokane County to facilitate planning unit meetings, conduct supporting technical tasks, and prepare the watershed plan update.

Section 202(2) of ESSB 6091 requires a review of the existing watershed plan for WRIA 55:

“the department shall work with the initiating governments and the planning units described in chapter 90.82 RCW to review existing watershed plans to identify the potential impacts of exempt well use, identify evidence-based conservation measures, and identify projects to improve watershed health”

Previous watershed planning in WRIA 55 was conducted in combination with WRIA 57 (Middle Spokane River). The Watershed Plan¹ for WRIsAs 55/57 was adopted in 2006, and the Detailed Implementation Plan² (DIP) was approved in 2008 for WRIsAs 55/57.

Ecology issued initial policy interpretations on ESSB 6091 in March 2018, including its interpretation that the requirement to review existing watershed plans is a procedural step to help inform the participants in the planning process in their endeavor to update the watershed plan as

¹ Prepared by the Little Spokane River and Middle Spokane River Planning Unit, Lead Agency: Spokane County
<http://spokanewatersheds.org/wria-55-57-watershed-plan>

² Prepared by the WRIA 55/57 Watershed Implementation Team
<http://spokanewatersheds.org/files/documents/WRIA-55-57-FINAL-DIP.pdf>

March 31, 2019

directed under Section 202(4)(a). Ecology noted it does not interpret the new law to necessitate a comprehensive review of the entire watershed plan. As stated in Section 202(4)(a) the purpose of the review is to identify references to:

- The potential impacts of exempt well use;
- Evidence-based conservation measures; and
- Projects to improve watershed health.

This memorandum reviews elements of the Watershed Plan, DIP, and additional projects conducted under Ecology Watershed Implementation Grants that are relevant to informing the above three topics.

Potential Impacts of Exempt Well Use

ESSB 6091 requires consideration of a 20-year planning horizon for estimating future exempt well use and linking it to net ecological benefits [Section 202(4)(c)]. A review of the Watershed Plan and DIP has been conducted to identify references to the potential impacts of exempt well use.

Estimated Exempt Well Use

The Watershed Plan presented an estimate of exempt well use for all of WRIA 55 of 11,000 acre-foot/year (afy) total³. The estimate is based on 320 gallons per day per capita water use and a population of 30,700 not served by public water systems. Per capita exempt well use was estimated based on water system data from systems outside the City of Spokane, which was consistent with Department of Health, Spokane County, and City of Spokane guidance. The population outside of public water systems was obtained from 2000 census data. This total was not broken down by subbasin, and no future projections of exempt well use were presented in the Plan. Consumptive versus non-consumptive use for exempt wells was not evaluated.

As part of preparing the current watershed plan update, a detailed analysis is underway in WRIA 55 to estimate future exempt well demand to meet the ESSB 6091 requirement to evaluate future exempt well use on a 20-year planning horizon. This work will supersede the limited work projecting exempt well use conducted during the previous planning process. The exempt well demand estimate analysis is based, in part, on a previously developed Spokane County Demand Forecast Model, which included demand estimates for new single-family, self-supplied residences within WRIA 55 that were estimated in the 2015-2040 timeframe through updating this model. The Spokane County Demand Forecast Model was expanded to Stevens and Pend Oreille Counties during development of the Little Spokane Water Bank.

A separate technical memorandum will present the 20-year planning estimates of new exempt wells and associated consumptive demand within WRIA 55 specifically to address ESSB 6091 requirements.

Groundwater-Surface Water Modeling

As part of the Watershed Plan development, the WRIA 55 and 57 Watershed Planning Unit used a numerical model (MIKE SHE) to assess water availability in the Middle Spokane and Little Spokane basins. The MIKE SHE model simulated hydrologic cycle processes, include

³ See Table 2.I.H of the Watershed Plan

March 31, 2019

evapotranspiration, overland flow, channel flow, unsaturated zone flow, saturated zone flow and snow pack. Model simulations included a 20-year growth projection scenario ending in 2020, but only looked at changes to municipal and domestic water use, wastewater discharge, and lawn irrigation for the year 2020. Changes were not made to water use for increases in exempt well use, with the model apparently incorporating only the existing total exempt water use of approximately 11,000 afy noted above.

The MIKE SHE modeling work conducted during the previous watershed planning process has now been superseded by more advanced and current modeling developed by a Spokane County consulting team (West Consultants and Earthfx), using GSFLOW, a coupled groundwater-surface water model. This work was conducted under a Bureau of Reclamation Drought Resiliency Grant, with a report issued in December 2018⁴. The modeling report includes a scenario that analyzed the incremental changes to the LSR watershed due to the increase in the permit exempt wells (single-family domestic supply) projected to occur over the next twenty years, including changes in groundwater levels and instream flows basin-wide. Spokane County staff used the County's Water Demand Model to predict where the demand would occur, and these values were incorporated into the model. The increase in demand was estimated to be on the order of 2,200 afy total, with the highest use during the summer months. This model will serve as a working tool for the current watershed planning process, including additional refinements of exempt well demand based on the updated estimates currently in progress. The model can also be used to evaluate the benefits of potential water offset projects.

Watershed Plan and DIP Recommendations on Exempt Wells

The Watershed Plan and DIP included several general recommendations to address the impacts of domestic exempt wells on overall water availability, including:

- Recommendation III.B.02: The Department of Ecology should enforce the minimum instream flow shutoff of water rights junior to WAC 173-555 on irrigation from exempt wells in the Little Spokane Watershed where it does not cause additional fire danger.
 - No action has been taken in this regard to date.
- Recommendation IV.A.01.b: The counties should implement a policy or procedure requiring a person who is developing property within a water service area to consult with the water purveyor about the potential for public water service before creating a development or single-family residence dependent on domestic exempt wells.
 - The Spokane County Coordinated Water System Plan encourages but does not require connections to public water service if feasible. As a matter of practice, this generally happens unless line extension costs are exorbitant.
- Recommendation IV.A.01.c: Request counties, cities, and/or the Regional Health Districts to evaluate the quantity of water necessary (currently 1 gallon per minute) from a domestic exempt well before issuing a building permit.
 - Spokane County convened a Water Availability Advisory Group. The group came up with recommendations for changes to the process currently used by Spokane

⁴ Integrated Groundwater/Surface Water Model for the Little Spokane Watershed – Water Bank Modeling and Decision Support Tool, Model Development and Application Report, December 2018

<http://spokanewatersheds.org/wria-55-57-current-projects>

March 31, 2019

Regional Health District to establish the physical availability of water for building permits. No action has been taken on the recommendations to date.

- Recommendation IV.A.01.f: Land use regulators are encouraged to consider available ground water resources when establishing minimum parcel sizes in areas where exempt wells will be the main source of domestic water in an effort to avoid future water shortages.
 - In general, Spokane County’s Comprehensive Plan limits rural parcels to a minimum of 10 acres, with some exceptions that may be grandfathered prior to implementation of the Growth Management Act. Similar measures are in place in Stevens and Pend Oreille Counties.
- Recommendation IV.A.02.a: Evaluate policies that will limit the maximum daily withdrawals to less than 5000 gallons per day where detrimental impacts are identified
 - No action has been taken in this regard to date.
- Recommendation IV.A.03.a: At a minimum, when flows in the Little Spokane River are expected to fall below minimum instream flows, caution letters should be sent to all domestic exempt well owners in the Little Spokane Watershed asking them to voluntarily conserve water. Methods for saving water and directions to a website with more information will be included with the letter.
 - As part of implementing the Watershed Plan, The WRIA 55/57 Implementation Group prepared and sent a “Water Smart” mailer to rural residences reviewing water availability issues and encouraging conservation.

Evidence-Based Conservation Measures

ESSB 6091 requires that the Watershed Plan be reviewed to identify recommended evidence-based conservation measures. In the context of ESSB 6091, we interpret “evidence-based” to refer to comparing baseline data on water use or estimates of water use made using accepted practices prior to implementing conservation measures to data or estimates on water use following conservation project implementation. Data sources could include, for example: water use metering; estimates of consumptive use before and after modifications to lawn irrigation methods or conversion of high-water landscape to low-water landscape; or estimates of the benefit of placing a water right, or a portion of a water right available as the result of a conservation project, in trust to benefit instream flows using Ecology’s accepted approach outlined in Ecology Guidance 1210 (Determining Irrigation Efficiency and Consumptive Use).

The Watershed Plan and DIP included several recommendations focused on water conservation, reclamation, and reuse. Most of these were applicable specifically to public water systems. Recommendations with applicability to exempt wells include:

- Recommendation I.A.01.a: Determine indoor conservation issues (approaches) on which the public needs to be educated (i.e. habits, indoor low-flow devices such as showerheads, faucets, toilets and appliances).
 - Spokane County conducted a rebate program for installation of low-flow toilets for rural homes. This can be considered evidenced-based as proof of purchase was required for the rebate.

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- Recommendation I.A.01.c: City and county governments will develop and implement a regional education and awareness program to promote wise and efficient use of the water supply with voluntary participation by water suppliers.
 - Several public outreach methods were used as part of Plan implementation to encourage conservation, including running an ad in the Spokesman Review, holding an Outdoor Conservation Summit in 2008, specialty landscape class offerings by WSU Extension and the City of Spokane, and making an EPA greenscaping brochure available at the Spokane County permit center.
- Recommendation I.A.02.a: Determine the outdoor conservation issues (approaches) on which the public needs to be educated (i.e., soil development, plant root development, native/drought-resistant vegetation, xeriscaping).
 - See previous bullet on public outreach.
- Recommendation I.C.01.c: Evaluate development of cost-effective options for reclamation and reuse in small-scale and decentralized settings.
 - No action has been taken in this regard to date.

Projects to Improve Watershed Health

The Watershed Plan and DIP included several recommendations applicable to improving watershed health and relevant to addressing impacts from exempt wells under ESSB 6091. Watershed Plan and DIP recommendations included:

- Recommendation III.A.01.c: Studies should be conducted on the major tributaries to determine the extent of and areas where spawning occurs. When this information becomes available, flow studies on the tributaries should be conducted to determine flow needs for the tributaries.
 - No action has been taken in response to this recommendation to date.
- Recommendation III.A.01.d: Recommend a study on the Little Spokane River tributaries on optimizing habitat for the target species and linking the preferred flows on the tributaries to flows at the control points.
 - No action has been taken in response to this recommendation to date.
- Recommendation V.A.02.a: Encourage the use of the State Trust Water Rights Program to secure water rights for instream flow.
 - No action was taken on this from direct implementation of the Watershed Plan. During development of the Little Spokane Water Bank, two water rights in the Dragoon Creek subbasin were purchased by Spokane County and transferred to the State Trust Water Right Program to provide seeding for the bank. With the passage of ESSB 6091, the water bank has been inactive and the future use of the water rights held in trust has not been determined by Spokane County. At the present time, these water rights are benefiting instream flows. Spokane County has also applied for funding through Ecology's Watershed Improvement Grant Program to purchase additional water rights in WRIA 55 to benefit instream flows. This work

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would be completed specifically in support of the watershed plan update and to address “water-for-water” requirements of ESSB 6091.

- Recommendation VI.A.01.a: Support the restoration, where feasible, of wetlands in areas where these features existed historically but have been drained.
 - As part of an evaluation of water storage investigation discussed below, PBS&J⁵ identified a number of wetland restoration opportunities, with further study recommended.
- Recommendation VI.A.01.b: Encourage the creation of new wetlands, where feasible, in upland areas and along stream corridors.
 - No action has been taken in response to this recommendation to date.
- Recommendation VI.A.02.a: Continue site identification and feasibility analysis for use of surface runoff storage in **existing** lakes as means of augmenting baseflow in the Little Spokane Watershed.
 - As part of Watershed Plan implementation, studies of water storage in WRIA 55 were conducted as part of the Watershed Planning process. Golder Associates⁶ looked at a number of storage sites in WRIA 55, with the only options evaluated in detail being new dams at Buck Creek and Beaver Creek in the Beaver Creek subbasin. The report concluded that costs of project implementation were prohibitive, and no further work has been completed.

PBS&J⁵ conducted additional storage investigations focused on the West Branch of the Little Spokane River. This study evaluated use of existing dams, natural lakes, and new dams, and infiltration using existing lakes or depressions. PBS&J concluded that raising existing dams to increase storage is not feasible, primarily because sufficient storage would not be obtained. They also concluded that increasing storage in natural lakes, such as Eloika Lake, is limited by the extent of development along the lakes, and associated effects on existing residential properties.

- Recommendation VI.A.02.b: Continue site identification and feasibility analysis for use of surface runoff storage in **new** artificial lakes or ponds as means of augmenting baseflow in the Little Spokane Watershed.
 - No action has been taken in response to this recommendation to date.
- Recommendation VI.A.02.c: Continue site identification and feasibility analysis for use of recharge and storage in aquifers as means of augmenting baseflow in the Little Spokane Watershed.
 - Golder Associates⁶ conducted preliminary work to evaluate aquifers in WRIA 55 for potential for artificial recharge including flood sands and gravels and basalt

⁵ Surface Water Storage Investigation, West Branch Little Spokane River, Wetland Restoration and Recharge Opportunities, WRIA 55 & 57

<http://spokanewatersheds.org/files/documents/PBSJ-WBLSR-SW-Storage-Final-090424.pdf>

⁶ First Step Storage Assessment, Little and Middle Spokane Watersheds

<http://spokanewatersheds.org/files/documents/855c545a-303f-4852-a0f2-54895b4eb329.pdf>

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aquifers. They considered recharge to gravel pits as an option and recommended more detailed screen of their suitability for potential recharge sites.

Spokane County has a pending funding application through Ecology's Watershed Improvement Grant Program focused on design, construction and implementation of managed aquifer recharge (MAR). This work would be completed specifically in support of the watershed plan update and to address "water-for-water" requirements of ESSB 6091.

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APPENDIX C

**WRIA 55 – Little Spokane River
Watershed Current Aquatic
Habitat Conditions
(Spokane County, February 2020)**

WRIA 55 – LITTLE SPOKANE RIVER WATERSHED CURRENT AQUATIC HABITAT CONDITIONS
FOR RCW 90.94 NET ECOLOGICAL BENEFIT EVALUATION

Prepared by:

Spokane County Water Resources Staff

February 2020

ACRONYMS AND ABBREVIATIONS

Ecology	Washington Department of Ecology
GIS	Geographical Information Services
IMP	Intermountain Province
NEB	Net Ecological Benefit
RCW	Revised Code of Washington
RKM	River Kilometer
SCD	Spokane Conservation District
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
UCUT	Upper Columbia United Tribes
UGA	Urban Growth Area
WDFW	Washington Department of Fish and Wildlife
WRIA	Watershed Resource Inventory Area
WSDOT	Washington State Department of Transportation

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ATTACHED SUMMARY TABLES

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INTRODUCTION

Revised Code of Washington (RCW) 90.94 requires an update to the Water Resource Inventory Area (WRIA) 55 Watershed Plan (Plan) that identifies projects and actions necessary to offset potential impacts to instream flows associated with new permit-exempt domestic water use projected over the next twenty years. At minimum, water offset projects must offset new projected use at the WRIA scale. There may be instances where the amount of offsets provided in certain subbasins will be more or less than the projected new consumptive water use.¹ In those instances, non-water offset projects such as habitat restoration and water quality improvement projects can be included in the Plan so that, in its entirety, it will achieve a Net Ecological Benefit (NEB).

To determine if there will be a NEB from implementing the Plan it is important to understand the current aquatic habitat conditions within the WRIA. This report is a compilation of existing information related to aquatic habitat and water quality that will serve as a baseline in the NEB determination for WRIA 55. Aquatic habitat conditions that will be addressed include water quality impairments, loss of riparian vegetation and wetlands, and habitat connectivity and complexity.

EXISTING CONDITIONS IN LITTLE SPOKANE RIVER WATERSHED (WRIA 55)

The Little Spokane River watershed, or WRIA 55, supports a variety of fish species (see attached Table 1) with redband trout being particularly important. Redband trout is a subspecies of rainbow trout and those within the Little Spokane River are included in the upper Columbia River basin geographic population group (*Oncorhynchus mykiss gairdneri*). Redband trout habitat is distributed throughout the Little Spokane River mainstem and the tributaries of Dartford, Deadman, Little Deep, Deer, Dragoon, Buck, and Otter Creeks (Western Native Trout Initiative 2010, Figure 1).

The freshwater habitat requirements for redband trout include clear, cold water streams that have coarse substrates in riffle-run area, adequate natural cover (e.g., overhanging vegetation, large woody debris, boulders), and pools that can act as a refuge during winter and other adverse conditions. Redband trout prefer water temperatures of 12 to 18 degrees Celsius (53.6 to 64.4 degrees Fahrenheit) and require dissolved oxygen at levels of at least 7 milligrams per liter. For embryo survivability, optimal conditions include water temperatures between 7 and 12 degrees Celsius and spawning gravels with less than 5 percent fines. Greater than 30 percent fines may result in low survival (Raleigh et al., 1984).

The ability of the Little Spokane River to support redband trout and other fish has been impacted by human activities throughout the watershed. WRIA 55 basin is primarily a rural landscape, except for the

¹ Ecology GUID-2094 notes that the NEB evaluation “should describe the projected impacts and any offsets within each of the subbasins. Because all impacts at a minimum must be offset at the WRIA level, the evaluation should determine if the plan has succeeded in offsetting the impacts at the WRIA level. This means there may be instances where the amount of offsets provided in certain subbasins will be more or less than the projected new consumptive water use there. This is acceptable because the offsets are provided within the WRIA and in sufficient quantities.”

urbanized southern portion of the watershed included within and immediately adjacent to the Spokane County Urban Growth Area (UGA).

Land use designations within the rural areas of the WRIA 55 include Rural Traditional, Rural Activity Center, Small Tract Agriculture, Mineral Lands, and Forest Land. These land use designations allow development at lower densities and limit commercial and community services to rural residential centers such as Riverside, Colbert, Chattaroy, Eloika, and Elk. Industrial activities are limited to resource-based industries, including ranching, farming, mining and forestry operations.

Land use designations within the urbanized areas of WRIA 55 within and immediately surrounding the UGA include Rural-5; Low, Medium and High Density Residential; Neighborhood, Community, and Regional Commercial; Low Density Commercial-Industrial; Light and Heavy Industrial; Mixed Use; and Urban Reserve. These allow development at higher densities and allow more types of commercial and industrial activities.

Throughout WRIA 55, the Rural Conservation designation is used along portions of the Little Spokane River and its tributaries. This designation applies to environmentally sensitive areas, including critical areas and wildlife corridors, and reduces development density.

Historical and current land uses in the watershed such as timber harvest, agriculture, industrial sand/gravel extraction, and urbanization have altered hydrology of the Little Spokane River and its tributaries, and degraded water quality and habitat by removing riparian vegetation, draining wetlands, diverting water, and straightening stream channels.

State water quality standards are set to protect designated beneficial uses, which include aquatic life uses and water contact recreational uses for the Little Spokane River. The water quality criteria applicable to the Little Spokane River are listed below (Table A).

Table A. Little Spokane River Water Quality Criteria

Parameter	Criteria
Fecal coliform bacteria	Levels shall both not exceed a geometric mean value of 50 colonies/100 mL, and not have more than 10% of all samples obtained for calculating the geometric mean value exceeding 100 colonies/100 mL.
Temperature	Shall not exceed a 7-day average daily maximum temperature of 16 °C due to human activities. When natural conditions exceed, or are within 0.3 °C of the criterion, cumulative human-caused activities will not raise temperatures more than 0.3 °C
Turbidity	Shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10% increase in turbidity when the background turbidity is more than 50 NTU.
Dissolved oxygen	Shall exceed 9.5 mg/L. When natural conditions exceed, or are within 0.2 mg/L of the criterion, cumulative human-caused activities will not decrease the dissolved oxygen more than 0.2 mg/L
pH	Shall be within the range of 6.5 to 8.5 standard units with a human-caused variation within the range of less than 0.5 units.

Notes: C = Celsius; mg/L = milligrams per liter; mL = milliliters; NTU = Nephelometric Turbidity Unit

However, the Little Spokane River mainstem, several tributaries and lakes within the watershed have been listed on the state’s 303(d) list for non-attainment of various state water quality standards including fecal coliform bacteria, temperature, turbidity, dissolved oxygen, and pH. In particular, high

summer water temperatures, increased sediment in the water column, low dissolved oxygen and alkaline conditions within the Little Spokane River watershed are problematic for fish like redband trout.

A multi-parameter Total Maximum Daily Load (TMDL) was developed in 2012 for the Little Spokane River watershed to address fecal coliform bacteria, temperature, and turbidity (Ecology, 2012). A TMDL is a study that determines the maximum amount, or “load,” of specific pollutants that a waterbody can receive and still maintain water quality standards and recommends load reductions for each pollutant source to achieve waterbody recovery. To meet the load reductions in the TMDL, the study’s overall recommendations were to restore riparian vegetation; implement Best Management Practices (BMPs) to control non-point sources of fecal coliform bacteria, heat and sediment; and to educate watershed residents. A TMDL has not yet been developed to address dissolved oxygen or pH, though Ecology is anticipating a draft TMDL in 2020.

Restoring riparian functions has been a primary focal point in improving poor water quality and habitat conditions in the Little Spokane River. Riparian habitats perform several functions, and when improved simultaneously address multiple concerns by:

- Providing stormwater capture and treatment
- Protecting streambanks from erosion
- Providing a source of large woody debris, allowing complexity in stream habitats
- Providing cover and food resources for terrestrial invertebrates, birds, and mammals
- Delivering leaf litter, organic debris, and terrestrial invertebrates to streams, which are sources of food for fish and aquatic invertebrates
- Shading streams to maintain cool water temperatures necessary for cold water fish species and other aquatic organisms
- Providing off-channel aquatic habitat as a flood refugium for rearing and overwintering fish

Prior to the 2012 multiparameter TMDL recommending restoration of riparian habitat, there was recognition that riparian habitat had been impacted throughout the Little Spokane River watershed. An analysis of aerial photos using Geographical Information System (GIS) to compare 2002 riparian conditions with historical riparian areas was used to estimate riparian losses on the Little Spokane River and select tributaries. This analysis concluded that the Little Spokane River mainstem lost 61 percent of its riparian vegetation, with losses in the tributaries ranging from 56 to 93 percent (Christian 2003).

A later survey conducted in 2005 by the Spokane Conservation District (SCD) assessed the riparian condition of the Little Spokane River mainstem and select tributaries managed under Spokane County’s Shoreline Master Program (SMP). This work assessed proper functioning condition and ecological condition of riparian habitat as well as restoration potential. Proper functioning condition was based on physical functions such as withstanding flood events and streambank stability. Ecological condition was based on habitat connectivity and diversity. From this work, the SCD identified 13 reaches with poor to fair riparian conditions, totaling approximately 18 river miles (Figure 2; Attached Table 4). Problems noted in these reaches include eroding streambanks, lack of large woody debris and riparian vegetation, well-established reed canarygrass, and inadequate livestock management. The presence of livestock, reed canary grass and residential lawns that go to the edge of the river are likely causes of riparian vegetation removal and continued suppression of natural regeneration (SCD 2005).

Since the publication of the 2012 TMDL (Ecology, 2012), the Lands Council (2015) compiled the 2005 SCD riparian condition surveys and other data to prioritize riparian restoration areas within the Spokane County portion of the Little Spokane River watershed. This prioritization was limited to the Little Spokane River mainstem and larger tributaries. From this work, the Lands Council recommended four general priority areas for riparian restoration to Ecology: Dragoon Creek near Wethy Creek, upper Deer Creek, West Branch Little Spokane above Eloika Lake, and the Little Spokane River mainstem between Little Deep Creek and the West Branch Little Spokane River.

Another focal point for improving conditions in WRIA 55 is improving aquatic habitat connectivity. Aquatic habitat connectivity includes longitudinal connectivity, or the connection between up- and downstream, and latitudinal connectivity, or the connection between the stream and its floodplain. Both are important for accessing spawning, foraging, and overwintering habitats necessary for reproduction and survival. Habitat fragmentation and alterations have been identified as threats to the viability of redband trout populations (Western Native Trout Initiative, 2010 and 2018; Interior Redband Conservation Team, 2016).

Longitudinal connectivity has been affected throughout the Little Spokane River watershed due to artificial barriers, primarily culverts. The Washington Department of Fish and Wildlife (WDFW) and the Washington Department of Transportation (WSDOT) maintain an inventory of artificial fish passage barriers in the Little Spokane River watershed. Currently, there is a total of 84 artificial barriers within the Little Spokane River watershed documented in this inventory (Figure 3). However, this number may change in the future as investigations of potential barriers are ongoing and as barriers are removed or replaced.

Poor longitudinal connectivity can contribute to problems facing redband trout such as isolation of populations. The Western Native Trout Initiative (Western Native Trout Initiative, 2010 and 2018) recommends restoring connectivity to historic habitats and improving fish passage to improve the status of redband trout. The Spokane Tribal Fisheries Anadromous Program in cooperation with the Northwest Fisheries Science Center created a GIS data layer and online tool that identifies and rates the intrinsic potential of the Little Spokane River watershed to support native steelhead/redband trout spawning and rearing. Intrinsic potential is the ability (low, moderate, high) to support redband habitat based on the natural characteristics of the stream reach without consideration to existing impacts.

The Spokane Tribe recommends that barriers isolating redband trout populations or preventing access to moderate or high intrinsic potential-rated habitat should be prioritized for correction. Using the Spokane Tribe's intrinsic potential habitat data, the Little Spokane River watershed has approximately 133.32 kilometers (82.85 miles) of stream rated as moderate to high intrinsic potential with only two artificial fish passage barriers potentially affecting access to these areas (Figure 4).

Latitudinal connectivity has been impacted from stream alterations to facilitate development and agricultural activities. A technical study prepared by PBS&J (2009) estimates that 21 percent of wetlands in the Little Spokane River watershed have been lost due to human activities, which includes those in the floodplain. Habitat restoration focusing on reconnecting floodplains, side channels and riparian zones is a strategy recommended by the Interior Redband Conservation Team (2016). The Western Native Trout Initiative also recommends restoring and improving altered channel habitats as an opportunity to improve the status of redband trout.

Since the identified intrinsic potential habitat does not consider impacts, stream reaches rated as moderate to high potential should be prioritized for conservation or restoration depending on actual conditions. PBS&J (2009) identified 115 sites for potential wetland restoration in WRIA 55, totaling 3,893 acres (Figure 5). Many of these sites are in proximity to a stream or lake, including moderate to high potential reaches, and were found to display some form of stream alteration such as stream straightening, stream relocation, stream or floodplain narrowing, or other alterations.

A third focal point for the Little Spokane River watershed is improving aquatic habitat complexity. To support diverse fish populations, streams should have a variety of instream habitat types (riffles, runs, pools) and structural components (large woody debris, undercut banks, boulders) to provide cover. The WDFW conducted surveys in the Little Spokane River watershed between 2001 and 2003 to establish baseline information regarding fish habitat and species distribution. These surveys included measurements of the physical habitat characteristics such as bankfull width, depth, gradient, and percent composition of the streambed substrate and determining the frequency of the available habitat types (riffle, run and pools). They also included fish surveys to determine species presence, relative abundance, population and density (McLellan 2002, 2003, and 2005).

Habitat complexity is necessary because homogenous habitats that result from water quality and habitat degradation typically benefit only a few, usually less desirable species. Species such as brook trout, brown trout, northern pike, smallmouth and largemouth bass, and common carp have been known to compete with redband trout for food and habitat (Western Native Trout Initiative, 2010 and 2018), and many of these species are found in the Little Spokane River watershed. In fact, the WDFW data indicate that eastern brook trout may have competitive advantages in the Little Spokane River system in lower velocity habitats (pool and runs) and in habitat dominated by fine substrates. While there is a mix of habitats throughout the watershed, most of the available fast water habitat is located within the systems on the eastern side of WRIA 55. Further, all but four streams within the Little Spokane River watershed have streambeds dominated by sand and finer particulates. In addition to potentially giving a competitive advantage to eastern brook trout, the WDFW surveys indicate that the predominance of fine substrates throughout the Little Spokane River watershed may be limiting interstitial habitat, spawning gravels, and overwintering habitat (McLellan 2002, 2003, and 2005; Attached Table 2).

Another concern regarding habitat complexity identified in the Little Spokane River watershed is the presence of invasive and noxious weeds. Ecology surveys conducted during the early 2000s identified Eurasian water-milfoil (*Myriophyllum spicatum*) in the West Branch Little Spokane subbasin in Sacheen Lake, Horseshoe Lake, Fan Lake, Eloika Lake and Diamond Lake. (Parsons and O'Neal, 2000; Ecology, 2017). These locations are currently listed as impaired (Category 4c) due to the presence of the Eurasian water-milfoil, which can alter aquatic habitats by forming dense mats that shade out other aquatic plants, inhibit water flow, and degrade water quality. Control of these plants can be difficult, as they can spread by seed and stem fragments (WA NWCB). The riparian condition surveys conducted by the SCD (2005) noted that reed canarygrass (*Phalaris arundinacea*) is well-established throughout the riparian zone. While Ecology has not listed the Little Spokane River as impaired due to reed canarygrass, this species is highly invasive. It forms dense monocultures that displace native plant communities and constrict stream channels by promoting deposition of sediment.

The Upper Columbia United Tribes (UCUT), which includes the Couer d’Alene Tribe of Indians, Confederated Tribes of the Colville Reservation, Kalispel Tribe of Indians, Kootenai Tribe of Idaho, and the Spokane Tribe of Indians, is interested in possible reintroduction of anadromous fish to habitats upstream of the Chief Joseph and Grand Coulee dams. The UCUT in cooperation with the U.S. Geological Survey and WDFW conducted several preliminary investigations to determine the feasibility of reintroducing salmon and steelhead (UCUT, 2019). These preliminary investigations confirmed that reintroduction is feasible, and that there is moderate to high intrinsic potential habitat for steelhead (anadromous redband trout) (Figure 4) and Chinook (Figure 6) in the Little Spokane River watershed that is currently blocked by hydroelectric facilities on the Spokane River.

The Northwest Power and Conservation Council is responsible for planning efforts in the Columbia River basin conducted under the Northwest Power Act. The purpose of this planning is to develop a regional approach to balance energy development and impacts to fish and wildlife. The Council implements their broader Fish and Wildlife Program through subbasin plans, and the Spokane River and the Little Spokane River are included in the 2004 Intermountain Province (IMP) Subbasin Plan (GEI Consultants Inc., 2004). The IMP Subbasin Plan primarily focuses on strategies and actions to address fish and wildlife impacts from the Chief Joseph and Grand Coulee dams. Many of these strategies and actions are similar to and compatible with previously described such as habitat restoration, habitat protection, fisheries augmentation, education/outreach, and additional research, monitoring and planning.

EXISTING HABITAT CONDITIONS BY SUBBASIN

Otter Creek

The Otter Creek subbasin is approximately 143.2 square miles includes the upper Little Spokane River mainstem from the headwaters to just above its confluence with the West Branch Little Spokane River (RKM 34.2), and the tributaries of Otter and Dry Creeks. This subbasin spans both Pend Oreille and Spokane Counties. Population centers include Elk and Scotia, which were historically small logging communities. The land use within the subbasin includes Rural Traditional, Rural Conservation, Rural Activity Center, Mineral Lands and Forest Land.

Fish Species

The WDFW surveyed Otter and Dry Creeks in 2001 (McLellan 2002), and the Little Spokane River in its entirety in 2003 (McLellan 2005). However, this subbasin only includes the Little Spokane River Reaches 1 through 20 from the WDFW survey. During these surveys, 13 fish species were identified on the upper Little Spokane River. The surveyed tributaries were less diverse with only six species identified in Otter Creek and eight species in Dry Creek (Attached Table 1). Eastern brook trout were the most abundant species in Otter Creek and rainbow trout were the most abundant species in Dry Creek (McLellan 2002 and 2005).

Genetic studies of the rainbow trout population conducted by WDFW indicate that Otter Creek supports interior redband strain (*Oncorhynchus mykiss gairdneri*), not coastal strain rainbow trout (*Oncorhynchus mykiss irideus*). Samples from rainbow trout in Dry Creek was not included in the genetic analysis (McLellan 2002).

Stream Profiles and Instream Habitat

Otter Creek is a third order stream originating from springs located north of Hwy 2 along Fertile Valley Rd. It flows 15.4 kilometers (9.57 miles) in a southeast direction before entering the Little Spokane River at RKM 53.9 (river mile 33.49). It is a relatively low gradient stream (average gradient of 2 percent) with a small drainage area. Otter Creek is dominated by slow water habitats, with runs averaging 57 percent of the instream habitat and pools contributing another 12 percent. Fine particulates constitute a high percentage in Otter Creek (79 percent) resulting in high embeddedness (84 percent) of coarser bed materials (McLellan 2002, Attached Table 2).

Dry Creek is a second order stream with headwaters originating on the western slopes of Mt. Spokane. It flows 12.9 kilometers (8.02 miles) before discharging into the Little Spokane River at RKM 55.5 (river mile 34.49). Reflection Lake is connected to Dry Creek through its outlet stream Sheets Creek, which enters Dry Creek just upstream of its confluence with the Little Spokane River. Dry Creek is a moderate gradient (averaging 3 percent) stream. It is dominated by fast water habitats, with riffles accounting for 54 percent of the instream habitat. Dry Creek's streambed is primarily sand and other fine particulates, which constitute 65 percent of the substrate. However, Dry Creek is one of the few surveyed streams with greater than 20 percent gravel. This corresponds to a lower embeddedness than Otter Creek at 58 percent (McLellan 2002, Attached Table 2).

Even though Otter Creek has a higher percentage of fines and embeddedness than Dry Creek, the 2012 Multi Parameter TMDL does not require reductions in total suspended sediment (TSS) in Otter Creek to

address turbidity. However, the TMDL requires a 10 percent reduction in TSS in Dry Creek (Ecology 2012).

The Otter Creek subbasin has approximately 23 kilometers (14.29 miles) of habitat with moderate to high intrinsic potential for steelhead and 11.52 kilometers (7.16 miles) for chinook (Attached Table 3). For both species, this intrinsic potential habitat is largely located in the upper Little Spokane River mainstem and Dry Creek (Figures 4 and 6).

Fish Passage Conditions

There are 10 artificial fish passage barriers documented in WDFW/WSDOTs inventory located in this subbasin (Figure 3), which includes all except one of those noted in the WDFW surveys. The barriers are on Otter Creek and the upper Little Spokane River mainstem. Most of the barriers are culvert crossings on private roads, though there is one earthen dam that is associated with an irrigation pond near Allen Road. The artificial barrier from the 2003 WDFW survey not documented in the inventory is a concrete railroad culvert on the Little Spokane River at RKM 68.7 that was noted as a potential barrier. There are currently no fish barriers identified on Dry Creek.

Natural barriers are not included in the inventory, but two natural fish barriers were noted during WDFW surveys. One natural barrier is located 400 meters upstream from the mouth of Otter Creek. This natural barrier is described as a waterfall and connected chute. All the artificial barriers on the Otter Creek system are upstream of this natural barrier (McLellan 2002). The second natural barrier is a 4.27-meter waterfall on the upper Little Spokane River mainstem upstream of Chain Lake at RKM 69.4 (McLellan 2005). Another potential barrier noted in the WDFW survey not included in the inventory is the observation that Otter Creek was dry between Highway 2 and the irrigation pond near Allen Road.

The known artificial fish passage barriers are all located upstream of the high to moderate intrinsic potential habitat and, therefore, would not impede access to these areas (Figures 4 and 6). The intrinsic potential of habitat in Otter Creek appears to be limited to below the natural barrier.

Riparian Conditions

Riparian conditions were assessed along the Little Spokane River mainstem by the SCD (2005). Otter and Dry Creeks were not included in this survey. This subbasin includes nine reaches on the Little Spokane River mainstem totaling approximately 7.4 river miles. Much of the riparian habitat along this length was found to be in proper functioning condition with fair to good ecological rating. However, three reaches totaling about 3.2 miles were assessed as functional-at-risk (FAR) with poor ecological rating (Attached Table 4, Figure 2).

An estimate of riparian area lost on Otter Creek was included in Christian (2003), but Dry Creek was not included in this study. It is estimated that Otter Creek lost 89 percent of its original riparian habitat. The ability of the riparian zone to provide shade to meet the temperature water quality standard was assessed during the development of the 2012 TMDL. This included the entire length of the Little Spokane River mainstem and Otter and Dry Creeks. The TMDL requires much of the upper Little Spokane River mainstem to have a 50 to 99 percent improvement in shade, with Otter and Dry Creeks requiring an additional 61 percent and 36 percent respectively (Ecology 2012).

To meet water quality criteria, the TMDL requires a 90 percent fecal coliform reduction in Otter Creek, and 46 percent in Dry Creek.

PBS&J (2009) identified 24 potential wetland restoration sites in this subbasin, totaling approximately 801 acres (Figure 5). Fourteen of these sites are located adjacent to a stream. Six of those 14 sites are located adjacent to sections rated as moderate and high intrinsic potential habitat, and four are adjacent to reaches with poor riparian conditions (Attached Table 5).

West Branch Little Spokane River

The West Branch Little Spokane River subbasin is approximately 101.8 square miles. This subbasin includes the mainstem of the West Branch Little Spokane River and all its tributaries. Major tributaries discussed herein include Beaver, Buck, Heel, and Spring Heel Creeks. This subbasin also includes several lakes: Diamond, Sacheen, Trout, Horseshoe, Eloika, Lost and Fan Lakes. This subbasin spans Pend Oreille and Spokane Counties. Population centers within this subbasin include Diamond Lake, Eloika and the northern most part of Riverside. Land use in the subbasin includes Rural Traditional, Rural Conservation, Mineral Lands, Rural Activity Center. Recreational activities are focused around Diamond, Sacheen, Horeshoe and Eloika Lakes.

Fish Species

The lower West Branch Little Spokane River from the mouth to just above Eloika Lake and the tributaries Spring Heel, Heel, Buck, and Beaver Creeks were surveyed by WDFW in 2001. The lower West Branch Little Spokane River fish assemblage includes 13 species, but sculpin was the most abundant. The tributaries had less diverse fish assemblages with two species found in Beaver Creek, three in Buck Creek, one in Heel Creek, and three in Spring Heel Creek (Attached Table 1). Eastern brook trout were the most abundant species in Beaver and Spring Heel Creeks, and the only species found in Heel Creek. Rainbow trout were the most abundant species in Buck Creek (McLellan 2002).

Genetic analysis by WDFW indicates that the rainbow trout population in Buck Creek is distinct from the Spokane Hatchery stock of rainbow trout, but found that the two populations were closely related. This may indicate that the Buck Creek rainbow population's ancestry has substantial influence from coastal rainbow hatchery genes (McLellan 2002).

Stream Profiles and Instream Habitat

The West Branch is a fourth order stream. It originates at Diamond Lake and flows 32.3 kilometers (20.07 miles) before entering the Little Spokane at RKM 34.2 (river mile 21.31). On its way toward the Little Spokane River, the West Branch LSR flows through a series of lakes: Sacheen, Trout, Horseshoe and Eloika Lakes. The lower West Branch Little Spokane River is a low gradient stream (average 2 percent) dominated by slow-water habitats, with runs contributing 57 percent of the instream habitat. The West Branch streambed substrate is dominated by sand (McLellan 2002, Attached Table 2).

The headwaters of Beaver Creek are in the Huckleberry Mountains north of Horseshoe Lake (note: there are two Beaver Creeks in WRIA 55; this one is a tributary to the West Branch Little Spokane River and the other is a tributary to Dragoon Creek, which is discussed later). Beaver Creek originally flowed into Fan Lake but was diverted into the West Branch Little Spokane River in the early 1990s. Although Beaver Creek originates in mountainous terrain, it is a relatively low-gradient stream (average 1 percent) dominated by slow water habitats. Runs and pools constitute 95 percent of instream habitat. However,

unlike other low-gradient streams within WRIA 55, the dominant streambed substrate in Beaver Creek is gravel. In fact, Beaver Creek has the highest percentage of gravel in WRIA 55 at 35 percent (McLellan 2002, Attached Table 2).

The headwaters of Buck and Heel Creeks are also in the Huckleberry Mountains north of Horseshoe Lake. Buck and Heel Creeks are relatively high gradient streams (average of 3 and 5 percent respectively) consisting primarily of riffle habitat at 75 and 52 percent respectively. However, both streams have a good proportion of pools to provide refuge for fish, comprising more than 20 percent of the instream habitat for both creeks. Though the streambed substrate in these streams is dominated by sand, the proportion of gravel and cobble to sand and fine particulates is nearly equal (McLellan 2002, Attached Table 2).

Spring Heel Creek originates from a spring two kilometers east of confluence with Heel Creek and flows through Lost Lake then into the West Branch Little Spokane River. Spring Heel Creek is a spring-fed, low-gradient stream that has an equal distribution of riffles, runs and pools. Sand and other fine particulates constitute 81 percent of the streambed in Spring Heel Creek (McLellan 2002, Attached Table 2).

In terms of streambed substrates, the proportions of fine particulates to coarser streambed materials in this subbasin are such that the embeddedness is relatively low (40 percent and less on average) compared to other subbasins (McLellan 2002, Attached Table 2). Perhaps this is due to the presence of the various connected lakes, which may be providing a natural sediment sink for the system. Even with this benefit, the TMDL requires TSS reductions on both Beaver Creek (30 percent reduction) and Buck Creek (40 percent reduction) to meet water quality standards. Reductions are not required on the mainstem (Ecology 2012).

The West Branch Little Spokane River subbasin has approximately 0.395 kilometers (0.25 miles) of habitat with moderate to high intrinsic potential for both steelhead and chinook (Attached Table 3). For both species, this intrinsic potential habitat is largely located in the mainstem of the West Branch Little Spokane River (Figures 4 and 6).

Fish Passage Conditions

There are eight fish passage barriers documented in WDFW/WSDOTs inventory located in this subbasin (Figure 3), including all of those identified during WDFW surveys. Most of these are located on Beaver Creek/Ponderosa Lake tributaries and include five culverts and one dam.

Natural barriers are not included on the inventory, and there were seven natural barriers identified by WDFW during surveys in the West Branch Little Spokane River. This includes two natural barriers on the West Branch Little Spokane River mainstem, three on Beaver Creek and two on Buck Creek. One of the natural barriers on the mainstem West Branch Little Spokane River is located 1200 meters upstream from the mouth and is described as a complex of waterfalls and chutes. The second natural barrier is a waterfall where the West Branch Little Spokane River enters Horseshoe Lake. Natural barriers on Beaver Creek include two waterfalls about 5 meters high located 810 and 830 meters upstream of Horseshoe Lake and a landslide in a steep section of the stream that buried 16.2 meters of the stream. The natural barriers on Buck Creek include two chutes, with the first about 1 kilometer above the Horseshoe Lake Road crossing (McLellan 2002).

The known artificial fish passage barriers are all located upstream of the high to moderate intrinsic potential habitat and, therefore, would not impede access to these areas (Figures 4 and 6).

Riparian Conditions

Riparian conditions on the West Branch Little Spokane River were assessed by SCD (2005). However, this survey only included 3.9 river miles along the West Branch Little Spokane River mainstem. Most of the surveyed length was found to be in proper functioning condition with fair to good ecological ratings. Two reaches totaling one river mile were found to be in a functional-at-risk condition with a poor to fair ecological rating (Attached Table 4, Figure 2).

Christian (2003) estimated 57 percent of the historic riparian area was lost on West Branch Little Spokane River. The ability of the existing riparian zone to provide shade to meet the temperature water quality standard was assessed during the development of the TMDL. This assessment includes 18.6 river miles on the West Branch Little Spokane River. To meet the temperature water quality standard, the TMDL requires only 11 percent additional shade on the West Branch, which is the lowest increase required along any tributary (Ecology 2012).

The TMDL requires fecal coliform reductions only on the West Branch Little Spokane River tributaries of Moon (28 percent) and Beaver Creeks (5 percent) (Ecology 2012).

PBS&J (2009) identified 17 potential wetland restoration sites in this subbasin, totaling approximately 600 acres (Figure 5). Seven of these sites are located adjacent to a stream or lake. However, two of these seven sites are located adjacent to the lower West Branch Spokane River sections rated as moderate and high intrinsic potential habitat or as having poor riparian conditions (Attached Table 5).

Beaver Creek

The Beaver Creek subbasin is approximately 72.9 square miles and includes the upper Dragoon Creek mainstem from the headwaters to the confluence with Beaver Creek, as well as the tributary itself. This subbasin spans Stevens and Spokane Counties. Population centers include a portion of the City of Deer Park and Clayton. Historically, Deer Park was largely based on timber industry and then became an agricultural center, though some logging continues. Clayton was primarily a brick and tile manufacturing town, though there was also timber industry. Outside of the Deer Park city limits, land use in the subbasin primarily includes Small Tract Agriculture and Rural Traditional. There are also small areas of Rural Conservation, Mineral Land and Urban Reserve.

Fish Species

The upper Dragoon Creek mainstem, Beaver Creek and the smaller tributary of Spring Creek were surveyed by WDFW in 2002. However, this subbasin only includes Dragoon Creek Reaches 1 through 14 from the survey. During this survey, WDFW identified 10 species on the upper Dragoon Creek mainstem. The tributaries included in this subbasin are less diverse with seven species identified in Beaver Creek and four in Spring Creek (McLellan 2003, Attached Table 1).

Stream Profiles and Instream Habitat

This subbasin consists of low gradient streams (average gradient of 1 percent) dominated by slow water habitats. Runs consisted of 93 and 100 percent of the instream habitat in Beaver and Spring Creeks respectively. Therefore, much of the available fast water habitat in this subbasin is concentrated in the

upper mainstem of Dragoon Creek. The streambed in the upper Dragoon Creek and its surveyed tributaries is dominated by sands and finer particulates, with coarser streambed materials highly embedded. Percent embeddedness reaches over 90 percent within the upper Dragoon Creek mainstem as well as in Beaver and Spring Creeks, which is higher than any other subbasin within WRIA 55 (McLellan 2003, Attached Table 2). To meet water quality standards for turbidity, the TMDL requires a 60 percent reduction of TSS in Dragoon Creek above Deer Park (Ecology 2012).

The Beaver Creek subbasin has 9.44 kilometers (5.87 miles) of stream rated as high to moderate intrinsic potential habitat for steelhead and 9.64 kilometers (5.99 miles) for chinook (Attached Table 3). Much of the available high to moderate intrinsic potential habitat in this subbasin is located within the upper mainstem of Dragoon Creek (Figures 4 and 6).

Fish Passage Conditions

There are seven artificial fish passage barriers in this subbasin documented in the WDFW/WSDOT inventory (Figure 3). Most of these are culverts on private roads, though one on the upper Dragoon Creek is a dam. The known artificial fish passage barriers are all located upstream of the high to moderate intrinsic potential habitat and, therefore, would not impede access to these areas (Figures 4 and 6). Riparian conditions on the Dragoon Creek mainstem were surveyed by SCD (2005). However, this subbasin only includes about 1.3 miles of the Dragoon Creek mainstem surveyed, from the Hwy 395 bridge crossing to the Beaver Creek confluence just below Antler Rd. bridge (Reaches 1 and a small portion of Reach 2). This section of Dragoon Creek was found to be in proper functioning condition with fair to good ecological rating (Attached Table 4).

An estimate of riparian area lost on Dragoon Creek was included in Christian (2003), but Beaver Creek was not included in this study. It is estimated that Dragoon Creek lost 70 percent of its original riparian habitat. The ability of the existing riparian zone to provide shade to meet the temperature water quality standard was assessed during the development of the TMDL. This assessment includes 25 river miles on Dragoon Creek. To meet the temperature water quality standard, the TMDL requires 55 percent more shade along Dragoon Creek (Ecology 2012).

PBS&J (2009) identified nine potential wetland restoration sites within the subbasin totaling about 587 acres (Figure 5). Seven of these sites are directly adjacent to either the Dragoon Creek mainstem or Beaver Creek. Two of these five sites are located adjacent to sections rated as moderate and high intrinsic potential habitat (Attached Table 5).

The upper mainstem of Dragoon Creek flows mostly through small tract agricultural land, which may contribute to high concentrations of fecal coliforms. Consequently, the TMDL requires a large reduction in fecal coliform along Dragoon Creek. Though different reductions are required at different points, the point furthest downstream in this subbasin, Crawford Road, requires a 95 percent reduction (Ecology 2012).

Dragoon Creek

The subbasin is approximately 87.4 square miles and includes the West Branch Dragoon Creek and the lower Dragoon Creek mainstem below the Beaver Creek confluence. This subbasin spans both Stevens and Spokane Counties. A portion of the Deer Park city limits is located within this subbasin. Land use outside of the Deer Park city limits is primarily Small Tract Agriculture and Rural Traditional. A portion of

the lower Dragoon Creek mainstem is designated Rural Conservation, and small tracts of Mineral Lands are located near Deer Park.

Fish Species

The Dragoon Creek mainstem and the West Branch Dragoon Creek were surveyed by WDFW in 2002. This subbasin only includes the Dragoon Creek Reaches 15 through 28 from the survey. WDFW identified 12 fish species within this lower portion of Dragoon Creek and nine species in West Branch Dragoon Creek. Genetic studies from WDFW indicate that Dragoon Creek supports rainbow trout subpopulations that are more closely related to coastal subspecies, suggesting substantial coastal influence (McLellan 2003, Attached Table 1).

Stream Profiles and Instream Habitat

Both the lower mainstem and the West Branch of Dragoon Creek are low gradient streams with the dominant instream habitat being runs. However, the mainstem offers more of a mix of instream habitat types. The streambed substrate in this subbasin is dominated by sand and fine particulates. However, the fines are contributing to a higher average embeddedness (90 percent) in the West Branch Dragoon Creek compared to the lower mainstem (60 percent) (McLellan 2003, Attached Table 2). To meet water quality standards, the TMDL requires a 35 percent reduction in TSS in the West Branch Dragoon Creek and 60 percent reduction in the mainstem at Crescent Road (Ecology 2012).

The Dragoon Creek basin has 24.03 kilometers (14.93 miles) of stream rated as high to moderate intrinsic potential habitat for steelhead and 22.02 kilometers (13.68 miles) for chinook (Attached Table 3). It has the highest potential of any subbasin for steelhead and the second highest for chinook. Much of this is found on the lower mainstem (Figures 4 and 6).

Fish Passage Conditions

There is one fish passage barrier documented in the WDFW/WSDOT inventory located in this subbasin. It is the culvert on the US 395 crossing of Dragoon Creek mainstem. This barrier is located within a continuous length of stream rated as moderated to high potential intrinsic habitat with approximately 13 river miles upstream of the barrier (Figures 4 and 6).

Riparian Conditions

Riparian conditions on the Dragoon Creek mainstem were surveyed by SCD (2005). This subbasin includes nine reaches totaling 16.2 river miles from the survey. The West Branch Dragoon Creek was not included in the survey. Most of the surveyed length of Dragoon Creek was found to be in proper functioning condition with fair to good ecological rating. Approximately 1.9 miles along three sections on the mainstem were noted to be in functional-at-risk condition with poor to fair ecological ratings (Attached Table 4, Figure 2).

Christian (2003) estimated that the West Branch Dragoon Creek and Dragoon Creek respectively lost 69 and 70 percent of their original riparian area. The ability of the existing riparian zone to provide shade to meet the temperature water quality standard was assessed during the development of the TMDL. This assessment includes 25 river miles on Dragoon Creek. To meet temperature water quality standard, the TMDL requires an additional 55 percent shade along Dragoon Creek.

PBS&J (2009) identified 19 potential wetland restoration sites within this subbasin totaling 798 acres (Figure 5). Twelve of these sites are located directly adjacent to a stream. Of these, four sites are located adjacent to sections rated as moderate and high intrinsic potential habitat, including immediately adjacent to the US 395 crossing. However, none of the restoration sites are located adjacent to sections with poor riparian habitat conditions (Attached Table 5).

The lower mainstem of Dragoon Creek and the West Branch Dragoon Creek flow mostly through small tract agricultural land, which may contribute to high concentrations of fecal coliforms. Consequently, the TMDL requires an 89 percent reduction in fecal coliforms in the West Branch Dragoon Creek and 70 percent reduction at the mouth of Dragoon Creek (Ecology 2012).

Little Spokane/Deer Creek

The Little Spokane/Deer Creek subbasin is approximately 71.9 square miles and includes the middle Little Spokane River mainstem from below the West Branch Little Spokane River confluence to just above the Dragoon Creek confluence and the tributaries of Deer and Bear Creeks. Population centers included in the subbasin include the eastern portion of Deer Park, the southern portion of Riverside and Chattaroy. Outside of these population centers, the primary land use designations include Rural Traditional and Rural Conservation. There is also forest land in the headwaters of Deer Creek and several small tracts of Mineral Land. Notable recreational features include Bear Lake Park and Antler Springs Golf Course.

Fish Species

Deer and Bear Creeks were surveyed by WDFW in 2001, followed by Little Deer Creek in 2002, and the Little Spokane River in 2003. This subbasin only includes 15.6 kilometers (9.69 miles) of the Little Spokane River mainstem (Reaches 21 through 29 from the WDFW survey). During these surveys, WDFW observed 16 species within the section of the Little Spokane River mainstem included in this subbasin. The tributaries are less diverse with nine species observed in Bear Creek, four species in Deer Creek and two in Little Deer Creek (McLellan 2002, 2003, and 2005; Attached Table 1).

Eastern brook trout were the most abundant species in Bear Creek, but rainbow trout was the most abundant species in Deer Creek. Despite stocking efforts, the WDFW indicated that rainbow trout likely failed to establish a population in Bear Creek due to habitat conditions, either directly from habitat preference or indirectly through interspecific competition. Genetic studies from WDFW indicate that Deer Creek including Little Deer supports interior redband subspecies of rainbow trout, not coastal subspecies of rainbow trout (McLellan 2002).

Stream Profiles and Instream Habitat

Deer Creek is a fourth order stream with headwaters originating on the western slopes of Mt. Spokane at 1,305 meters. It flows 20.9 kilometers (20.99 miles) in a southwesterly direction and into the Little Spokane River at RKM 37 (river mile 22.99). As relatively high-gradient streams, Deer and Little Deer Creeks are dominated by riffle habitat (McLellan 2002 and 2003).

Bear Creek is a second order stream originating from two springs located approximately 1 kilometer west of Eloika Lake. It flows 11.9 kilometers (7.39 miles) in a southeasterly direction through Little Trout Lake to the confluence with Little Spokane at RKM 44.8 (river mile 27.84). Bear Creek is occasionally connected with Bailey's Lake through a small outlet ditch. As a low-gradient, spring-fed stream Bear

Creek is dominated by slow water habitats. Runs contribute 63 percent of Bear Creek's instream habitat and riffles 34 percent. It was noted by WDFW that wide wetlands along upper Bear Creek are likely accessible to fish during high water periods (McLellan 2002).

The streambed is dominated by gravels in Little Deer Creek and by sand and finer particulates in Deer Creek, Bear Creek and the Little Spokane River. The embeddedness in Deer and Bear Creeks are relatively high (63 and 74 percent respectively). The embeddedness in Little Deer Creek is relatively low (49 percent) compared to other parts of WRIA 55 (Attached Table 2). To meet water quality standards, the TMDL requires an 80 percent reduction in TSS in Deer Creek. Bear Creek does not require reductions in TSS (Ecology 2012).

Deer Creek subbasin contains 31.03 kilometers (19.28 miles) of stream rated as high to moderate intrinsic potential habitat for steelhead and 20.89 kilometers (12.98 miles) of stream for chinook (Attached Table 3). Much of this is located on the Little Spokane River mainstem and Deer Creek. Bear Creek was not identified as having high or moderate intrinsic potential habitat for either steelhead or chinook (Figures 4 and 6).

Fish Passage Conditions

Twelve artificial barriers are documented in the WDFW/WSDOT inventory in this subbasin, and all are located on Deer Creek and its tributaries (Figure 3). Most of these barriers are culvert crossings on private roads. However, there are also several culverts on state-owned roads, including the concrete culvert at the Highway 2 crossing near the mouth of the creek. Not included on the inventory is the concrete culvert at the railroad crossing 200 meters upstream from the Highway 2 crossing. During the WDFW survey, Deer Creek was also noted to go dry between the Elk Chattaroy Rd and railroad crossing (McLellan 2002). The fish passage barriers near the mouth of Deer Creek could impact access to the moderate to high intrinsic potential habitat upstream (Figures 4 and 6).

Riparian Conditions

Riparian conditions were assessed on the Little Spokane River mainstem by SCD (2005), but Deer and Bear Creeks were not included in these surveys. This subbasin includes approximately 10.65 river miles surveyed along the Little Spokane River mainstem (Reaches 7 through 12 with about half of Reach 13, which spans across subbasins). Nearly half of this, or 4.9 river miles, were found to have riparian habitat in functional-at-risk condition with poor to fair ecological condition. An additional 1.6 river miles, though in proper functioning condition, was given a poor to fair ecological rating (Attached Table 4, Figure 2).

Christian (2003) estimated Bear and Deer Creeks respectively lost 56 and 86 percent of their historical riparian area. The ability of the existing riparian zone to provide shade to meet the temperature water quality standard was assessed during the development of the TMDL. This assessment includes 15 river miles on Deer Creek and 6.2 miles on Bear Creek. To meet temperature water quality standard, the TMDL requires a 50 to 99 percent increase in shade along section of the LSR mainstem within this subbasin. In addition, the required increase in shade along Bear and Deer Creeks are 19 and 39 percent respectively (Ecology 2012).

PBS&J (2009) identified 16 potential wetland restoration sites within this subbasin, totaling approximately 472 acres. Half of these are located immediately adjacent to a stream. Five adjacent to

moderate and high intrinsic potential, but one also has poor riparian conditions (Figure 5 and Attached Table 5).

To meet water quality standards, the TMDL requires an 87 percent reduction in fecal coliforms in Deer Creek and 24 percent reduction in Bear Creek (Ecology 2012).

Little Deep Creek

The Little Deep Creek subbasin is 49.9 square miles and includes the middle Little Spokane River mainstem from below the Dragoon Creek confluence to just above the Deadman Creek confluence and the tributary of Little Deep Creek. Little Deep Creek's tributaries discussed herein include the North and South Forks and Pell Creek. The entire subbasin is within Spokane County. The only population center within the subbasin is Colbert. Primary land use designations include Rural Traditional and Rural Conservation. There is also Forest Land in the headwaters of Little Deep Creek and some Small Tract Agricultural land. In the southern portion of the subbasin near the Deadman Creek confluence, there is some land designated Low Density Residential, Urban Reserve and Low Density Commercial-Industrial.

Fish Species

The Little Spokane River mainstem, Little Deep Creek and its tributaries were surveyed by WDFW in 2003. During this survey, WDFW observed seven fish species within the Little Deep Creek mainstem. Its tributaries have less diverse fish assemblages with five species observed in the North Fork, four in the South Fork and only one in Pell Creek (McLellan 2005; Attached Table 1).

Speckled dace was the most abundant species in the Little Deep Creek mainstem. Rainbow trout were the most abundant species in both the North and South Forks and the only species found in Pell Creek. Genetic results indicated that the rainbow trout in Little Deep Creek and its tributaries are a single population that have had little influence from the Spokane Hatchery stock of rainbow trout, suggesting they are native redband rainbow trout (McLellan 2005).

Stream Profiles and Instream Habitat

Little Deep Creek is a low-gradient stream that flows across the Valley Prairie. The instream habitat in the Little Deep Creek mainstem almost constitutes an equal amount of riffle and runs. The streambed substrate in the mainstem is dominated by sand with other fines (McLellan 2005 and Attached Table 2).

The North Fork originates on Mt. Spokane and is a moderate gradient stream (average gradient of 2.4 percent). The dominant habitat type is riffles with a good proportion of runs to provide slow-water habitat. The North Fork is one of four streams within WRIA 55 where the streambed substrate is dominated by gravel (McLellan 2005 and Attached Table 2).

Pell Creek and the South Fork also originate on Mt. Spokane, but are relatively high-gradient streams (average 4.3 and 5 percent gradients respectively). Both have riffles comprising about three-fourths of the instream habitat. The streambed substrate in Pell Creek is dominated by sand, but also has some of the highest proportion of gravel of any stream within WRIA 55. The South Fork is equally dominated by sand and gravel (McLellan 2005 and Attached Table 2).

The embeddedness of coarser substrates increases downstream within the subbasin. The South Fork and Pell Creek having the lowest embeddedness at 48 and 54 percent respectively. The North Fork and Little Deep having higher embeddedness at 65 and 77 percent respectively (McLellan 2005 and Attached

Table 2). To meet water quality standards, the TMDL requires an 80 percent reduction in TSS in Little Deep Creek (Ecology 2012).

Little Deep Creek subbasin has 18.49 kilometers (11.49 miles) of stream rated moderate to high intrinsic potential habitat for steelhead and 18.23 kilometers (11.33 miles) for chinook (Attached Table 3). This is largely contained in the Little Deep Creek mainstem, though the South Fork has habitat capacity for steelhead only (Figures 4 and 6).

Fish Passage Conditions

Little Deep Creek has four fish passage barriers documented in the WDFW/WSDOT inventory (Figure 3). This includes all but one of the barriers noted in the WDFW survey. The known fish passage barriers are all located upstream of the available moderate to high intrinsic potential habitat and, therefore, are not impacting fish movement (Figures 4 and 6).

Riparian Conditions

Riparian conditions were assessed on the Little Spokane River mainstem by the SCD (2005), but the Little Deep Creek watershed was not included in the survey. This subbasin includes approximately 8 river miles of the assessed Little Spokane River mainstem (Reach 14 and portions of Reaches 13 and 15, which span multiple subbasins). Most of the river miles assessed along the section of the Little Spokane River mainstem within this subbasin were found to be in proper functioning condition with fair to good ecological ratings. However, one river mile was assessed as functional-at-risk with a fair ecological rating (Attached Table 4, Figure 2).

Christian (2003) estimated that Little Deep Creek lost 93 percent of its historical riparian area. The ability of the existing riparian zone to provide shade to meet the temperature water quality standard was assessed during the development of the TMDL. This assessment did not include or specify requirements for Little Deep Creek. To meet temperature water quality standard, the TMDL requires 15 to 19 percent increase in shade along the LSR mainstem within this subbasin (Ecology 2012).

PBS&J (2009) identified seven potential wetland restoration sites within this subbasin totaling approximately 133 acres (Figure 5). Six of these are immediately adjacent to a stream. Five adjacent to moderate and high intrinsic potential, but one adjacent to moderate and high intrinsic potential with poor riparian conditions (Attached Table 5).

To meet water quality standards, the TMDL requires a 95 percent reduction in fecal coliform in Little Deep Creek (Ecology 2012).

Deadman Creek/Peone Creek

The Deadman Creek/Peone Creek subbasin is 83.9 square miles and includes the entire Deadman Creek watershed, excluding the Little Deep Creek watershed. This subbasin is located entirely within Spokane County, and the lower subbasin includes a portion of the Urban Growth Area. Mead is the only population center in the subbasin. Land use designations in the more urbanized area of the subbasin includes High and Low Density Residential, Low Density Commercial-Industrial, Neighborhood and Community Commercial, Urban Reserve, Mineral Land, and Heavy Industrial. Rural areas of the subbasin are designated under Rural-5, Small Tract Agriculture, and Rural Traditional. In the headwaters, there is also a large amount of land designated under Rural Conservation, with portions designated as Forest

Land. Notable features in the subbasin includes portions of Mt. Spokane State Park in the headwaters and a Spokane County Conservation Futures property, the Feryn Conservation Area, along the Deadman Creek mainstem at the Peone Creek confluence.

Fish Species

Deadman Creek, its South Fork and the tributary Burping Brook were surveyed by WDFW in 2003. During the survey, WDFW observed 10 species within the Deadman Creek mainstem. The fish assemblage in the South Fork Deadman Creek only consisted of three species and Burping Brook only two species (McLellan 2005, Attached Table 1).

Sculpin were the most abundant species observed in the Deadman Creek mainstem. The most abundant species in the tributaries were eastern brook trout in Burping Brook and rainbow trout in the South Fork. Genetic results indicated that the rainbow trout in Deadman Creek and its South Fork are one population that have had little influence from the Spokane Hatchery stock of rainbow trout, suggesting they are native redband rainbow trout (McLellan 2005).

Stream Profiles and Instream Habitat

In the Deadman Creek subbasin, the dominant instream habitat is riffle. However, the Deadman Creek mainstem offers a better mix of fast and slow water habitats than its tributaries. The Deadman Creek mainstem consists of 61 percent riffles with runs at 23 percent and pools at 16 percent. In Burping Brook, riffles constitute a much higher proportion of instream habitat at 84 percent. South Fork instream habitat is comprised of 81 percent riffles (McLellan 2005 and Attached Table 2).

Streambed substrate throughout the system is dominated by sand, but there is a relatively high percent of gravel compared to other subbasins. The embeddedness of the gravels increases downstream with Burping Brook and South Fork at 58 and 56 percent respectively, and Deadman Creek at 70 percent (McLellan 2005 and Attached Table 2).

To meet water quality standards, the TMDL set reductions in TSS at several points along Deadman Creek: 70 percent reduction at the mouth of Deadman Creek, a 45 percent reduction above the Little Deep confluence, a 95 percent reduction at Heglar Road, and 40 percent at Holcombe Road. There is also a 40 reduction in TSS required in Peone Creek (Ecology 2012).

Deadman Creek subbasin has 20.91 kilometers (12.99 miles) of stream rated as moderate to high intrinsic potential habitat for steelhead and 18.57 kilometers (11.54 miles) for chinook (Attached Table 3). Much of this is within the Deadman Creek mainstem and the South Fork. Despite the high number of barriers, they are all located above the available moderate to high intrinsic potential habitat in the subbasin (Figures 4 and 6).

Fish Passage Conditions

This subbasin has the highest number of fish passage barriers documented in the WDFW/WSDOT inventory at 35 (Figure 3). Most of these are culvert crossings on Burping Creek and the South Fork. Most of the known fish passage barriers are located upstream of the continuous stretch of moderate to

high intrinsic potential habitat on the Deadman Creek mainstem and, therefore, are not impacting access to this area (Figures 4 and 6).

Riparian Conditions

Riparian conditions on Deadman Creek were surveyed by SCD (2005). The survey included 23 river miles along the mainstem of Deadman Creek, and did not include the tributaries. Most of the surveyed stream length was found to be in proper functioning condition with a fair to good ecological rating. However, 9.5 river miles were found to be in a functional-at-risk condition with 2.7 of these miles in poor ecological condition (Attached Table 4, Figure 2).

Christian (2003) estimated that Deadman Creek lost 74 percent of its historical riparian area. The ability of the existing riparian zone to provide shade to meet the temperature water quality standard was assessed during the development of the 2012 TMDL. This assessment included 21 miles on Deadman Creek. To meet water quality standards for temperature, the TMDL requires a 46 percent increase in shade along Deadman Creek (Ecology 2012). The WDFW noted that low densities of salmonids in the middle reaches of Deadman Creek were likely due to the high temperatures experienced during their survey (McLellan 2005).

PBS&J (2009) identified eight potential wetland restoration sites within this subbasin totaling approximately 319 acres (Figure 5). Six of these sites are located adjacent to a stream. Four of those six are adjacent to sections of Deadman Creek rated as moderate to high intrinsic potential habitat (Attached Table 5).

Little Spokane/Dartford Creek

The Little Spokane/Dartford Creek subbasin includes Dartford Creek and the lower Little Spokane River mainstem from just below the Deadman Creek confluence to the mouth, excluding the portion of the lower watershed influenced by the Spokane Valley Rathdrum Prairie aquifer. This subbasin is located entirely within Spokane County, and includes a portion of the Urban Growth Area. Notable features in the subbasin include the Wandemere Golf Course, Pine River Park, Glenneden Park and Haynes Estates Conservation Area.

Fish Species

The Little Spokane River and Dartford Creek were surveyed by WDFW in 2003. This subbasin includes Little Spokane River Reaches 35 through 41 from the survey. During the survey, the WDFW observed nine fish species in the lower reaches of the Little Spokane River that are within this subbasin. In Dartford Creek, WDFW only observed three species (Attached Table 1). Rainbow trout were the most abundant species observed in Dartford Creek. Genetic results indicate that the rainbow trout in Dartford Creek have had little influence from the Spokane Hatchery stock of rainbow trout, suggesting they are native redband rainbow trout (McLellan 2005).

Stream Profiles and Instream Habitat

In the portion of the Little Spokane River mainstem included within this subbasin, the instream habitat is a mix of riffles and runs. This portion of the Little Spokane River is the only segment where the streambed substrate is not dominated by sand. Here the streambed is dominated by cobbles. However,

the sand component contributes to a 66 percent embeddedness along this portion of the Little Spokane River (McLellan 2005 and Attached Table 2).

Dartford Creek is a moderate gradient stream (average gradient of 2.5 percent) that flows through a residential area. The instream habitat in Dartford Creek instream is predominantly riffles and the streambed is comprised mostly of sand. Dartford Creek has high embeddedness at 75 percent (McLellan 2005 and Attached Table 2). To meet water quality standards, the TMDL requires a 90 percent reduction in TSS in Dartford Creek (Ecology 2012).

The Dartford Creek subbasin has 6.03 kilometers (3.75 miles) of stream rated as moderate to high intrinsic potential habitat for steelhead and 2.83 kilometers (1.76 miles) for chinook (Attached Table 3). Much of the habitat potential is within the Little Spokane River mainstem. Dartford Creek only has capacity for steelhead (Figures 4 and 6).

Fish Passage Conditions

There are no fish barriers within this subbasin documented in the WDFW/WSDOT inventory (Figure 3). However, the WDFW survey noted a potential fish passage barrier on Dartford Creek at RKM 0.2. The barrier consisted of a square concrete culvert suspected to limit the distribution of smaller fish encountered in the stream (McLellan 2005).

Riparian Conditions

Riparian conditions on the Little Spokane River mainstem were conducted by SCD (2005), but Dartford Creek was not included in the survey. This subbasin includes approximately 13 river miles surveyed on the lower Little Spokane River mainstem (Reaches 16 through 20, and a portion of Reach 15 which spans multiple subbasins). The riparian habitat along this segment of the Little Spokane River was found to be in proper functioning condition with fair to good ecological ratings (Attached Table 4, Figure 2).

The ability of the riparian zone to provide shade to meet the temperature water quality standard was assessed during the development of the TMDL. This assessment included 6.8 river miles on Dartford Creek. To meet temperature standard, the lower portion of the LSR mainstem requires up to a 50 percent increase in shade around Dartford, but much lower increases of up to 15 percent below Dartford. In addition, the TMDL requires a 40 percent increase in shade along Dartford Creek (Ecology 2012).

To meet water quality standards, the TMDL requires a 63 percent reduction in fecal coliforms in Dartford Creek (Ecology 2012).

PBS&J (2009) identified seven potential wetland restoration sites in the Dartford Creek subbasin totaling approximately 116 acres (Figure 5). Four of these sites are located immediately adjacent to a stream. Two of those four sites are adjacent to sections of the lower Little Spokane River mainstem rated as moderate to high intrinsic potential habitat (Attached Table 5).

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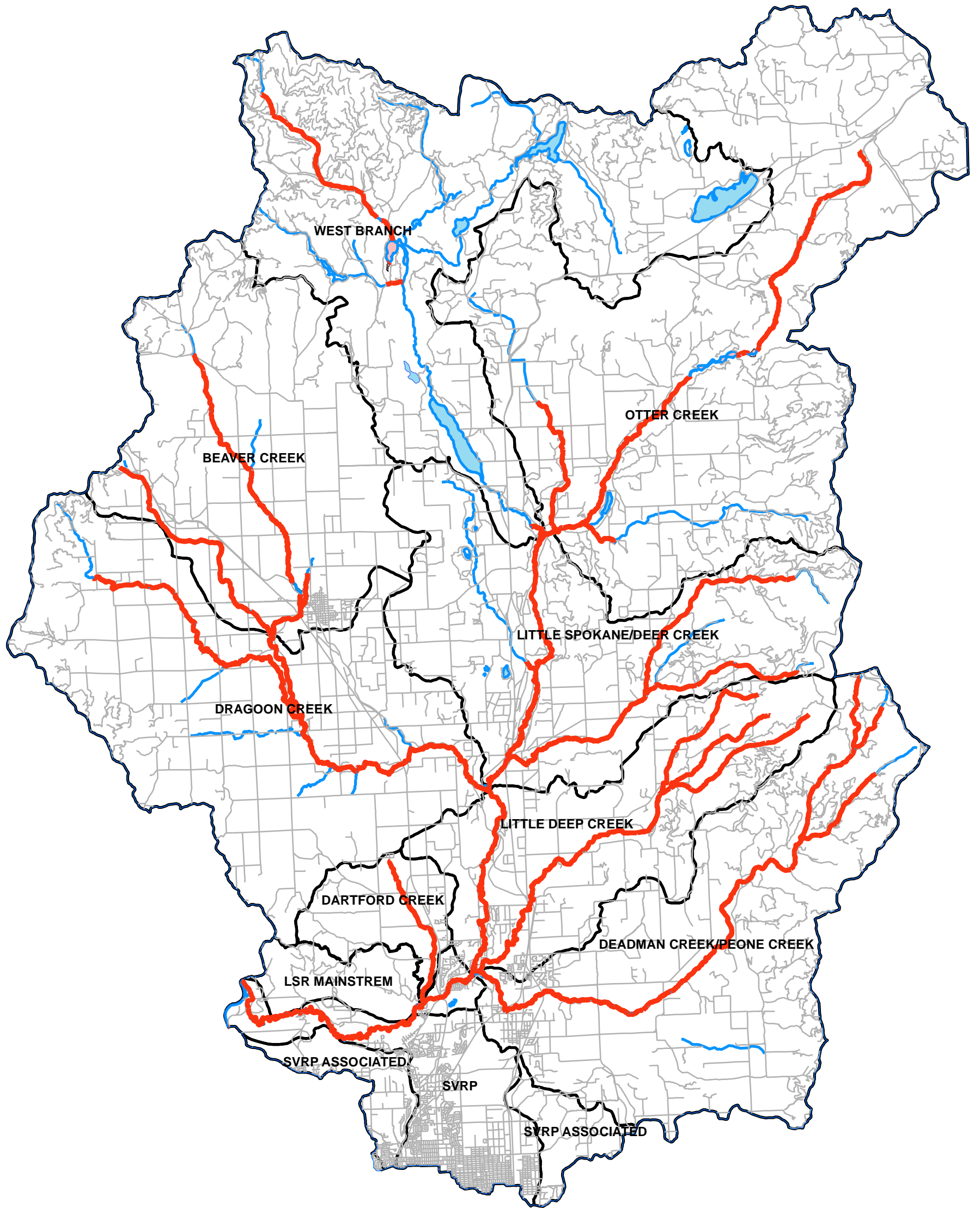
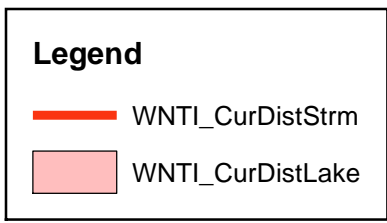


Figure 1
Current Distribution of Redband Trout by Subbasin
Little Spokane River watershed/WRIA 55



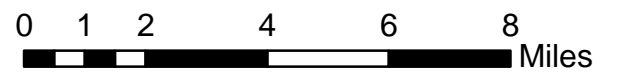
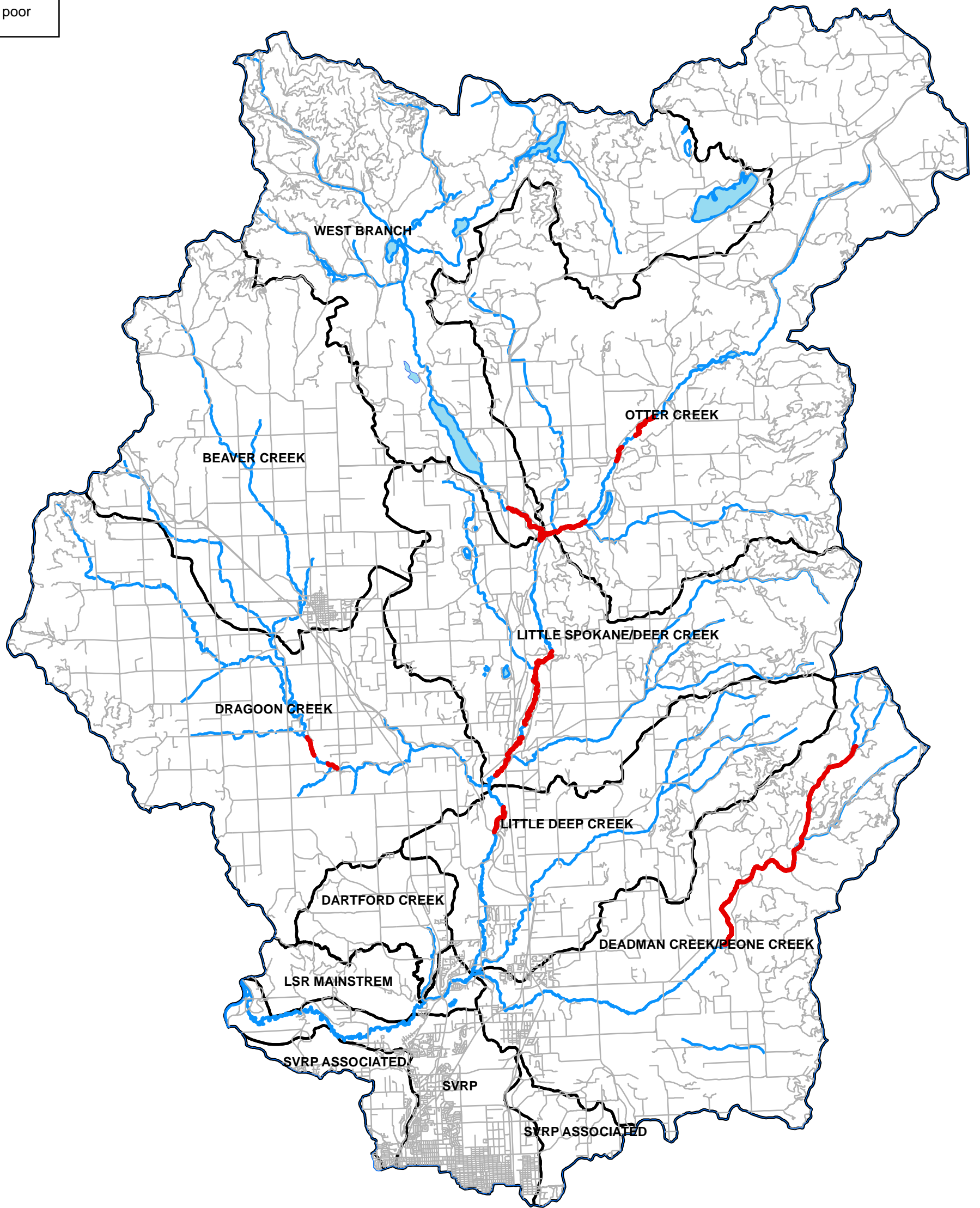
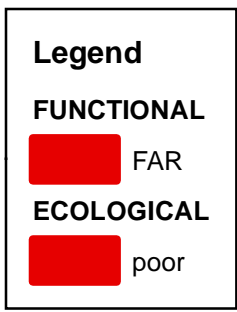


Figure 2
Poor Riparian Habitat by Subbasin
Classified as Functional-at-Risk (FAR) and Poor Ecological Rating
Little Spokane River watershed/WRIA 55



Legend

Fish Passage

- Barrier

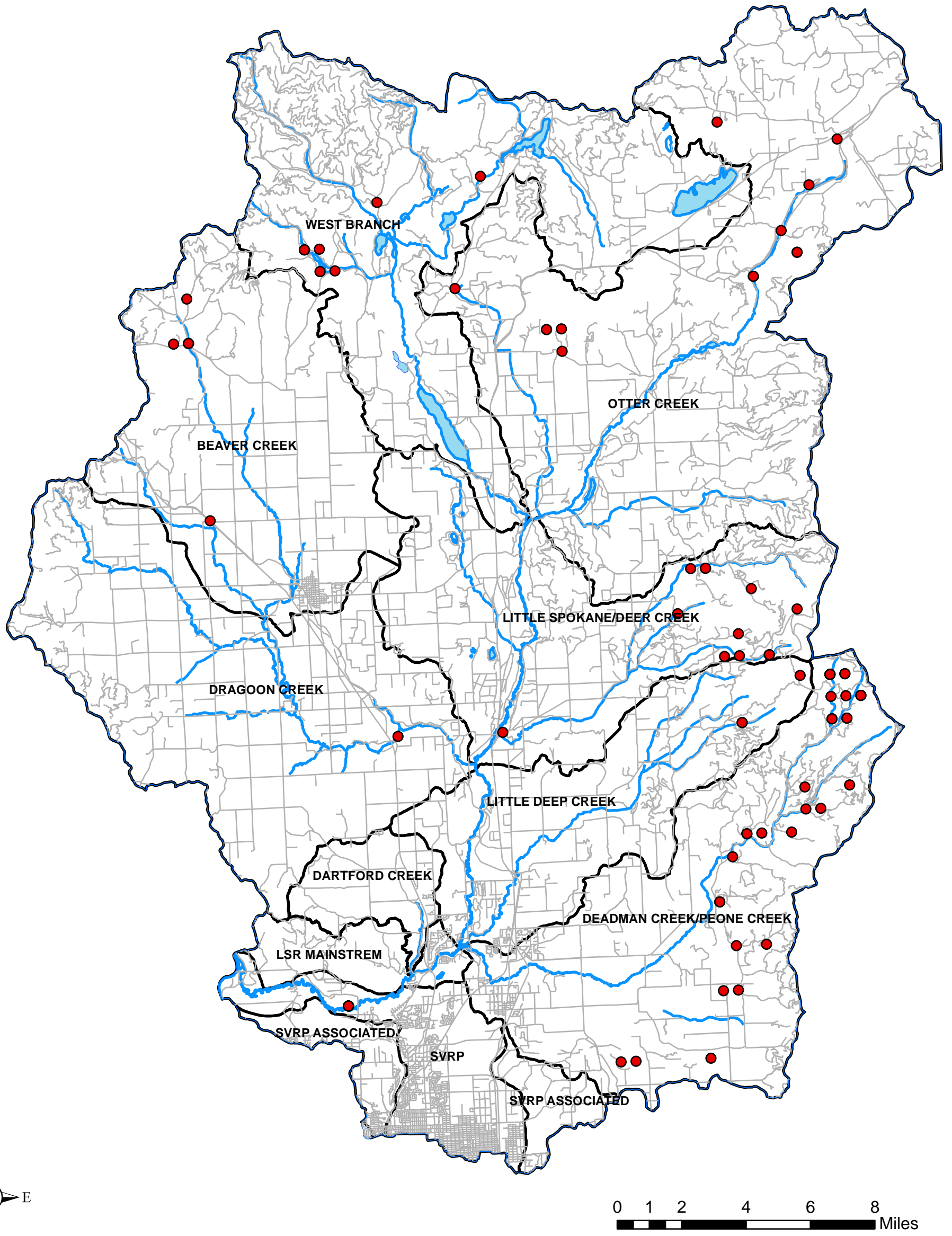


Figure 3
Fish Passage Barriers by Subbasin
Little Spokane River watershed/WRIA 55



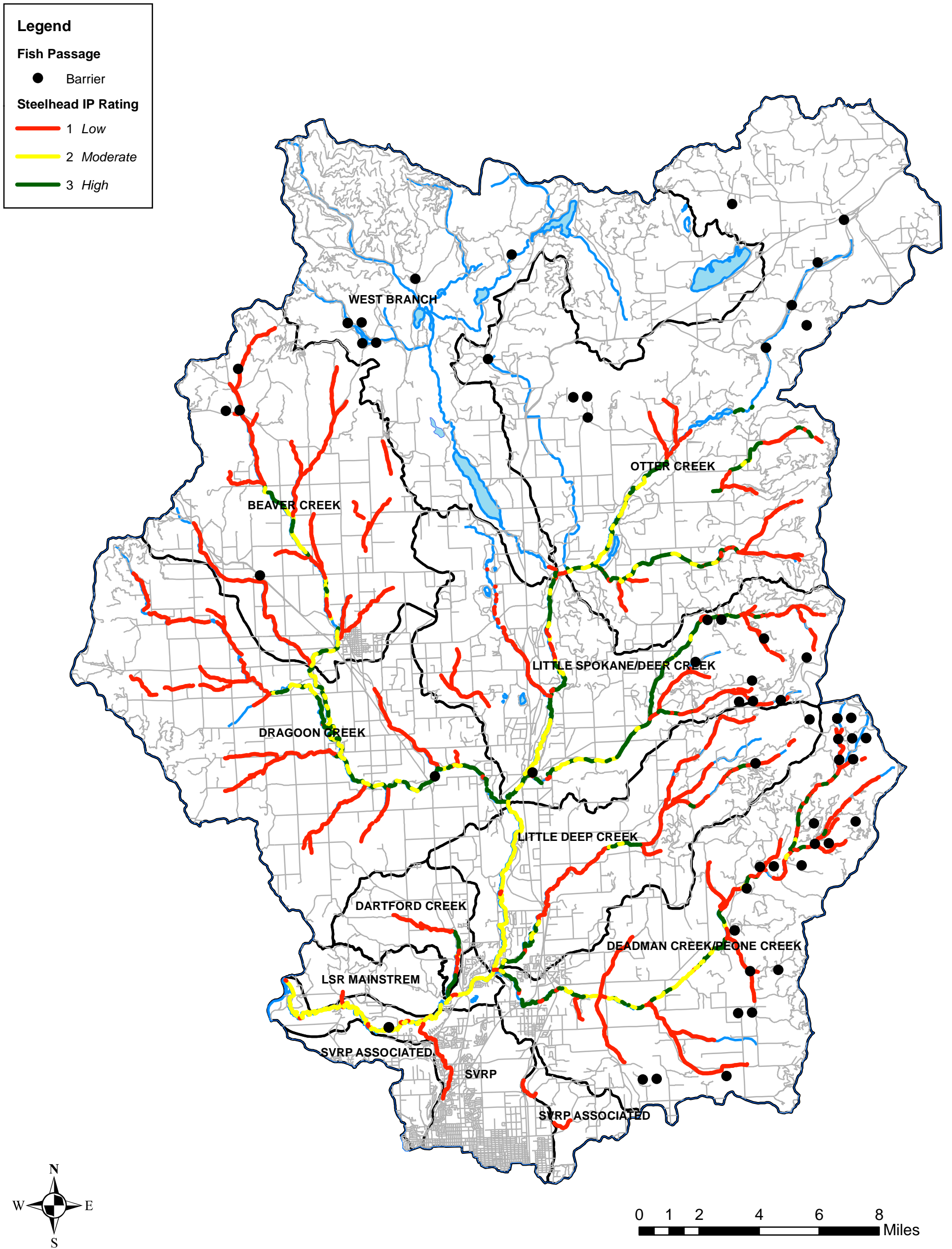



Figure 4
Intrinsic Potential Habitat for Steelhead/Redband
and Fish Passage Barriers by Subbasin
Little Spokane River watershed/WRIA 55



Legend

 Wetland Sites

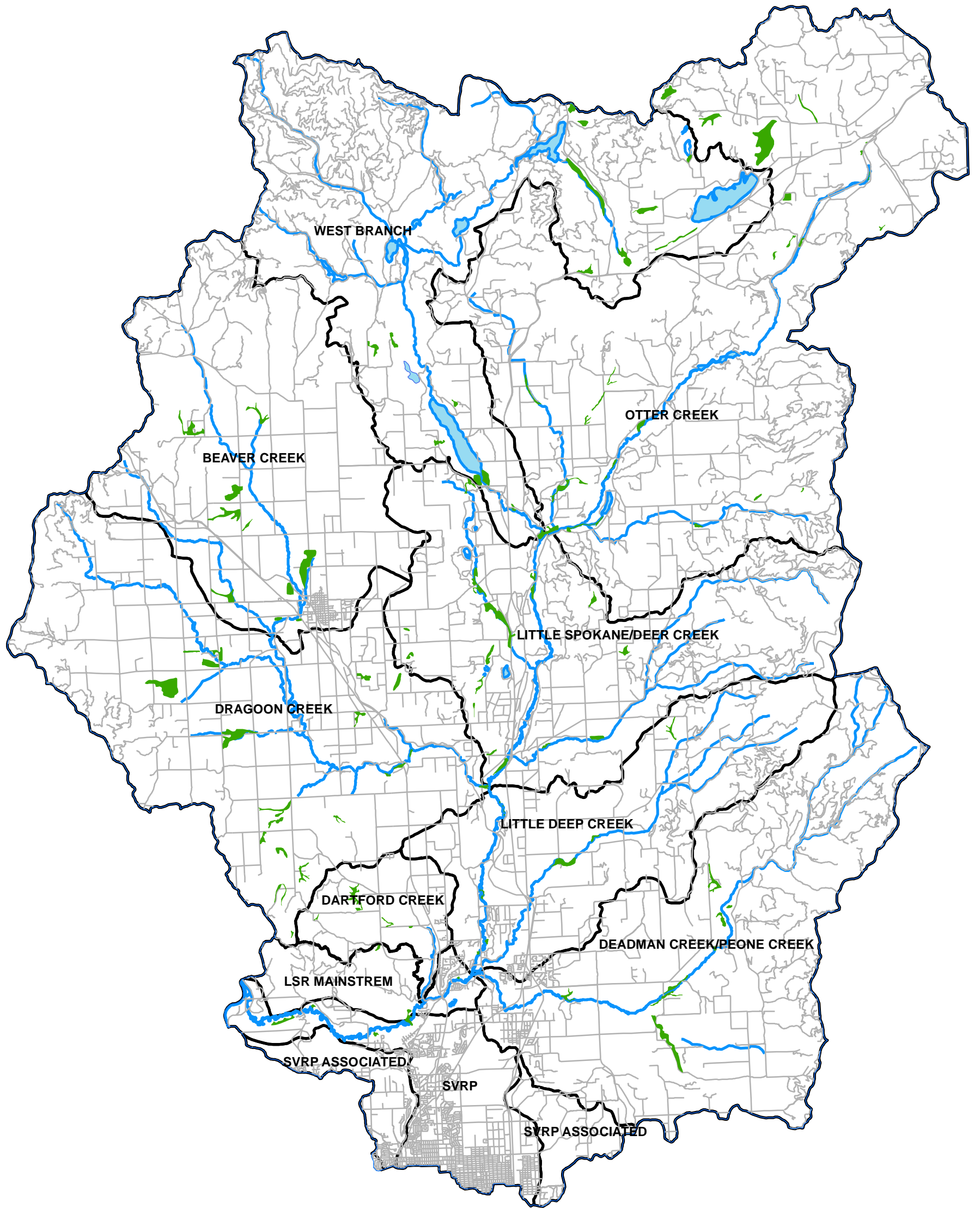


Figure 5
Potential Wetland Restoration Sites by Subbasin
Little Spokane River watershed/WRIA 55



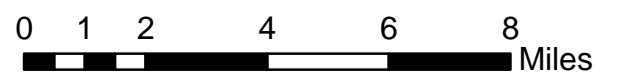
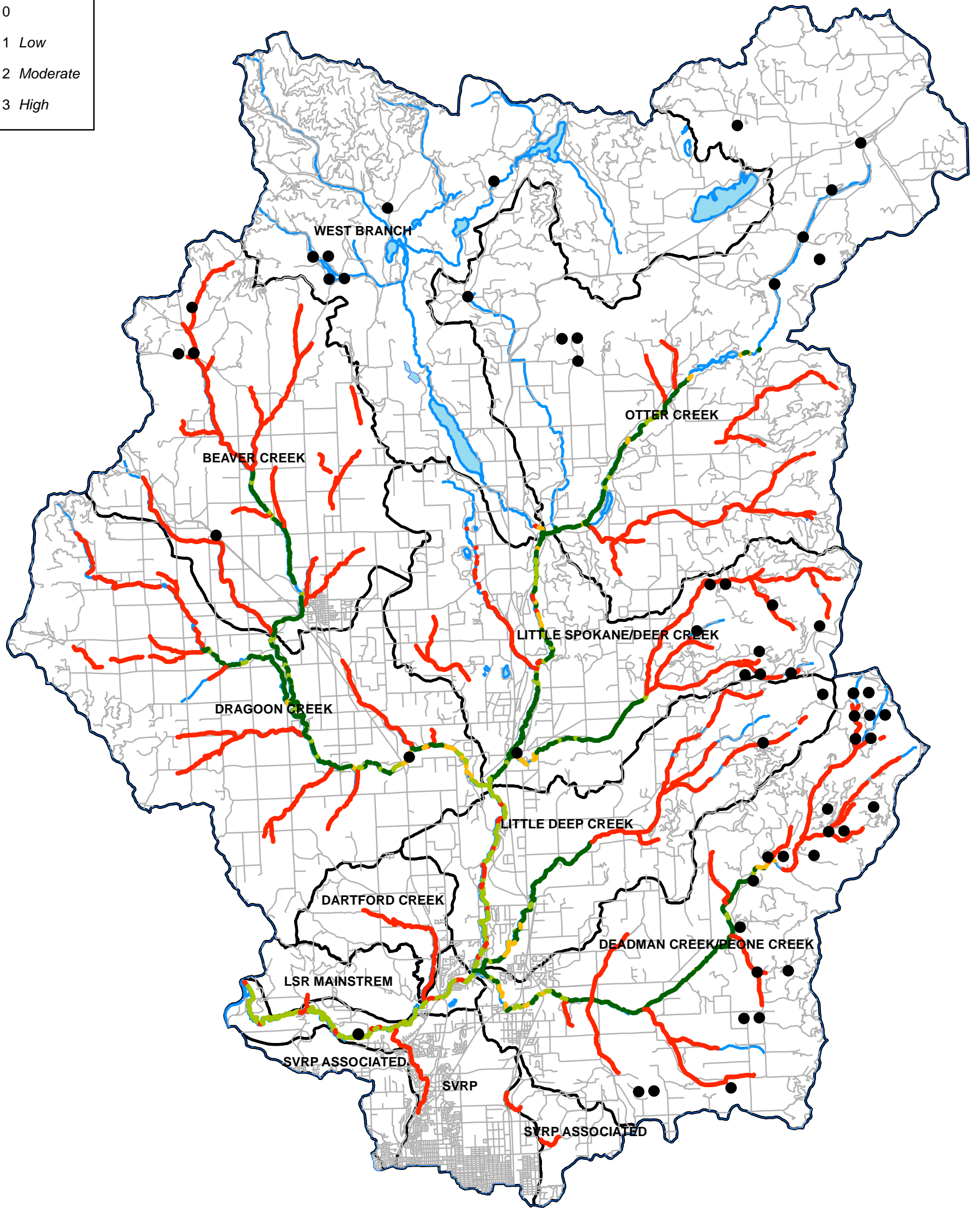
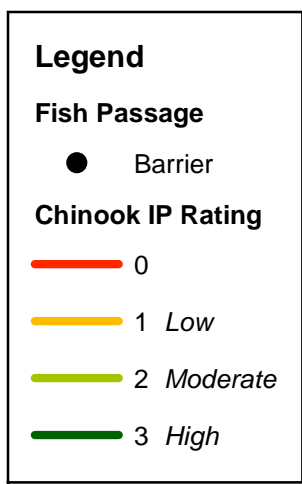


Figure 6
Intrinsic Potential Habitat for Chinook
and Fish Passage Barriers by Subbasin
Little Spokane River watershed/WRIA 55



Table 1. Fish species by subbasin and waterbody. Data compiled from McLellan 2002, 2003 and 2005.

Subbasin	Waterbody (Reach #s)*	Eastern brook trout <i>Salvelinus fontinalis</i>	Lake trout <i>S. namaycush</i>	Brown trout <i>Salmo trutta</i>	Rainbow Trout <i>Onchorhynchus mykiss</i>	Kokanee <i>O. nerka</i>	Mountain whitefish <i>Prosopium williamsoni</i>	Pygmy whitefish <i>P. coulteri</i>	Black crappie <i>Pomoxis nigromaculatus</i>
Otter Creek	LSR (1 - 20)	X			X		X		
	Otter	X		X	X		X		
	Dry	X		X	X		X		
	Chain Lake**				O	O	O		
WB	WB			X	X		X		
	Beaver	X			X				
	Buck	X			X	O			
	Heel	X							
	Spring Heel	X							
	Diamond Lake**				O				
	Sacheen Lake**	O		O					
	Fan Lake**				O				
	Trout Lake**	O			O				
Horseshoe Lake**		O		O	O	O	O		
Eloika Lake**			O	O					
Deer	LSR (21 - 29)	X			X		X		
	Deer	X			X				
	Little Deer	X			X				
	Bear	X			X		X		
Beaver	Beaver	X		X	X				
	Upper Dragoon (1-14)	X		X	X		X		
	Spring	X		X	X				
Dragoon	West Branch Dragoon	X		X	X				
	Lower Dragoon (15 - 28)	X		X	X		X		
	Mud	O							
	Wethey Creek**	O		O	O		O		
Little Deep	LSR (30 - 34)				X				
	Little Deep				X		X		
	North Fork	X			X				
	South Fork	X			X				
	Pell Creek				X				
Deadman	Deadman Creek	X			X		X		
	South Fork	X			X				
	Burping Brook	X			X				
Dartford	LSR (35 - 41)			X	X		X		
	Dartford	X			X				

X Species observed during WDFW surveys conducted between 2001 and 2003

O Species noted as present from other sources as summarized in McLellan 2002, 2003, and 2005.

* Reach numbers from WDFW surveys provided where waterbody is divided by multiple subbasins

** Waterbody not included in WDFW surveys

Table 1. Fish species by subbasin and waterbody. Data compiled from McLellan 2002, 2003 and 2005.

Subbasin	Waterbody (Reach #s)*	Redside shiners <i>Richardsonius balteatus</i>	Bluegill <i>Lepomis macrochirus</i>	Grass pickerel <i>Esox americanus vermiculatus</i>	Green sunfish <i>Lepomis cyanellus</i>	Northern pikeminnow <i>Ptychocheilus oregonensis</i>	Largemouth bass <i>Micropterus salmoides</i>	Smallmouth bass <i>M. dolomieu</i>
Otter Creek	LSR (1 - 20)	X	X			X	X	
	Otter							
	Dry					X	X	
	Chain Lake**	O				O		
WB	WB		X	X			X	
	Beaver							
	Buck			O				
	Heel							
	Spring Heel						X	
	Diamond Lake**					O	O	
	Sacheen Lake**					O	O	
	Fan Lake**			O		O	O	
	Trout Lake**					O	O	
	Horseshoe Lake**		O			O		
Eloika Lake**			O		O	O	O	
Deer	LSR (21 - 29)	X		X		X		
	Deer							
	Little Deer							
	Bear				X			
Beaver	Beaver	X						
	Upper Dragoon (1-14)	X				X		
	Spring							
Dragoon	West Branch Dragoon	X						
	Lower Dragoon (15 - 28)	X				X		
	Mud							
	Wethey Creek**							
Little Deep	LSR (30 - 34)	X				X		
	Little Deep	X						
	North Fork	X						
	South Fork	X						
	Pell Creek							
Deadman	Deadman Creek	X				X		
	South Fork							
	Burping Brook							
Dartford	LSR (35 - 41)	X				X		
	Dartford							

X Species observed during WDFW surveys conducted between 2001 and 2003

O Species noted as present from other sources as summarized in McLellan 2002, 2003, and 2005.

* Reach numbers from WDFW surveys provided where waterbody is divided by multiple subbasins

** Waterbody not included in WDFW surveys

Table 1. Fish species by subbasin and waterbody. Data compiled from McLellan 2002, 2003 and 2005.

Subbasin	Waterbody (Reach #s)*	Carp Cyprinus carpio	Chiselmouth Acrocheilus alutaceus	Longnose dace Rhinichthys cataractae	Speckled dace R. oculus	Pumpkinseed Lepomis gibbosus	Bridgelip sucker Catostomus columbianus	Largescale sucker C. macrocheilu	Longnose sucker C. catostomus
Otter Creek	LSR (1 - 20)		X	X	X		X	X	
	Otter				X				
	Dry			X					
	Chain Lake**		O					O	
WB	WB			X		X			
	Beaver								
	Buck								
	Heel								
	Spring Heel								
	Diamond Lake**					O			
	Sacheen Lake**					O			
	Fan Lake**					O			
	Trout Lake**								O
	Horseshoe Lake**					O			O
Eloika Lake**					O				
Deer	LSR (21 - 29)		X	X	X	X	X	X	
	Deer			X					
	Little Deer								
	Bear			X	X		X		
Beaver	Beaver				X		X		
	Upper Dragoon (1-14)				X		X		
	Spring								
Dragoon	West Branch Dragoon		X	X	X		X		
	Lower Dragoon (15 - 28)		X	X	X		X		
	Mud								
	Wethey Creek**								
Little Deep	LSR (30 - 34)			X		X	X	X	
	Little Deep			X	X		X		
	North Fork				X		X		
	South Fork				X				
	Pell Creek								
Deadman	Deadman Creek		X	X	X		X		
	South Fork								
	Burping Brook								
Dartford	LSR (35 - 41)		X				X	X	
	Dartford			X					

X Species observed during WDFW surveys conducted between 2001 and 2003

O Species noted as present from other sources as summarized in McLellan 2002, 2003, and 2005.

* Reach numbers from WDFW surveys provided where waterbody is divided by multiple subbasins

** Waterbody not included in WDFW surveys

Table 1. Fish species by subbasin and waterbody. Data compiled from McLellan 2002, 2003 and 2005.

Subbasin	Waterbody (Reach #s)*	White sucker C. commersi	Tench Tinca tinca	Yellow bullhead Ameiurus natalis	Black bullhead A. melas	Brown bullhead A. nebulosus	Yellow perch Perca flavescens	Slimy sculpin Cottus cognatus	Mottled Sculpin C. bairdi	Torrent sculpin C. rotheus
Otter Creek	LSR (1 - 20)		X					X		
	Otter								X	
	Dry								X	X
	Chain Lake**		O				O			
WB	WB		X	X			X		X	
	Beaver									
	Buck							X		
	Heel									
	Spring Heel			X						
	Diamond Lake**					O	O			
	Sacheen Lake**		O			O	O			
	Fan Lake**		O	O			O			
	Trout Lake**		O			O	O			
	Horseshoe Lake**				O		O			
Deer	Eloika Lake**		O	O	O	O	O			
	LSR (21 - 29)		X	X			X		X	
	Deer								X	
	Little Deer								X	
Beaver	Bear							X		
	Beaver								X	
	Upper Dragoon (1-14)					X			X	
Dragoon	Spring								X	
	West Branch Dragoon								X	X
	Lower Dragoon (15 - 28)								X	X
	Mud									
Little Deep	Wetthey Creek**									
	LSR (30 - 34)								X	
	Little Deep									X
	North Fork									
	South Fork									
Deadman	Pell Creek									
	Deadman Creek								X	
	South Fork								X	
Dartford	Burping Brook									
	LSR (35 - 41)								X	
	Dartford									

X Species observed during WDFW surveys conducted between 2001 and 2003

O Species noted as present from other sources as summarized in McLellan 2002, 2003, and 2005.

* Reach numbers from WDFW surveys provided where waterbody is divided by multiple subbasins

** Waterbody not included in WDFW surveys

Table 2. Fish habitat characteristics by Subbasin. Data compiled from McLellan 2002, 2003 and 2005.

Subbasin	Waterbody (Reach #s)*	Stream Characteristics									Mean % Habitat Occurrence			Mean % Composition of Substrate and % Embeddedness									
		Stream Order	Length (km)	Headwater Elevation (m)	Mouth Elevation (m)	Mean Wetted Width (m)	Mean Bankful Width (m)	Mean Depth (cm)	Mean Max Depth (cm)	Mean % Gradient	Riffle	Pool	Run	Organic	Muck	Silt	Sand	Gravel	Cobble	Rubble	Boulder	Bedrock	Embed
Otter Creek	LSR (1 - 20)	--	25.7	667	546	9.6	11.4	43	72	1.7	12	3	85	24	3	20	38	5	3	4	4	0	92
	Otter	3	15.4	817	546	1.8	2.8	15	27	2.0	31	12	57	2	15	13	51	9	4	2	5	1	84
	Dry	2	12.9	963	552	2.7	3.7	18	33	3.0	54	6	40	4	1	16	44	22	5	3	3	1	58
WB	WB	4	32.3	713	546	10.7	12.6	35	63	2.0	34	18	48	1	5	8	28	11	12	8	10	15	32
	Beaver	2	20.1	878	594	1.8	3.3	6	12	1.0	27	10	63	0	0	12	25	35	22	6	0	0	36
	Buck	3	10.3	1244	600	3.5	5.1	13	26	3.0	75	21	4	0	0	5	45	21	23	3	1	1	38
	Heel	2	7.7	1280	664	2.0	3.2	10	19	5.0	73	25	2	0	0	2	39	30	14	4	10	0	40
	Spring Heel	2	4.8	692	616	2.9	3.8	29	47	1.0	33	33	33	1	6	2	72	6	3	2	1	6	41
Deer	LSR (21 - 29)	--	15.6	546	512	12.5	14.2	36	65	1.8	17	0	83	7	5	8	51	4	7	4	12	0	80
	Deer	4	20.9	1305	515	2.3	4.3	10	21	2.0	52	18	30	1	0	11	54	20	7	3	2	2	63
	Little Deer	3	10.2	1463	604	1.2	3.4	6	12	4.0	79	15	6	1	0	7	27	30	18	10	5	0	49
	Bear	2	11.9	634	521	2.9	15.2	24	40	2.0	34	3	63	4	18	15	35	19	4	2	4	0	74
Beaver	Beaver	3	13.0	731	636	1.7	3.5	21	28	1.0	5	2	93	8	51	16	19	3	2	0	0	0	96
	Upper Dragoon (1-14)	--	16.1	770	636	3.2	6.7	31	55	1.2	15	20	65	4	12	23	48	7	5	1	0	0	94
	Spring	2	2.7	649	639	3.8	5.1	33	57	1.0	0	0	100	14	19	20	46	0	0	0	0	0	100
Dragoon	West Branch Dragoon	4	18.5	704	611	2.3	4.6	25	42	1.1	15	9	76	5	10	32	39	4	8	1	0	0	90
	Lower Dragoon (15 - 28)	5	20.2	636	512	7.0	11.6	38	67	1.3	36	15	49	6	2	4	35	9	26	9	5	4	60
Little Deep	LSR (30 - 34)	--	11.4	512	497	15.6	17.4	49	84	1.1	25	0	75	1	0	16	42	10	13	13	5	0	79
	Little Deep	3	15.6	609	499	2.8	4.0	19	35	1.1	43	17	40	0	0	28	40	15	11	4	2	0	77
	North Fork	2	8.0	1254	609	1.6	2.8	9	16	2.4	67	10	23	1	3	23	25	34	6	4	4	0	65
	South Fork	2	3.9	1408	609	1.9	3.2	9	18	5.0	74	21	5	0	0	13	25	25	14	13	8	2	48
	Pell Creek	1	7.4	943	610	1.2	2.8	5	10	4.3	73	13	14	1	1	18	30	25	14	6	1	6	54
Deadman	Deadman Creek	4	33.8	1494	497	3.7	5.4	15	30	3.5	61	16	23	0	0	14	31	13	17	12	11	1	70
	South Fork	2	8.7	1383	747	2.0	3.5	7	15	4.3	81	14	5	0	0	5	35	28	18	7	7	0	56
	Burping Brook	2	2.4	1566	1003	1.7	3.1	6	14	11.6	84	10	6	5	0	7	37	17	14	10	11	0	58
Dartford	LSR (35 - 41)	6	19.9	497	471	16.8	19.5	39	74	1.7	65	0	35	1	0	7	24	12	41	14	4	0	66
	Dartford	3	7.6	580	487	2.1	2.8	12	21	2.5	86	8	6	2	0	16	49	12	10	3	4	4	75

* Reach numbers from WDFW surveys provided where waterbody is divided by multiple subbasins. Data from these reaches is averaged for the section included in the subbasin.

Table 3. Amount of Intrinsic Potential Habitat for Steelhead and Chinook by Subbasin. Stream kilometers calculated in ArcGIS using Intrinsic Potential Habitat datalayer developed by the Spokane Tribe.

Subbasin	Steelhead Intrinsic Potential (River Kilometers)				Chinook Intrinsic Potential (River Kilometers)					Moderate to High Combined	
	Low (1)	Moderate (2)	High (3)	Total	None (0)	Low (1)	Moderate (2)	High (3)	Total	Steelhead	Chinook
Otter Creek	25.74	7.19	15.81	48.74	36.02	1.20	1.60	9.92	48.74	23.00	11.52
WB	0.40	0.00	0.39	0.79	0.20	0.20	0.00	0.39	0.79	0.39	0.39
Deer	36.75	9.46	21.57	67.78	44.88	2.00	4.99	15.89	67.76	31.03	20.88
Beaver	58.05	5.40	4.04	67.49	57.85	0.00	1.24	8.40	67.49	9.44	9.64
Dragoon	49.63	8.40	15.62	73.65	48.03	3.60	5.61	1.64	58.88	24.02	7.25
Little Deep	27.03	12.09	6.40	45.52	25.89	1.40	9.29	8.94	45.52	18.49	18.23
Deadman	49.09	7.10	13.81	70.00	48.83	2.60	2.49	1.61	55.53	20.91	4.10
Dartford	5.84	3.63	2.41	11.88	9.04	0.00	2.83	0.00	11.87	6.04	2.83
WRIA 55	252.53	53.27	80.05	385.85	270.74	11.00	28.05	46.79	356.58	133.32	74.84

Table 4. Riparian habitat conditions by subbasin. Data compiled from SCD (2005).

Subbasin	Waterbody	Reach	Length (River Miles)	Functional Condition Rating	Ecological Rating	Restoration Potential	Development Risk
Otter Creek	Little Spokane mainstem	1-A	0.6	PFC	Good	NA	Medium
		1-B	0.7	PFC	Good	NA	Medium
		1-C	0.8	FAR	Poor	Good	Medium
		1-D	0.6	PFC	Fair-good	NA	Medium
		2	0.5	FAR	Poor	Good	Medium
		3	1	PFC	Fair-good	NA	Medium
		4	1	PFC	Good	NA	Medium
		5	0.3	PFC	Good	NA	Medium
		6	1.9	PFC	Poor	Good	Medium
WB	WB	1	0.5	PFC	Good	NA	Medium
		2	0.4	PFC	Fair-good	NA	Medium
		3	0.9	PFC	Fair-good	Good	Medium
		4	0.5	FAR	Fair	Fair-good	Medium
		5	1.1	PFC	Good	NA	Medium
		6	0.5	FAR	Poor	Fair-good	Medium
Deer	Little Spokane mainstem	7	1.6	PFC	Poor-fair	Fair	Medium
		8	0.5	PFC	Fair	Good	Medium
		9	1.9	PFC	Fair-good	NA	Medium
		10	3.6	FAR	Poor	Good	Medium
		11	0.8	PFC	Good	NA	Medium
		12	1.3	FAR	Poor-fair	Good	Medium
		13	0.95 (1.9)	PFC	Fair-good	NA	Medium
Beaver	Dragoon	1	1.3	PFC	Fair-good	NA	NA
Dragoon	Dragoon	2	3	PFC	Fair	Fair-good	NA
		3	0.6	PFC	Poor-fair	Fair-good	NA
		4	3.1	PFC	Fair	Fair-good	High
		5	0.9	FAR	Poor-fair	Fair-good	High
		6	0.7	PFC	Fair-good	Fair	High
		7	0.4	FAR	Poor-fair	Fair-good	High
		8	1.8	PFC	Good	Good	High
		9	1.4	PFC	Fair-good	Fair	Medium
		10	4.3	PFC	Fair-good	Fair	Medium
		Little Deep	Little Spokane mainstem	13	0.95 (1.9)	PFC	Fair-good
14	1			FAR	Fair	Fair-good	Medium
15	6.1 (9.2)			PFC	Fair	Fair-good	Medium
Deadman	Deadman Creek	1	2	PFC	Good	NA	NA
		2	6.8	FAR	Good	Fair	NA
		3	0.9	FAR	Poor	Good	NA
		4	1.8	FAR	Poor	Good	NA
		5	2.8	PFC	Fair	Fair	NA
		6	1.7	PFC	Fair-good	NA	NA
		7	2	PFC	Fair-good	NA	Medium
		8	5	PFC	Fair-good	Fair-good	High
Dartford	Little Spokane mainstem	15	3.1 (9.2)	PFC	Fair	Fair-good	Medium
		16	0.4	PFC	Good	NA	Low
		17	0.3	PFC	Good	NA	Low
		18	2.9	PFC	Fair	NA	Low
		19	5.3	PFC	Good	NA	Low
		20	1.1	PFC	Good	NA	Medim

Table 5. Potential wetland restoration sites adjacent to waterbodies by subbasin. Adjacency to moderate to high intrinsic potential habitat and poor riparian conditions is also indicated.

Subbasin	Wetland Site Name	Size (acres)	Adjacent to:	
			Moderate to High Intrinsic Potential Habitat	Poor Riparian Conditions
Otter Creek	Little Spokane	57.64	X	X
	Reflection	34.84	X	X
	Otter 1	60.28		
	Otter 2	13.25		
	Otter 3	15.82		
	Otter 4	14.88		
	County Line E	30.57		
	Blanchard	12.92	X	
	Nelson 1	10.81		
	Elk 1	10.14	X	X
	Elk 2	3.89	X	
	Camden	28.29	X	X
	Scotia	11.43		
	Penrith	4.2		
WB	Little Spokane	57.64	X	X
	Eloika Road S	5.62		X
	Eloika SE	49.3		
	Eloika S	38.57		
	Sacheen S	144.94		
	Highway 211 E	62.61		
	Diamond SW	38.71		
	Mallard	13.99		
Deer	Chattaroy 1	34.84	X	X
	Chattaroy 5	9.73	X	
	Chattaroy 6	27.65	X	
	Bear 1	61.49		
	Bear 2	131.53		
	Eloika SW	24.37		
	Milan 1	13.37	X	
	Milian 2	20.92	X	
Beaver	Beaver	53.31		
	Deer	159.89		
	Deer West 2	12.79	X	
	Deer West 3	7.29	X	
	Clayton 2	87.95		
	Loon	83.93		
	Oregon	47.53		

Table 5. Potential wetland restoration sites adjacent to waterbodies by subbasin. Adjacency to moderate to high intrinsic potential habitat and poor riparian conditions is also indicated.

Subbasin	Wetland Site Name	Size (acres)	Adjacent to:	
			Moderate to High Intrinsic Potential Habitat	Poor Riparian Conditions
Dragoon	Chattaroy 3	14.32	X	
	Dragoon 1	7.73	X	
	Dragoon 2	16.02	X	
	Dragoon 3	7.66	X	
	Wildrose 2	22.03		
	Wildrose 3	27.98		
	Wildrose 4	51.28		
	Wildrose 5	13.35		
	Mud	58.48		
	Frog 2	16.24		
	Frog 3	52.98		
	Frog 4	35.73		
Little Deep	Chattaroy 4	4.24	X	X
	Buckeye	9.2	X	
	Colburt 1	7.9	X	
	Colburt 2	4.88	X	
	Woolard 1	66.34		
	Woolard 2	12.77	X	
Deadman	Deadman 1	26.39	X	
	Deadman 2	30.37	X	
	Deadman 3	30.51	X	
	Moffatt	137.64		
	Peone 1	5.36	X	
	Madison	52.06		
Dartford	Ballard 1	13.26		
	Ballard 2	3.69		
	Dartford 1	31.23	X	
	Colburt 3	2.99	X	

APPENDIX D

Evaluation of Future Exempt Well Demand (Aspect, June 2020)

June 25, 2020

To: Mike Hermanson – Spokane County Environmental Services, Lead Agency
WRIA 55 Planning Unit Members

From:



Carl Einberger, LHG
Associate Hydrogeologist
ceinberger@aspectconsulting.com

**Re: Evaluation of Future Exempt Well Demand
ESSB 6091/RCW 90.94 Watershed Plan Update**

Background

The passage of Engrossed Substitute Senate Bill (ESSB) 6091, as codified by RCW 90.94, requires that an update to the existing Watershed Plan for Water Resource Inventory Area (WRIA) 55, the Little Spokane Watershed, be approved by the Washington Department of Ecology (Ecology) by February 1, 2021. Spokane County Environmental Services is serving as the lead agency for this process. The WRIA 55 Initiating Governments for the watershed planning process are Spokane County, Stevens County, Pend Oreille County, the City of Spokane, and Whitworth Water District. The process is supported by convening the WRIA 55 Planning Unit to review technical tasks and memorandums, policy decisions, and the pending watershed plan update. Aspect Consulting, LLC (Aspect) has been contracted by Spokane County to facilitate planning unit meetings, conduct supporting technical tasks, and prepare the Watershed Plan update.

Section 202 of ESSB 6091, which is applicable to WRIA 55, contains several provisions regarding how updated watershed plans are to offset or account for projected water use.

Specifically, Section 202(4)(b) states, in part:

“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.”

In March 2018, Ecology issued Recommendations for Water Use Estimates¹ for ESSB 6091 that provides guidance on evaluation of future exempt well demand. Key excerpts from this document include:

¹ <https://fortress.wa.gov/ecy/publications/documents/1811007.pdf>

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- **Timeframe:** To evaluate and offset potential consumptive impacts from permit-exempt domestic wells, a timeframe over which new domestic² use will be considered must be designated. Since a “subsequent twenty years” is referenced throughout other sections of ESSB 6091 (such as sections 202(4)(c), Ecology interprets the timeframe for 202(4)(b) ... to be the next twenty years. In its *Interim Guidance for Determining Net Ecological Benefit*³, Ecology further clarified that this 20-year planning horizon begins on the date ESSB 6091 was signed into law – January 19, 2018.
- **Scope of “water use”:** Ecology interprets all projected water use referenced in sections 202(4)(c)...to refer to only consumptive permit-exempt domestic groundwater water use (as opposed to water use associated with municipalities, for example).
- **Consumptive use:** Water Resources Program Policy 1020 (1991) states, “Consumptive water use causes diminishment of the source at the point of appropriation,” and that, “Diminishment is defined as to make smaller or less in quantity, quality, rate of flow, or availability.” This guidance document is focused on estimating only quantity diminishment, so for the purposes described here, consumptive water use is considered water that is evaporated, transpired, consumed by humans, or otherwise removed from an immediate water environment due to the use of permit-exempt domestic wells.
- **Subbasins:** ESSB 6091 is written in the context of WRIA-wide mitigation, so Ecology interprets the words “same basin or tributary” to refer to subareas or subbasins as opposed to entire WRIs. For the purposes of this document, the term “subbasin” is equivalent to the words “same basin or tributary” as used in sections 202(4)(b).

This memorandum presents an evaluation of future exempt well demand on a subbasin level and on a 20-year horizon within WRIA 55 that is intended to meet the requirements of ESSB 6091. Figure 1 presents a map of WRIA 55 delineating the subbasins used in the evaluation, which are the Washington Department of Natural Resources Watershed Administrative Units (WAUs) and are consistent with subbasin boundaries used in previous watershed planning and management.

WRIA 55 extends into Spokane, Stevens, and Pend Oreille Counties. All three counties have conducted analysis and worked cooperatively together to develop estimates of future residential permits in WRIA 55 outside of public water districts to support the development of the exempt well demand estimates.

Memorandum Revision History

The evaluation of future exempt well demand is a critical component of the WRIA 55 watershed plan update. As such, several discussions regarding the approach were held with the WRIA 55 Planning Unit, and three drafts of this memorandum were previously distributed for Planning Unit review and comment, with each successive draft updated to respond to Planning Unit comments:

- **January 18, 2019 initial draft.** In this draft, the Washington Office of Financial Management (OFM) 2010 to 2040 medium growth projections were used for Spokane

² Ecology’s *ESSB 6091-Streamflow Restoration Initial Policy Interpretations* defines domestic use as “indoor and outdoor uses for a household (including watering of a lawn and noncommercial garden).”

<https://fortress.wa.gov/ecy/publications/documents/1811008.pdf>

³ <https://fortress.wa.gov/ecy/publications/documents/1811009.pdf>

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County, while Stevens and Pend Oreille Counties used historical growth rates from 2001-2017.

- **September 9, 2019 second draft.** The second draft included calculations with the historical (2001-2017) growth rates for Spokane County, in addition to use of the OFM Medium growth rate projections reported in the first draft, along with other responses to Planning Unit and Ecology comments.
- **March 2, 2020 third draft.** The draft included a modification to the distribution of demand in the Dartford subbasin, to 1) remove demand projected to occur in the area governed by WAC 173-557 (Instream flow rule for the Spokane River and Spokane Valley Rathdrum Prairie aquifer). Permit-exempt wells in this area are regulated separately, and Ecology has established a water bank to mitigate for new uses, and 2) separate demand from exempt wells in the Dartford subbasin that do not impact Dartford Creek, but do impact the mainstem Little Spokane River.
- **Final June 2020 memorandum.** This final memorandum has been refined from previous drafts to focus on the final scenario approved by the Planning Unit at its March 5, 2020 meeting. Based on comments from the Planning Unit, consensus was reached to add a 10% contingency to the final demand numbers to address the potential effects of climate change, based on a climate change analysis that was conducted in conjunction with the Bureau of Reclamation Water Smart grant that supported the development of the Little Spokane integrated ground and surface water model. A summary of the analysis, prepared by Spokane County, is attached to this memorandum.

General Approach

Prior to conducting the exempt well demand analysis described in this memorandum, staff from Spokane, Stevens, and Pend Oreille Counties, Aspect, and Ecology discussed potential approaches with consideration of Ecology's Recommendations for Water Use Estimates for ESSB 6091. The following approach was agreed upon and implemented:

Each county developed growth projections on a subbasin level for single family residential units (SFUs) relying on exempt wells on the mandated 20-year horizon. Each county used professional judgment in developing the forecast based on available county specific information. Specific approaches for each county are summarized below.

Each county then developed the estimates of average lawn size, on a subbasin level, through geographical information system (GIS) analysis of suitable aerial photos for homes relying on exempt wells built between 2001 to 2017. Each county analyzed a sufficient sample size from the set of exempt well properties to attain an approximate 95 percent confidence interval with a 5 percent margin of error, within that county's portion of WRIA 55 that is served by exempt wells.

Aspect then used this information to estimate the average amount of consumptive use associated with the growth projections for SFUs relying on exempt wells, using the following methodology:

- Indoor consumptive use estimates were based on examples presented in Ecology's Recommendations for Water Use Estimates for ESSB 6091 and a review of US Census data on average persons per household by county.

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- Outdoor consumptive use estimates were made based on average irrigation lawn size determined on a subbasin level and methods described in Ecology Guidance 1210 (Determining Irrigation Efficiency and Consumptive Use), using crop demand estimates provided in the Washington Irrigation Guide (WIG) for pasture/turf for the Spokane and Newport stations.

County-specific approaches and the number of estimated new SFUs relying on exempt wells per subbasin are summarized below, followed by estimates of indoor, outdoor, and total consumptive use.

Spokane County Growth Projections and Estimated Lawn Sizes

As described above DNR WAU boundaries were utilized for subbasin delineation. One exception is the Dartford Creek subbasin. This subbasin includes areas that drain to Dartford Creek, the Spokane Valley Rathdrum Prairie aquifer, and the mainstem of the Little Spokane. To address those complexities the following approach was utilized::

- 1) Demand projected to occur in the area governed by WAC 173-557 (Instream flow rule for the Spokane River and Spokane Valley Rathdrum Prairie aquifer) was removed from the analysis. Permit-exempt wells in this area are regulated separately, and Ecology has established a water bank to mitigate for new uses.
- 2) Demand from exempt wells in the Dartford subbasin that do not impact Dartford Creek, and those that impact the mainstem Little Spokane River were separated. The change results in the addition of a Mainstem Little Spokane River subbasin to the DNR WAUs.

Approaches to Projecting Future Residential Units

Spokane County estimated the projected increase over the next 20 years in residential units relying on permit exempt wells within the Spokane County portion of WRIA 55, outside of the area covered by WAC 173-557. Spokane County estimated the projected increase in two ways:

- The first approach is based on the Spokane Regional Transportation Council (SRTC) Horizon 2040 projected increase in SFUs. The SRTC Horizon 2040 growth projections are derived from and consistent with the OFM 2017 Growth Management Act population projections for counties in the category: 2010 to 2040 medium growth.
- The second approach is based on extrapolating the historical growth rate based on the average number of new homes built annually from 2001 – 2017. **This is the growth rate that the Planning Unit has reached concurrence on using for calculating final demand numbers to include in the WRIA 55 Watershed Plan Addendum.**

Estimates of New SFUs Based on OFM Medium Growth Projections

The SRTC projected increase in single family residential units are spatially distributed into Transportation Analysis Zones (TAZs). TAZ boundaries do not conform to subbasin boundaries or areas served by public water supplies versus permit exempt wells. A GIS analysis was completed to allocate the distribution of the projected increase in SFUs within each TAZ into each subbasin, followed by allocations between areas served by public water supplies and areas served by permit exempt wells in proportion to the distribution of existing SFUs derived from Spokane County Assessor data. Table 1, below provides an example of this approach, using TAZ 487, which has

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area within the City of Deer Park water service area, the Dragoon Creek subbasin, and the Beaver Creek subbasin (Figure 1).

Table 1. Example of SFU Allocation Approach by TAZ

TAZ 487	Existing		Projected Growth in SFUs (20-Year Planning Horizon)
	Units	% of Total	
Total Residential Units	354		56
Within Public Water Supply	242	68.4	38
Outside Public Water Supply	112	31.6	18
<i>Dragoon Subbasin</i>	54	15.3	9
<i>Beaver Creek Subbasin</i>	58	16.3	9

Based on the allocation methodology described above, Table 2 presents the projected increases in SFUs by subbasin within Spokane County that are estimated to rely on a permit exempt well for domestic water supply in the next 20 years.

Table 2. Projected Growth in SFUs Relying on Exempt Wells in Spokane County (WRIA 55), based on OFM Medium Growth Projections

Subbasin	Projected increase in SFUs (20-Year Planning Horizon)
Dartford Creek	93
Mainstem LSR	124
Dragoon Creek	281
Deadman Creek/Peone Creek	319
Beaver Creek	155
Otter Creek	156
West Branch	67
Little Spokane/Deer Creek	261
Little Deep Creek	98
Total	1,554

Estimates of New SFUs Based on 2001-2017 Historical Growth Rate

Between 2001 and 2017 there were 1855 new residences that rely on permit exempt wells in Spokane County’s portion of WRIA 55. This equates to an average growth rate of 109 homes per year. Based on this rate, there will be an estimated 2,182 new homes relying on permit exempt wells built within WRIA 55 in Spokane County in the next 20 years. Table 3 presents the historical growth data, along with the 20-year planning horizon projected growth estimated based on extrapolating the historical growth rate, with a comparison to the SRTC/OFM medium growth rate projected growth as outlined in Table 2. In both cases, the TAZ analysis approach discussed above was used to allocate the projected growth to each subbasin, which changes the percentages of growth estimated within each subbasin from the historical 2001-2017 distribution, based on where new growth is expected to occur. The remainder of this document carries forward use of the historical growth rate projection for Spokane County in this demand analysis, rather than SRTC/OFM medium growth scenario, given the concurrence of the Planning Unit with use of the historical growth rate data.

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Table 3. Comparison of Historical and Projected Growth in SFUs Relying on Exempt Wells in Spokane County (WRIA 55)

Subbasin	Actual 2001-2017		Historical Growth Rate - Projected 20-Year Growth		OFM Medium - Projected 20-Year Growth	
	SFUs	% of total	SFUs	% of total	SFUs	% of total
Dartford Creek	90	5%	131	6%	93	6%
Mainstem LSR	120	6%	174	8%	124	8%
Dragoon Creek	367	20%	395	18%	281	18%
Deadman-Peone Creek	338	18%	448	21%	319	20%
Beaver Creek	178	10%	218	10%	155	10%
Otter Creek	216	12%	219	10%	156	10%
West Branch	104	6%	94	4%	67	4%
Little Spokane/Deer Creek	370	20%	366	17%	261	16%
Little Deep Creek	72	4%	137	6%	98	6%
Total	1855		2182		1554	
Yearly Average	109		109		78	

Irrigated Area Estimate by Subbasin

A random sample of the 1,855 SFUs built between 2001-2017 were analyzed with aerial photos from 2006, 2009, 2014, 2016, and 2018. GIS methods were used to delineate the size of apparent area of lawn irrigation. A sample size of 321 was selected to achieve a 5 percent margin of error with a 95 percent confidence interval. Table 4 presents the results of this analysis.

Table 4. Estimated Irrigated Area by Subbasin in Spokane County (WRIA 55)

Subbasin	Number of Household Lawns Analyzed	Average Irrigated Lawn Size (sq. ft.)	Average Irrigated Lawn Size (acres)
Dartford Creek	47	15,290	0.35
Dragoon Creek	50	15,211	0.35
Deadman-Peone Creek	52	17,334	0.40
Beaver Creek	44	14,753	0.34
Otter Creek	42	14,282	0.33
West Branch	14	8,948	0.21
Little Spokane/Deer Creek	53	10,433	0.24
Little Deep Creek	19	7,769	0.18
WRIA 55 Average	321	13,880	0.32

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Stevens County Growth Projections and Estimated Lawn Sizes

Projected Residential Units

Stevens County estimated the projected increase over the next 20 years in SFUs relying on permit exempt wells within the Stevens County portion of WRIA 55. The County reviewed the number of building permits issued from 2001-2017 for new homes using a private water supply. GIS methods were used to filter the data to include only parcels within both WRIA 55 and Stevens County.

The average number of new homes built annually from 2001-2017 was used to predict the number of new homes for the 20-year planning horizon. Between 2001 and 2017 there were 209 new residences that rely on permit exempt wells in Stevens County’s portion of WRIA 55. This equates to an average growth rate of 12.3 homes per year. This rate was used to extrapolate growth over the next 20 years. Based on this rate, there will be an estimated 246 new homes relying on permit exempt wells built within WRIA 55 in Stevens County in the next 20 years (Table 5). That total will include an estimated 65 homes in the Beaver Creek subbasin, 179 homes in the Dragoon Creek subbasin, and 2 homes in the West Branch subbasin.

Table 5. Historical and Projected Growth in SFUs Relying on Exempt Wells in Stevens County (WRIA 55)

Year	Beaver Creek	Dragoon Creek	West Branch	Total
2001	4	12	1	17
2002	6	13		19
2003	6	16		22
2004	6	16		22
2005	6	16		22
2006	3	12		15
2007	6	10		16
2008	2	9		11
2009		8		8
2010	3	8		11
2011	3	3		6
2012	2	4		6
2013	2	3		5
2014	1	8		9
2015	1	4	1	6
2016		6		6
2017	4	4		8
Total	55	152	2	209
Projected SFUs 20-Year Horizon	65	179	2	246

Average Irrigated Area Estimate by Subbasin

Average lawn size was estimated by choosing a random sample of the building permits and using aerial imagery (2015, 2017) to make a digitally-measured estimate of irrigated lawn and garden area. The sample for the lawn size analysis was chosen randomly to obtain a 95 percent confidence level with a 5 percent margin of error. Lawns were digitally measured for a randomly selected sample of 136 out of the 209 new residences in WRIA 55, providing a 95 percent confidence level with a 5 percent margin of error. The sample’s average lawn size was 6,316 square feet(sq. ft.; 0.1450 acres), with 97 out of 136 parcels having any identifiable irrigated lawn.

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Table 6: Average Estimated Lawn Size in Stevens County for New Homes on Private Water Supply (WRIA 55)

Subbasin	Lawns Sampled	Average Lawn Size (sq. ft.)	Average Lawn Size (acres)
Beaver Creek	33	3,944	0.09
Dragoon Creek	102	7,145	0.16
West Branch	1	0	0
Total	136	6,316	0.15

Pend Oreille County Growth Projections and Estimated Lawn Sizes

Projected Residential Units

Pend Oreille County estimated the projected increase over the next 20 years in SFUs relying on permit exempt wells within the Pend Oreille County portion of WRIA 55. GIS methods were used to filter residential building permit data for the period 2011-2017 to include only permits that were in WRIA 55, but outside public water districts, indicating use of an exempt well. Between the years of 2011-2017 there were 116 new residential permits that are or will be relying on permit exempt wells in Pend Oreille County’s portion of WRIA 55 (Table 7). The average annual growth rate of 16.6 homes was used to extrapolate growth on a 20-year horizon. Based on this rate, there will be an estimated 332 new homes relying on permit exempt wells built within WRIA 55 in Pend Oreille County in the next 20 years (Table 8). That total will include an estimated 138 homes in the West Branch subbasin and 194 homes in the Otter Creek subbasin (Table 8).

Table 7: Pend Oreille County Residential Permits Issued Outside of Public Water Districts, 2011-2017 (WRIA 55)

Year	Number	Percentage of Total
2011	15	12.9%
2012	13	11.2%
2013	9	7.8%
2014	21	18.1%
2015	20	17.2%
2016	22	19.0%
2017	16	13.8%
Total	116	100.0%
Average of 16.6 New Residential Permits a Year		

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Table 8. Project SFUs Relying on Exempt Wells in Pend Oreille County (WRIA 55)

Sub Basins	Projected SFU Growth 20-Year Planning Horizon
West Branch	138
Otter Creek	194
WRIA 55 Total	332

Average Irrigated Area Estimate by Subbasin

An average lawn size was determined by choosing a random sample of the building permits, with a 95 percent confidence interval to achieve a 5 percent margin of error, and digitizing their irrigated lawn based off aerial photography (2011, 2015, 2017), NDVI imagery, and the Pend Oreille County Assessor photos from the field. All indefinable agricultural activity was excluded. Of the 116 newly permitted residence that rely on permit exempt wells within WRIA 55, 89 had their lawns digitized, providing a 95 percent confidence level with a 5 percent margin of error. The sample's average lawn size was 9,648 sq. ft, with 53 out of 89 having any identifiable irrigated lawn (Table 9).

Table 9. Estimated Irrigated Area by Subbasin in Pend Oreille County (WRIA 55)

Subbasin	Lawns Sampled	Average Lawn Size (sq. ft.)	Average Lawn Size (acres)
West Branch	53	5,355	0.12
Otter Creek	36	12,564	0.29
Total	89	9,648	0.22

Analysis of Consumptive Use by Subbasin

Aspect used the information provided by each County to estimate the average amount of consumptive use associated with the growth projections for SFUs relying on exempt wells, as described below:

Indoor Consumptive Use

Indoor consumptive use estimates were developed based on examples presented in Ecology's Recommendations for Water Use Estimates for ESSB 6091 and a review of US Census data on average persons per household by county. Key assumptions incorporated into the analysis include:

- The number of new exempt wells in the next 20 years in each subbasin is based on the analyses conducted by Spokane, Stevens, and Pend Oreille Counties discussed in this memorandum.
- US Census Data⁴ tabulating the persons per household from 2013-2017 were used combined with the per capita water use noted below. The US Census Data indicates that the average number of people per household is 2.43 in Spokane County, 2.48 in Stevens County, and 2.3 in Pend Oreille County.
- Per capita water use is 60 gallons per day (gpd), based on the analysis provided in Ecology's Recommendations for Water Use Estimates for ESSB 6091:

⁴ <https://www.census.gov/quickfacts>

MEMORANDUM

Project No. 180249

June 25, 2020

- *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.*
- Indoor consumptive is equal to 10 percent of total use, based on the analysis provided in Ecology's Recommendations for Water Use Estimates for ESSB 6091:
 - *A reasonable assumption for much of Washington is that about 10 percent of indoor domestic water use is consumed, and about 80 percent of outdoor domestic water use is consumed (Culhane and Nazy, 2015). A consumptive use rate of 10 percent for indoor domestic use is in keeping with recent groundwater models constructed by the U.S. Geological Survey (USGS) for the Kitsap peninsula (Frans and Olsen, 2016) and the Chamokane Creek basin (Ely and Kahle, 2012).*

Table 10 (attached) presents the 20-year projected consumptive indoor use associated with exempt wells in WRIA 55 by county.

June 25, 2020

Outdoor Consumptive Use

Outdoor consumptive use estimates were developed based on average irrigation lawn size determined on a subbasin level and methods described in Ecology Guidance 1210 (Determining Irrigation Efficiency and Consumptive Use). Key assumptions incorporated into the analysis include:

- The number of new exempt wells in the next 20 years in each subbasin is based on the analyses conducted by Spokane, Stevens, and Pend Oreille Counties discussed in this memorandum.
- Average irrigation lawn sizes in each subbasin are based on the analyses conducted by Spokane, Stevens, and Pend Oreille Counties discussed in this memorandum.
- The seasonal net irrigation requirement was taken from Washington Irrigation Guide (WIG) for pasture/turf for the Spokane station (29.81 inches) for all subbasins, with the exception of the West Branch and Otter Creek subbasins, for which the Newport station (24.11 inches) was used. Data from a relatively new (2015) AgriMet station at Deer Park was also reviewed but not used in the analysis, as it was generally consistent with Spokane WIG values, ranging between 27.08 and 30.66 inches of lawn evapotranspiration between 2015 and 2018.
- An irrigation efficiency of 75 percent was used, which is applicable to sprinkler methods typically used for lawn irrigation, such as pop-up impact or handline methods referenced in Table 1 of Ecology Guidance 1210.
- Consumptive irrigation quantities are calculated from the number of new exempt wells in each subbasin, average irrigation lawn size, net irrigation demand from the WIG, and irrigation efficiency.
- For subbasins that have land in multiple counties, the analysis was aggregated using the average lawn size and estimated number of new exempt wells for each county within that subbasin.

Table 11 (attached) presents the 20-year projected consumptive outdoor use associated with exempt wells in WRIA 55⁵ by county.

Total Consumptive Use by New Exempt Wells in WRIA 55, 20-Year Planning Horizon

Table 12 presents a summary which combines the results for indoor and outdoor consumptive use discussed above and presents the 20-year projected total consumptive use associated with exempt wells. The total estimated consumptive use is estimated to be 2,139.72 afy (2.95 cfs) for the 20-year planning horizon.

⁵ In both Stevens and Pend Oreille Counties, there is a distinct reduction in average irrigated lawn size compared to Spokane County in shared subbasins. This appears to be associated with the presence of low yield granite aquifers, mobile homes, cabins, and the presence of more forested land cover in Stevens and Pend Oreille County, while Spokane County tends to have larger homes and more landscaping.

Table 12. Total Projected Combined Indoor/Outdoor Consumptive Use in WRIA 55, 20-Year Planning Horizon

	Projected Consumptive Use (afy)	Projected Consumptive Use (cfs)
Dartford Creek	124.91	0.17
Mainstem	165.91	0.23
Dragoon Creek	456.05	0.63
Deadman-Peone Creek	483.31	0.67
Beaver Creek	217.47	0.30
Otter Creek	298.04	0.41
West Branch	86.53	0.12
Little Spokane/Deer Creek	240.03	0.33
Little Deep Creek	67.48	0.09
TOTAL	2139.72	2.95

Additional of Climate Change Contingency Factor

Some members of the WRIA 55 Planning Unit members have advocated that future climate change should be incorporated into the future demand estimate. At the March 5, 2020 WRIA 55 Planning Unit meeting Spokane County staff reported that they had evaluated the impact of climate change on potential evapotranspiration utilizing the Little Spokane Integrated Ground and Surface Water model and found that there is an approximately 10% increase in potential evapotranspiration between the baseline model results and results from the climate change scenario. Spokane County’s analysis is provided as an attachment to this memorandum. During the March 5, 2020 WRIA 55 Planning Unit meeting, members discussed the inclusion of climate change in the demand estimate and reached consensus to include it in the final demand estimate.

Table 13 presents the estimated total consumptive use estimates prior to and with the inclusion of the 10% contingency factor for climate change. Given the consensus of the Planning Unit on including the climate change contingency, the demand estimate to be used in the WRIA 55 Watershed Plan Addendum is 2,353.69 afy (3.25 cfs) for the 20-year planning horizon.

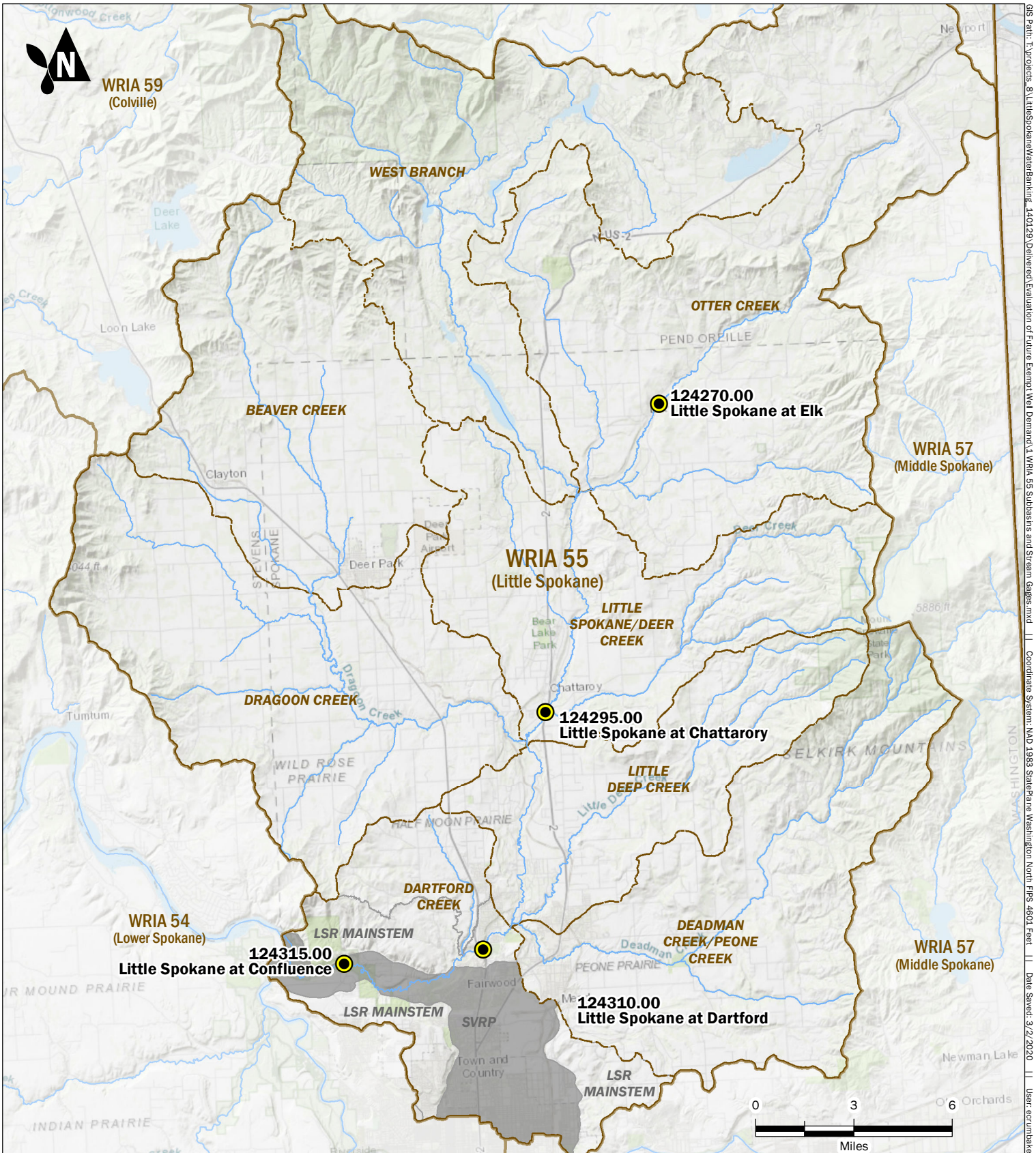
Table 13. Total Projected Combined Indoor/Outdoor Consumptive Use in WRIA 55, 20-Year Planning Horizon (with Climate Change 10% Contingency Factor)

WRIA 55 Subbasins	Without Climate Change Contingency Factor		With Climate Change Contingency Factor	
	Projected Consumptive Use (afy)	Projected Consumptive Use (cfs)	Projected Consumptive Use (afy)	Projected Consumptive Use (cfs)
Dartford Creek	124.91	0.17	137.40	0.19
Mainstem	165.91	0.23	182.51	0.25
Dragoon Creek	456.05	0.63	501.65	0.69
Deadman-Peone Creek	483.31	0.67	531.64	0.73
Beaver Creek	217.47	0.30	239.22	0.33
Otter Creek	298.04	0.41	327.84	0.45
West Branch	86.53	0.12	95.18	0.13
Little Spokane/Deer Creek	240.03	0.33	264.03	0.36
Little Deep Creek	67.48	0.09	74.22	0.10
TOTAL	2139.72	2.95	2353.69	3.25

- Attachments: Figure 1 – WRIA 55 Subbasins and Stream Gages
 Table 10 - Projected Consumptive Indoor Use Associated with Exempt Wells in WRIA 55, 20-Year Planning Horizon
 Table 11 - Projected Consumptive Outdoor Use Associated with Exempt Wells in WRIA 55, 20-Year Planning Horizon
 Attachment 1 - WRIA 55 Permit Exempt Well Demand Climate Change Analysis

S:\Little Spokane Watershed Planning 180249\Exempt Well Demand TMDFinal TMDraft WRIA 55 6091 Exempt Well Demand Memo_6_25_20.docx

FIGURES



WRIA 59
(Colville)

WRIA 57
(Middle Spokane)

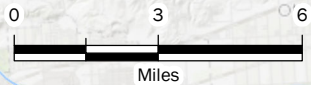
WRIA 55
(Little Spokane)

WRIA 57
(Middle Spokane)

WRIA 54
(Lower Spokane)

124315.00
Little Spokane at Confluence

124310.00
Little Spokane at Dartford



- USGS Gaging Station/Control Station
- WRIA Boundary
- WRIA 55 Subbasins
- Named Watercourse

WRIA 55 Subbasins and Stream Gages

Evaluation of Future Exempt Well Demand
ESSB 6091/RCW 90.94 Watershed Plan Update
WRIA 55, Washington

Notes:
-WRIA 55 Subbasin Source: Spokane County Water Resources Division of Utilities, 2015



MAR-2020
PROJECT NO.
140129

BY:
CME / RAA
REVISED BY:
EAC

FIGURE NO.
1

GIS Path: I:\Projects_8\LittleSpokaneWaterDenking_140129\Delivered\Evaluation of Future Exempt Well Demand_1 WRIA 55 Subbasins and Stream Gages.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 3/2/2020 || User: erumbaker || Print Date: 3/2/2020

TABLES

Table 10. Projected Consumptive Indoor Use Associated with Exempt Wells in WRIA 55, 20-Year Planning Horizon

	Spokane County		Stevens County		Pend Oreille County		All Counties		
	SFUs	Projected Consumptive Indoor Use (afy)	SFUs	Projected Consumptive Indoor Use (afy)	SFUs	Projected Consumptive Indoor Use (afy)	Totals SFUs	Projected Consumptive Indoor Use (afy)	Projected Consumptive Indoor Use (cfs)
WRIA 55 Subbasins	Spokane County		Stevens County		Pend Oreille County				
Dartford Creek	131	2.14					131	2.14	0.003
Mainstem	174	2.84					174	2.84	0.004
Dragoon Creek	395	6.45	179	2.92			574	9.37	0.013
Deadman-Peone Creek	448	7.32					448	7.32	0.010
Beaver Creek	218	3.56	65	1.06			283	4.62	0.006
Otter Creek	219	3.58			194	3.17	413	6.74	0.009
West Branch	94	1.54	2	0.03	138	2.25	234	3.82	0.005
Little Spokane/Deer Creek	366	5.98					366	5.98	0.008
Little Deep Creek	137	2.24					137	2.24	0.003
TOTAL	2,182	35.64	246	4.02	332	5.42	2,760	45.08	0.062

Table 11. Projected Consumptive Outdoor Use Associated with Exempt Wells in WRIA 55, 20-Year Planning Horizon

	Spokane County				Stevens County				Pend Oreille County				All Counties	
	SFUs	Average Irrigated Lawn Size (ft ²)	Average Irrigated Lawn Size (acres)	Projected Consumptive Outdoor Use (afy)	SFUs	Average Irrigated Lawn Size (ft ²)	Average Irrigated Lawn Size (acres)	Projected Consumptive Outdoor Use (afy)	SFUs	Average Irrigated Lawn Size (ft ²)	Average Irrigated Lawn Size (acres)	Projected Consumptive Outdoor Use (afy)	Projected Consumptive Outdoor Use (afy)	Projected Consumptive Outdoor Use (cfs)
WRIA 55 Subbasins	Spokane County				Stevens County				Pend Oreille County				Total	
Dartford Creek	131	15,290	0.35	122.77									122.77	0.169
Mainstem	174	15,290	0.35	163.07									163.07	0.225
Dragoon Creek	395	15,211	0.35	368.28	179	7,145	0.16	78.39					446.67	0.617
Deadman-Peone Creek	448	17,334	0.40	475.99									475.99	0.657
Beaver Creek	218	14,753	0.34	197.13	65	3,944	0.09	15.71					212.85	0.294
Otter Creek	219	14,282	0.33	163.71					194	12,564	0.29	127.58	291.29	0.402
West Branch	94	8,948	0.21	44.03	2	0	0	0	138	5,355	0.12	38.68	82.71	0.114
Little Spokane/Deer Creek	366	10,433	0.24	234.05									234.05	0.323
Little Deep Creek	137	7,769	0.18	65.24									65.24	0.090
TOTAL	2,182	-	-	1,834.28	246	-	-	94	332	-	-	166	2,094.65	2.891

ATTACHMENT 1

WRIA 55 Permit Exempt Well

Demand Climate Change Analysis

TO: WRIA 55 PLANNING UNIT
FROM: MIKE HERMANSON
SUBJECT: WRIA 55 PERMIT EXEMPT WELL DEMAND CLIMATE CHANGE
ANALYSIS
DATE: 6/16/2020



TECHNICAL MEMORANDUM

The WRIA 55 Initiating Governments in collaboration with the WRIA 55 Planning Unit are developing an update to the WRIA 55 Watershed Plan to meet the requirements of RCW 90.94.020. To meet the requirements an estimate of water demand from future permit exempt wells used for domestic use put into use over the period 2018-2038 is necessary. An evaluation of water demand was completed by Aspect Consulting and is available in the memorandum entitled *Evaluation of Future Exempt Well Demand, ESSB 6091/RCW 90.94*. Some WRIA 55 Planning Unit members have advocated that future climate change should be incorporated into the future demand estimate. At the March 5, 2020 WRIA 55 Planning Unit meeting Spokane County staff reported that they had evaluated the impact of climate change on potential evapotranspiration utilizing the Little Spokane Integrated Ground and Surface Water model and found that there is an approximately 10% increase in potential evapotranspiration between the baseline model results and results from the climate change scenario. At the meeting the Planning Unit discussed the inclusion of climate change in the demand estimate and reached consensus that it would be included in the final demand estimate. This technical memorandum describes the analysis utilized to derive the 10% increase.

In December 2018 an integrated groundwater/surface water model for the Little Spokane Watershed was completed (EarthFX, 2018). The model represents the interaction of the physical characteristics of the watershed (geology, hydrogeology, soils, surface water bodies, landcover, etc.), water use, and climate. The model represents the time period 2002-2017. The utility of the model is that input variables can be changed and the model results can be compared to the baseline model results to see the impact of the change on the hydrology of the basin. A climate change model scenario was run and is fully described in the model report (EarthFX, 2018). The climate change model scenario was developed by adjusting the temperature and precipitation values according to the 2050 climate change predictions for east of the Cascades developed by the University of Washington Climate Impacts Group.

The parameter of interest is potential evapotranspiration (PoET), or the amount of water that would be used by vegetation if a sufficient water source were available. This is a measure of the quantity of water required to keep landscaping associated with domestic residences in good condition. The model provides values for PoET for every model cell for every day of the model period. To assess the impact of climate change, average monthly PoET for May through September was compared between the baseline scenario and climate change scenario. Locations in the southern, middle and northern parts of the watershed were evaluated. There was an overall average increase in PoET of 10.3%. Tables 1-3 present the results for each month for each station.

Table 1 - Comparison of Baseline and Climate Change Potential Evapotranspiration, Deer Park Location

Model Cell Row506 Col241 (Deer Park)

Year	May			June			July			August			September		
	Baseline PoET	Climate Change PoET	% Change	Baseline PoET	Climate Change PoET	% Change	Baseline PoET	Climate Change PoET	% Change	Baseline PoET	Climate Change PoET	% Change	Baseline PoET	Climate Change PoET	% Change
2003	0.15	0.17	11%	0.25	0.28	11%	0.31	0.34	9%	0.23	0.26	10%	0.15	0.16	9%
2004	0.15	0.16	11%	0.23	0.25	11%	0.29	0.31	9%	0.21	0.24	9%	0.11	0.13	10%
2005	0.16	0.18	10%	0.19	0.22	12%	0.28	0.31	10%	0.24	0.27	10%	0.12	0.14	10%
2006	0.17	0.19	11%	0.22	0.24	11%	0.31	0.33	9%	0.23	0.25	10%	0.14	0.15	10%
2007	0.17	0.19	11%	0.21	0.23	11%	0.30	0.33	9%	0.22	0.25	10%	0.14	0.16	10%
2008	0.17	0.18	10%	0.21	0.23	12%	0.29	0.32	10%	0.22	0.24	10%	0.14	0.16	10%
2009	0.18	0.20	11%	0.23	0.26	11%	0.28	0.31	10%	0.23	0.26	10%	0.16	0.18	9%
2010	0.13	0.15	12%	0.19	0.22	12%	0.26	0.28	10%	0.23	0.25	10%	0.12	0.14	10%
2011	0.14	0.16	12%	0.19	0.21	12%	0.24	0.27	11%	0.26	0.28	10%	0.17	0.18	9%
2012	0.16	0.18	11%	0.16	0.18	12%	0.23	0.26	9%	0.25	0.27	10%	0.16	0.17	9%
2013	0.17	0.19	11%	0.21	0.23	11%	0.31	0.34	9%	0.23	0.25	9%	0.13	0.14	9%
2014	0.18	0.20	11%	0.20	0.23	11%	0.31	0.34	9%	0.24	0.26	9%	0.15	0.16	9%
2015	0.21	0.23	10%	0.30	0.33	10%	0.30	0.33	9%	0.22	0.24	9%	0.13	0.14	10%
2016	0.18	0.20	10%	0.24	0.27	11%	0.26	0.28	10%	0.24	0.27	9%	0.13	0.15	10%
2017	0.18	0.20	10%	0.23	0.26	11%	0.33	0.36	9%	0.25	0.27	9%	0.14	0.15	9%
Average	0.17	0.19	11%	0.22	0.24	11%	0.29	0.31	9%	0.23	0.26	10%	0.14	0.15	10%

PoET in inches per day

Table 2 - Comparison of Baseline and Climate Change Potential Evapotranspiration, Deadmand Creek Location

Model Cell Row770 Col411 (Deadman Subbasin)

Year	May			June			July			August			September		
	Baseline PoET	Climate Change PoET	% Change	Baseline PoET	Climate Change PoET	% Change	Baseline PoET	Climate Change PoET	% Change	Baseline PoET	Climate Change PoET	% Change	Baseline PoET	Climate Change PoET	% Change
2003	0.16	0.17	11%	0.26	0.29	11%	0.33	0.36	9%	0.25	0.27	10%	0.15	0.17	9%
2004	0.15	0.17	11%	0.24	0.26	11%	0.30	0.33	9%	0.22	0.24	9%	0.12	0.13	10%
2005	0.17	0.19	10%	0.21	0.23	12%	0.30	0.33	10%	0.26	0.28	10%	0.13	0.15	10%
2006	0.18	0.20	11%	0.23	0.26	11%	0.33	0.36	9%	0.24	0.27	10%	0.15	0.16	9%
2007	0.18	0.20	11%	0.22	0.24	11%	0.32	0.35	9%	0.24	0.26	10%	0.15	0.17	10%
2008	0.17	0.19	11%	0.22	0.25	12%	0.31	0.34	10%	0.23	0.25	10%	0.15	0.17	10%
2009	0.19	0.21	11%	0.25	0.27	11%	0.29	0.32	10%	0.24	0.27	10%	0.17	0.19	9%
2010	0.14	0.16	12%	0.20	0.23	12%	0.27	0.30	10%	0.24	0.26	10%	0.13	0.14	10%
2011	0.15	0.16	12%	0.20	0.22	12%	0.26	0.29	11%	0.27	0.29	10%	0.17	0.19	9%
2012	0.17	0.19	11%	0.17	0.19	12%	0.24	0.27	9%	0.26	0.29	10%	0.17	0.18	9%
2013	0.18	0.20	11%	0.22	0.24	11%	0.33	0.36	9%	0.24	0.26	9%	0.13	0.14	9%
2014	0.19	0.21	11%	0.21	0.24	12%	0.32	0.35	9%	0.25	0.27	9%	0.15	0.17	9%
2015	0.22	0.24	10%	0.31	0.34	10%	0.31	0.34	9%	0.23	0.25	9%	0.13	0.15	10%
2016	0.19	0.21	10%	0.25	0.28	11%	0.27	0.30	10%	0.25	0.28	9%	0.14	0.16	10%
2017	0.19	0.21	10%	0.24	0.27	11%	0.35	0.38	9%	0.26	0.29	9%	0.15	0.16	9%
Average	0.18	0.20	11%	0.23	0.25	11%	0.30	0.33	9%	0.24	0.27	10%	0.15	0.16	9%

PoET in inches per day

Table 3 - Comparison of Baseline and Climate Change Potential Evapotranspiration, Otter Creek Location

Model Cell Row322 Col399 (Otter Creek Subbasin)

Year	May			June			July			August			September		
	Baseline PoET	Climate Change	% Change	Baseline PoET	Climate Change	% Change	Baseline PoET	Climate Change PoET	% Change	Baseline PoET	Climate Change	% Change	Baseline PoET	Climate Change	% Change
2003	0.15	0.16	0.12	0.25	0.28	0.11	0.32	0.35	0.10	0.24	0.26	0.10	0.15	0.16	0.09
2004	0.14	0.16	0.12	0.23	0.25	0.12	0.28	0.31	0.10	0.22	0.24	0.10	0.12	0.13	0.10
2005	0.16	0.18	0.11	0.19	0.22	0.12	0.28	0.31	0.10	0.24	0.27	0.10	0.13	0.14	0.11
2006	0.17	0.19	0.11	0.22	0.24	0.11	0.31	0.34	0.09	0.23	0.26	0.10	0.14	0.16	0.10
2007	0.17	0.19	0.11	0.21	0.23	0.12	0.31	0.33	0.09	0.23	0.25	0.10	0.15	0.16	0.10
2008	0.16	0.18	0.11	0.21	0.23	0.12	0.29	0.32	0.10	0.22	0.24	0.10	0.15	0.16	0.10
2009	0.18	0.20	0.11	0.23	0.26	0.12	0.28	0.31	0.10	0.23	0.26	0.10	0.17	0.18	0.09
2010	0.13	0.15	0.13	0.19	0.21	0.13	0.26	0.29	0.11	0.23	0.25	0.10	0.12	0.14	0.10
2011	0.14	0.16	0.13	0.18	0.21	0.13	0.25	0.27	0.11	0.26	0.29	0.10	0.17	0.18	0.09
2012	0.16	0.18	0.12	0.16	0.18	0.13	0.23	0.26	0.10	0.25	0.28	0.10	0.16	0.18	0.10
2013	0.17	0.19	0.11	0.20	0.23	0.12	0.31	0.34	0.10	0.23	0.25	0.10	0.13	0.14	0.09
2014	0.18	0.20	0.11	0.20	0.23	0.12	0.31	0.33	0.09	0.24	0.26	0.10	0.15	0.16	0.10
2015	0.21	0.23	0.10	0.29	0.32	0.10	0.30	0.33	0.10	0.22	0.24	0.10	0.13	0.14	0.11
2016	0.18	0.20	0.11	0.24	0.26	0.12	0.25	0.28	0.10	0.24	0.26	0.10	0.13	0.15	0.10
2017	0.18	0.19	0.11	0.23	0.25	0.12	0.33	0.36	0.09	0.25	0.27	0.09	0.14	0.15	0.09
Average	0.17	0.18	11%	0.21	0.24	12%	0.29	0.32	10%	0.24	0.26	10%	0.14	0.16	10%

PoET in inches per day

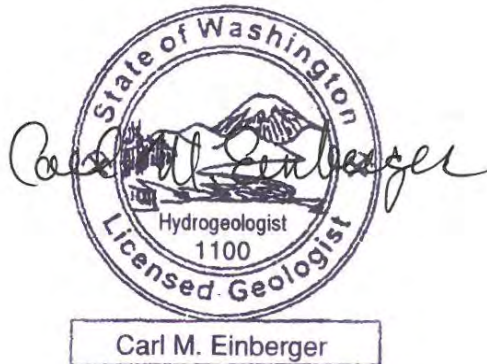
APPENDIX E

MAR Site Optimization and Selection (Aspect, December 2019))

December 2, 2019

To: Mike Hermanson – Spokane County Environmental Services, Lead Agency
WRIA 55 Planning Unit Members

From:



Carl Einberger, LHG
Associate Hydrogeologist

**Re: Managed Aquifer Recharge Site Optimization and Selection
WRIA 55 ESSB 6091/RCW 90.94 Watershed Plan Update**

Background

The passage of Engrossed Substitute Senate Bill (ESSB) 6091, as codified by RCW 90.94, requires that an update to the existing Watershed Plan for Water Resource Inventory Area (WRIA) 55, the Little Spokane Watershed, be approved by the Washington Department of Ecology (Ecology) by February 1, 2021. Spokane County Environmental Services is serving as the lead agency for this process. The WRIA 55 Initiating Governments for the watershed planning process are Spokane County, Stevens County, Pend Oreille County, the City of Spokane, and Whitworth Water District. The process is supported by convening the WRIA 55 Planning Unit to review technical tasks and memorandums, policy decisions, and the pending watershed plan update. Aspect Consulting, LLC (Aspect) has been contracted by Spokane County to facilitate planning unit meetings, conduct supporting technical tasks, and prepare the Watershed Plan update.

Spokane County previously received a grant from the Bureau of Reclamation's Drought Resiliency grant program to develop modeling tools to identify and quantify projects aimed at enhancing streamflows. Through that project, a transient integrated surface and groundwater model was developed for WRIA 55 by EarthFX, a consulting group specializing in groundwater modeling, using the USGS modeling package GSFLOW. EarthFX is supporting Aspect and Spokane County in conducting modeling and analysis specific to the Watershed Plan update.

The model is an ideal tool to identify and optimize selection of potential water offset project sites, given that it has been calibrated to surface water flows and groundwater conditions in the basin and can model the predicted effects of proposed projects. Model results have been combined with GIS

December 2, 2019

analysis to evaluation potentially suitable managed aquifer recharge (MAR) locations within WRIA 55. Based on the screening criteria discussed in this memorandum, 18 sites were targeted for additional GSFLOW modeling, to evaluate the response of streamflows to induced recharge at the target sites. This memorandum summarizes the evaluation of those 18 sites.

Approach

There are several site-specific criteria that control the suitability of a particular area for a MAR facility. The suitability of a site for an MAR project is based on a number of factors that have been considered in this analysis. The screening approach for this investigation has been conducted, in essence, as a process of elimination of areas of WRIA 55 based on consideration of key factors discussed below:

Availability of Water Rights for Purchase

A portion of the WRIA 55 watershed within the Dragoon and Beaver Creek subbasins was excluded from the study area based on the availability of water rights that were either already purchased by the County for the WRIA 55 Water Bank or are identified as target water rights for future purchase based on interested water right sellers. **The study area covers the portions of WRIA 55 where no clear water right purchase targets have been identified.**

Infiltration Capacity and Available Water Table Rise

MAR projects can be implemented with either infiltration ponds or subsurface drainfield piping (similar to a septic field). In both cases, near surface soils with suitable hydraulic conductivity are needed to allow for adequate infiltration rates. One concern is that under certain geologic conditions, the water table beneath the basin may rise rapidly and thereby affect the efficiency of the recharge operations. This is likely to occur in areas with shallow depth to the water-table and/or a surficial aquifer with low to moderate permeability. The rise of the water table beneath a recharge basin face depends on several factors including the rate of infiltration, the hydraulic conductivity and thickness of the surficial aquifer, proximity to aquifer boundaries, and the area and shape of the recharge basin.

Several analytical solutions (simple groundwater models) have been developed that can be used to estimate the rise of the water table beneath a rectangular or circular recharge basin. These models can be applied in situations where the aquifer geometry and properties are relatively uniform over reasonably large distances. Analytical solutions were used in this phase of the study as a screening tool to identify areas where water table rise could pose a limit to the effectiveness of aquifer recharge operations. An analytical solution for water table rise was developed by Hantush (1966) for rectangular and circular basins. This solution was integrated with data from the WRIA 55 GSFLOW model to estimate the available water table rise in target WRIA 55.

The solution for the maximum rise of the water table at the center of a circular basin is given as:

$$s^2 = h^2 - h_i^2 = \frac{NR^2}{2K} [W(u_0) + (1 - \exp(-u_0)/u_0)]$$

where:

s is the maximum increase in head (height of water table) below the basin at a given time;

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h is the head (height of the water table) at a given time;

h_i is the initial head;

N is the infiltration rate;

R is the radius of the basin;

$W(u_0)$ is the well function for non-leaky aquifers;

$u_0 = \frac{R^2 S}{4K\bar{b}t}$; where:

S is the storage coefficient of the aquifer (specific yield);

K is the hydraulic conductivity of the surficial aquifer;

\bar{b} is the average saturated thickness of the surficial aquifer; and;

t is time measured from the start of recharge.

The analytical solution can be easily evaluated if the aquifer properties (hydraulic conductivity and storage coefficient) are known. One small complication is that the average saturated thickness, \bar{b} , is unknown because it depends on the water table rise. An iterative technique can be used where the starting saturated thickness is substituted in the equation as an initial guess. The calculated rise is then used to update the average saturated thickness and the process repeated until \bar{b} ceases to change.

A Visual Basic code program was written to evaluate the analytical solution at the center of every cell in the numerical model grid. The aquifer properties were determined from the calibrated model parameters. The average hydraulic conductivity was determined by summing the transmissivities of the underlying model layers and divided by the total thickness.

The suitability for recharge was measured in terms of the “percent of available rise” (PAR), where:

$$PAR = \left(1 - \frac{S}{\text{available rise}}\right) \times 100$$

The available rise was determined in each cell as the average topographic elevation minus the average head for March in Model Layer 1 (as averaged over the 15-year numerical model simulation period). March was selected because it would be the start of a typical 3-month recharge period, assumed to extend from March through May where flows in the streams would accommodate the diversion of water needed for recharge. An injection rate of 1 cubic foot per second (cfs) was selected and the radius of the recharge basin was assumed to be 165 ft (equivalent to a two-acre site). Large PAR values (e.g., 90 percent) would indicate that the expected rise in the water table uses a small portion of the total available. **Percent available rise of less than 50 percent was considered unsuitable for recharge sites in the screening process**, to provide a safety factor given the uncertainty typically associated with subsurface conditions.

Figure 1 shows the computed percent available rise for each cell in the model. A geologic section through some of the suitable areas is provided in Figure 2 (section line shown on Figure 1) that also

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shows the March water levels. Results show that the suitability is strongly dependent on (1) the presence of sandy materials in the shallow subsurface, and (2) the presence of a relatively deep water table.

Stream Augmentation Factor (SAF)

In addition to being able to accept the infiltrated water, another consideration is the time it takes for the recharge to affect flow in the nearest stream. If the facility is located too close to the stream, recharge from the basin could cause an increase in streamflow during the diversion period. Ideally, the streamflow should be augmented starting after the diversion period and extending through the period of typically low stream flow.

Early studies of streamflow depletion (i.e., loss of streamflow to the aquifer caused by pumping a well adjacent to a stream) identified a “Stream Depletion Factor” used to determine when a stream will first show the influence of the nearby pumping (Jenkins, 1968). This same factor, in reverse, can be used to identify when augmentation of streamflow due to aquifer recharge will first be detected. This streamflow augmentation factor (SAF) is a measure of how rapidly the pressure increase caused by the increased heads beneath the recharge facility propagates through the aquifer and depends on the aquifer storage and transmissivity values. It differs from the actual arrival time of the injected water because the pressure increase will typically move through the aquifer much faster than the water itself.

The Streamflow Augmentation Factor (SAF) is given by:

$$SAF = \frac{L^2 S_y}{T}$$

where:

L is the length of the flowpath between the recharge facility and the stream;

S_y is the specific yield of the surficial aquifer;

T is the transmissivity of the aquifer.

A Visual Basic code program was written to evaluate the SAF at the center of every cell in the numerical model grid. Flowpaths from each cell were determined by analyzing the average March water table. This code started at a cell and analyzed heads in each adjacent cell to determine the path with the steepest gradient. The search continued until a stream segment was intersected. Average transmissivity and specific yields were computed by keeping a running average of the transmissivity and specific yield of all model cells encountered along the flowpath. The SAF factor was computed and the process was repeated for each cell in the model grid.

A small SAF means small lag between start of recharge and start of stream response. **Areas with SAF less than 90 days were excluded from the selection process.** Large SAF factors would indicate that a measurable response to recharge would not be detected for a long period. Accordingly, SAF factors greater than 5 years were also excluded. Figure 3 the SAF values within the study area. The SAF value grows quickly as the length of the flowpath increases.

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Distance from Surface Water Sources

Another consideration in siting MAR projects is access to a suitable water source to provide water for infiltration and recharge. **For this investigation, areas further than one mile from a surface water source were eliminated from consideration**, given the high cost of infrastructure and conveyance costs expected to be associated with developing an MAR site at further distances from a water source than this. Figure 4 shows the areas excluded based on distance for surface water sources.

Surface Slope Limitations on Conveyance

In addition to distance from a surface water source, another factor that can affect infrastructure and conveyance costs is the elevation difference between a water source and the site targeted for MAR. This both complicates a conveyance alignment and adds significantly to pumping costs to the MAR project site. **For this investigation, areas with slopes great than 25 percent were eliminated from consideration**, given the high cost of infrastructure and conveyance costs expected to be associated with developing an MAR site in this circumstance. Figure 5 shows the areas excluded based on this factor.

Availability of Public Versus Private Land for Project Access

While not an exclusionary factor, emphasis was placed on availability of public lands for target site selection for additional investigation, with particular emphasis on county lands within WRIA 55. This focus was based on the relative ease of securing access to these lands, versus privately held lands. Figure 6 shows the distribution of public lands within the study area.

Distribution of Target Sites Based on Instream Flow Needs

A final factor considered in selecting target sites focused on identifying a distribution of sites for further analysis that were spread through all the key subbasins needing water offset projects.

Selection of Sites for GSFLOW Modeling of MAR

In summary, the exclusionary factors considered in this analysis are:

- Areas within WRIA 55 where water right purchases have been made or are considered likely.
- The estimated percent available water table rise is less than 50 percent.
- The Stream Augmentation Factors is less than 90 days.
- Areas further than one mile from a surface water source.
- Areas with slopes great than 25 percent were eliminated from consideration,

Figure 7 shows the 18 site locations that were selected for additional GSFLOW modeling investigation. The modeling was conducted with the following assumptions:

- 1 cubic foot per second (cfs) was recharged (when available in the water source) at the modeled MAR site over the period March, April, and May.
- Streamflow was calculated at the nearest surface water discharge point from recharge site.

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- Modeling was done over a multi-year period to provide an indication of longer term response of groundwater discharge to the recharge process.

MAR Modeling Results

A summary of the GSFLOW modeling results for each tested MAR site is presented below. The graphs discussed in this section present monthly averages of flow differences induced by the simulated MAR projects. Negative cfs values are indicative of recharge to the project site (reflected as decreases in streamflow from the diversions to the project sites), while positive cfs values show the benefits to streamflow from the MAR project.

Site #1 Milan Road/Bear Creek

This site responded well to the MAR modeling simulation (Figure 8). Suitable March to May streamflow was generally available for infiltration, and associated increases in nearby streamflows of up to 0.2+ cfs were apparent over the modeled period, including during critical low streamflow periods. This site was selected for field investigations, including infiltration testing. The field investigations will be summarized in a separate memorandum to be completed after field work is complete.

Site #2 Otter Creek 1

This site responded somewhat poorly to the MAR modeling simulation. Instream flow benefits were inconsistent, with poor timing of release to nearby surface water. Based on these results, it does not appear that this specific site warrants further consideration as an MAR site; however, other sites may exist in the Otter Creek area where the timing of release of recharged water back to surface water would be more suitable. Based on these results, it does not appear that this site warrants further consideration as an MAR site. Given the poor response, a figure with the modeling results was excluded from this memorandum.

Site #3 Feryn/Deadman

This site responded well to the MAR modeling simulation (Figure 9). Suitable March to May streamflow was available for infiltration, although with gaps. Associated increases in nearby streamflows of up to 0.4 cfs were apparent during portions of the modeled period, including during some, but not all critical low streamflow periods. This site was selected for field investigations, including infiltration testing. The field investigations will be summarized in a separate memorandum to be completed after field work is complete.

Site #4 Dartford 1

This site responded very poorly to the MAR modeling simulation due to insufficient streamflow availability for recharge. Based on these results, it does not appear that this site warrants further consideration as an MAR site. Given the poor response, a figure with the modeling results was excluded from this memorandum.

Site #5 Chattaroy – Deer Creek

This site responded very poorly to the MAR modeling simulation due to insufficient streamflow availability for recharge. Based on these results, it does not appear that this site warrants further consideration as an MAR site. Given the poor response, a figure with the modeling results was excluded from this memorandum.

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Site #6 Deer Creek – Fire District

This site responded very poorly to the MAR modeling simulation due to insufficient streamflow availability for recharge. Based on these results, it does not appear that this site warrants further consideration as an MAR site. Given the poor response, a figure with the modeling results was excluded from this memorandum.

Site #7 Dry Creek 1

This site responded well to the MAR modeling simulation (Figure 10). Suitable March to May streamflow was generally available for infiltration, and associated increases in nearby streamflows of up to 0.2+ cfs were apparent over the modeled period, including during critical low streamflow periods. This site was selected for field investigations, including infiltration testing. The field investigations will be summarized in a separate memorandum to be completed after field work is complete.

Site #8 County Park/Last Chance Road

This site responded well to the MAR modeling simulation (Figure 11). Suitable March to May streamflow was available for infiltration during many, but not all periods, and associated increases in nearby streamflows of up to 0.2+ cfs were apparent over the modeled period, including during many critical low streamflow periods. We recommend that this site continue to be considered for a MAR project.

Site #9 Little Deep Creek 1

This site responded well to the MAR modeling simulation (Figure 12). Suitable March to May streamflow was available for infiltration during many, but not all periods, and associated increases in nearby streamflows of up to 0.3+ cfs were apparent over the modeled period, including during many critical low streamflow periods. We recommend that this site continue to be considered for a MAR project.

Site #10 Deadman

This site responded well to the MAR modeling simulation (Figure 13). Suitable March to May streamflow was available for infiltration during many, but not all periods, and associated increases in nearby streamflows of up to 0.2+ cfs were apparent early in the modeled period, including during many critical low streamflow periods. Additional increases in streamflow were predicted in later years of the modeling simulation. We recommend that this site continue to be considered for a MAR project.

Site #11 Little Deep Creek 2

This site responded poorly to the MAR modeling simulation due to insufficient streamflow during most periods, and limited streamflow benefits. Based on these results, it does not appear that this site warrants further consideration as an MAR site. Given the poor response, a figure with the modeling results was excluded from this memorandum.

Site #12 Deer Creek

This site responded poorly to the MAR modeling simulation due to insufficient streamflow during most periods, and limited streamflow benefits. Based on these results, it does not appear that this site warrants further consideration as an MAR site. Given the poor response, a figure with the modeling results was excluded from this memorandum.

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Site #13 Dry Creek 2

This site responded well to the MAR modeling simulation (Figure 14). Suitable March to May streamflow was generally available for infiltration, and associated increases in nearby streamflows of up to 0.2+ cfs were apparent over the modeled period, including during critical low streamflow periods. We recommend that this site continue to be considered for a MAR project..

Site #14 Otter Creek 2

This site responded somewhat poorly to the MAR modeling simulation due to inconsistent streamflow availability for recharge and corresponding inconsistent streamflow benefits. Based on these results, it does not appear that this site warrants further consideration as an MAR site. Given the poor response, a figure with the modeling results was excluded from this memorandum.

Site #15 Dragoon DNR

This site was located outside of the original study area but was added later in the study. It responded well to the MAR modeling simulation (Figure 15). Suitable March to May streamflow was available for infiltration during many, but not all periods, and associated increases in nearby streamflows of up to 0.2+ cfs were apparent over the modeled period, including during many critical low streamflow periods. We recommend that this site continue to be considered for a MAR project.

Site #16 Dartford 2

This site responded poorly to the MAR modeling simulation due to insufficient streamflow during most periods, and limited streamflow benefits. Based on these results, it does not appear that this site warrants further consideration as an MAR site. Given the poor response, a figure with the modeling results was excluded from this memorandum.

Site #17 Bear Creek

This site responded well to the MAR modeling simulation (Figure 16). Suitable March to May streamflow was generally available for infiltration, and associated increases in nearby streamflows of up to 0.2+ cfs were apparent over the modeled period, including during critical low streamflow periods. We recommend that this site continue to be considered for a MAR project.

Site #18 Otter Creek 3

This site was modeled as an early test case during development of the GSFLOW model. Variable recharge rates ranging from 1 to 3 cfs were tested. Suitable March to May streamflow was generally available for infiltration, and associated increases in nearby streamflows were predicted. We recommend that this site continue to be considered for an MAR project.

December 2, 2019

References

Jenkins, C.T., 1968, Computation of rate and volume of stream depletion by wells: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 4, chap. D1, 17 p.

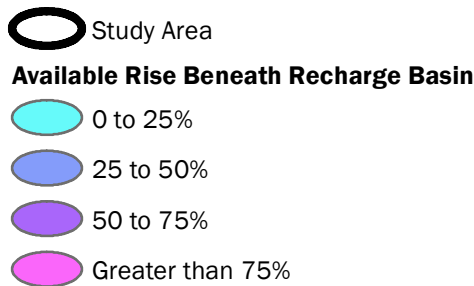
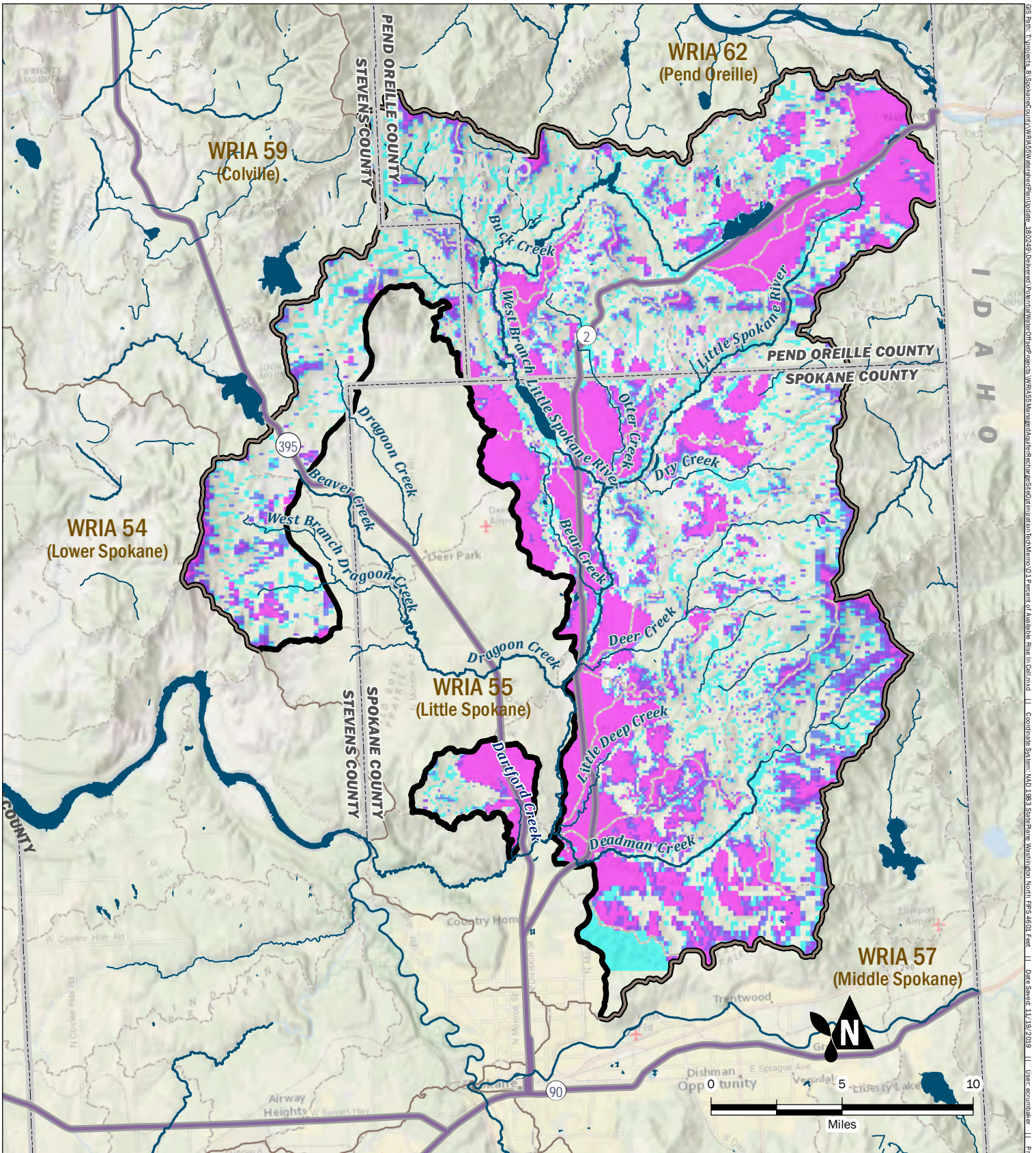
Hantush, M.S., 1967, Growth and decay of groundwater mounds in response to uniform percolation: Water Resources Research, v. 3, p. 227–234.

Attachments

- Figure 1 – Percent Available Rise in Cell, Circular Basin at 1 cfs for 3 months
- Figure 2 – Geologic Section Showing Areas with Percent Available Rise Greater than 50%
- Figure 3 - Stream Augmentation Factor
- Figure 4 – Area Beyond One Mile From Stream
- Figure 5 - Surface Slope
- Figure 6 – Public Lands
- Figure 7 - Modeled Site Locations
- Figure 8 - Site #1 Modeled Streamflow Differences, Milan Road/Bear Creek
- Figure 9 - Site #3 Modeled Streamflow Differences, Feryn/Deadman
- Figure 10 - Site #7 Modeled Streamflow Differences, Dry Creek 1
- Figure 11 - Site #8 Modeled Streamflow Differences, County Park/Last Chance Road
- Figure 12 - Site #9 Modeled Streamflow Differences, Little Deep Creek 1
- Figure 13 - Site #14 Modeled Streamflow Differences, Deadman
- Figure 14 - Site #13 Modeled Streamflow Differences, Dry Creek 2
- Figure 15 - Site #15 Modeled Streamflow Differences, Dragoon DNR
- Figure 16 - Site #17 Modeled Streamflow Differences, Bear Creek



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FIGURES

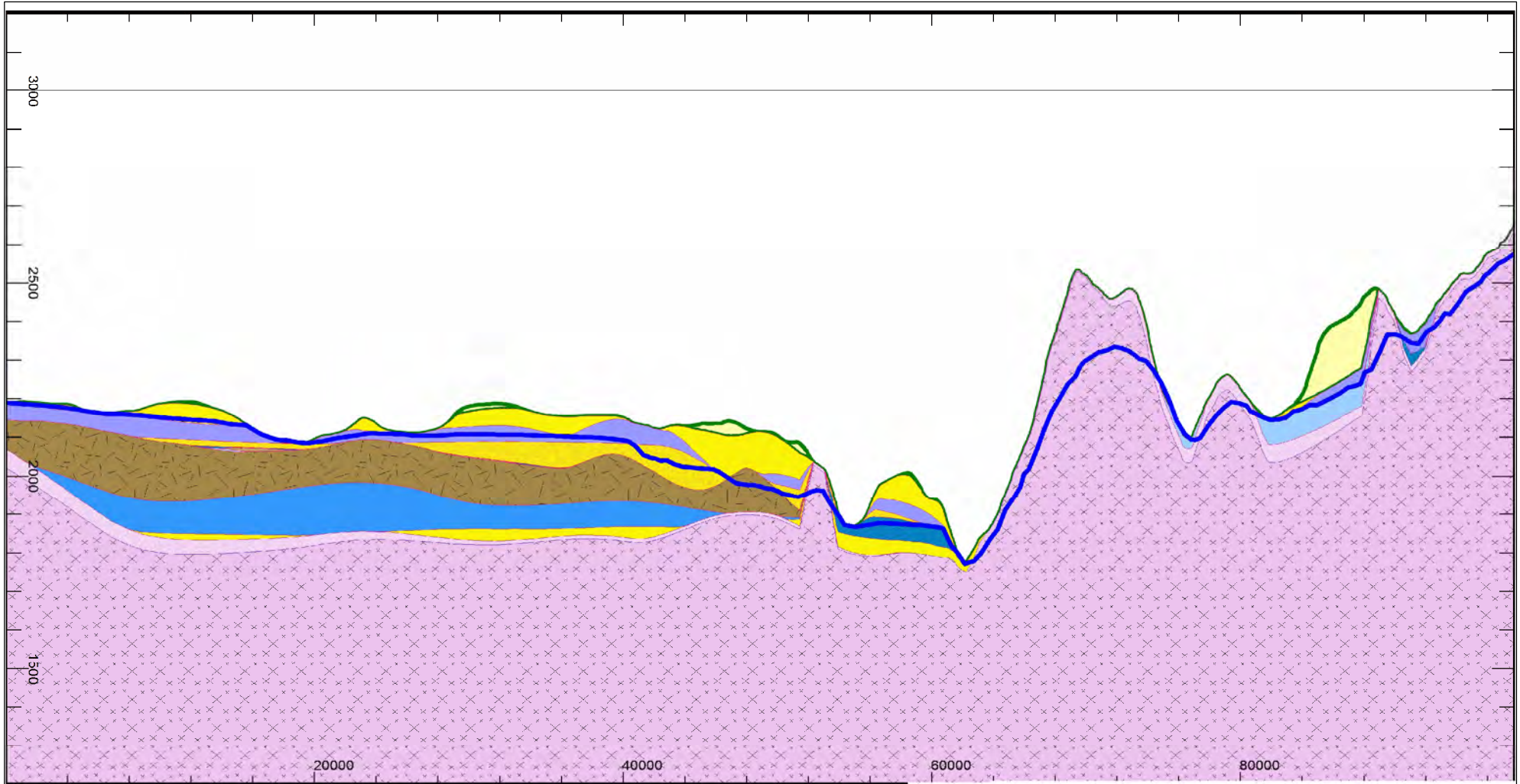


**Percent Available Rise in Cell
Circular Basin at 1 cfs for 3 Months**

WRIA 55 Managed Aquifer Recharge Site Optimization Tech Memo
WRIA 55, Washington

		NOV-2019	BY: CME / EAC	FIGURE NO. 1
		PROJECT NO. 180249	REVISED BY: ---	

Basemap Layer Credits || Sources: Esri, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodastyrrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.



- Legend:**
- March Water Levels
% of Available head (feet) - hantush basin 165 9
- Geologic Unit Legend:**
- Upper Aquifer/Silts
 - Upper Aquifer
 - Upper Confining Unit
 - Lower Aquifer
 - Lower Confining Unit
 - Wanapum Basalt
 - Upper Latah Fm
 - Grand Ronde Basalt
 - Lower Latah Fm
 - Pre-Latah Sands
 - Weathered Bedrock/Granite
 - Bedrock/Granite

Map Projection: State Plane Washington North
Datum: NAD83 HARN

0 4000 8000
Map Units: Feet

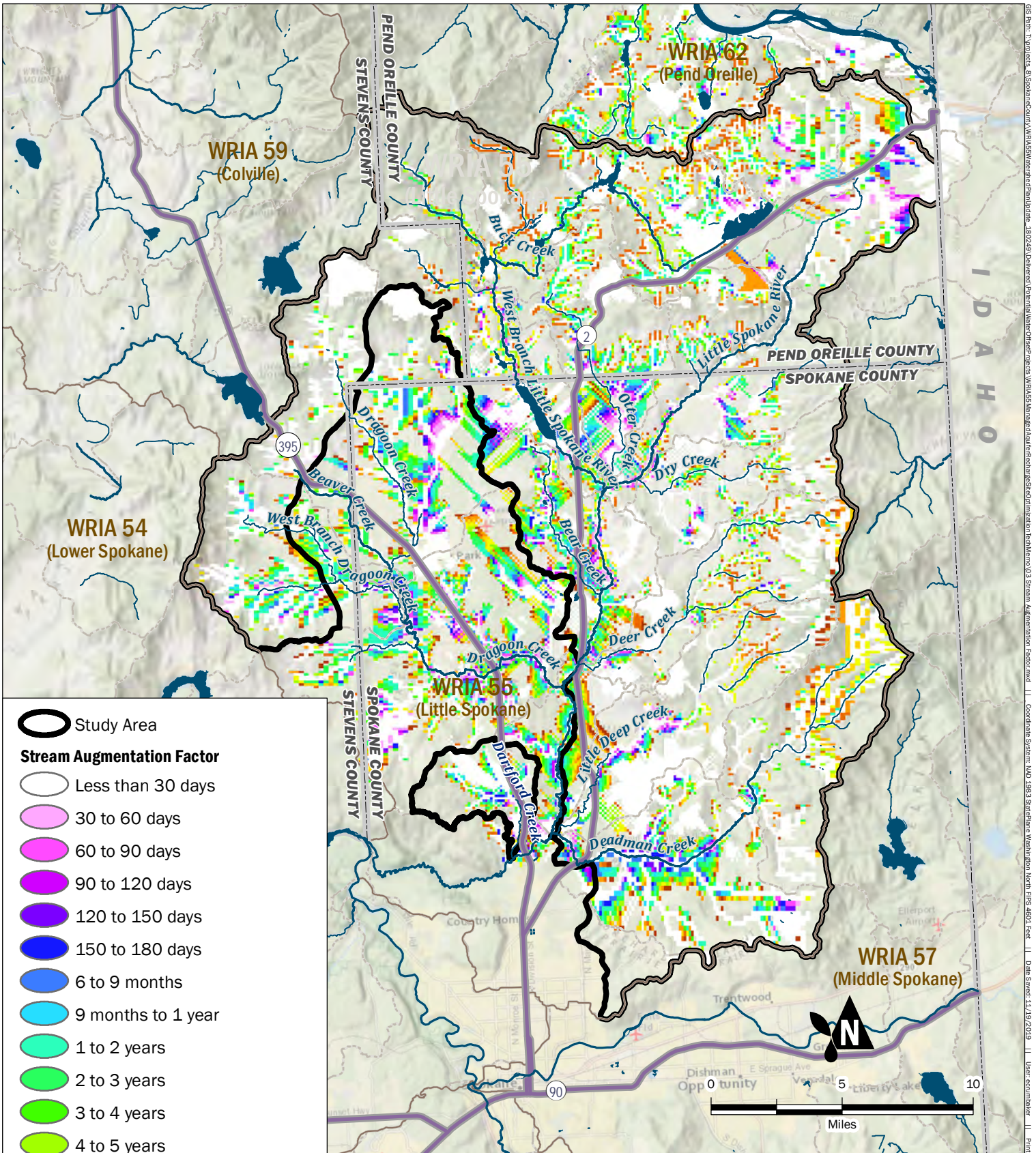
Elevation: Feet above sea level (feet)
Vertical Exaggeration: 25
Borehole Projection Offset: 500 ft
Section Reference Shift: 0

Data Sources:
Produced with information provided by:
Spokane County
State of Washington
US Geological Survey

Geologic Section Showing Areas with Percent Available Rise Greater than 50%
WRIA 55 Managed Aquifer Recharge Site Optimization Tech Memo
WRIA 55, Washington

		NOV-2019	BY: CME / EAC	FIGURE NO. 2
		PROJECT NO. 180249	REVISED BY: ---	

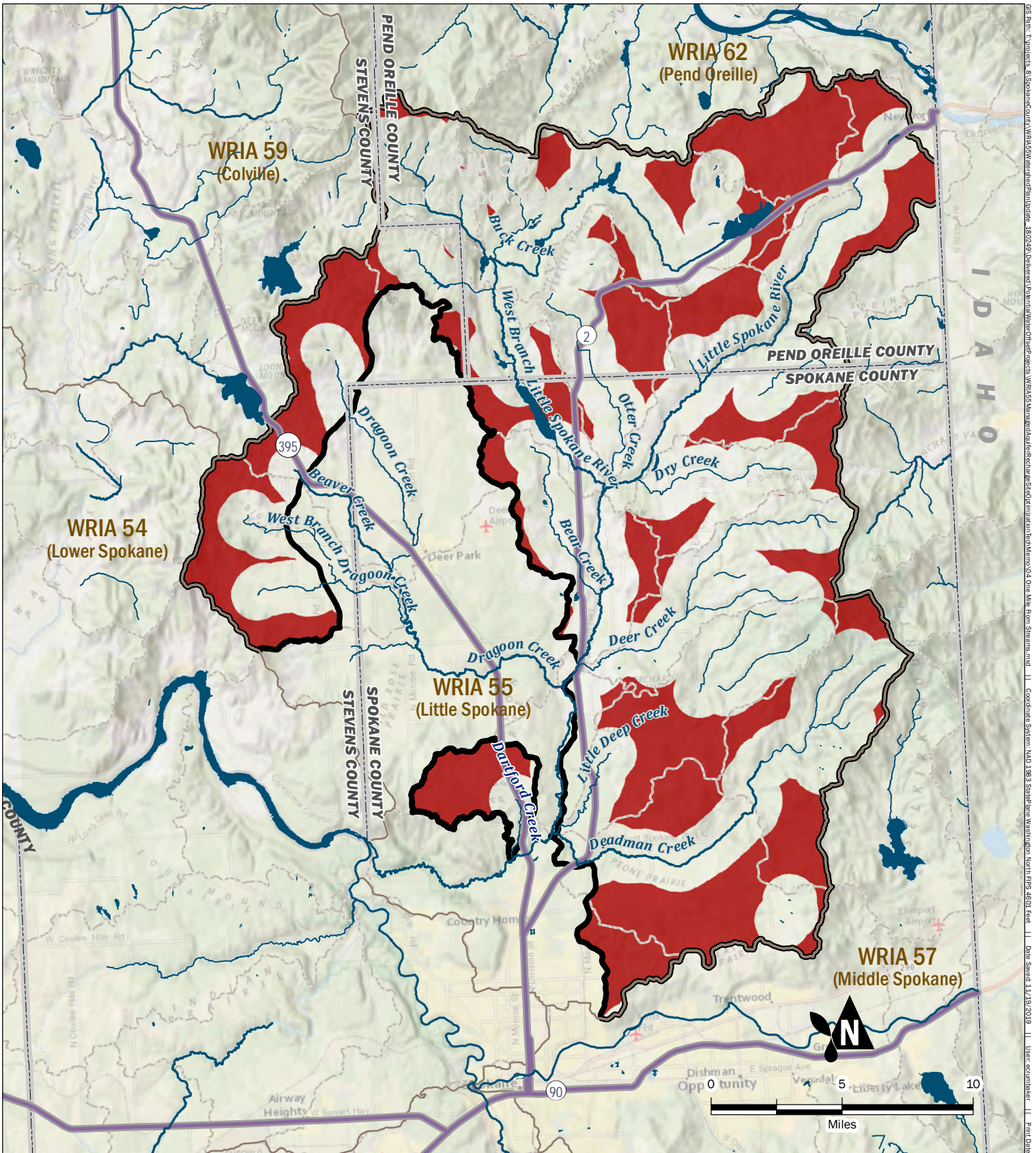
Drawings prepared by Earthfi: 9/20/18





- Study Area
- Stream Augmentation Factor**
- Less than 30 days
- 30 to 60 days
- 60 to 90 days
- 90 to 120 days
- 120 to 150 days
- 150 to 180 days
- 6 to 9 months
- 9 months to 1 year
- 1 to 2 years
- 2 to 3 years
- 3 to 4 years
- 4 to 5 years
- 5 to 6 years
- 6 to 7 years
- 7 to 8 years
- 8 to 9 years
- 9 to 10 years
- Greater than 10 years no color


Stream Augmentation Factor
 WRIA 55 Managed Aquifer Recharge Site Optimization Tech Memo
 WRIA 55, Washington

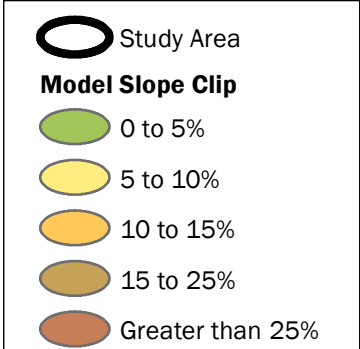
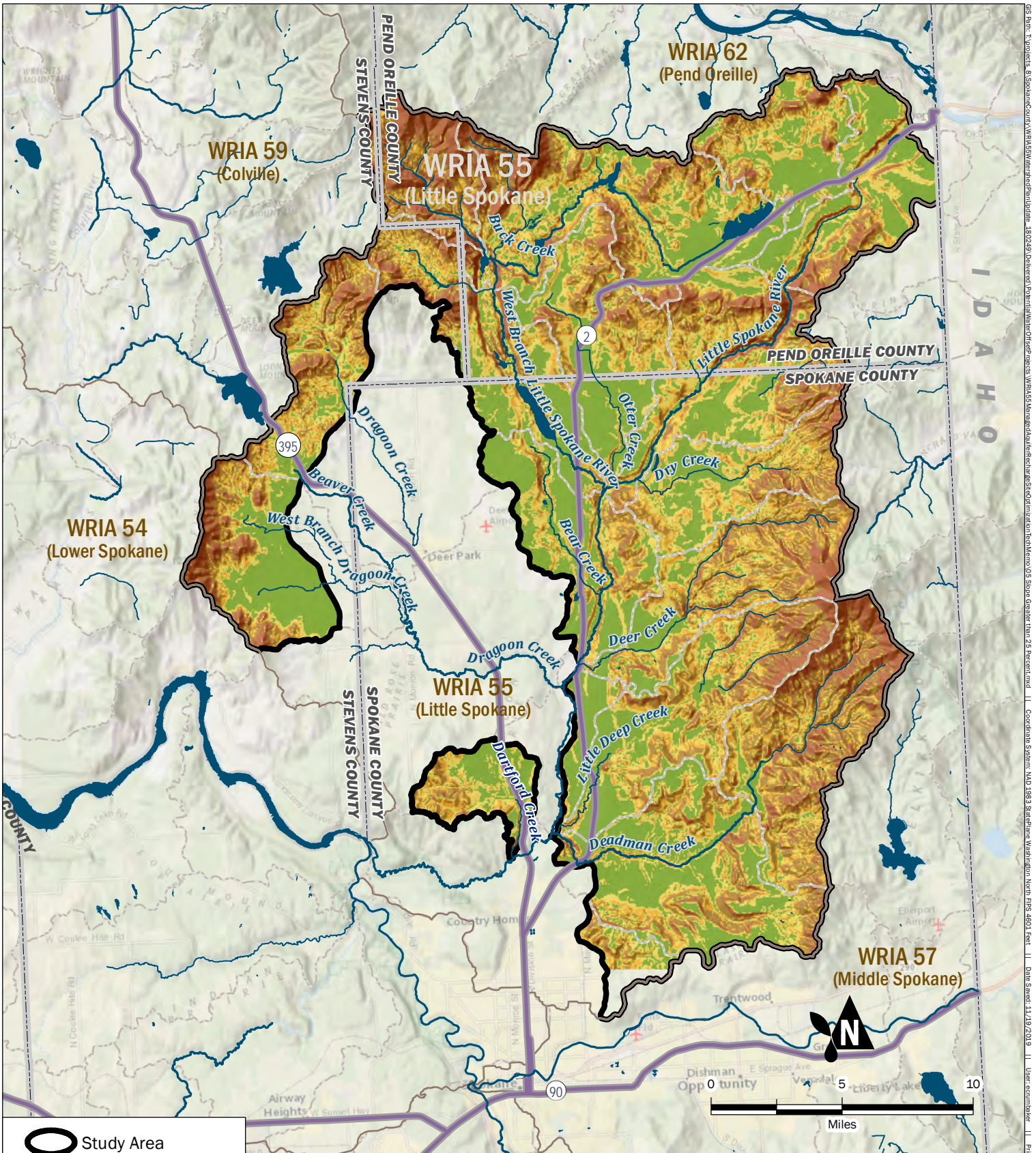
		NOV-2019	BY: CME / EAC	FIGURE NO. 3
		PROJECT NO. 180249	REVISED BY: ---	



-  Study Area
-  Area Beyond 1 mile from Stream

Area Beyond One Mile From Stream
 WRIA 55 Managed Aquifer Recharge Site Optimization Tech Memo
 WRIA 55, Washington

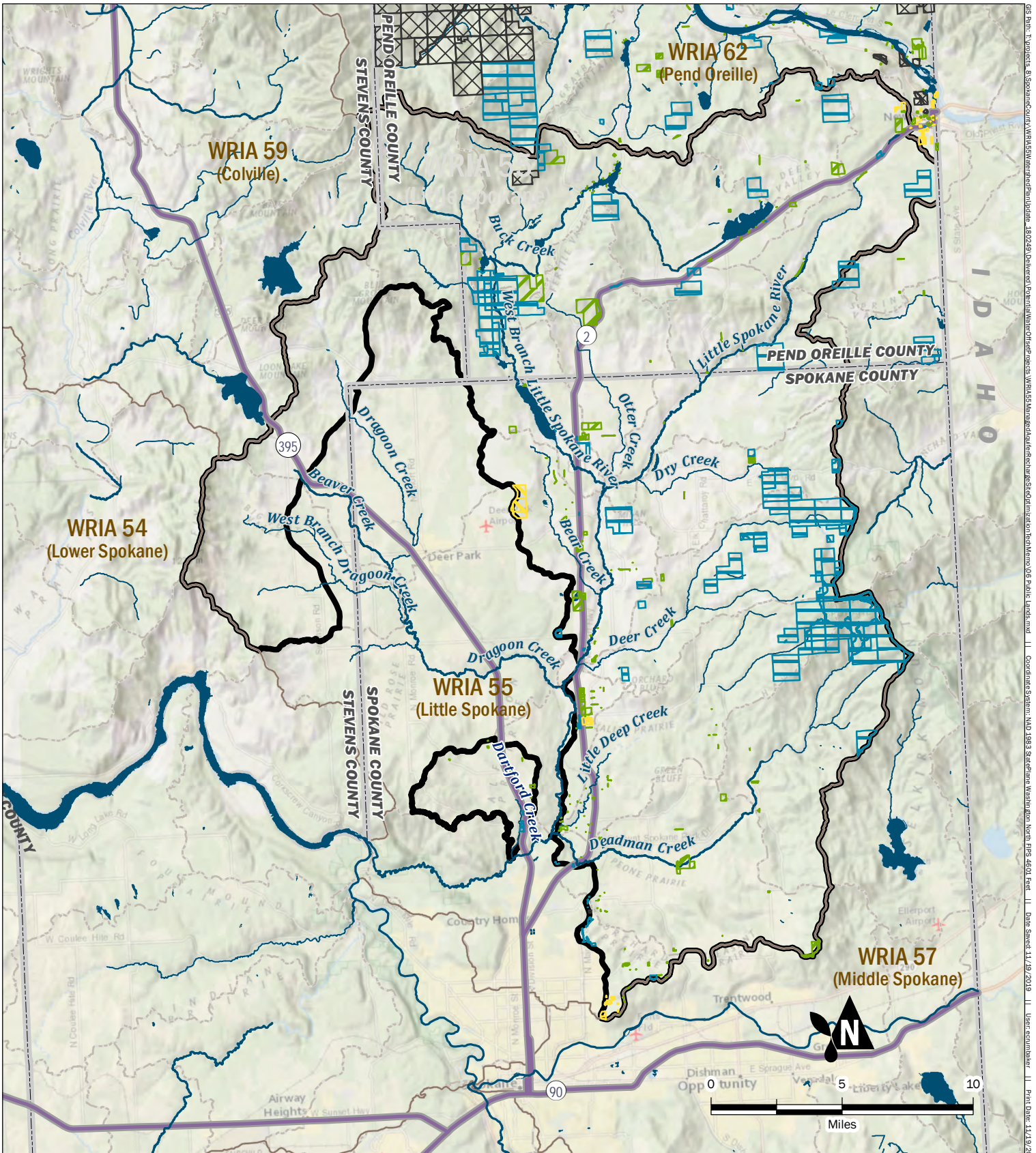
	NOV-2019	BY: CME / EAC	FIGURE NO. 4
	PROJECT NO. 180249	REVISED BY: ---	



Surface Slope
 WRIA 55 Managed Aquifer Recharge Site Optimization Tech Memo
 WRIA 55, Washington

	NOV-2019	BY: CME / EAC	FIGURE NO. 5
	PROJECT NO. 180249	REVISED BY: ---	

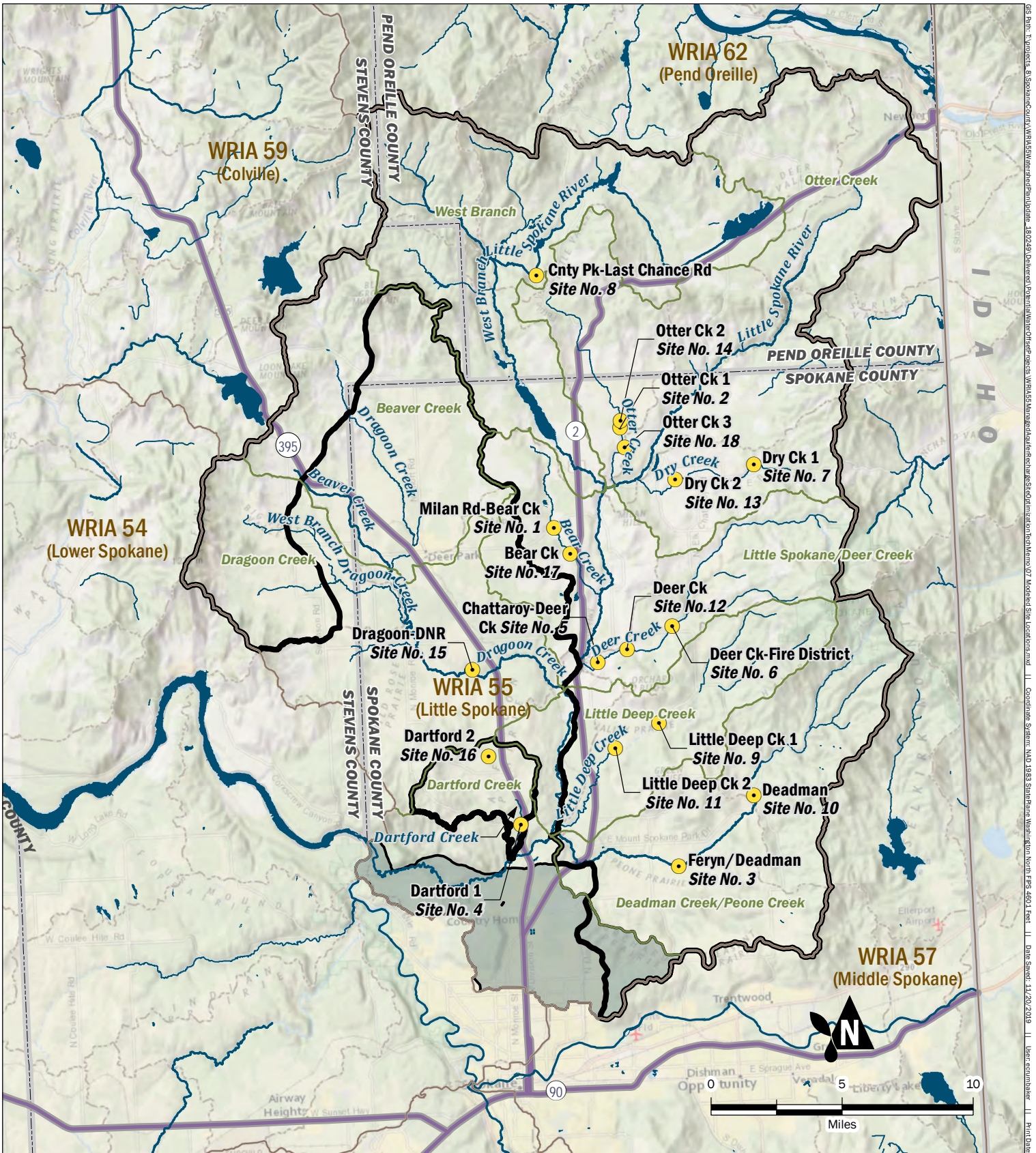
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- Study Area
- Federal-owned Parcels
- State-owned Parcels
- County-owned Parcels
- Muni-owned Parcels

Public Lands
 WRIA 55 Managed Aquifer Recharge Site Optimization Tech Memo
 WRIA 55, Washington

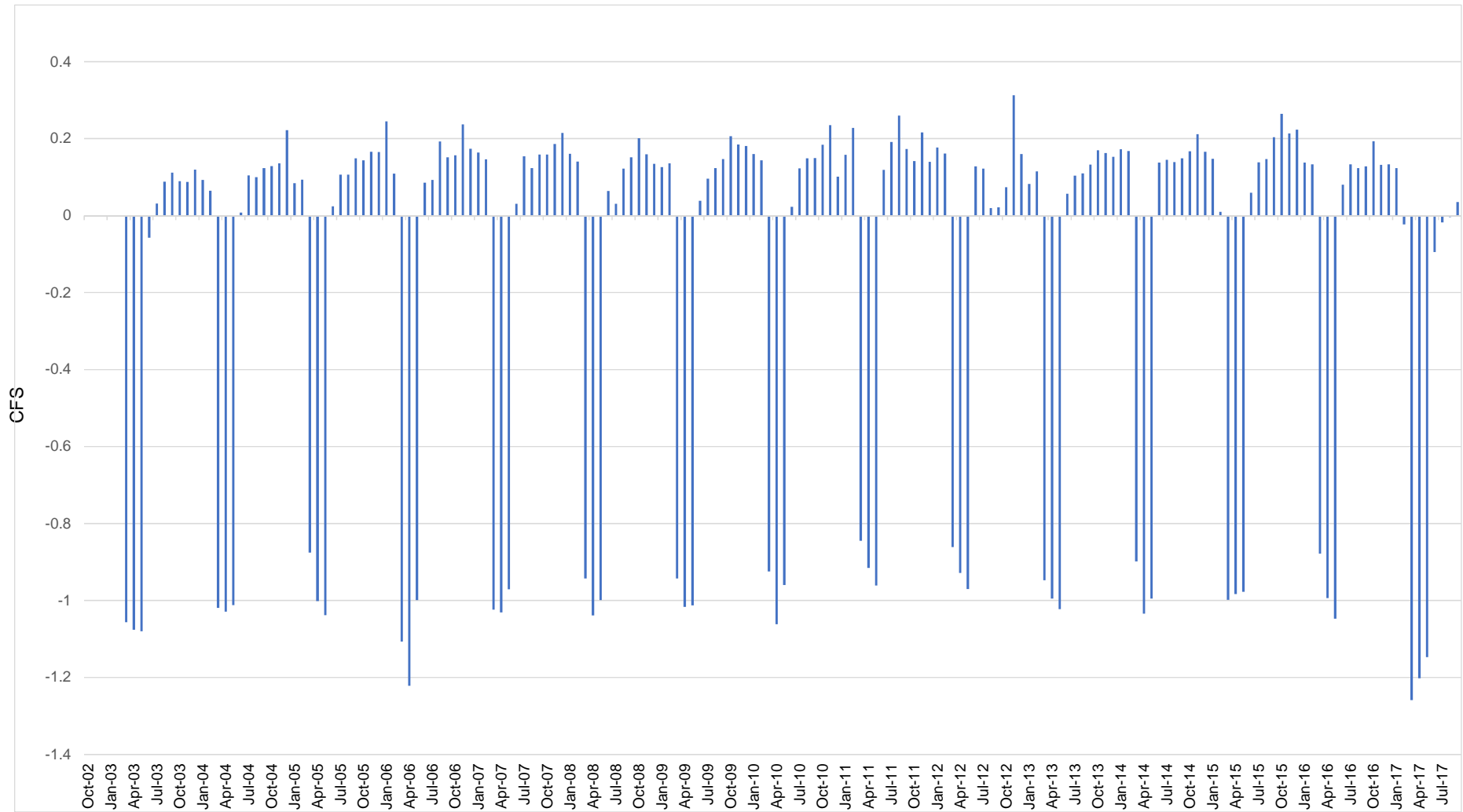
	NOV-2019	BY: CME / EAC	FIGURE NO. 6
	PROJECT NO. 180249	REVISED BY: ---	



- Project Location
- Study Area
- WRIA 55 Subbasins

Modeled Site Locations
 WRIA 55 Managed Aquifer Recharge Site Optimization Tech Memo
 WRIA 55, Washington

	NOV-2019	BY: CME / EAC	FIGURE NO. 7
	PROJECT NO. 180249	REVISED BY: ---	



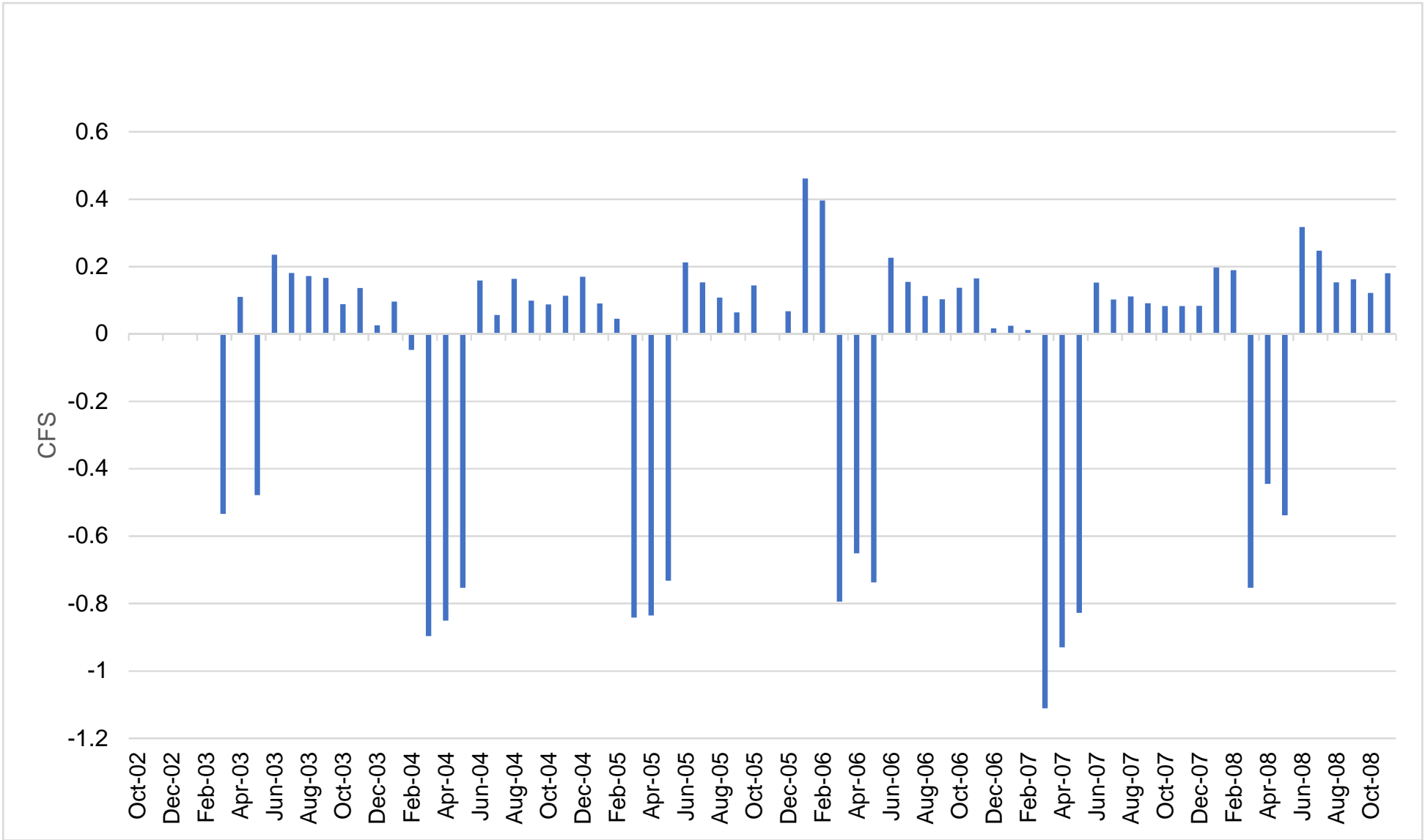
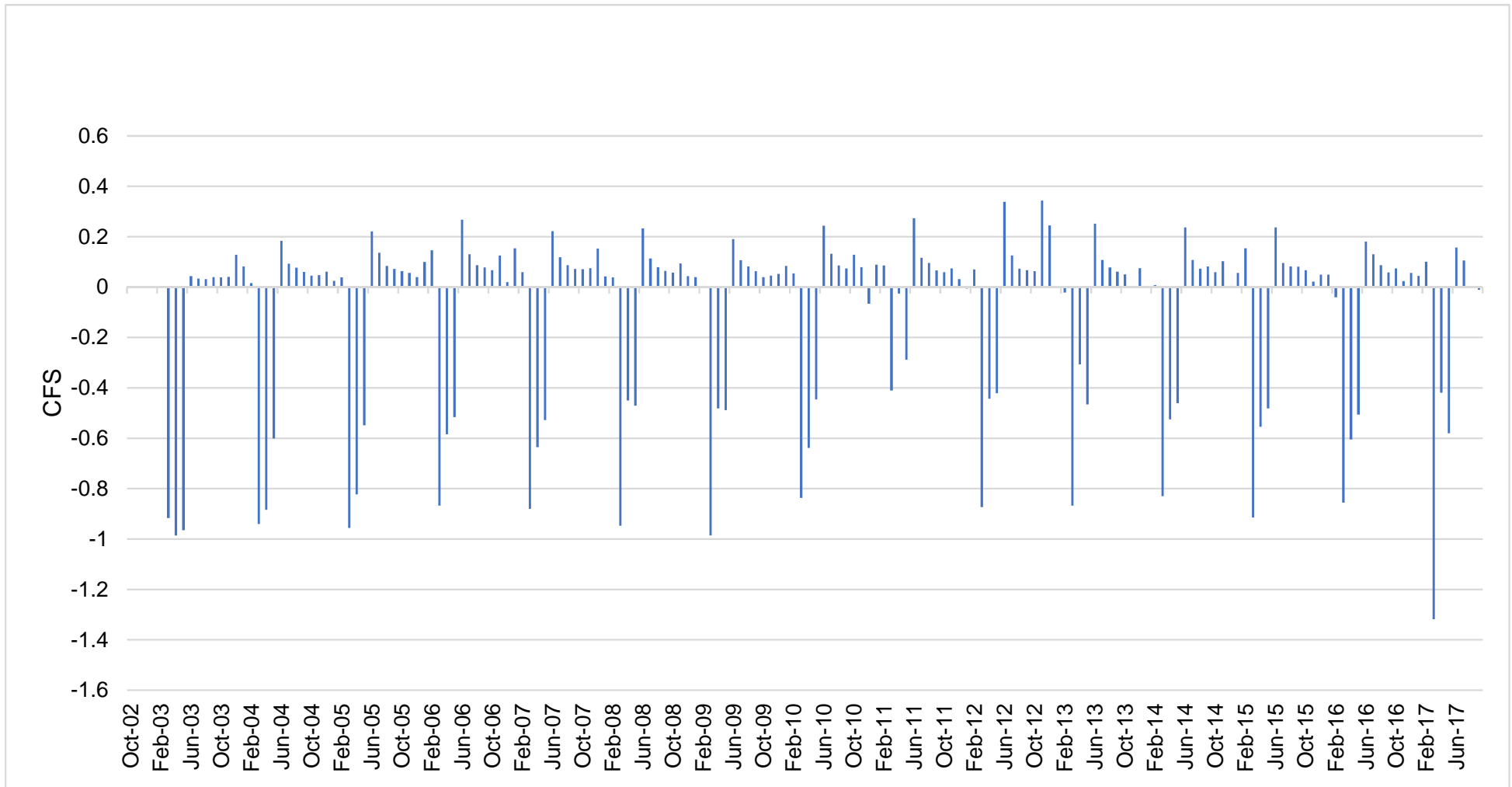
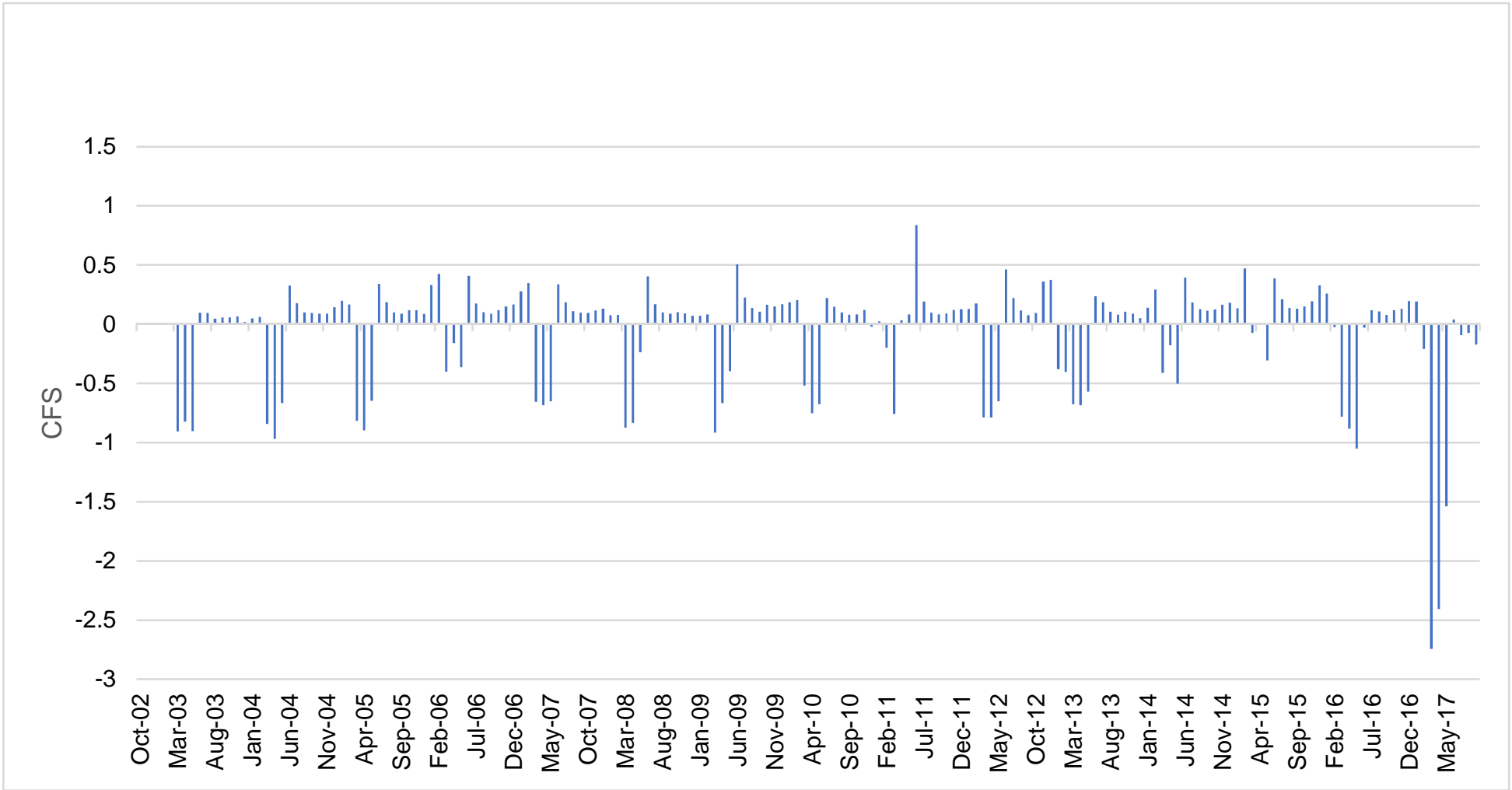
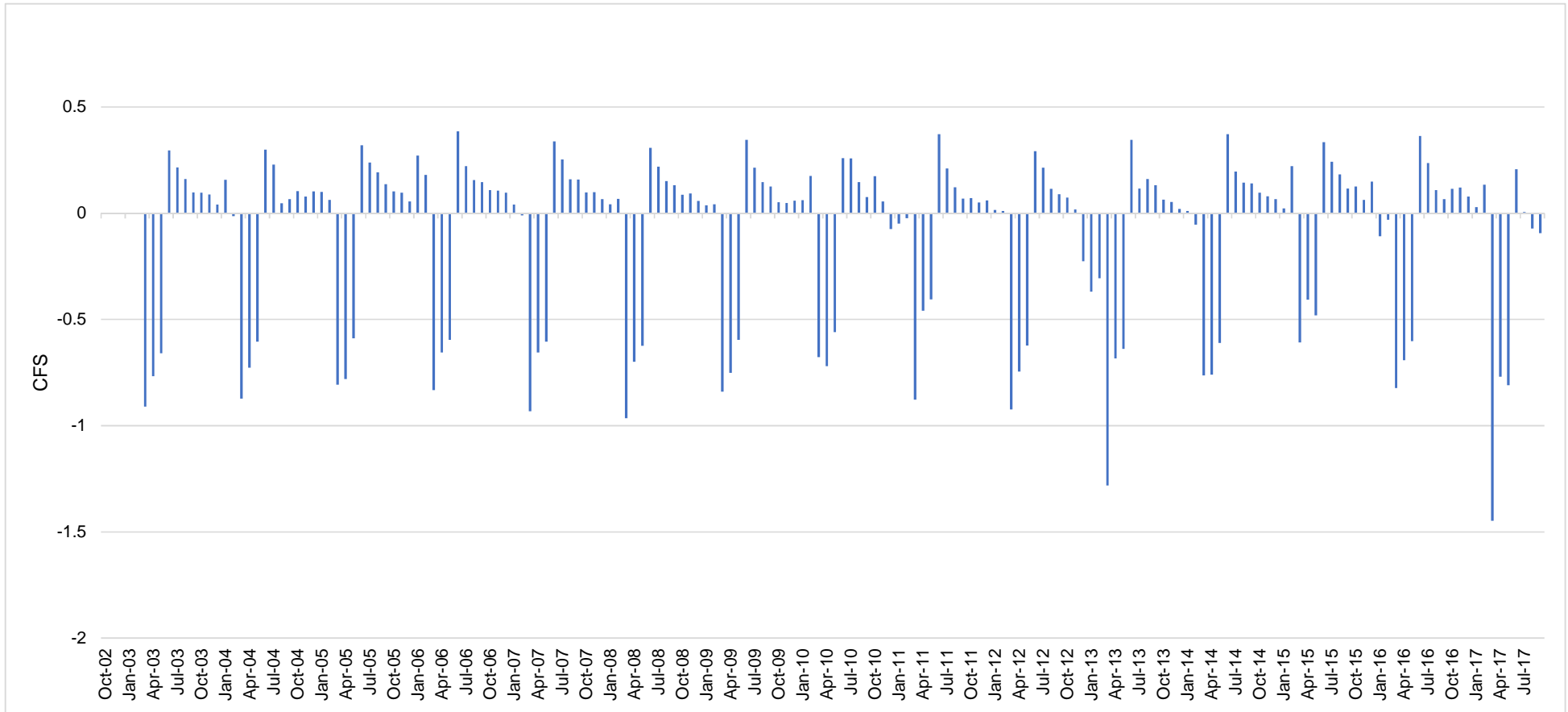
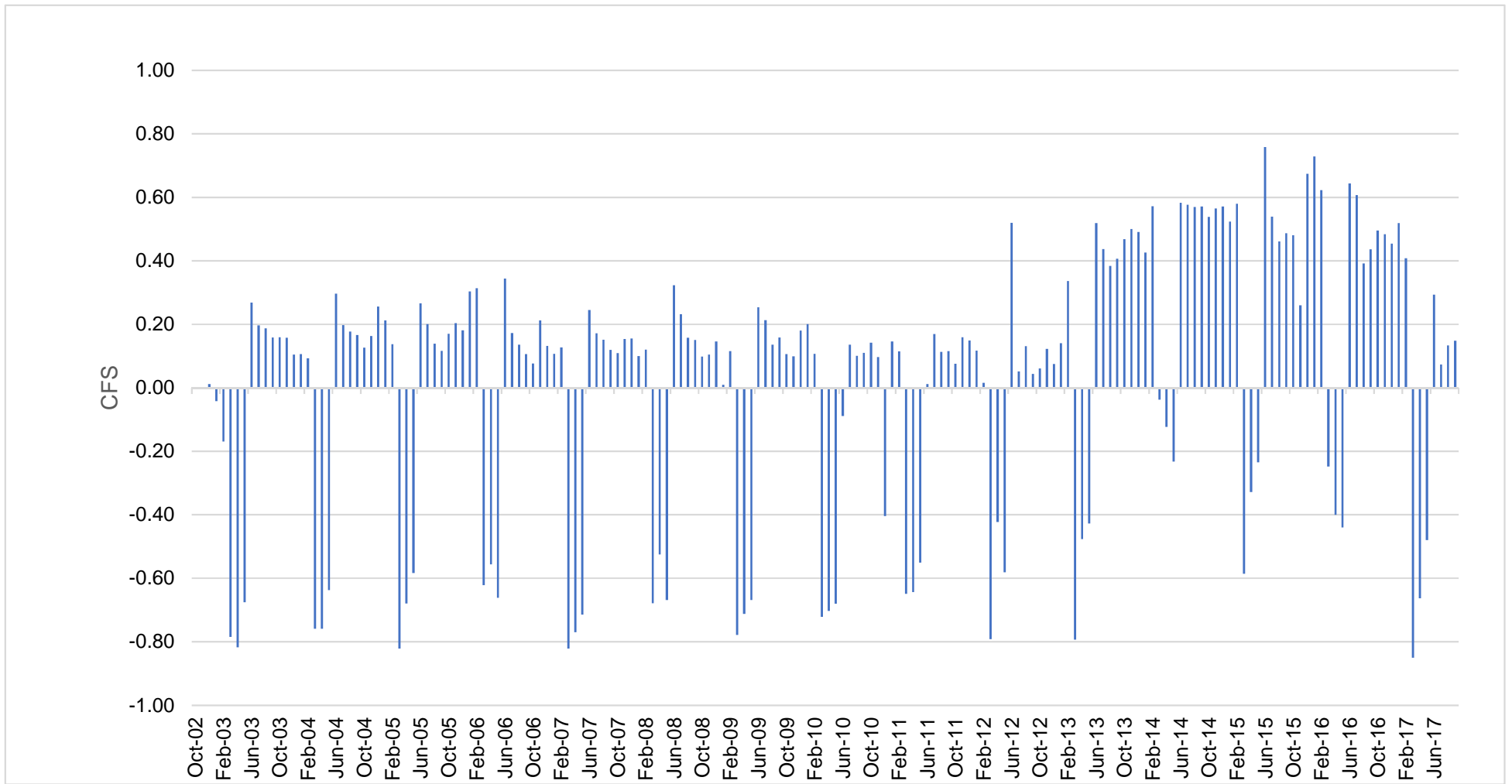


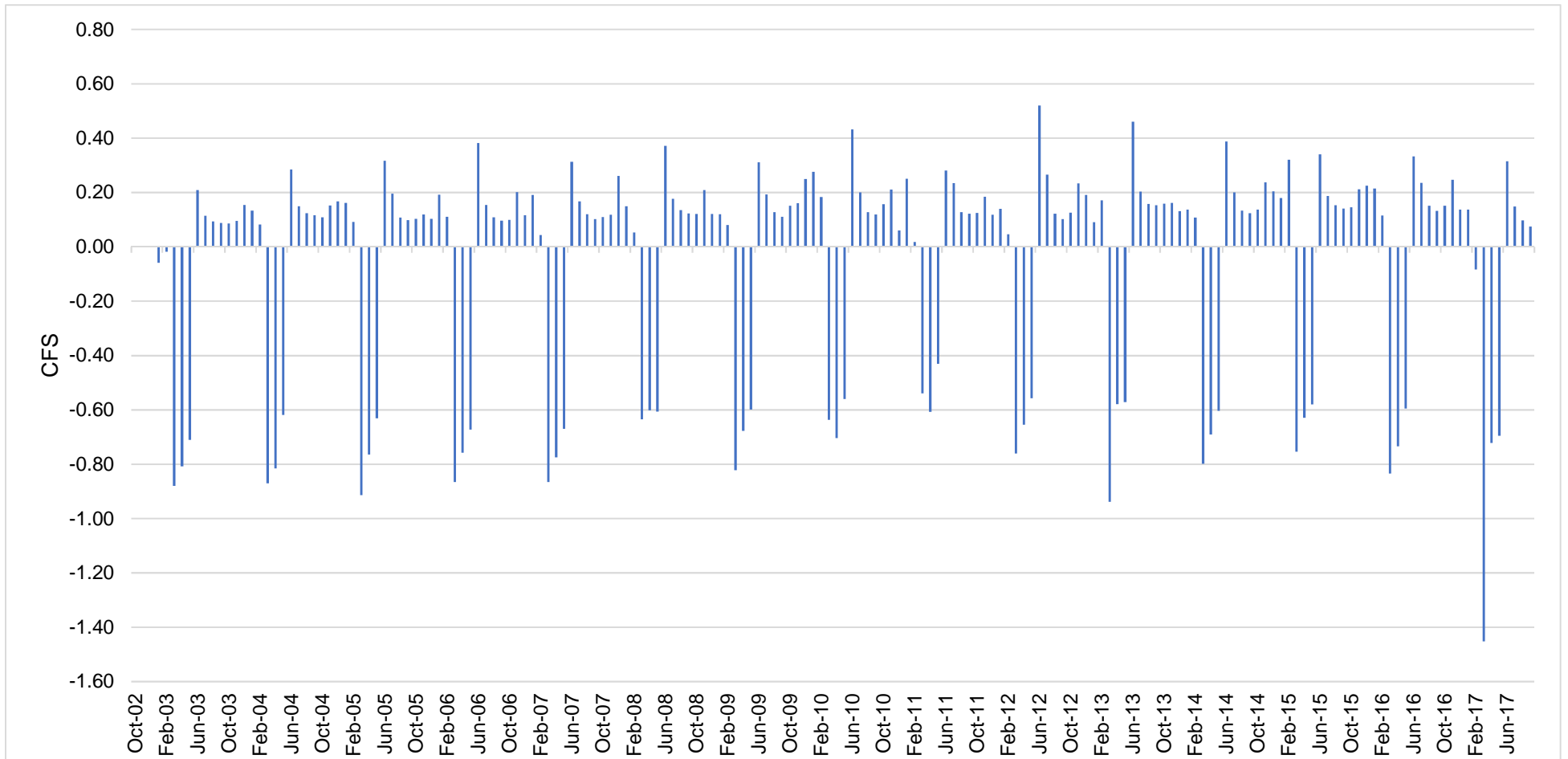
Figure 9
Site #3 Modeled Streamflow Differences
Feryn/Deadman

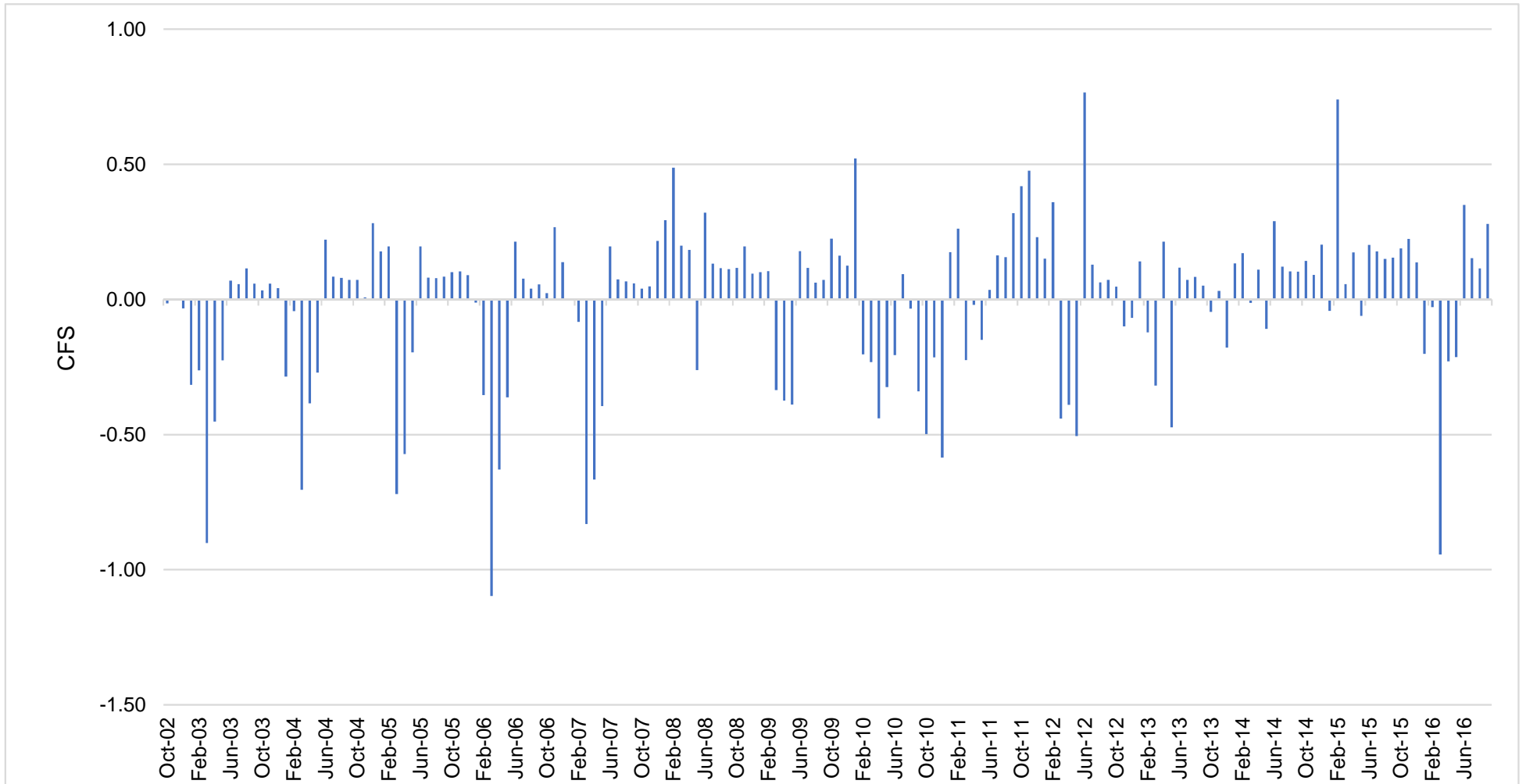


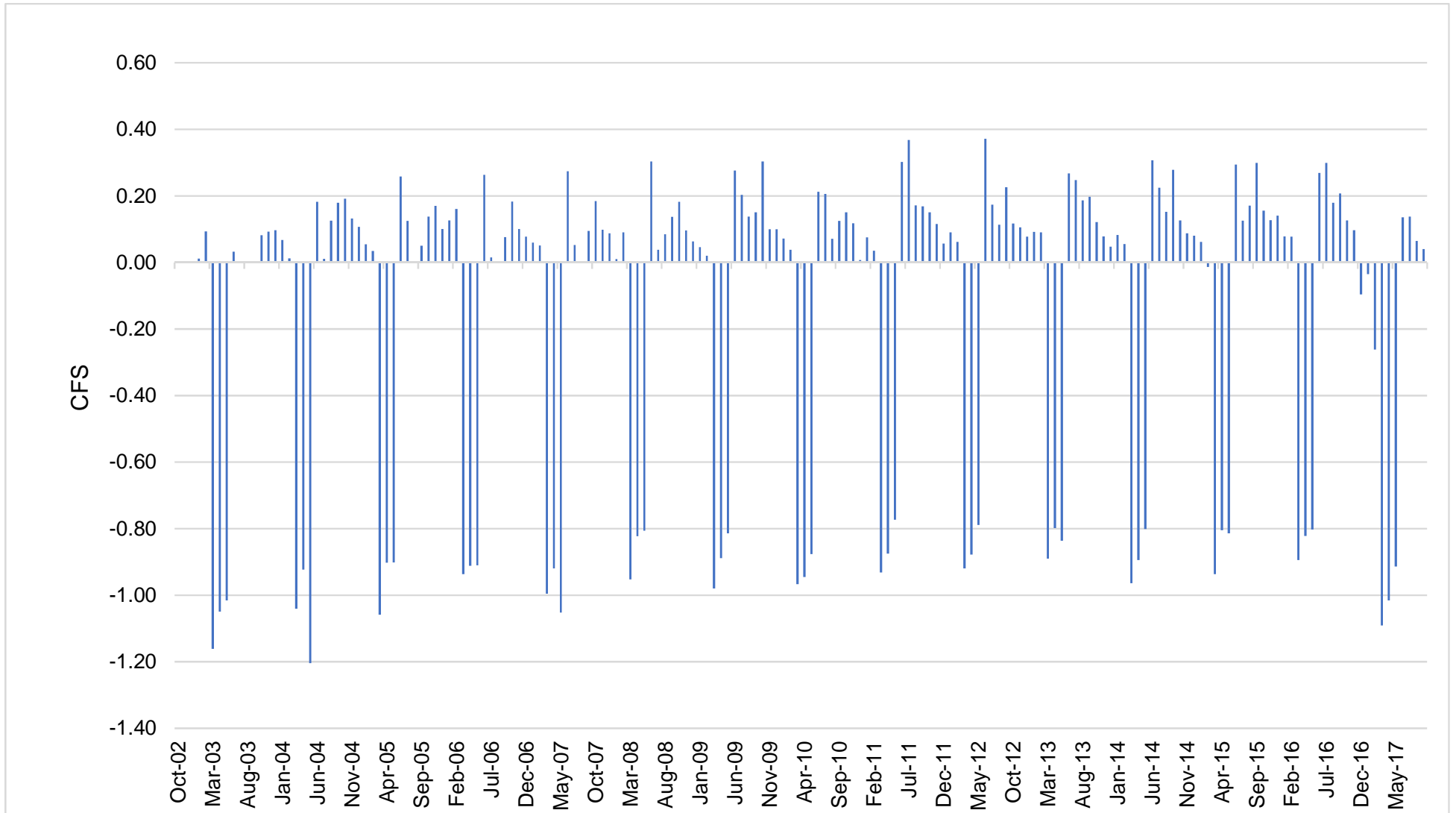












APPENDIX F

MAR Field Investigation (Aspect, June 2020)

MEMORANDUM

Project No. 180249

June 19, 2020

To: Mike Hermanson, Spokane County Environmental Services

From:



Jason Shira, LHG
Project Hydrogeologist
jshira@aspectconsulting.com



Carl Einberger, LHG, CWRE
Associate Hydrogeologist
ceinberger@aspectconsulting.com

**Re: Managed Aquifer Recharge Field Investigation
WRIA 55 ESSB 6091/RCW 90.94 Watershed Plan Update**

The passage of Engrossed Substitute Senate Bill (ESSB) 6091, as codified by RCW 90.94, requires that an update to the existing Watershed Plan for Water Resource Inventory Area (WRIA) 55, the Little Spokane Watershed, be approved by the Washington Department of Ecology (Ecology) by February 1, 2021. Spokane County Environmental Services is serving as the lead agency for this process. The WRIA 55 Initiating Governments for the watershed planning process are Spokane County, Stevens County, Pend Oreille County, the City of Spokane, and Whitworth Water District. The process is supported by convening the WRIA 55 Planning Unit to review technical tasks and memorandums, policy decisions, and the pending watershed plan update. Aspect Consulting, LLC (Aspect) has been contracted by Spokane County to facilitate planning unit meetings, conduct supporting technical tasks, and prepare the Watershed Plan update.

As part of technical tasks associated with the WRIA 55 Watershed Plan update, Aspect assisted with development of water offset projects, including managed aquifer recharge (MAR) projects. A MAR site optimization and selection process was previously conducted in WRIA 55 by Aspect and EarthFX (a consulting group specializing in groundwater modeling). Details of the screening and selection analysis were documented in a December 2019 memorandum (Aspect, 2019a) that was distributed to the WRIA 55 Planning Unit. Based on the screening criteria discussed in that memorandum, 18 sites were targeted for further evaluation, with three sites ultimately selected for the field investigations summarized in this memorandum. All three sites are owned by Spokane County.

The two primary sites were Milan Road-Bear Creek (Bear Creek) and Feryn Conservation Area-Deadman Creek (Deadman Creek), and the alternative site was Dry Creek. This technical memorandum summarizes the findings from field investigations to evaluate site conditions (infiltration rates, water quality, and aquifer transmissivity) to inform preliminary design and permitting for potential construction of MAR facilities at select sites.

Summary of Findings

Field investigations occurred over three weeks between October and December 2019. The following observations and conclusions were made during the field investigation:

- Infiltration rates of the receptor unit(s) at:
 - The Deadman Creek site are too low (0.01 inches per hour [in/hr]) to feasibly implement surface infiltration; therefore, the alternative Dry Creek site was evaluated.
 - Dry Creek and the Bear Creek site have adequate subsurface conditions for surface infiltration.
- Surface water and groundwater quality and aquifer characteristics at Deadman Creek were not evaluated further due to limited feasibility for surface infiltration.
- Dry Creek was evaluated for surface water parameters only due to unsaturated conditions above a confining unit (competent bedrock). No surface water quality criteria were exceeded. The thickness of the overlying unconsolidated sand unit (coarse-grained outburst flood deposit) is 52 feet.
- Bear Creek was evaluated for surface water and groundwater quality. No surface water quality criteria were exceeded; however, groundwater quality criteria were exceeded for total dissolved solids (TDS), chloride, and total iron. Groundwater quality has likely been affected by storage of road salt on the ground without cover at the County gravel pit.
- The depth to the water table aquifer at Bear Creek is 71 feet below ground surface (bgs). The aquifer transmissivity is estimated at 2,300 square feet per day (feet²/day) based on the aquifer testing conducted in this study. The aquifer thickness is approximately 12 feet resulting in a horizontal hydraulic conductivity of 194 feet/day.

The Bear and Dry Creek sites appear suitable for surficial infiltration of diverted surface water based on the raw infiltration rates and depth to water table or confining units. The groundwater quality at the Bear Creek site should see water quality improvement with infiltration of surface water if best management practices (BMPs) are implemented to prevent further infiltration of road salts.

Aspect recommends Spokane County Environmental Services continuously monitor groundwater levels in monitoring well MB1 at the Bear Creek site to better understand seasonal changes to the water table aquifer. In addition, surface water quality monitoring at Bear and Dry Creek during peak runoff is recommended to provide additional characterization of the water source for MAR infiltration. Lastly, additional investigation at the Bear Creek site should occur as part of final design work to determine if diversion of surface water with large capacity wells adjacent to the creek is feasible, as this would simplify permitting by eliminating a surface diversion structure and reduce infrastructure required for settling solids in the source water prior to infiltration.

Project Location

The project is located within Spokane County, Little Spokane River watershed (WRIA 55) as shown on Figure 1. Detail study locations for individual projects are shown on Figures 2, 3, and 4.

Methodology

The objectives of this field investigation are to characterize each selected MAR site in terms of physical attributes (infiltration rates, depth to water table or confining unit, water quality). An adaptive management approach based on the results of infiltration testing was implemented to control costs and move forward with potential MAR implementation sites. The investigation process is described below.

Soils and Geology

Subsurface investigations were conducted at all three project sites. Shallow subsurface conditions were investigated using a small excavator (Caterpillar 304E and Bobcat E50) and deeper excavations (greater than 5 feet below ground surface [bgs]) were obtained using an air rotary drill rig (Speedstar 50K). Shallow subsurface samples were collected from the excavator bucket; whereas, drill cuttings were collected either directly from the rotary swivel (Bear Creek) or from a cyclone (Dry Creek).

Samples were described in the field and bagged for analysis. Per the QAPP (Aspect, 2019b), the soils were analyzed for grain size, cation exchange capacity, percent organic matter, major cations and anions, plus nitrate and phosphorous.

Infiltration

Infiltration rates were measured following the small-scale pilot infiltration (PIT) tests as described in the QAPP (Aspect, 2019b). At each site a test pit was excavated. Due to the coarse-grained nature of the Dry and Bear Creek sites a new, never-used, bottom-less, 55-gallon drum was set into the receptor unit. This allowed for the PIT to occur over a known area and eliminate potential for sidewalls to slough into the excavation. A staff gage and stilling well (equipped with a Van Essen Diver and Baro) instrumented the test pit to allow for manual observations and collection of continuous pressure data.

A 2,000-gallon water truck was used as a water source for the PIT. A 2-inch discharge line was used to convey water from the truck through a 2-inch Seametrics MJ series water meter and into the test pit. Manual reads were made from the water meter during the duration of the PIT.

The continuous pressure and flowrate data were managed in EXCEL to perform the analysis. The barometrically compensated pressure data was reduced to determine water levels in the test pit. These water levels were then associated with an observed flowrate to evaluate the constant head portion of the test and determine when the falling head portion of the test began. Both the constant head and falling head tests were used to determine the infiltration rate. Depending on the quality of the test either the constant or falling head portion of the test was used to calculate a raw infiltration rate.

Pumping Test

A step rate pumping test was performed on the Bear Creek monitoring well (MB1, BKW220) using a contractor supplied submersible test pump and the flowrate was measured using a 5-gallon bucket and a stopwatch. The flowrate during the pumping test was controlled using a ball valve. Pumped water was conveyed downhill away from MB1 and discharged onto the ground.

Groundwater levels during the pumping test were measured using an electronic water level indicator, and continuous pressure measurements were collected using an Instrument Northwest PT2X gaged pressure transducer.

The step rate test consisted of three one-hour long steps followed by a 2-hour last step.

Manually collected flow rate and depth to water measurements were compiled with the continuous pressure measurements from the PT2X in EXCEL. The manual measurements and continuous pressure measurements were evaluated graphically for quality control and assurance.

Recovery measurements were used to calculate aquifer transmissivity using the Theis recovery method for an unconfined aquifer. The Theis method is appropriate for determining transmissivity using the late-time recovery measurements only (Kruseman and deRidder, 2001).

Water Quality

Surface water was collected from Dry and Bear Creek at locations shown on Figure 3 and 4, respectively. Due to the shallow depth, a peristaltic pump was used to collect samples, as shown on Photograph 1 of Attachment 2. Clean low-density polythene (LDPE) tubing and silicone tubing were used at each site. Samples were pumped directly into lab supplied bottles. Filtered samples were filtered through a 0.45-micron (um) filter cartridge. Preservative was added to bottles as necessary prior to placing sample bottles into a cooler. A calibrated YSI Pro Series multi-parameter water meter (YSI) was used to collect field parameters during sample collection.

Groundwater samples were collected from MB1 using a submersible pump (12V stainless steel Hurricane XL) and LDPE tubing. Samples were collected using low-flow sampling techniques. Groundwater was pumped through a flow-cell connected to the calibrated YSI and field parameters were measured every 5 minutes until the parameters stabilized. Pumped water was discharged onto the ground. Samples were collected and stored in the same manner as the surface water samples for transport to the respective laboratories for analysis.

All samples were received at the respective laboratory within holding times and in good condition.

QAPP Deviations

The Quality Assurance Project Plan (QAPP) planned for 6-hour pre-wetting phase during the pilot infiltration tests (PIT). A shorter pre-wetting phase was conducted to control costs for mobilizing multiple water trucks and labor. Therefore, each PIT was limited to a single water truck capacity of 2,000 gallons. This deviation is not expected to affect the quality of the results. Pre-wetting of the soil profile is conducted to demonstrate if infiltration rates are limited by strata underlying the receptor unit. The Deadman Creek site has very low infiltration rates, therefore wetting exceeded the 6-hour timeframe due to ponding. The Bear Creek and Dry Creek sites were over-excavated, which demonstrated the underlying strata are consistent with the receptor unit. In addition, further subsurface investigation via drilling with air rotary indicated that a boundary condition due to poorly transmissive material was unlikely to occur that would limit infiltration into the shallow subsurface.

Deadman Creek

The Deadman Creek site subsurface consists of a thick (greater than 200 feet) glaciolacustrine deposit underlain by a thin sandy water bearing unit that is underlain by granitic bedrock. The upper glaciolacustrine deposit is characterized as fine-grained glacial deposit (Kahle et. al., 2013) in the project area and turns to a coarse-grained glacial deposit downstream of the project site.

Domestic water use in the area targets the thin sandy water bearing unit underlying the fine-grained glacial deposit. Static water levels in this water bearing unit vary from 60 to 140 feet bgs depending on location. The aquifer is in a confined to semi-confined condition with recharge occurring along the glacial deposit and bedrock contact and higher elevations to the east of the Peone Prairie, and groundwater discharge toward the west and the Little Spokane River.

Soils

A 7 x 9-foot test pit was excavated to a total depth of 13 feet bgs. The surficial soils (1 to 10 feet bgs) are a very soft, brown, silt (ML) that transitions to a stiff, platy, clay (CH) with some calcium precipitate between peds. A soils log (FD-S) is presented in Attachment 1 and a photograph of the soil profile is included on Photograph 2 of Attachment 2.

Analytical results from soils analysis of major cations and anions plus nitrate and phosphorous are presented in Table 1.

Infiltration

As shown on Figure 5, an average of 22 gallons per minute (gpm) was introduced into the test pit over a 4-minute period rapidly raising the water level in the test pit to 28 inches. The flow rate was then reduced to 8 gpm for the next 45 minutes raising the water level to 33 inches. The flow rate was further reduced to 4.5 gpm for 15 minutes, then further reduced to 1.75 gpm to obtain a constant head of 3 feet in the test pit. A near constant head was maintained for 30 minutes at 1.75 gpm; however, incremental increase in head (0.5 inches) was observed.

Following the constant head portion of the test the water was shut-off and the falling head portion of the test was measured over a 12-hour period using pressure transducers, as shown on Figure 6.

Reduction of the constant head and falling head data result in a raw infiltration of 3 and 0.25 in/hr, respectively. The raw infiltration rate of 0.25 in/hr from the falling head portion of the test likely better represents the long-term infiltration rate and the high water-entry-pressure necessary to infiltrate water into the tight material.

Dry Creek

The Dry Creek subsurface consists of a 50 to 150 feet thick layer of coarse-grained glacial deposits that overlay a weathered granitic bedrock. Domestic water use in the area targets fracture zones within the granitic bedrock at depths of 200 to 550 feet bgs. Static water levels range from 100 to 180 feet bgs. Recharge is expected to occur on the higher surrounding elevations creating a semi-confined to confined groundwater condition in the fractured water bearing zones. Discharge likely occurs down valley toward the west and ultimately to the Little Spokane River. Interflow at the site is expected to mimic the local topography.

Soils and Geology

A 5 x 5-foot test pit was excavated to a total depth of 4 feet bgs. The soils are a medium dense, gray brown sand (SW) with crossbedding across the entire excavated depth. A profile of the excavation is shown in Photograph 3 of Attachment 2.

A nominal 8-inch drill bit and casing were driven to 57 feet bgs. The subsurface was consistent with the well sorted sand deposit observed in the test pit to a depth of 45 feet where some gravel was encountered. This is interpreted as a weathered granite (gruss) zone from 45 to 52 feet bgs. At 52 feet bgs a hard, granitic, basement rock was encountered.

A soil log (ND-S) and borehole log (ND1) with schematic of monitoring well are shown in Attachment 1. No water was encountered while drilling; however, a monitoring well was installed with a completion above the granitic basement rock for future monitoring of infiltrated water. The monitoring well construction consists of a screen interval between 42 to 52 feet bgs, immediately above the competent bedrock. A bentonite seal was installed from ground surface to 38 feet bgs and a filter pack of 10/20 silica sand was installed from 38 to 57 feet bgs.

Analytical results from soils analysis of major cations and anions plus nitrate and phosphorous are presented in Table 1. A copy of the laboratory data deliverables is provided in Attachment 3.

Infiltration

As shown on Figure 7, an average of 20 gpm was introduced into the 400 square inch infiltration ring. Minor adjustments to the flowrate resulted in 3 small (approximately 1 to 1.5 inch each) increases in head over the 2.7-hour PIT.

Following the infiltration of 2,000 gallons of water into the infiltration ring, the falling head portion of the test was measured over a 3-minute period until the infiltration ring drained, as shown on Figure 8.

Reduction of the constant head and falling head data result in a raw infiltration of 700 and 165 in/hr, respectively. The more conservative raw infiltration rate of 165 in/hr was selected as representative of a long-term infiltration rate.

Water Quality

Surface water samples were collected at the location shown on Figure 3. No surface water quality criteria were exceeded. A summary of the detected analytes and field parameters are presented in Tables 2 and 3, respectively. A copy of the laboratory data deliverables is provided in Attachment 3.

Bear Creek

The Bear Creek site consists of a vertically stratified coarse-grained glacial deposit that overlays a granitic bedrock. Groundwater in the area may occur as a multilayer aquifer system. A water table aquifer (unconfined) was encountered at 71 feet bgs in a sandy unit that is comprised of both coarse-grained glacial deposit and weathered granite (gruss). Domestic water use in the area targets fractured or weathered zones of granitic bedrock at a depth of 100 to 200 feet bgs, or the shallower weathered granitic surface at 50 to 70 feet bgs.

Regional recharge of the upper unconfined aquifer in the Bear Creek area likely occurs from the north-northwest with limited local recharge occurring in the lowland area near the Bear Creek site. Discharge of groundwater from the local area is expected to occur toward the south-southwest mimicking the Bear Creek drainage. The Bear Creek drainage appears to follow a glacial outburst channel carved into the underlying granitic bedrock. The flow of groundwater in the unconfined aquifer is expected to follow the buried surface of the granitic bedrock.

Soil and Geology

A 6 x 6-foot test pit was excavated to a depth of 6 feet bgs. The top 2 feet of the subsurface consisted of a brown silty gravel. At 2-feet bgs a cemented layer is encountered, and the gravels are oxidized. Below 3 feet the subsurface is gravel with silt and cobbles becoming more coarse with depth. Boulders were present at total depth. A soil log (MB-S) is presented in Attachment 1 and a photograph of the soil profile is shown on Photograph 4 of Attachment 2.

A nominal 8-inch drill bit and casing were driven to 87 feet bgs. The subsurface was consistent with the observations in the test pit with coarse grained glacial deposits coarser (boulders and gravels) than the Dry Creek site (sand). The upper 9 feet consists predominantly of a gravel with silt, cobbles and boulders. Below the very coarse unit of boulders, the subsurface material fines to a 13-foot gravelly unit underlain by a 4-foot clayey unit (23 to 27 feet bgs). Below the clayey unit the subsurface is predominantly sand. At 47 feet bgs the subsurface material changes to a sandy unit (gruss) derived from weathered granitic bedrock. Groundwater was encountered at 76 feet bgs during drilling. At 83 feet bgs competent granitic bedrock was encountered. The drill bit and casing were advanced to 87 feet bgs, which sealed-off the overlying water bearing unit, so drilling ceased, and a monitoring well was installed with a completion above the granitic basement rock for monitoring of infiltrated water.

The static water level raised to 71 feet bgs after completion of drilling. The borehole log (MB1) and monitoring well construction are presented in Attachment 1. The monitoring well construction consists of a screen interval between 72.5 to 82.5 feet bgs, immediately above the competent bedrock. A bentonite seal was installed from ground surface to 67 feet bgs and a filter pack of 10/20 silica sand was installed from 67 to 87 feet bgs. The monitoring well was developed by pumping until the discharged water ran clear.

Analytical results from soils analysis of major cations and anions plus nitrate and phosphorous are presented in Table 1. A copy of the laboratory data deliverables are provided in Attachment 3.

Infiltration

As shown on Figure 9, an initial flow rate of 30 gpm was introduced in the first 3 minutes into the 400 square inch infiltration ring. An average of 23 gpm was introduced for 1 hour and 22 minutes. Then the flow rate was increased to 50 gpm over the final 25 minutes. The flow rate was insufficient to exceed the time to ponding for the gravel, cobble, boulder subsurface during the PIT, indicating excellent infiltration capacity.

Following the infiltration of 2,000 gallons of water into the infiltration ring, no falling head portion of the test was measured due to the rapid infiltration.

Reduction of the constant head data result in a raw infiltration greater than 770 in/hr.

Water Quality

Surface water samples were collected at the location shown on Figure 4. No surface water quality criteria were exceeded. A summary of the field parameters and detects are presented in Tables 2 and 3, respectively. A copy of the laboratory data deliverables are provided in Attachment 3.

Groundwater samples were collected from the monitoring well (MB1). Groundwater quality results are shown in Table 2. Groundwater quality criteria were exceeded for TDS, chloride, and total iron. It is presumed the source of TDS and chloride is from road salt stockpiled on bare ground without cover. The road salt provided an opportunity to determine if the 4-foot clayey unit behaves as a confining unit impeding recharge of the underlying aquifer with surface infiltration. The detection of apparent road salt elements suggests the clayey unit does not impede recharge from surface infiltration, supporting the suitability of the site for MAR infiltration.

An equipment blank for total and dissolved metals was collected by pumping distilled water through the submersible pump used to collect groundwater samples. Total calcium was detected (0.104 mg/L) in the equipment blank sample. The detect in the equipment blank suggest the groundwater result for total calcium (517 mg/L) may be biased high; however, this represents a small fraction of the concentration compared to the observed groundwater concentration.

Aquifer Characteristics

The extended step rate pumping test hydrograph and associated flow rates are presented on Figure 10. The upward trending drawdown measurements along the first step (1 gpm) indicates some well development may have occurred. Subsequent steps (2.5, 5, and 18 gpm) show the typical downward trend with drawdown over time for each step. At later pumping times, as seen in the final step, the drawdown curve typically approaches an asymptotic horizontal slope until a boundary condition is encountered (recharge or barrier). Neither a recharge nor barrier boundary to groundwater flow is evident in the drawdown curve.

Care was taken in conducting the initial step at lower flow rates due to the uncertainty of well performance and aquifer extent. The first three steps (1, 2.5, and 5 gpm) resulted in minimal drawdown. Therefore, the final step was conducted at the maximum flow rate possible with a submersible pump installed. The final step ran for a total of two hours, then recovery was measured. The recovery portion of the test was used to determine the aquifer transmissivity.

A comparison of the manual and continuously measured drawdown revealed an average difference of 0.03 feet, ranging from 0.00 to 0.07 feet, as shown on Figure 10. This variability is within the expected total field and measurement error.

Figure 11 presents the residual drawdown versus ratio of t/t' , which is the ratio of the time since pumping started (t) and the time since pumping stopped (t'). Late time recovery data was selected for calculating the transmissivity (Kruseman and deRidder, 2001). Transmissivity was calculated using the Cooper-Jacob Straight-line Method (Driscoll, 1986) which states:

$$T = \frac{264Q}{\Delta(s-s')} \text{ where;}$$

$T = \text{transmissivity}$

$Q = \text{pumping rate, and}$

$\Delta(s - s') = \text{water level recovery per log cycle.}$

For a calculated transmissivity of 2,300 square feet per day (ft^2/day), or 17,400 gallons per day per foot (gpd/ft).

The hydraulic conductivity of the water bearing unit was calculated using the relationship that the transmissivity is the product of the effective hydraulic conductivity and the saturated thickness of the aquifer given by:

$$T = Kb \text{ where;}$$

$K = \text{hydraulic conductivity, and}$

$b = \text{aquifer thickness.}$

The total aquifer thickness is 12 feet; therefore, the effective hydraulic conductivity is approximately 7×10^{-2} centimeters per second (cm/s), or 194 feet per day (feet/day). This hydraulic conductivity is consistent with literature values for a well sorted sand (Fetter, 2001) and observed conditions.

The aquifer is unconfined, therefore the storativity (specific yield) is equivalent to the effective porosity of the aquifer, or approximately 0.25.

References

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- Kruseman, G.P. and N.A. de Ridder, 2001, Analysis and Evaluation of Pumping Test Data, Second Edition, International Institute for Land Reclamation and Improvement, The Netherlands.

Limitations

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

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Attachments: Table 1 – Soil Laboratory Results
Table 2 – Surface Water and Groundwater Laboratory Results for Detects
Table 3 – Surface Water and Groundwater Field Parameters
Figure 1 – Field Investigation Locations
Figure 2 – Feryn Conservation Area - Deadman Creek
Figure 3 – Dry Creek
Figure 4 – Milan Road - Bear Creek
Figure 5 – Deadman Creek Constant Head
Figure 6 – Deadman Creek Falling Head
Figure 7 – Dry Creek Constant Head
Figure 8 – Dry Creek Falling Head
Figure 9 – Bear Creek Constant Head
Figure 10 – Bear Creek Pumping Test Hydrograph
Figure 11 – Bear Creek Theis Recovery Analysis
Attachment 1 – Exploration Logs
Attachment 2 – Photograph Log
Attachment 3 – Laboratory Results

TABLES

Table 1. Soil Laboratory Results

Project No. 180249, Spokane County, Washington

Project Site Name			Bear Creek	Dry Creek	
Location			MB-S	ND1-S	ND-S
Date			10/21/2019	12/13/2019	10/23/2019
Sample			MB-S-03	ND1-S-45	ND-S-03
Depth			3 ft	45 ft	3 ft
Analyte	CAS_RN	Unit			
Conventionals					
Cation-exchange capacity (CEC)	CEC	meq/100g	12.1	5.3	7.6
Chloride	16887-00-6	mg/kg	< 2.1 U	< 2.1 U	< 2.0 U
Nitrate as Nitrogen	14797-55-8	mg/kg	< 0.52 U	< 0.52 U	< 0.51 U
Phosphorus	7723-14-0	mg/kg	298 J	480	420
Organic Matter	OMC	%	1.96	1.6	0.86
Sulfate	14808-79-8	mg/kg	6	< 3.1 U	< 3.1 U
Total Solids	TS	%	96	96.9	97.9
Metals					
Calcium	7440-70-2	mg/kg	1810 J	2640	1980
Magnesium	7439-95-4	mg/kg	3550	4240	4190
Potassium	7440-09-7	mg/kg	1480 J	3050	2520
Sodium	7440-23-5	mg/kg	< 52.1 U	100	65.8

Bold - detected

U - Analyte not detected at or above Reporting Limit (RL) shown

J - Result value estimated

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V:\180249 WRIA 55 Watershed Plan Update\Deliverables\MAR Field Report\Final\Tables\Table 1 - Soil Results with CEC_jms

Table 1

MAR Field Investigation

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Table 2. Surface Water and Groundwater Laboratory Results for Detects

Project No. 180249 , Spokane County, Washington

				Project Site Name		Bear Creek		Dry Creek	
				Location		MB1-GW	MB-SW	ND-SW	
				Date		12/18/2019	12/18/2019	12/18/2019	
				Sample		MB1-GW-191218	MB-SW-191218	ND-SW-191218	
				Surface Water					
				WAC 173-201A-200 & 240					
				Groundwater					
				WAC 173-200-040					
Analyte	CAS_RN	Fraction	Unit	Acute	Chronic				
Bacteria									
E.Coli	68583-22-2	N	MPN/100mL				< 1.8 U	2	79
Total Coliform	ColiTot	N	MPN/100mL			1	< 1.8 U	350	170
Conventionals									
Alkalinity, Total	ALKT	T	mg/L as CaCO3				78.4	149	42.6
Chloride	16887-00-6	T	mg/L			250	2140	3.91	3.34
Nitrate as Nitrogen	14797-55-8	T	mg/L			10	1.69	1.47	0.102
Nitrate-Nitrite	NO3NO2N	T	mg/L				1.69	1.48	0.102
Nitrogen	7727-37-9	T	mg/L				1.69	1.48	< 0.600 U
Orthophosphate	14265-44-2	T	mg/L				0.016	0.016	0.039
Phosphorus	7723-14-0	T	mg/L				0.018	< 0.010 U	0.046
Sulfate	14808-79-8	T	mg/L			250	23.7	6.46	4.6
Total Dissolved Solids	TDS	T	mg/L	10000	10000	500	3900	172	125
Total Suspended Solids	TSS	T	mg/L				11	< 5.0 U	< 5.0 U
Destination									
Hardness (destination)	Hard_MixZone	N	mg/L				1940	147	33.7
Field Parameters									
Temperature	Temp	N	deg C				11.4	1	1.6
Specific Conductance	Cond	N	uS/cm			700	5866	289.8	96.2
Dissolved Oxygen	DO	N	mg/L				9.87	10.64	12.54
pH	pH	N	pH units		6.5-8.5	6.5-8.5	7.65	7.85	7.84
Oxidation Reduction Potential	ORP	N	mV				140.4	234.7	206.1
Turbidity	Turb	N	NTU				10	--	--
Metals									
Calcium	7440-70-2	T	mg/L				517	44.7	9.84
Chromium	7440-47-3	T	mg/L	ND = 0.225; MB = 0.752	ND = 0.073; MB = 0.244	0.05	0.0068	< 0.0060 U	< 0.0060 U
Iron	7439-89-6	D	mg/L				< 0.100 U	< 0.100 U	0.164
Iron	7439-89-6	T	mg/L			0.3	0.936	< 0.100 U	0.464
Magnesium	7439-95-4	T	mg/L				157	8.71	2.23
Potassium	7440-09-7	T	mg/L				10	2.29	1.48
Sodium	7440-23-5	T	mg/L				504	4.85	7.64
Zinc	7440-66-6	D	mg/L	ND = 0.045; MB = 0.159	ND = 0.042; MB = 0.145		0.04	< 0.010 U	< 0.010 U
Zinc	7440-66-6	T	mg/L			5	0.054	< 0.010 U	< 0.010 U

Bold - detected

Blue Shaded - Detected result exceeded Acute Aquatic Life level (if WS) or WAC-173-200 (if WG)

Red Text - Detected result exceeded Chronic Aquatic Life Level

U - Analyte not detected at or above Reporting Limit (RL) shown

D - Dissolved Fraction (filtered) sample result

T - Total Fraction (unfiltered) sample result

N - Fraction Not Applicable

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V:\180249 WRIA 55 Watershed Plan Update\Deliverables\MAR Field Report\Final\Tables\Table 2 - Water Detections with screening levels_jms

Table 2

MAR Field Investigation

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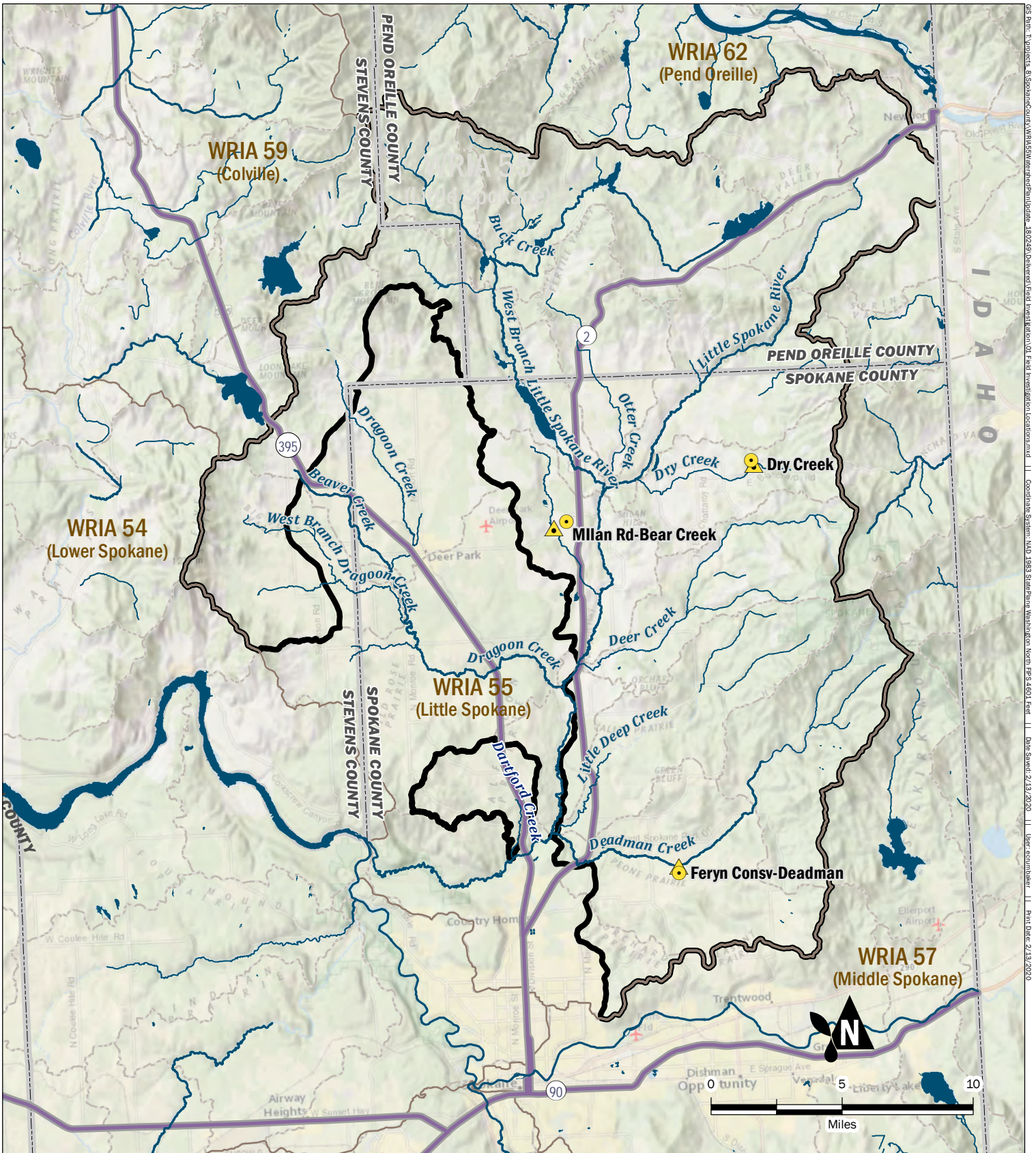
Table 3. Surface Water and Groundwater Field Parameters




Project No. 180249 , Spokane County, Washington

Project Site Name				Bear Creek		Dry Creek
Location				MB1-GW	MB-SW	ND-SW
Date				12/18/2019	12/18/2019	12/18/2019
Sample				MB1-GW-191218	MB-SW-191218	ND-SW-191218
Analyte	CAS_RN	Fraction	Unit			
Field Parameters						
Temperature	Temp	N	deg C	11.4	1	1.6
Specific Conductance	Cond	N	uS/cm	5866	289.8	96.2
Dissolved Oxygen	DO	N	mg/L	9.87	10.64	12.54
pH	pH	N	pH units	7.65	7.85	7.84
Oxidation Reduction Potential	ORP	N	mV	140.4	234.7	206.1
Turbidity	Turb	N	NTU	10	--	--

Bold - detected


FIGURES



-  Study Area
-  Potential Diversion Site Location
-  Potential Infiltration Site Location

Field Investigation Locations

Managed Aquifer Recharge Field Investigation
 WRIA 55 ESSB 6091/RCW 90.94 Watershed Plan Update
 Spokane County, Washington

	FEB-2020	BY: JS / EAC	FIGURE NO. 1
	PROJECT NO. 180249-06	REVISED BY: ---	







GIS Path: T:\projects_8\SpokaneCounty\WRIA55\WaterPlan\update_180249_Delivered_Field_Investigation\021\spn_Conservation_Area_Deadman_Creek.mxd | Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet | Data Served: 2/19/2020 | User: esrcumbler | Print Date: 2/13/2020

Pilot Infiltration Test

Feryn Conservation Area
Deadman Creek
 Managed Aquifer Recharge Field Investigation
 WRIA 55 ESSB 6091/RCW 90.94 Watershed Plan Update
 Spokane County, Washington


FEB-2020 <small>PROJECT NO. 180249-06</small>	<small>BY:</small> JS / EAC <small>REVISED BY:</small> ---	<small>FIGURE NO.</small> 2
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-  Monitoring Well
-  Pilot Infiltration Test
-  Surface Water Gaging/Sampling Location
-  Potential Diversion Site Location

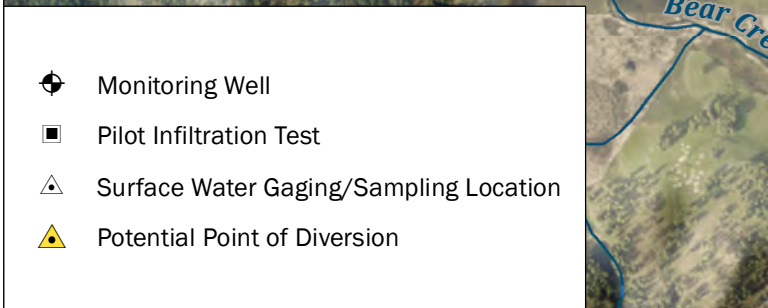
Dry Creek

Managed Aquifer Recharge Field Investigation
 WRIA 55 ESSB 6091/RCW 90.94 Watershed Plan Update
 Spokane County, Washington

	FEB-2020	BY: JS / EAC	FIGURE NO. 3
	PROJECT NO. 180249-06	REVISED BY: ---	



GIS Path: \\projects\8_SpokaneCounty\WR15\WaterPlan\update_180249_Delivered_Field_Inv\Station\04_Milan_Rd_Bear_Creek.mxd | Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet | Date Stamp: 2/13/2020 | User: ericmshaw | Print Date: 2/13/2020



Milan Road - Bear Creek

Managed Aquifer Recharge Field Investigation
 WRIA 55 ESSB 6091/RCW 90.94 Watershed Plan Update
 Spokane County, Washington

FEB-2020 <small>PROJECT NO. 180249-06</small>	<small>BY:</small> JS / EAC <small>REVISED BY:</small> ---	<small>FIGURE NO.</small> 4
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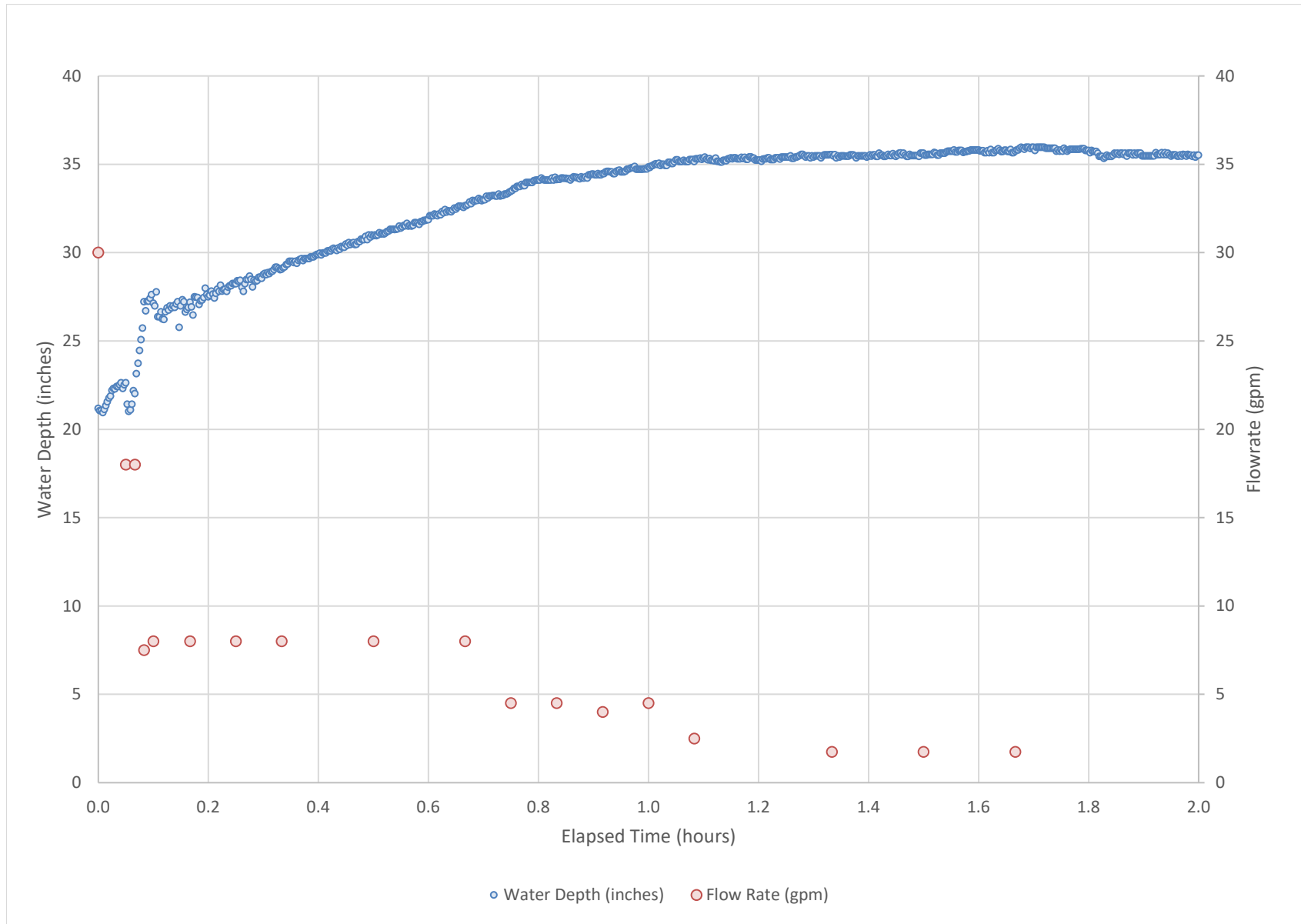


Figure 5

Aspect Consulting

6/19/2020

V:\180249 WRIA 55 Watershed Plan Update\Deliverables\MAR Field Report\Final\Figures\05 - 11 Figures_jms

Deadman Creek Constant Head

Managed Aquifer Recharge Field Investigation
 WRIA 55 ESSB 6091/RCW 90.94 Watershed Plan Update

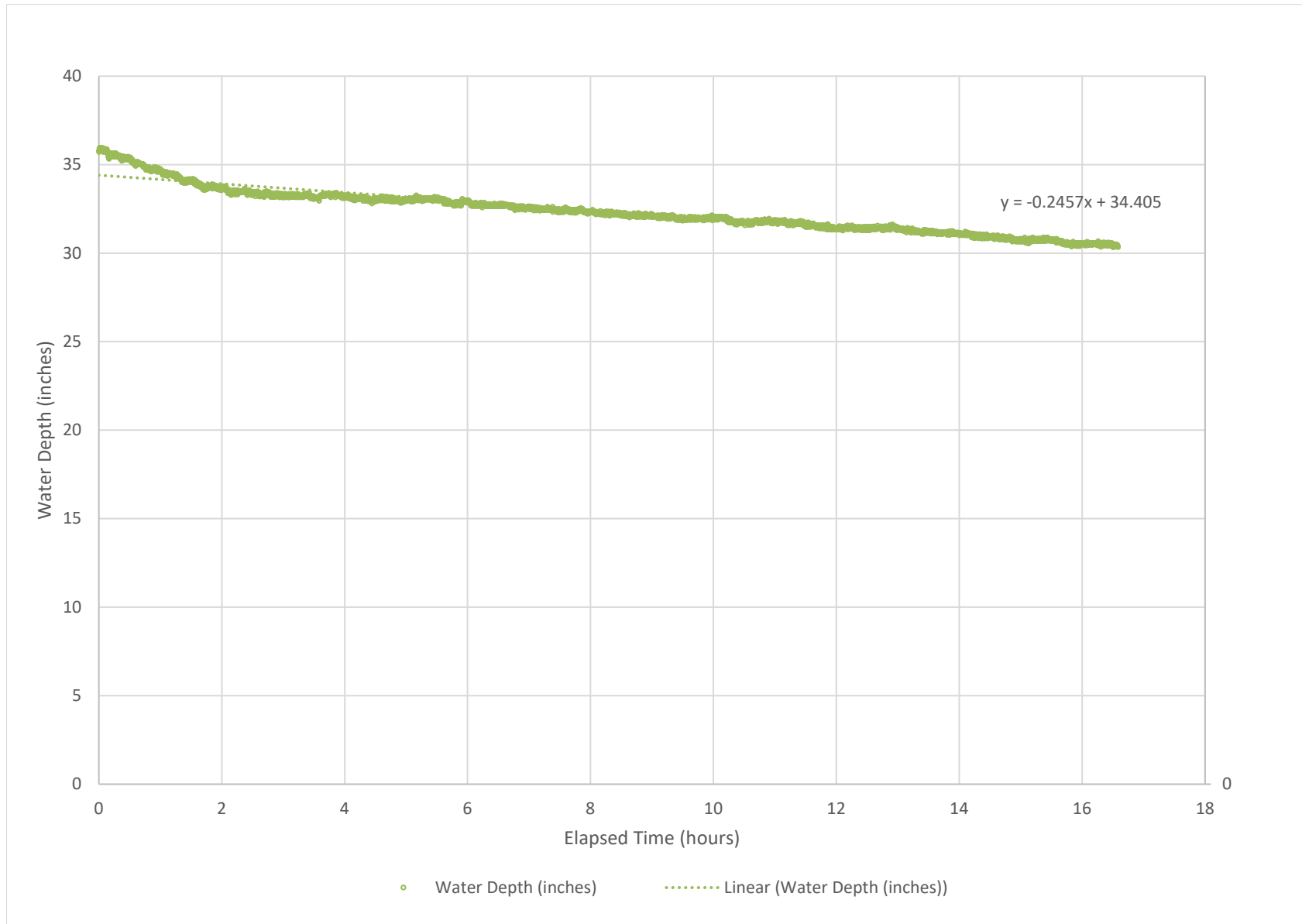


Figure 6

Deadman Creek Falling Head

Managed Aquifer Recharge Field Investigation
 WRIA 55 ESSB 6091/RCW 90.94 Watershed Plan Update

Aspect Consulting

6/19/2020

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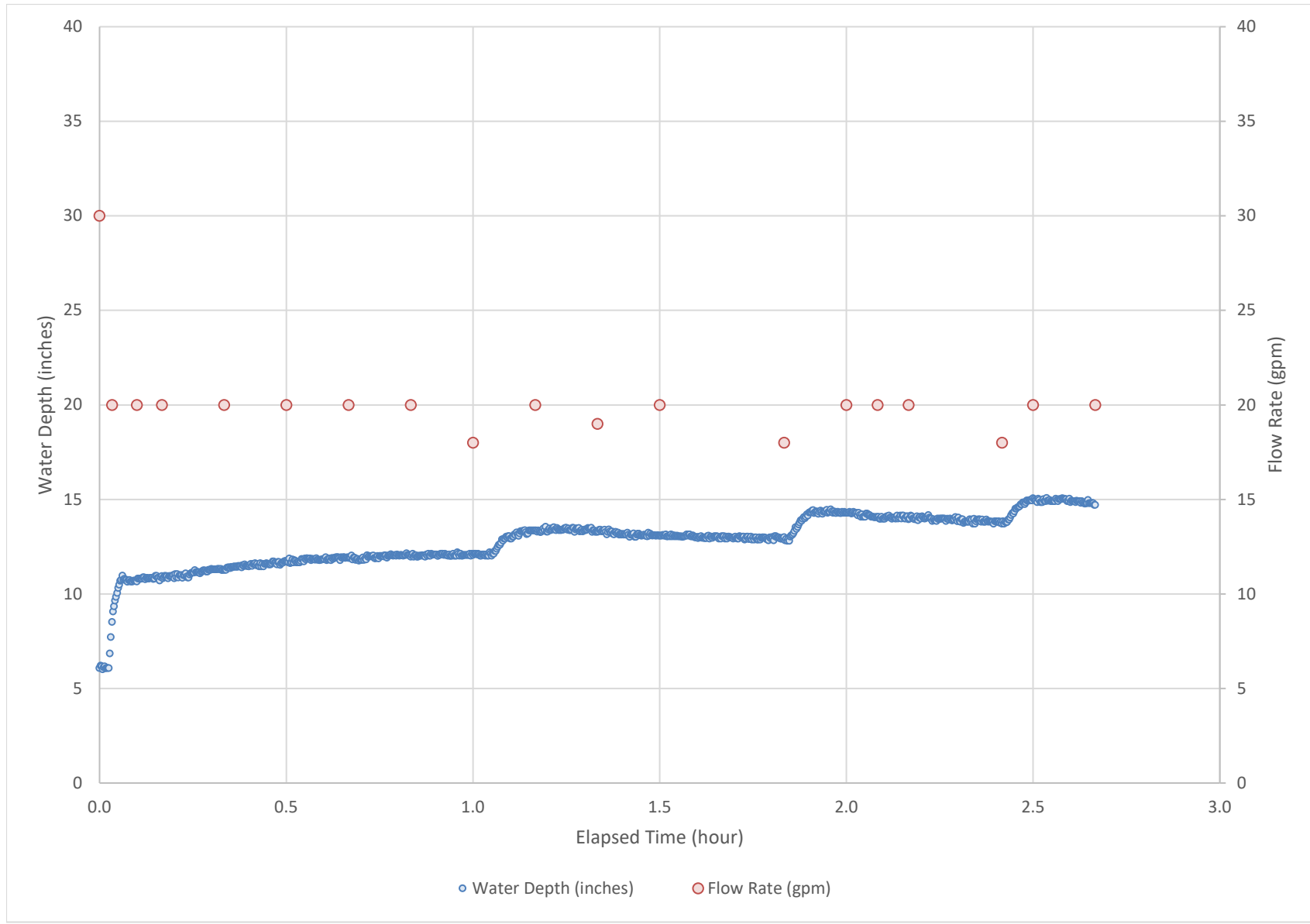


Figure 7

Aspect Consulting

6/19/2020

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Dry Creek Constant Head

Managed Aquifer Recharge Field Investigation
 WRIA 55 ESSB 6091/RCW 90.94 Watershed Plan Update

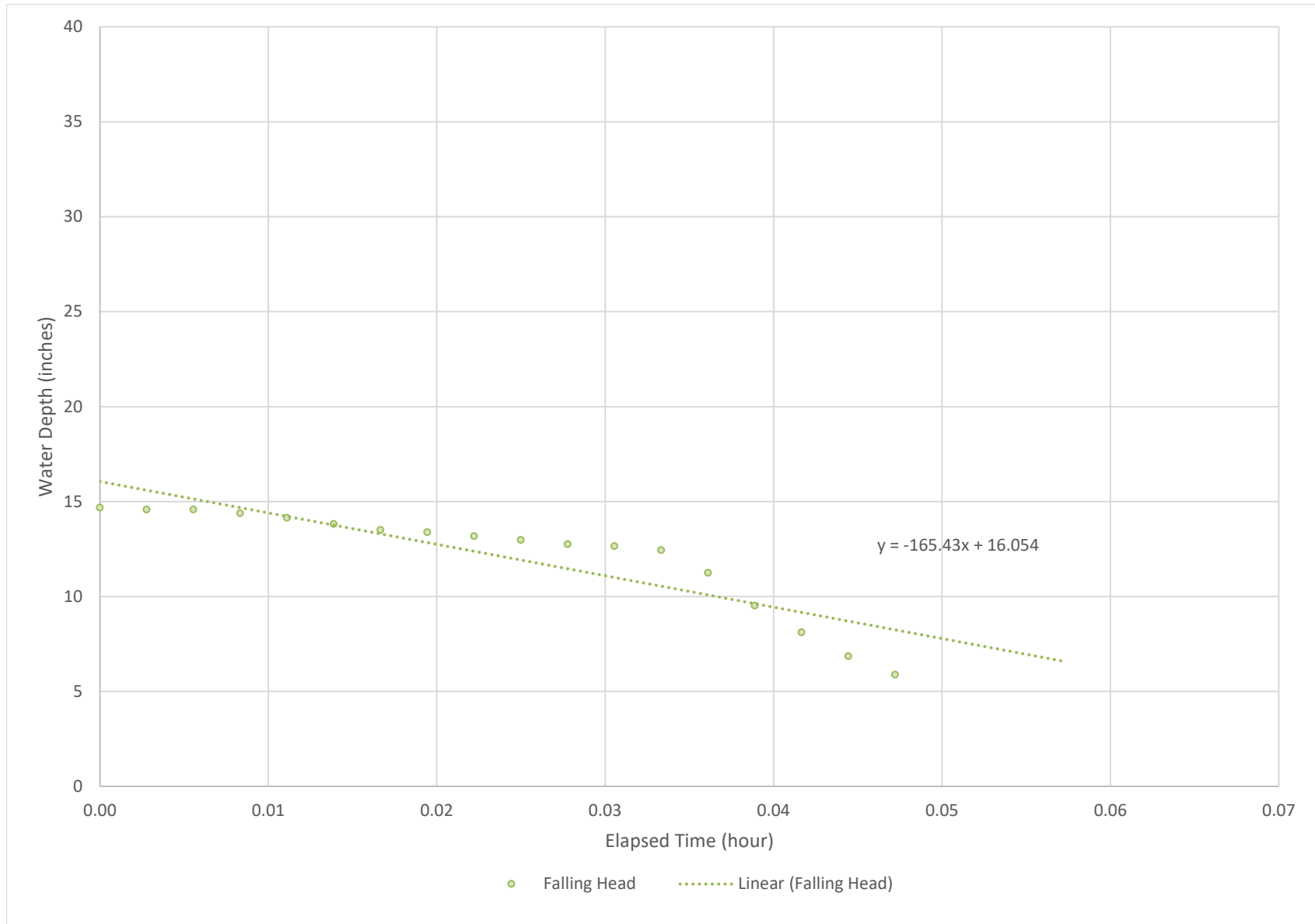


Figure 8

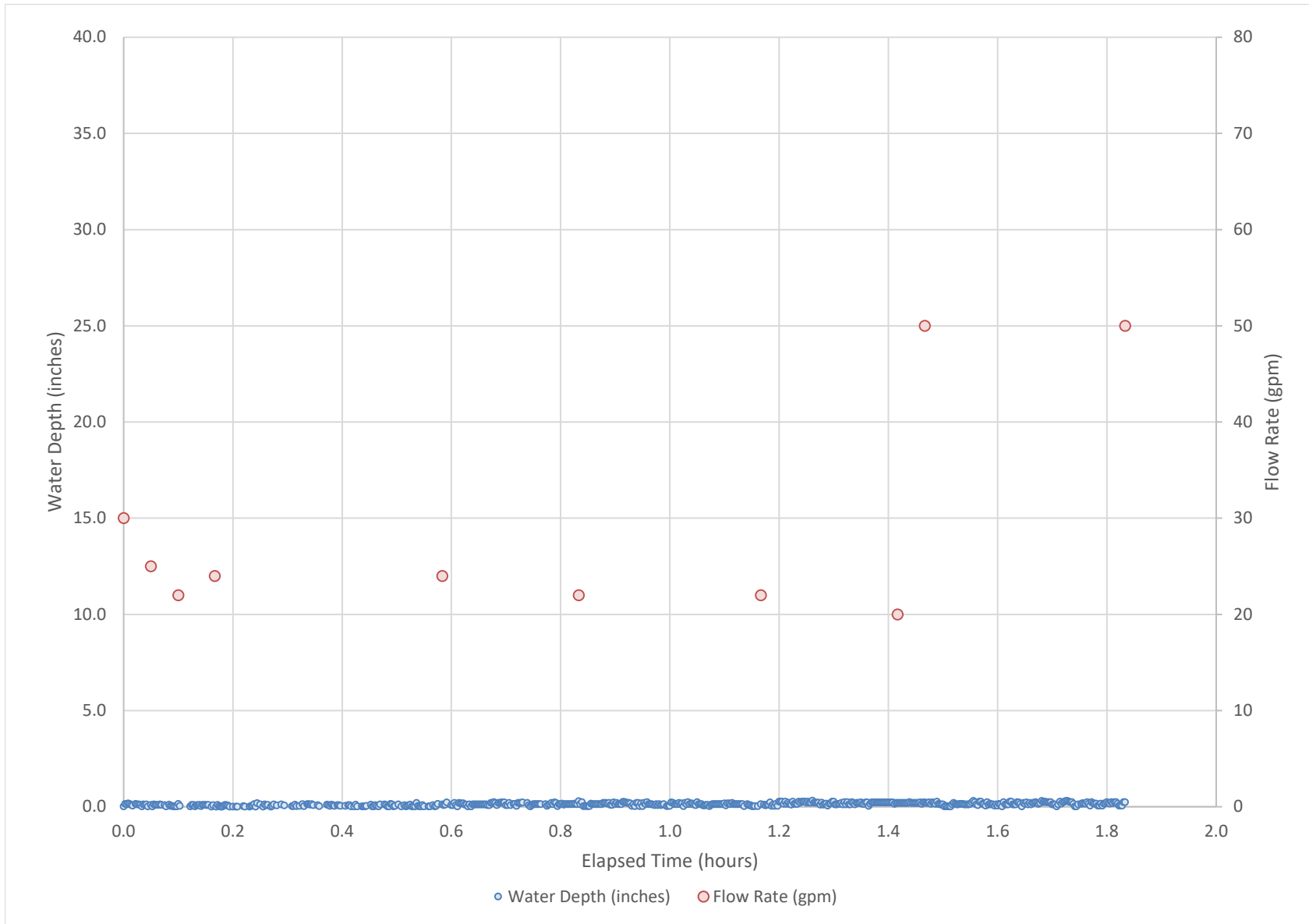


Figure 9

Aspect Consulting

6/19/2020

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Bear Creek Constant Head

Managed Aquifer Recharge Field Investigation
 WRIA 55 ESSB 6091/RCW 90.94 Watershed Plan Update

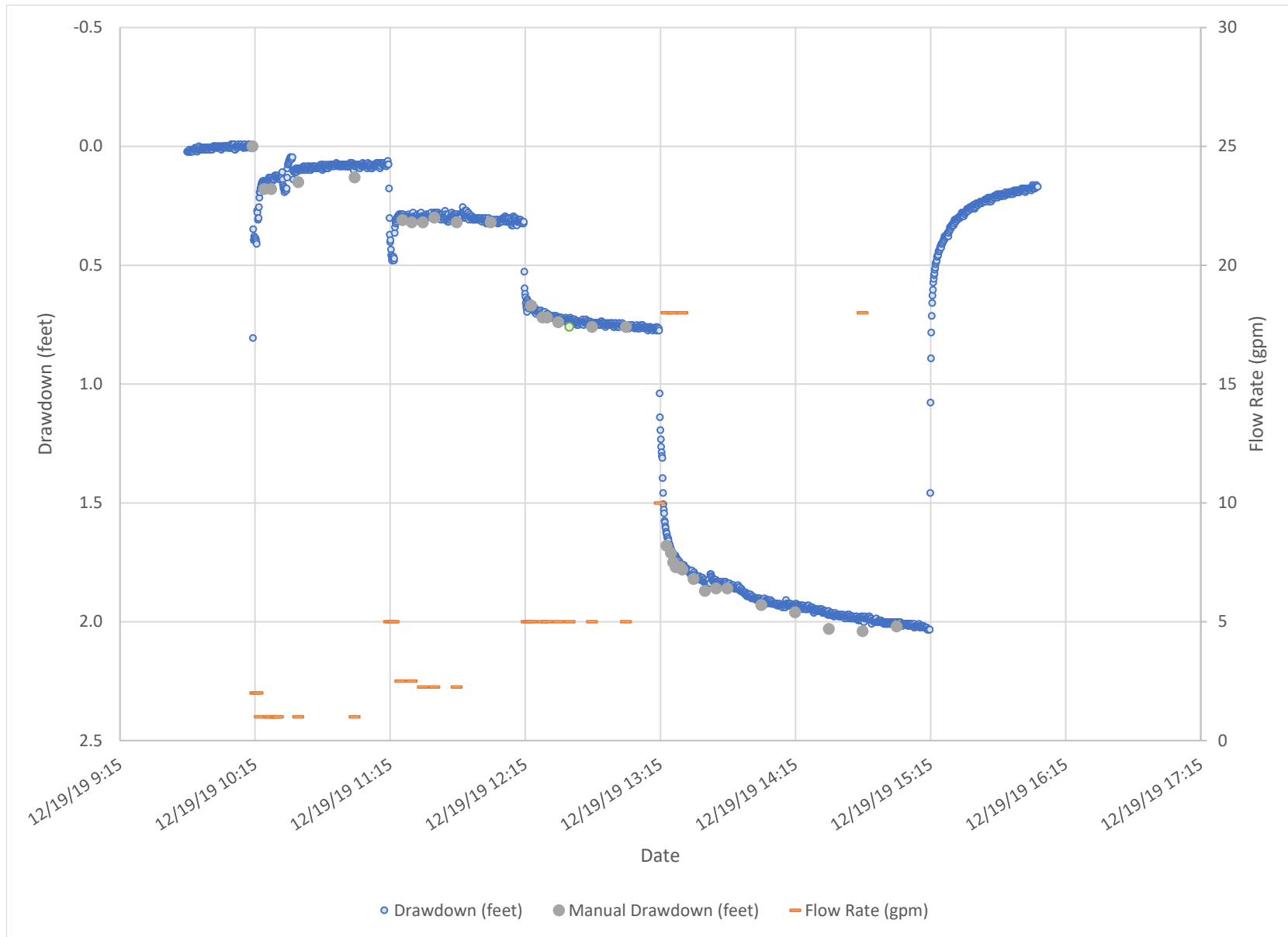


Figure 10

Aspect Consulting

6/19/2020

V:\180249 WRIA 55 Watershed Plan Update\Deliverables\MAR Field Report\Final\Figures\05 - 11 Figures_jms

Bear Creek Pumping Test Hydrograph

Managed Aquifer Recharge Field Investigation
 WRIA 55 ESSB 6091/RCW 90.94 Watershed Plan Update

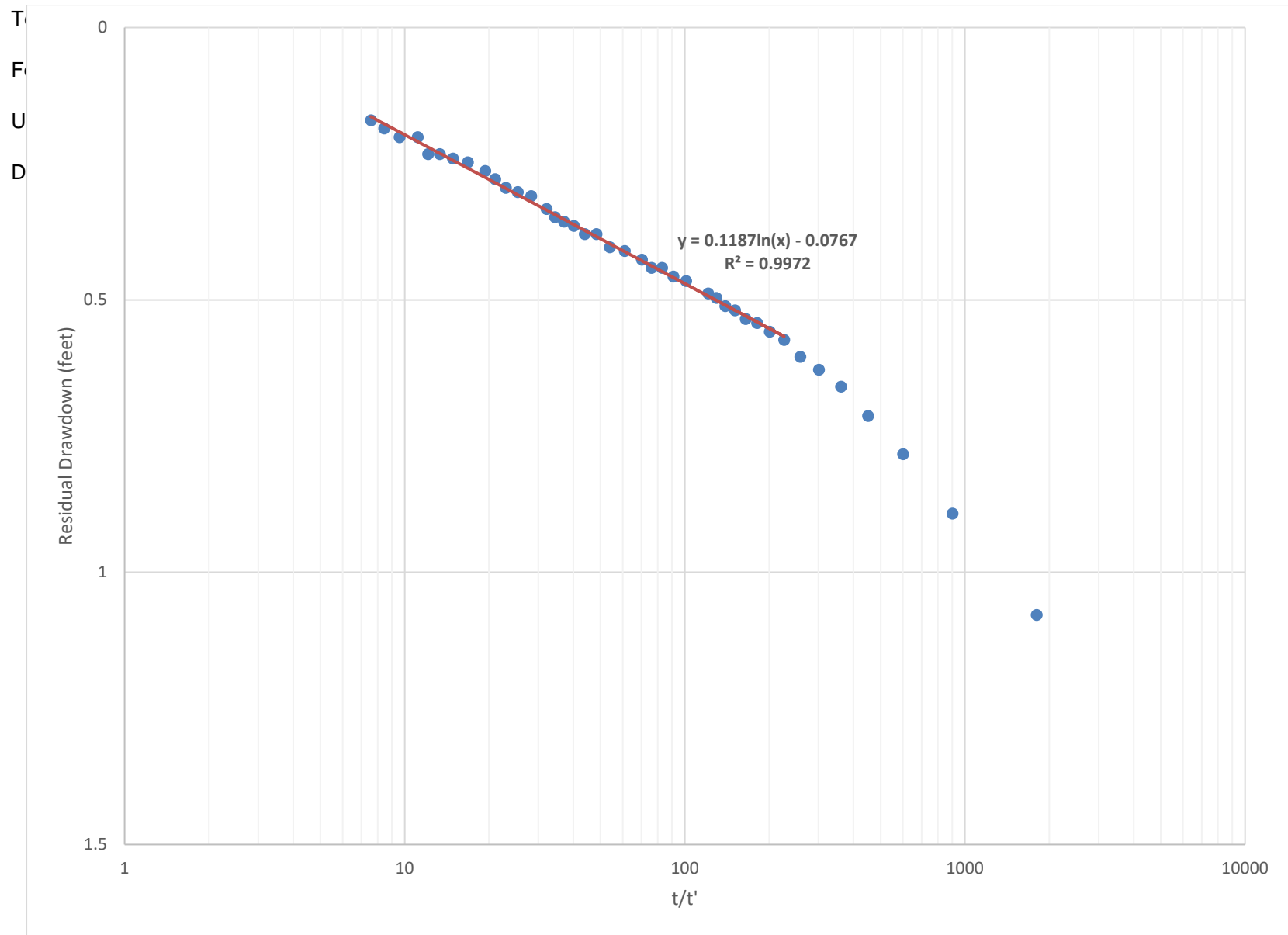


Figure 11

ATTACHMENT 1

Exploration Logs

Resource Protection Well Report

Submit one well report per well installed. See page two for instructions.

Type of Work:

- Construction
 Decommission ⇒ Original NOI No. _____

Ecology Well ID Tag No. BKW - 221

Site Well Name _____

Consulting Firm _____

Was a variance approved for this well/boring? Yes No

If yes, what was the variance for? _____

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported are true to my best knowledge and belief.

Driller Trainee Engineer

Name (Print Last, First Name) Jim McLeslie

Driller/Engineer/Trainee Signature *Jim McLeslie*

License No. 2871

Company Name H2O Well Service Inc.

If trainee box is checked, sponsor's license number: _____

Sponsor's signature _____

Notice of Intent No. RE18500

Type of Well:

- Resource Protection Well Injection Point
 Remediation Well Grounding Well
 Geotechnical Soil Boring Ground Source Heat Pump
 Environmental Boring Other _____

↳ Soil- Vapor- Water-sampling

Property Owner Spokane County

Well Street Address E. Nelson Rd.

City Elk County Spokane

Tax Parcel No. 49231.9056

Location (see instructions): WWM or EWM

SW ¼-¼ NE ¼, Section 23 Town 29N Range 44E

Latitude (Example: 47.12345) _____

Longitude (Example: -120.12345) _____

(WGS 84 Coordinate System)

Borehole diameter 8" inches Casing diameter 4" inches

Static water level 0' ft below top of casing Date 12/13/19

Above-ground completion with bollards Flush monument

↳ Stick-up of top of well casing 3 ft above ground surface

Start Date 12/12/2019 Completed Date 12/13/2019

Construction Design	Well Data	Driller's Log
	8" Bore Hole to 57' 4" PVC +3 to 52' 4" PVC Screen .10 Slot set @ 42' to 52' 4" PVC Threaded end cap 4" PVC Slip on cap (3) 4" Centralizers 10/20 Silica sand -38' to 57' 3/8 Holeplug from surface to -38' to 0' Monument, 6" Steel +3' to -3'	0' - 3' Top Soil 3' - 27' Tan Sand 27' - 52' Sand & Some Gravel 52' - 57' Granite

Resource Protection Well Report

Submit one well report per well installed. See page two for instructions.

Type of Work:

- Construction
 Decommission \Rightarrow Original NOI No. _____

Ecology Well ID Tag No. BKW - 220

Site Well Name _____

Consulting Firm _____

Was a variance approved for this well/boring? Yes No

If yes, what was the variance for? _____

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported are true to my best knowledge and belief.

Driller Trainee Engineer

Name (Print Last, First Name) Jim McLeslie

Driller/Engineer/Trainee Signature *Jim McLeslie*

License No. 2871

Company Name H2O Well Service Inc.

If trainee box is checked, sponsor's license number: _____

Sponsor's signature _____

Notice of Intent No. RE18501

Type of Well:

- Resource Protection Well Injection Point
 Remediation Well Grounding Well
 Geotechnical Soil Boring Ground Source Heat Pump
 Environmental Boring Other _____
 \hookrightarrow Soil- Vapor- Water-sampling

Property Owner Spokane County

Well Street Address S. Deer Park Milan Rd.

City Deer Park County Spokane

Tax Parcel No. 39342.9072

Location (see instructions): WWM or EWM

SE $\frac{1}{4}$ - $\frac{1}{4}$ NW $\frac{1}{4}$, Section 34 Town 29N Range 43E

Latitude (Example: 47.12345) 47.96775

Longitude (Example: -120.12345) 117.36412

(WGS 84 Coordinate System)

Borehole diameter 8" inches Casing diameter 4" inches

Static water level 73' ft below top of casing Date 12/12/2019

Above-ground completion with bollards Flush monument

\hookrightarrow Stick-up of top of well casing 3 ft above ground surface

Start Date 12/9/2019 Completed Date 12/12/2019

Construction Design	Well Data	Driller's Log
	8" Bore Hole completed at 83'	0' - 1' Top Soil
	4" PVC +3 to 72.5'	1' - 6' Gravels
	4" PVC Screen .10 Slot set @ 72.5' to 82.5'	6' - 7' Boulder
	4" PVC Threaded end cap	7'-23' Large Gravels
	4" PVC Slip on cap	23'-27' Clay & Sand
	(4) 4" Centralizers	27'-48' Sand & Some Gravels
	10/20 Silica sand -68' to 83'	48'-55' Fine Sand
	Pel Plug -67' to 68'	55'-85' Coarse Sand
	Bentonite grout -5' to 67'	85'-87' Granite
	3/8 Holeplug from surface to -5'	



Little Spokane Watershed Planning - 180249

Excavation Log

Project Address & Site Specific Location

Coordinates (Lat,Lon WGS84)

Exploration Number

Spokane, Deadman Creek

47.7704, -117.2827 (est)

FD-S

Contractor

Equipment

Sampling Method

Ground Surface Elev.

SES

Excavator or Backhoe

Grab

1875' (est)

Operator

Exploration Method(s)

Work Start/Completion Dates

Top of Casing Elev.

Depth to Water (Below GS)

Backhoe or trackhoe

10/20/2019

NA

No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
1	1874	Open hole, backfilled with excavator.					SILT (ML); soft, dry, brown	1
2	1873							2
3	1872							3
4	1871							4
5	1870							5
6	1869							6
7	1868							7
8	1867							8
9	1866							9
10	1865							10
11	1864							11
12	1863							12
13	1862							13
14	1861						Bottom of exploration at 13 ft. bgs.	14
15	1860							15
16	1859							16
17	1858							17
18	1857							18
19	1856							19
20	1855							20
21	1854							21
22	1853							22
23	1852							23
24	1851							24

Legend

Sample Type

Water Level

No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: Jason Shira
Approved by:

**Exploration Log
FD-S**



Little Spokane Watershed Planning - 180249

Excavation Log

Project Address & Site Specific Location
Spokane, Nelson Rd and Dry Creek

Coordinates (Lat,Lon WGS84)
47.9970, -117.2081 (est)

Exploration Number

ND-S

Contractor

Equipment

Sampling Method

Ground Surface Elev.

SES

Excavator or Backhoe

Grab

2373' (est)

Operator

Exploration Method(s)

Work Start/Completion Dates

Top of Casing Elev.

Depth to Water (Below GS)

Backhoe or trackhoe

10/22/2019

NA

No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
1	2372	Open hole, backfilled with excavator.	ND-S-03	150275 PS	OC=0.86% FC=1.1% D50=5.8mm		SAND WITH GRAVEL (SP); loose, dry, light brown; trace silt.	1
2	2371						2	
3	2370						3	
4	2369						4	
5	2368						Bottom of exploration at 4 ft. bgs.	5
6	2367							6
7	2366							7
8	2365							8
9	2364							9
10	2363							10
11	2362							11
12	2361							12
13	2360							13
14	2359							14
15	2358							15
16	2357							16
17	2356							17
18	2355							18
19	2354							19
20	2353							20
21	2352							21
22	2351							22
23	2350							23
24	2349							24

Legend

Grab sample

Water Level

No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: Jason Shira
Approved by:

Exploration Log ND-S

Sheet 1 of 1



Little Spokane Watershed Planning - 180249

Monitoring Well Log

Project Address & Site Specific Location
Spokane, Nelson Rd and Dry Creek

Coordinates (Lat,Lon WGS84)
47.9969, -117.2081 (est)

Exploration Number

ND1

Contractor

Equipment

Sampling Method

Ground Surface Elev.

H2O Drilling

Rotary drill rig

Grab

2370' (est)

Operator

Exploration Method(s)

Work Start/Completion Dates

Top of Casing Elev.

Depth to Water (Below GS)

Air rotary

12/13/2019

NA

No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
1	2369	4" PVC from +3' to 52'					hard, dry, brown; bare ground.	1
2	2368		SAND (SW); loose, dry, gray brown	2				
3	2367		3					
4	2366		4					
5	2365		5					
6	2364		6					
7	2363		7					
8	2362		8					
9	2361		9					
10	2360							
11	2359	11						
12	2358	12						
13	2357	13						
14	2356	14						
15	2355						SAND (SW); loose, dry, gray brown; fine to coarse, subangular gravel.	15
16	2354	16						
17	2353	17						
18	2352	18						
19	2351	19						
20	2350						SAND (SW); loose, dry, gray brown	20
21	2349	21						
22	2348	22						
23	2347	23						
24	2346	24						

Legend

Grab sample

Water Level

No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: Jason Shira
Approved by:

Exploration Log ND1

Sheet 1 of 3



Little Spokane Watershed Planning - 180249

Monitoring Well Log

Project Address & Site Specific Location
Spokane, Nelson Rd and Dry Creek

Coordinates (Lat, Lon WGS84)
47.9969, -117.2081 (est)

Exploration Number

ND1

Contractor
H2O Drilling

Equipment
Rotary drill rig

Sampling Method
Grab

Ground Surface Elev.
2370' (est)

Operator

Exploration Method(s)
Air rotary

Work Start/Completion Dates
12/13/2019

Top of Casing Elev.
NA

Depth to Water (Below GS)
No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
26	2344						SAND WITH GRAVEL (SW); loose, dry, gray brown; angular, fine gravel.	26
27	2343							27
28	2342							28
29	2341							29
30	2340						SAND WITH GRAVEL (SW); medium dense, dry, gray brown	30
31	2339							31
32	2338							32
33	2337							33
34	2336							34
35	2335						SAND WITH GRAVEL (SW); dense, dry, gray brown; [GRUSS].	35
36	2334							36
37	2333							37
38	2332							38
39	2331							39
40	2330							40
41	2329							41
42	2328							42
43	2327							43
44	2326	0.10 screen slot						44
45	2325	10/20 Sand	ND1-S-45	ND1-S-45 PS	OC=1.6% FC=7.9% D50=5.8mm			45
46	2324							46
47	2323							47
48	2322							48
49	2321							49

Legend

Grab sample

Water Level

No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: Jason Shira
Approved by:

Exploration Log ND1

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINT\PROJECTS\180249-LITTLESPokane.GPJ February 12, 2020



Little Spokane Watershed Planning - 180249

Monitoring Well Log

Project Address & Site Specific Location
Spokane, Nelson Rd and Dry Creek

Coordinates (Lat, Lon WGS84)
47.9969, -117.2081 (est)

Exploration Number

ND1

Contractor
H2O Drilling

Equipment
Rotary drill rig

Sampling Method
Grab

Ground Surface Elev.
2370' (est)

Operator

Exploration Method(s)
Air rotary

Work Start/Completion Dates
12/13/2019

Top of Casing Elev.
NA

Depth to Water (Below GS)
No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)	
51	2319						SAND WITH GRAVEL (SW); dense, dry, gray brown; [GRUSS]. (continued)	51	
52	2318						FELSIC IGNEOUS BEDROCK; dense, dry; granite.	52	
53	2317							53	
54	2316							54	
55	2315							55	
56	2314							56	
57	2313							57	
58	2312							Bottom of exploration at 57 ft. bgs.	58
59	2311								59
60	2310								60
61	2309								61
62	2308								62
63	2307								63
64	2306								64
65	2305							65	
66	2304							66	
67	2303							67	
68	2302							68	
69	2301							69	
70	2300							70	
71	2299							71	
72	2298							72	
73	2297							73	
74	2296							74	

Legend

Grab sample

Water Level

No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: Jason Shira
Approved by:

Exploration Log ND1

Sheet 3 of 3



Little Spokane Watershed Planning - 180249

Excavation Log

Project Address & Site Specific Location
Spokane, Deer Park and N. Finley RD

Coordinates (Lat, Lon WGS84)
47.9676, -117.3645 (est)

Exploration Number

MB-S

Contractor

Equipment

Sampling Method

Ground Surface Elev.

SES

Excavator or Backhoe

Grab

1962' (est)

Operator

Exploration Method(s)

Work Start/Completion Dates

Top of Casing Elev.

Depth to Water (Below GS)

Backhoe or trackhoe

10/21/2019

NA

No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
1	1961	Open hole, backfilled with excavator.	MB-S-03	PS	OC=1.96% FC=11% D50=5.8mm		GRAVEL WITH SAND AND COBBLES (GP); loose, dry, brown; oxidized hardpan.	1
2	1960						2	
3	1959						3	
4	1958						4	
5	1957						5	
6	1956						GRAVEL WITH COBBLES AND BOULDERS (GW); loose, dry, brown	6
7	1955	Bottom of exploration at 6 ft. bgs.	7					
8	1954		8					
9	1953		9					
10	1952		10					
11	1951		11					
12	1950		12					
13	1949		13					
14	1948		14					
15	1947		15					
16	1946		16					
17	1945		17					
18	1944		18					
19	1943		19					
20	1942		20					
21	1941		21					
22	1940		22					
23	1939		23					
24	1938		24					

Legend

Grab sample

Water Level

No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: Jason Shira
Approved by:

Exploration Log MB-S

Sheet 1 of 1



Little Spokane Watershed Planning - 180249

Monitoring Well Log

Project Address & Site Specific Location
Spokane, Deer Park and N. Finley RD

Coordinates (Lat, Lon WGS84)
47.9674, -117.3649 (est)

Exploration Number

MB1

Contractor

Equipment

Sampling Method

Ground Surface Elev.

H2O Drilling

Rotary drill rig

Grab

1956' (est)

Operator

Exploration Method(s)

Work Start/Completion Dates

Top of Casing Elev.

Depth to Water (Below GS)

Air rotary

12/9/2019 to 12/12/2019

NA

70.95' (Static)

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)	
1	1955	4" PVC form +3' to 82.5'					GRAVEL (GP); dense, dry, brown; gravel lot.	1	
2	1954						GRAVEL WITH SILT (GP-GM); dense, dry, brown; minor silt.	2	
3	1953						GRAVEL WITH SILT AND COBBLES (GP-GM); dense, dry, brown	3	
4	1952							4	
5	1951							5	
6	1950							6	
7	1949						GRAVEL WITH COBBLES AND BOULDERS (GW); dense, dry, brown; granitic boulders.	7	
8	1948						GRAVEL WITH SILT (GW-GM); dense, dry, brown; fine to coarse, basaltic and granitic gravel.	8	
9	1947							9	
10	1946							10	
11	1945							11	
12	1944							12	
13	1943							13	
14	1942							14	
15	1941							15	
16	1940							16	
17	1939							17	
18	1938							18	
19	1937							19	
20	1936							20	
21	1935							21	
22	1934							22	
23	1933							CLAY WITH SAND (CH); soft, moist, red brown; trace medium, sub angular sand.	23
24	1932							24	

Legend

Sample Type

Water Level

- ▼ Static Water Level
- ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: Jason Shira
Approved by:

Exploration Log MB1

Sheet 1 of 4



Little Spokane Watershed Planning - 180249

Monitoring Well Log

Project Address & Site Specific Location

Spokane, Deer Park and N. Finley RD

Coordinates (Lat,Lon WGS84)

47.9674, -117.3649 (est)

Exploration Number

MB1

Contractor

H2O Drilling

Equipment

Rotary drill rig

Sampling Method

Grab

Ground Surface Elev.

1956' (est)

Operator

Exploration Method(s)

Air rotary

Work Start/Completion Dates

12/9/2019 to 12/12/2019

Top of Casing Elev.

NA

Depth to Water (Below GS)

70.95' (Static)

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
26	1930						CLAY WITH SAND (CH); soft, moist, red brown; trace medium, sub angular sand. (continued)	26
27	1929						CLAYEY SAND (SC); soft, slight moisture, brown-yellow; trace non-plastic fines; subangular sand.	27
28	1928							28
29	1927							29
30	1926							30
31	1925							31
32	1924							32
33	1923							33
34	1922							34
35	1921							35
36	1920							36
37	1919							37
38	1918							38
39	1917							39
40	1916							40
41	1915							41
42	1914							42
43	1913							43
44	1912							44
45	1911							45
46	1910							46
47	1909						CLAYEY SAND (SC); soft, dry, weathered granite, [GRUSS].	47
48	1908							48
49	1907						SAND (SW); med. dense, slight moisture, light brown; fine to coarse, subangular sand; trace medium gravel; [GRUSS]	49

Legend

Sample Type

Water Level

- Static Water Level
- Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: Jason Shira
Approved by:

Exploration Log MB1

Sheet 2 of 4



Little Spokane Watershed Planning - 180249

Monitoring Well Log

Project Address & Site Specific Location
Spokane, Deer Park and N. Finley RD

Coordinates (Lat, Lon WGS84)
47.9674, -117.3649 (est)

Exploration Number

MB1

Contractor
H2O Drilling

Equipment
Rotary drill rig

Sampling Method
Grab

Ground Surface Elev.
1956' (est)

Operator

Exploration Method(s)
Air rotary

Work Start/Completion Dates
12/9/2019 to 12/12/2019

Top of Casing Elev.
NA

Depth to Water (Below GS)
70.95' (Static)

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
51	1905					[Dotted pattern]	SAND (SW); med. dense, slight moisture, light brown; fine to coarse, subangular sand; trace medium gravel; [GRUSS] (continued)	51
52	1904					[Dotted pattern]		52
53	1903					[Dotted pattern]		53
54	1902					[Dotted pattern]		54
55	1901					[Diagonal lines]	CLAYEY SAND (SC); medium stiff, slight moisture, brown; thin beds of clay throughout unit [GRUSS]	55
56	1900					[Diagonal lines]		56
57	1899					[Diagonal lines]		57
58	1898					[Diagonal lines]		58
59	1897					[Diagonal lines]		59
60	1896					[Diagonal lines]		60
61	1895					[Diagonal lines]		61
62	1894					[Diagonal lines]		62
63	1893					[Diagonal lines]		63
64	1892					[Diagonal lines]		64
65	1891					[Dotted pattern]	SAND (SW); med. dense, moist to very moist, brown; fine to medium, subangular sand; [GRUSS].	65
66	1890					[Dotted pattern]		66
67	1889					[Dotted pattern]		67
68	1888					[Dotted pattern]		68
69	1887					[Dotted pattern]		69
70	1886					[Dotted pattern]		70
71	1885	▼ 12/16/2019				[Dotted pattern]		71
72	1884					[Dotted pattern]		72
73	1883					[Dotted pattern]		73
74	1882					[Dotted pattern]		74

Legend

Sample Type

Water Level

- ▼ Static Water Level
- ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: Jason Shira
Approved by:

Exploration Log MB1



Little Spokane Watershed Planning - 180249

Monitoring Well Log

Project Address & Site Specific Location
Spokane, Deer Park and N. Finley RD

Coordinates (Lat,Lon WGS84)
47.9674, -117.3649 (est)

Exploration Number

MB1

Contractor

Equipment

Sampling Method

Ground Surface Elev.

H2O Drilling

Rotary drill rig

Grab

1956' (est)

Operator

Exploration Method(s)

Work Start/Completion Dates

Top of Casing Elev.

Depth to Water (Below GS)

Air rotary

12/9/2019 to 12/12/2019

NA

70.95' (Static)

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)	
76	1880	<p>12/9/2019</p> <p>0.10 screen slot</p> <p>10/20 Sand</p>					SAND (SW); med. dense, moist to very moist, brown; fine to medium, subangular sand; [GRUSS]. (continued)	76	
77	1879							SAND (SW); med. dense, wet, brown; [GRUSS]	77
78	1878								78
79	1877							79	
80	1876							80	
81	1875							81	
82	1874							82	
83	1873							FELSIC IGNEOUS BEDROCK; Granite	83
84	1872								84
85	1871								85
86	1870						86		
87	1869						Bottom of exploration at 87 ft. bgs.	87	
88	1868							88	
89	1867							89	
90	1866							90	
91	1865							91	
92	1864							92	
93	1863							93	
94	1862							94	
95	1861							95	
96	1860							96	
97	1859							97	
98	1858							98	
99	1857							99	

Legend

Sample Type

Water Level

- ▼ Static Water Level
- ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: Jason Shira
Approved by:

Exploration Log MB1

Sheet 4 of 4

ATTACHMENT 2

Photograph Log



Photograph 1. Bear Creek surface water station. The photograph shows the use of a peristaltic pump to collect total and field filtered water quality samples.



Photograph 2. Deadman Creek Site Soil Profile. Changes in color correspond with change from sandy silt to silt to fat clay with depth.



Photograph 3. Dry Creek Site Soil Profile. Photo shows crossbedding in the top portion of photo. Over excavation revealed lateral spreading of the wetting front in the soil profile. The water spread at the contact between forest and bottom set likely due to a change in vertical hydraulic conductivity.



Photograph 4. Bear Creek Site Soil Profile. The photo shows the coarsening with depth and relatively clean gravels below a surface horizon that contained a hardpan layer comprised of iron oxides at 2 feet bgs.

ATTACHMENT 3

Laboratory Results



Anatek Labs, Inc.

E 504 Sprague Ave., Suite D

Spokane WA 99202

(509) 838-3999 F: (509) 838-4433

Invoice

DATE	12/24/2019
INVOICE #	191218097
TERMS	Due on receipt
DUE DATE	12/24/2019

BILL TO

ASPECT CONSULTING LLC
123 E. YAKIMA AVE SUITE 200
YAKIMA WA 98902

PAID
12/31/2019

PROJECT MANAGER	PURCHASE ORDER	Account #	PROJECT		
	180249		LITTLE SPOKANE RIVER OFF...		
ITEM	DESCRIPTION	QUANTITY	RATE	AMOUNT	
WS COLIFOR...	TOTAL COLIFORM BACTERIA IN WATER BY SM 9221B MPN/MTF	3	40.00	120.00	
WS ECOLI	E. COLI (MPN/MTF) IN WATER BY SM 9221B/SM 9221E	3	20.00	60.00	
THANK YOU FOR YOUR BUSINESS!		Total		\$180.00	
		Payments/Credits		-\$180.00	
		Balance Due		\$0.00	

PLEASE REFERENCE INVOICE NUMBER WITH YOUR PAYMENT. 1.75% MONTHLY INTEREST CHARGED ON OVERDUE INVOICES.

Anatek Labs, Inc.

1282 Alturas Drive • Moscow, ID 83843 • (208) 883-2839 • Fax (208) 882-9246 • email moscow@anateklabs.com
504 E Sprague Ste. D • Spokane WA 99202 • (509) 838-3999 • Fax (509) 838-4433 • email spokane@anateklabs.com

Client: ASPECT CONSULTING, LLC.
Address: 123 E YALINA AVE, STE 200
YAKIMA, WA 98902
Attn: CARL EINBERGER

Batch #: 191218097
Project Name: LITTLE SPOKANE RIVER
OFFSET 180249

Analytical Results Report

Sample Number	191218097-001	Sampling Date	12/18/2019	Date/Time Received	12/18/2019 4:40 PM		
Client Sample ID	MB-SW-191218	Sampling Time	10:45 AM	Extraction Date			
Matrix	Water	Sample Location					
Comments							
Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
E. Coli	2.0	MPN/100 mL	1.8	12/21/2019 2:06:00 PM	MMS	SM9221F	
Total Coliform	350	MPN/100mL	1.8	12/23/2019 9:00:00 AM	TLM	SM9221B	

Sample Number	191218097-002	Sampling Date	12/18/2019	Date/Time Received	12/18/2019 4:40 PM		
Client Sample ID	MB2-GW-191218	Sampling Time	1:00 PM	Extraction Date			
Matrix	Water	Sample Location					
Comments							
Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
E. Coli	<1.8	MPN/100 mL	1.8	12/20/2019 4:05:00 PM	MMS	SM9221F	
Total Coliform	<1.8	MPN/100mL	1.8	12/20/2019 4:05:00 PM	MMS	SM9221B	

Anatek Labs, Inc.

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504 E Sprague Ste. D • Spokane WA 99202 • (509) 838-3999 • Fax (509) 838-4433 • email spokane@anateklabs.com

Client: ASPECT CONSULTING, LLC.
Address: 123 E YALINA AVE, STE 200
YAKIMA, WA 98902
Attn: CARL EINBERGER

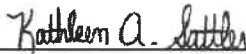
Batch #: 191218097
Project Name: LITTLE SPOKANE RIVER
OFFSET 180249

Analytical Results Report

Sample Number	191218097-003	Sampling Date	12/18/2019	Date/Time Received	12/18/2019 4:40 PM
Client Sample ID	MD-SW-191218	Sampling Time	3:00 PM	Extraction Date	
Matrix	Water	Sample Location			
Comments					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
E. Coli	79	MPN/100 mL	1.8	12/21/2019 2:06:00 PM	MMS	SM9221F	
Total Coliform	170	MPN/100mL	1.8	12/23/2019 9:00:00 AM	TLM	SM9221B	

Authorized Signature


Kathleen A. Sattler, Lab Manager

MCL EPA's Maximum Contaminant Level
ND Not Detected
PQL Practical Quantitation Limit

This report shall not be reproduced except in full, without the written approval of the laboratory.
The results reported relate only to the samples indicated.
Soil/solid results are reported on a dry-weight basis unless otherwise noted.

Anatek Labs, Inc.

1282 Alturas Drive • Moscow, ID 83843 • (208) 883-2839 • Fax (208) 882-9246 • email moscow@anateklabs.com
504 E Sprague Ste. D • Spokane WA 99202 • (509) 838-3999 • Fax (509) 838-4433 • email spokane@anateklabs.com

Login Report

Customer Name: ASPECT CONSULTING, LLC.
123 E YALINA AVE, STE 200
YAKIMA WA 98902

Order ID: 191218097
Order Date: 12/18/2019

Contact Name: CARL EINBERGER

Project Name: LITTLE SPOKANE
RIVER OFFICE 180249

Comment:

Sample #: 191218097-001 **Customer Sample #:** MB-SW-191218

Recv'd: **Matrix:** Water **Collector:** JASON SCHIVA **Date Collected:** 12/18/2019

Quantity: 1 **Date Received:** 12/18/2019 4:40:00 PM **Time Collected:** 10:45 AM

Comment:

Test	Lab	Method	Due Date	Priority
BACT - E COLI	S	SM9221F	12/31/2019	<u>Normal (~10 Days)</u>
BACT - TOTAL COLIFORMS	S	SM9221B	12/31/2019	<u>Normal (~10 Days)</u>

Sample #: 191218097-002 **Customer Sample #:** MB2-GW-191218

Recv'd: **Matrix:** Water **Collector:** JASON SCHIVA **Date Collected:** 12/18/2019

Quantity: 1 **Date Received:** 12/18/2019 4:40:00 PM **Time Collected:** 1:00 PM

Comment:

Test	Lab	Method	Due Date	Priority
BACT - E COLI	S	SM9221F	12/31/2019	<u>Normal (~10 Days)</u>
BACT - TOTAL COLIFORMS	S	SM9221B	12/31/2019	<u>Normal (~10 Days)</u>

Sample #: 191218097-003 **Customer Sample #:** MD-SW-191218

Recv'd: **Matrix:** Water **Collector:** JASON SCHIVA **Date Collected:** 12/18/2019

Quantity: 1 **Date Received:** 12/18/2019 4:40:00 PM **Time Collected:** 3:00 PM

Comment:

Test	Lab	Method	Due Date	Priority
BACT - E COLI	S	SM9221F	12/31/2019	<u>Normal (~10 Days)</u>
BACT - TOTAL COLIFORMS	S	SM9221B	12/31/2019	<u>Normal (~10 Days)</u>

Customer Name: ASPECT CONSULTING, LLC.

123 E YALINA AVE, STE 200

YAKIMA

WA

98902

Order ID: 191218097

Order Date: 12/18/2019

Contact Name: CARL EINBERGER

Project Name: LITTLE SPOKANE
RIVER OFFICE 180249

Comment:

SAMPLE CONDITION RECORD

Samples received in a cooler?	No
Samples received intact?	Yes
What is the temperature of the sample(s)? (°C)	12.6
Samples received with a COC?	Yes
Samples received within holding time?	Yes
Are all sample bottles properly preserved?	Yes
Labels and chain agree?	Yes
Total number of containers?	3

Chain of Custody Record

91218 097 **ASPT** Last 12/31/2019
1st SAMP 12/18/201 1st RCVD 12/18/2019
LITTLE SPOKANE RIVER OFFSET
130249

1 Unit Around 1 time & Reporting

Please refer to our normal turn around times at:
<http://www.anatelabs.com/services/guidelines/reporting.asp>

Normal Phone
Next Day* Mail
2nd Day* Fax
Other* Email

*All rush order requests must be prior approved.

Company Name: **Aspect Consulting LLC**
Project Manager: **Carl E. Inberger**
Address: **123 E Yakima Ave Suite 200**
Project Name & #: **Little Spokane River Offset 130249**
City: **Yakima** State: **WA** Zip: **98902**
Email Address: **jshira@aspectconsulting.com**
Phone: **(509) 895-5430** Purchase Order #:
Fax: **(509) 895-5430** Sampler Name & phone: **Sean Shira (509) 895-5430**

Provide Sample Description

List Analyses Requested

Note Special Instructions/Comments

Lab ID	Sample Identification	Sampling Date/Time	Matrix	Preservative		# of Containers	Sample Volume	Company	Date	Time
	MIR-SUB-191218	12/18/19	10:45 W			1	Total 6l	Aspect	12-18-19	10:40
	MIR-SUB-191218		13:00			1	R.C. 6l	Aspect		
	M.D. SUB-191218		15:00			1		Aspect		

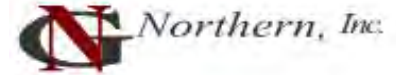
SWBS

Inspection Checklist:
 Received intact? N
 Labels & Chains Agree? N
 Containers Sealed? N
 VOC Head Space? N

WJ/mc/mi
 Temperature (°C) 12.6 ^{SDS} 04 _{R109}
 Preservative: _____

Relinquished by _____ Printed Name: **Sean Shira** Signature: *[Signature]*
 Received by **Brandon Berger** Signature: *[Signature]*
 Relinquished by _____ Company: **Aspect**
 Received by _____ Date: **12-18-19** Time: **11:40**
 Relinquished by _____
 Received by _____
 Inspected By: **WJ**

LABORATORY SIEVE ANALYSIS



Project: # 180249	Date Sampled: 1/6/20
Client: Aspect Consulting	Job #: Y19-450
Material: Soil.	W.O. #: 156031
Source: ND-S-03	Lab #: 150275

Sieve Size	Percent Passing	Specifications	
		Minimum	Maximum
4"			
3"			
2"			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"	100%		
3/8"	98.5%		
1/4"			
#4	84.1%		
#8			
#10	50.5%		
#16			
#20	14.8%		
#30			
#40	4.1%		
#50			
#60			
#80	1.7%		
#100	1.5%		
#200	1.1%		

Sieve Analysis Data: ASTM D6913/ D1140

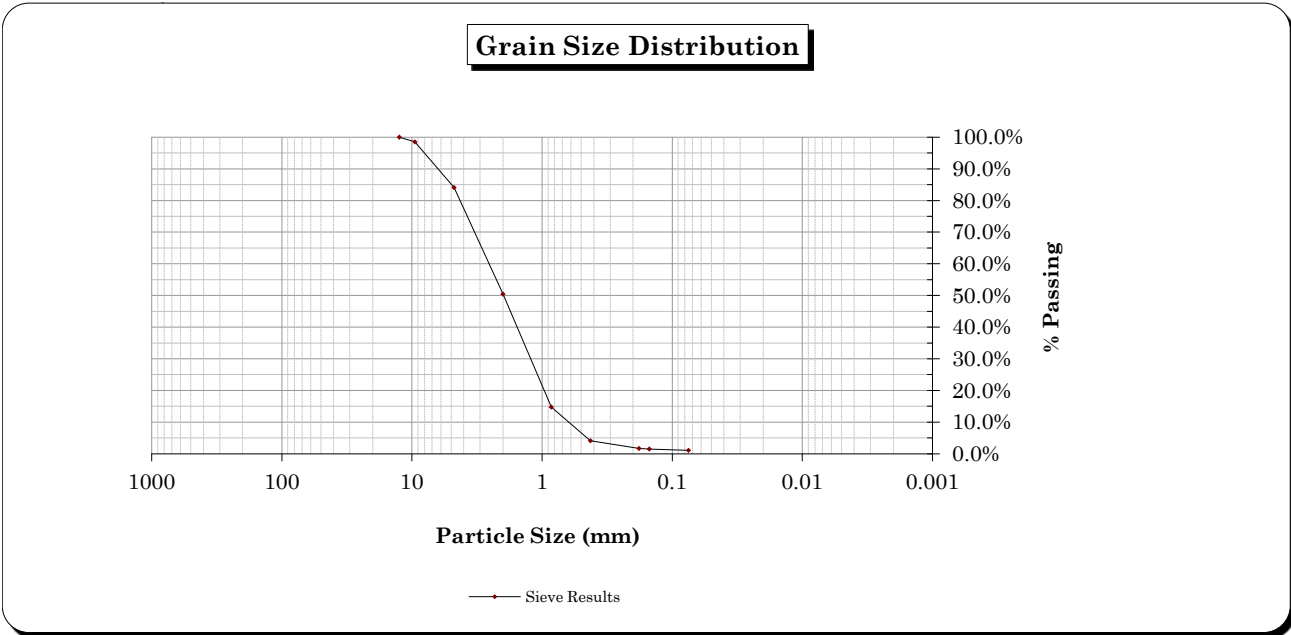
Fineness Modulus:
 % Gravel: 15.9
 % Sand: 83.0
 % Silt & Clay: 1.1
 Moisture Content:

Organic Matter ASTM D2974
 0.86%

Cation Exchange Capacity EPA 9081
 7.6 meq/100g

Gradation Coefficient of Uniformity C_u

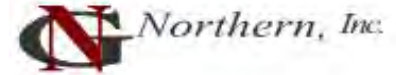
%passing	sieve (mm)
D10 :	0.5
D30 :	2.2
D60 :	5.8
C_u :	11.6
C_c :	1.7



Reviewed by: _____

Date: _____

LABORATORY SIEVE ANALYSIS



Project: # 180249	Date Sampled: 1/6/20
Client: Aspect Consulting	Job #: Y19-450
Material: Soil	W.O. #: 156031
Source: MB-S-03	Lab #: 150276

Sieve Size	Percent Passing	Specifications	
		Minimum	Maximum
4"			
3"			
2"			
1 3/4"			
1 1/2"			
1 1/4"	100%		
1"	92%		
3/4"	81%		
5/8"			
1/2"	69%		
3/8"	57.6%		
1/4"			
#4	36.9%		
#8			
#10	20.6%		
#16			
#20	14.9%		
#30			
#40	13.5%		
#50			
#60			
#80	12.3%		
#100	12.1%		
#200	11.0%		

Sieve Analysis Data: ASTM D6913/ D1140

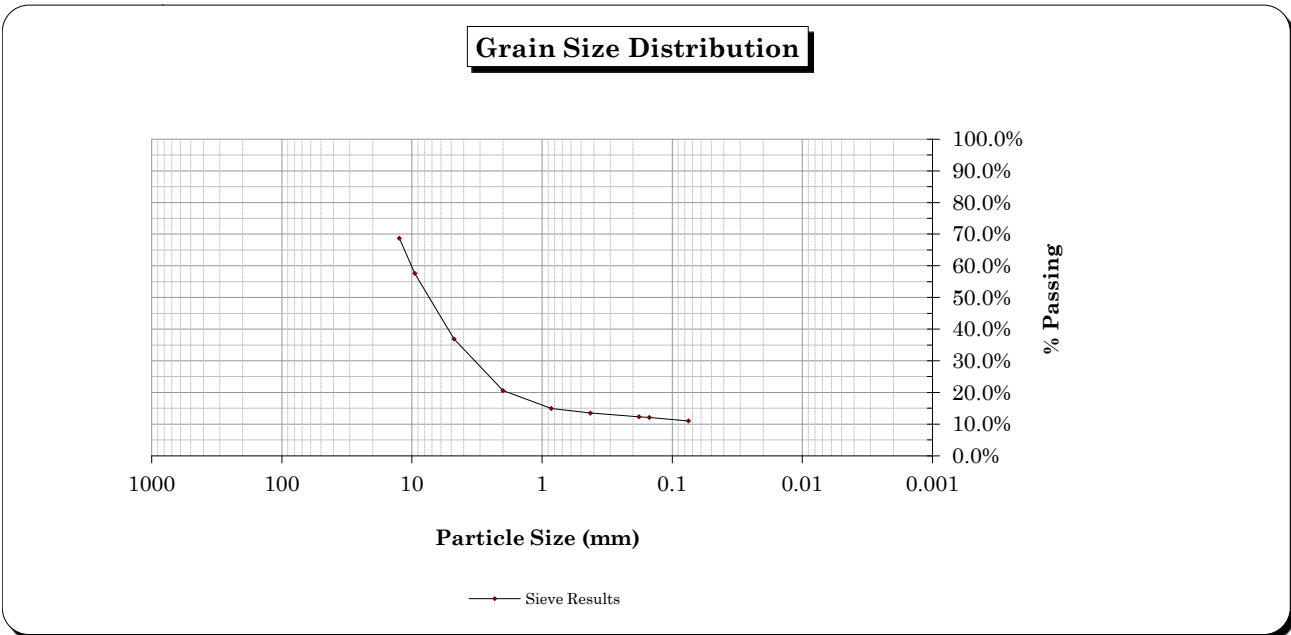
Fineness Modulus:
 % Gravel: 63.1
 % Sand: 25.9
 % Silt & Clay: 11.0
 Moisture Content:

Organic Matter ASTM D2974
 1.96%

Cation Exchange Capacity EPA 9081
 12.1 meq/100g

Gradation Coefficient of Uniformity Cu

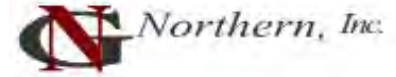
%passing	sieve (mm)
D10 :	0.5
D30 :	2.2
D60 :	5.8
C_u :	11.6
C_c :	1.7



Reviewed by: _____

Date: _____

LABORATORY SIEVE ANALYSIS



Project: # 180249	Date Sampled: 1/6/20
Client: Aspect Consulting	Job #: Y19-450
Material: Soil	W.O. #: 156031
Source: ND.S-45	Lab #: 150277

Sieve Size	Percent Passing	Specifications	
		Minimum	Maximum
4"			
3"			
2"			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"			
3/8"			
1/4"	100.0%		
#4	97.7%		
#8			
#10	76.1%		
#16			
#20	42.1%		
#30			
#40	23.7%		
#50			
#60			
#80	12.4%		
#100	11.0%		
#200	7.9%		

Sieve Analysis Data: ASTM D6913/ D1140

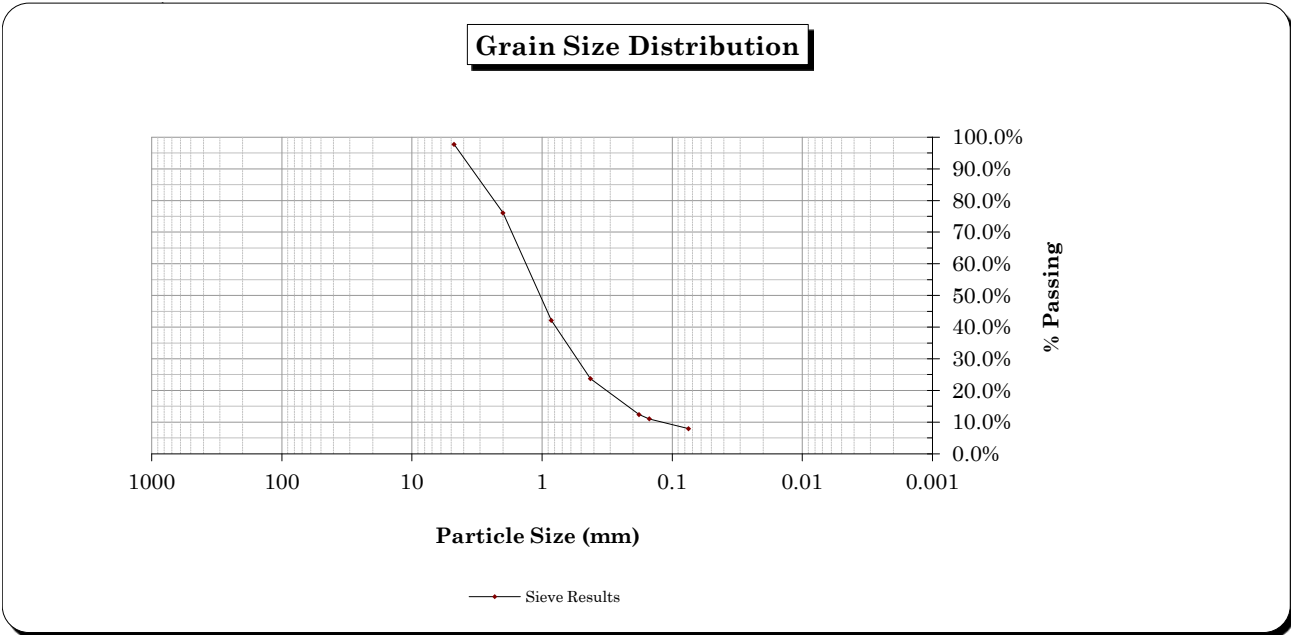
Fineness Modulus:
 % Gravel: 2.3
 % Sand: 89.8
 % Silt & Clay: 7.9
 Moisture Content:

Organic Matter ASTM D2974
 1.60^%

Cation Exchange Capacity EPA 9081
 5.3 meq/100g

Gradation Coefficient of Uniformity Cu

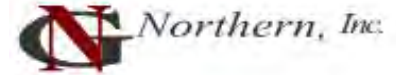
%passing	sieve (mm)
D10 :	0.5
D30 :	2.2
D60 :	5.8
C_u :	11.6
C_c :	1.7



Reviewed by: _____

Date: _____

LABORATORY SIEVE ANALYSIS



Project: # 180249	Date Sampled: 1/6/20
Client: Aspect Consulting	Job #: Y19-450
Material: Soil.	W.O. #: 156031
Source: ND-S-03	Lab #: 150275

Sieve Size	Percent Passing	Specifications	
		Minimum	Maximum
4"			
3"			
2"			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"	100%		
3/8"	98.5%		
1/4"			
#4	84.1%		
#8			
#10	50.5%		
#16			
#20	14.8%		
#30			
#40	4.1%		
#50			
#60			
#80	1.7%		
#100	1.5%		
#200	1.1%		

Sieve Analysis Data: ASTM D6913/ D1140

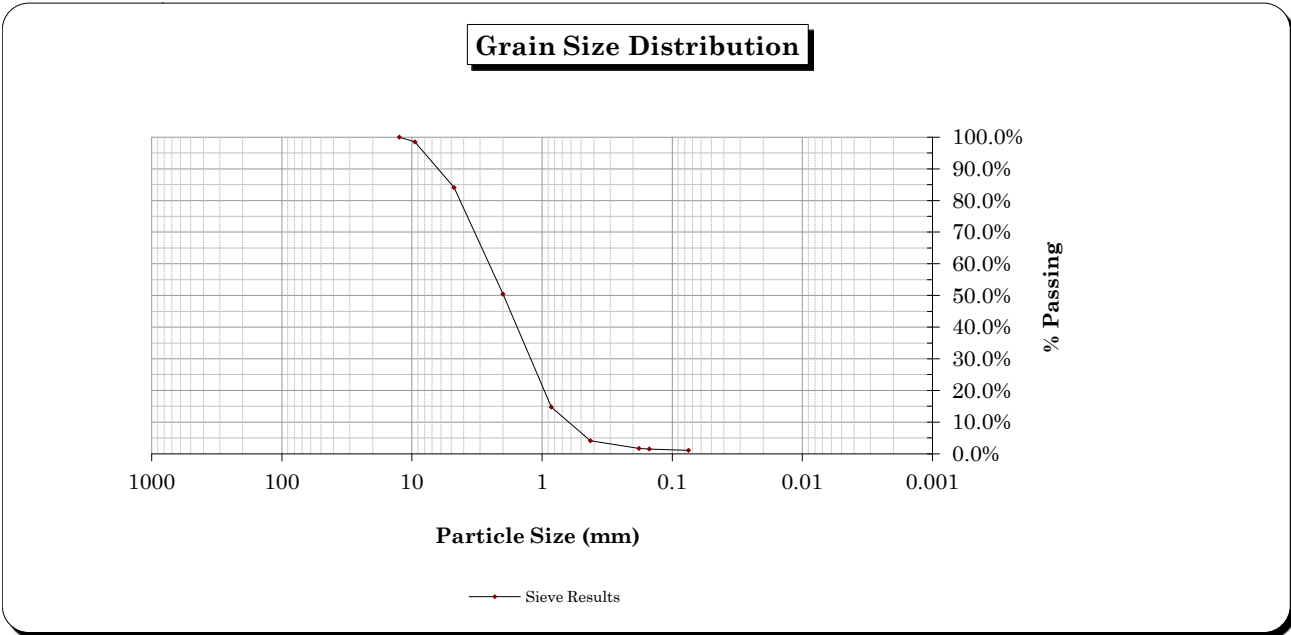
Fineness Modulus:
 % Gravel: 15.9
 % Sand: 83.0
 % Silt & Clay: 1.1
 Moisture Content:

Organic Matter ASTM D2974
 0.86%

Cation Exchange Capacity EPA 9081
 7.6 meq/100g

Gradation Coefficient of Uniformity Cu

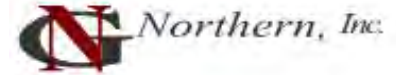
%passing	sieve (mm)
D10 :	0.5
D30 :	2.2
D60 :	5.8
C_u :	11.6
C_c :	1.7



Reviewed by: _____

Date: _____

LABORATORY SIEVE ANALYSIS



Project: # 180249	Date Sampled: 1/6/20
Client: Aspect Consulting	Job #: Y19-450
Material: Soil	W.O. #: 156031
Source: MB-S-03	Lab #: 150276

Sieve Size	Percent Passing	Specifications	
		Minimum	Maximum
4"			
3"			
2"			
1 3/4"			
1 1/2"			
1 1/4"	100%		
1"	92%		
3/4"	81%		
5/8"			
1/2"	69%		
3/8"	57.6%		
1/4"			
#4	36.9%		
#8			
#10	20.6%		
#16			
#20	14.9%		
#30			
#40	13.5%		
#50			
#60			
#80	12.3%		
#100	12.1%		
#200	11.0%		

Sieve Analysis Data: ASTM D6913/ D1140

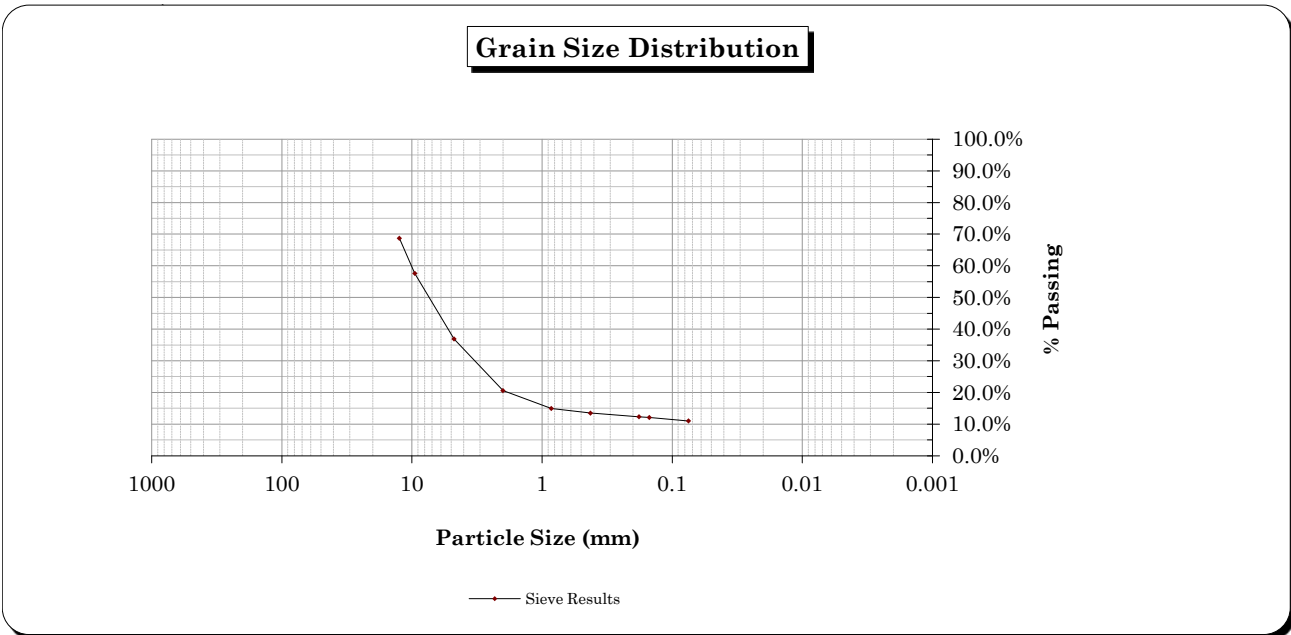
Fineness Modulus:
 % Gravel: 63.1
 % Sand: 25.9
 % Silt & Clay: 11.0
 Moisture Content:

Organic Matter ASTM D2974
 1.96%

Cation Exchange Capacity EPA 9081
 12.1 meq/100g

Gradation Coefficient of Uniformity C_u

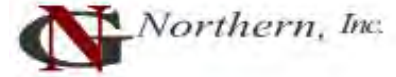
%passing	sieve (mm)
D10 :	0.5
D30 :	2.2
D60 :	5.8
C_u :	11.6
C_c :	1.7



Reviewed by: _____

Date: _____

LABORATORY SIEVE ANALYSIS



Project: # 180249	Date Sampled: 1/6/20
Client: Aspect Consulting	Job #: Y19-450
Material: Soil	W.O. #: 156031
Source: ND-S-45	Lab #: 150277

Sieve Size	Percent Passing	Specifications	
		Minimum	Maximum
4"			
3"			
2"			
1 3/4"			
1 1/2"			
1 1/4"			
1"			
3/4"			
5/8"			
1/2"			
3/8"			
1/4"	100.0%		
#4	97.7%		
#8			
#10	76.1%		
#16			
#20	42.1%		
#30			
#40	23.7%		
#50			
#60			
#80	12.4%		
#100	11.0%		
#200	7.9%		

Sieve Analysis Data: ASTM D6913/ D1140

Fineness Modulus:
 % Gravel: 2.3
 % Sand: 89.8
 % Silt & Clay: 7.9
 Moisture Content:

Organic Matter ASTM D2974

1.60^%

Cation Exchange Capacity EPA 9081

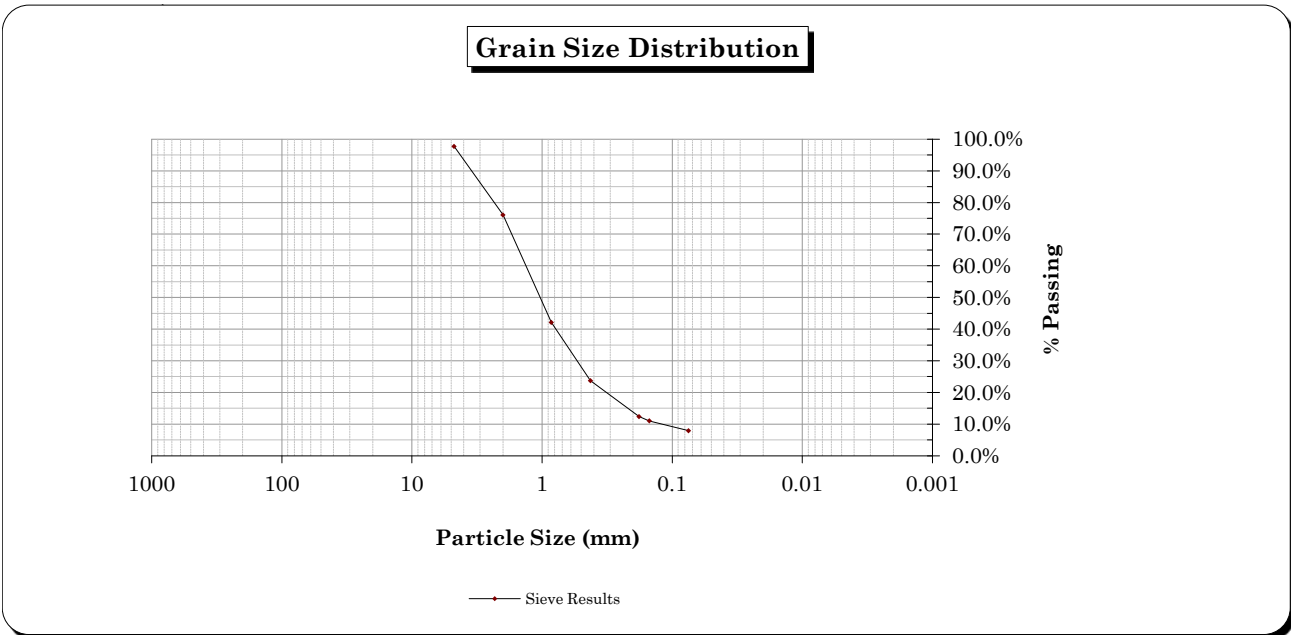
5.3 meq/100g

Gradation Coefficient of Uniformity Cu

%passing	sieve (mm)
D10 :	0.5
D30 :	2.2
D60 :	5.8

C_u: 11.6

C_c: 1.7



Reviewed by: _____

Date: _____



Aspect Consulting
123 E Yakima Avenue Suite 200
Yakima, WA 98901

Project Name: Routine / No Project
Work Order: **X9L0363**
Reported: 10-Feb-20 16:45

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Sampled By	Date Received	Notes
MB-SW-191218	X9L0363-01	Surface Water	18-Dec-19 10:15	JS	19-Dec-2019	
MB1-GW-191218	X9L0363-02	Ground Water	18-Dec-19 13:00	JS	19-Dec-2019	
ND-SW-191218	X9L0363-03	Surface Water	18-Dec-19 15:00	JS	19-Dec-2019	
MB-S-03	X9L0363-04	Soil	21-Oct-19 00:00	JS	19-Dec-2019	
ND-S-03	X9L0363-05	Soil	23-Oct-19 00:00	JS	19-Dec-2019	
ND1-S-45	X9L0363-06	Soil	13-Dec-19 00:00	JS	19-Dec-2019	
SCWR01-191218	X9L0363-07	Water	18-Dec-19 13:30	JS	19-Dec-2019	

Solid samples are analyzed on an as-received, wet-weight basis, unless otherwise requested.

Sample preparation is defined by the client as per their Data Quality Objectives.

This report supercedes any previous reports for this Work Order. The complete report includes pages for each sample, a full QC report, and a notes section.

Analyses were performed in accordance with SVL standard operating procedures and calibrations were performed and met SVL internal QC criteria.

The results presented in this report relate only to the samples, and meet all requirements of the NELAC Standards unless otherwise noted.

Case Narrative: X9L0363

SVL is not accredited in the state of Washington for T 6010D P.

CRW 1/16/20 This report is reissued, adding 200.7 TR and D Sn for sample -02.

CRW 2/10/20 This report is reissued, changing the solid samples to report on a dry-weight basis.



Aspect Consulting
123 E Yakima Avenue Suite 200
Yakima, WA 98901

Project Name: Routine / No Project
Work Order: **X9L0363**
Reported: 10-Feb-20 16:45

Client Sample ID: **MB-SW-191218**

Sampled: 18-Dec-19 10:15

SVL Sample ID: **X9L0363-01 (Surface Water)**

Received: 19-Dec-19

Sample Report Page 1 of 2

Sampled By: JS

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
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Metals (Total)

EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.000093		X953018	JFB	01/03/20 13:27	
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Metals (Total Recoverable--reportable as Total per 40 CFR 136)

EPA 200.7	Antimony	< 0.020	mg/L	0.020	0.004		X952158	KH	01/03/20 14:43	
EPA 200.7	Beryllium	< 0.0020	mg/L	0.0020	0.0004		X952158	KH	01/03/20 14:43	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0008		X952158	KH	01/03/20 14:43	
EPA 200.7	Calcium	44.7	mg/L	0.100	0.035		X952158	KH	01/03/20 14:43	
EPA 200.7	Chromium	< 0.0060	mg/L	0.0060	0.0010		X952158	KH	01/03/20 14:43	
EPA 200.7	Copper	< 0.0100	mg/L	0.0100	0.0014		X952158	KH	01/03/20 14:43	
EPA 200.7	Iron	< 0.100	mg/L	0.100	0.028		X952158	KH	01/03/20 14:43	
EPA 200.7	Magnesium	8.71	mg/L	0.50	0.04		X952158	KH	01/03/20 14:43	
EPA 200.7	Nickel	< 0.0100	mg/L	0.0100	0.0012		X952158	KH	01/03/20 14:43	
EPA 200.7	Potassium	2.29	mg/L	0.50	0.09		X952158	KH	01/03/20 14:43	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0010		X952158	KH	01/06/20 12:32	
EPA 200.7	Sodium	4.85	mg/L	0.50	0.06		X952158	KH	01/03/20 14:43	
EPA 200.7	Zinc	< 0.010	mg/L	0.010	0.003		X952158	KH	01/03/20 14:43	
EPA 200.8	Arsenic	< 0.00300	mg/L	0.00300	0.00021	2	X952008	AS	01/03/20 11:55	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.00014	2	X952008	AS	01/03/20 11:55	
EPA 200.8	Selenium	< 0.0030	mg/L	0.0030	0.0002	2	X952008	AS	01/03/20 11:55	
EPA 200.8	Thallium	< 0.00100	mg/L	0.00100	0.00008	2	X952008	AS	01/03/20 11:55	

Metals (Dissolved)

EPA 200.7	Antimony	< 0.020	mg/L	0.020	0.009		X952154	KH	01/03/20 15:17	
EPA 200.7	Beryllium	< 0.0020	mg/L	0.0020	0.0008		X952154	KH	01/03/20 16:23	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0016		X952154	KH	01/03/20 16:23	
EPA 200.7	Chromium	< 0.0060	mg/L	0.0060	0.0020		X952154	KH	01/03/20 15:17	
EPA 200.7	Copper	< 0.0100	mg/L	0.0100	0.0027		X952154	KH	01/03/20 15:17	
EPA 200.7	Iron	< 0.100	mg/L	0.100	0.056		X952154	KH	01/03/20 15:17	
EPA 200.7	Nickel	< 0.0100	mg/L	0.0100	0.0023		X952154	KH	01/03/20 15:17	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0019		X952154	KH	01/03/20 15:17	
EPA 200.7	Zinc	< 0.010	mg/L	0.010	0.005		X952154	KH	01/03/20 15:17	
EPA 200.8	Arsenic	< 0.00300	mg/L	0.00300	0.00021		X952011	AS	01/03/20 10:56	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.00014		X952011	AS	01/03/20 10:56	
EPA 200.8	Selenium	< 0.0030	mg/L	0.0030	0.0002		X952011	AS	01/03/20 10:56	
EPA 200.8	Thallium	< 0.00100	mg/L	0.00100	0.00008		X952011	AS	01/03/20 10:56	

Metals (Filtered)

EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.000093		X953023	JFB	01/02/20 15:08	
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Classical Chemistry Parameters

Calculation	Nitrogen, Total as N	1.48	mg/L	0.600	0.381		N/A		12/31/19 16:31	
EPA 351.2	TKN	< 0.50	mg/L	0.50	0.31		X952170	DT	12/31/19 16:31	
SM 2320 B	Total Alkalinity	149	mg/L as CaCO3	1.0			X951065	KAG	12/20/19 14:00	
SM 2540 C	Total Diss. Solids	172	mg/L	10			X951195	TL	12/20/19 12:40	
SM 2540 D	Total Susp. Solids	< 5.0	mg/L	5.0			X951196	TL	12/20/19 12:40	
SM 4500-P-E	Orthophosphate as P	0.016	mg/L	0.010	0.004		X951177	MH	12/19/19 15:56	
SM 4500-P-E	Phosphorus	< 0.010	mg/L	0.010	0.003		X952095	MH	12/26/19 12:47	



Aspect Consulting
123 E Yakima Avenue Suite 200
Yakima, WA 98901

Project Name: Routine / No Project
Work Order: **X9L0363**
Reported: 10-Feb-20 16:45

Client Sample ID: **MB-SW-191218**
SVL Sample ID: **X9L0363-01 (Surface Water)**

Sampled: 18-Dec-19 10:15
Received: 19-Dec-19
Sampled By: JS

Sample Report Page 2 of 2

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Anions by Ion Chromatography										
EPA 300.0	Chloride	3.91	mg/L	0.20	0.14		X951160	RS	12/19/19 16:52	
EPA 300.0	Nitrate as N	1.47	mg/L	0.050	0.043		X951160	RS	12/19/19 16:52	
EPA 300.0	Nitrate/Nitrite as N	1.48	mg/L	0.100	0.074		X951160	RS	12/19/19 16:52	
EPA 300.0	Nitrite as N	< 0.050	mg/L	0.050	0.031		X951160	RS	12/19/19 16:52	
EPA 300.0	Sulfate as SO4	6.46	mg/L	0.30	0.18		X951160	RS	12/19/19 16:52	

Cation/Anion Balance and TDS Ratios

Cation Sum: 3.22 meq/L Anion Sum: 3.33 meq/L C/A Balance: -1.68 % Calculated TDS: 167 TDS/cTDS: 1.03

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Connor Williams
Project Manager



Aspect Consulting
123 E Yakima Avenue Suite 200
Yakima, WA 98901

Project Name: Routine / No Project
Work Order: **X9L0363**
Reported: 10-Feb-20 16:45

Client Sample ID: **MB1-GW-191218**

Sampled: 18-Dec-19 13:00

Received: 19-Dec-19

Sampled By: JS

SVL Sample ID: **X9L0363-02 (Ground Water)****Sample Report Page 1 of 2**

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
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Metals (Total)

EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.000093		X953018	JFB	01/03/20 13:29	
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Metals (Total Recoverable--reportable as Total per 40 CFR 136)

EPA 200.7	Antimony	< 0.020	mg/L	0.020	0.004		X952158	KH	01/03/20 14:46	
EPA 200.7	Beryllium	< 0.0020	mg/L	0.0020	0.0004		X952158	KH	01/03/20 14:46	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0008		X952158	KH	01/03/20 14:46	
EPA 200.7	Calcium	517	mg/L	0.500	0.345	10	X952158	KH	01/03/20 16:04	D2,M4
EPA 200.7	Chromium	0.0068	mg/L	0.0060	0.0010		X952158	KH	01/03/20 14:46	
EPA 200.7	Copper	< 0.0100	mg/L	0.0100	0.0014		X952158	KH	01/03/20 14:46	
EPA 200.7	Iron	0.936	mg/L	0.100	0.028		X952158	KH	01/03/20 14:46	
EPA 200.7	Magnesium	157	mg/L	0.50	0.04		X952158	KH	01/03/20 14:46	
EPA 200.7	Nickel	< 0.0100	mg/L	0.0100	0.0012		X952158	KH	01/03/20 14:46	
EPA 200.7	Potassium	10.0	mg/L	0.50	0.09		X952158	KH	01/03/20 14:46	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0010		X952158	KH	01/06/20 12:36	
EPA 200.7	Sodium	504	mg/L	2.50	0.60	10	X952158	KH	01/03/20 16:04	D2,M4
EPA 200.7	Tin	< 0.050	mg/L	0.050	0.003		X952158	KH	01/03/20 14:46	
EPA 200.7	Zinc	0.054	mg/L	0.010	0.003		X952158	KH	01/03/20 14:46	
EPA 200.8	Arsenic	< 0.00300	mg/L	0.00300	0.00021	2	X952008	AS	01/03/20 12:04	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.00014	2	X952008	AS	01/03/20 12:04	
EPA 200.8	Selenium	< 0.0030	mg/L	0.0030	0.0002	2	X952008	AS	01/03/20 12:04	
EPA 200.8	Thallium	< 0.00100	mg/L	0.00100	0.00008	2	X952008	AS	01/03/20 12:04	

Metals (Dissolved)

EPA 200.7	Antimony	< 0.020	mg/L	0.020	0.009		X952154	KH	01/03/20 15:21	
EPA 200.7	Beryllium	< 0.0020	mg/L	0.0020	0.0008		X002072	KH	01/07/20 13:27	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0016		X002072	KH	01/07/20 13:27	
EPA 200.7	Chromium	< 0.0060	mg/L	0.0060	0.0020		X952154	KH	01/03/20 15:21	
EPA 200.7	Copper	< 0.0100	mg/L	0.0100	0.0027		X952154	KH	01/03/20 15:21	
EPA 200.7	Iron	< 0.100	mg/L	0.100	0.056		X952154	KH	01/03/20 15:21	
EPA 200.7	Nickel	< 0.0100	mg/L	0.0100	0.0023		X952154	KH	01/03/20 15:21	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0019		X952154	KH	01/03/20 15:21	
EPA 200.7	Tin	< 0.050	mg/L	0.050	0.007		X952154	KH	01/03/20 15:21	
EPA 200.7	Zinc	0.040	mg/L	0.010	0.005		X952154	KH	01/03/20 15:21	
EPA 200.8	Arsenic	< 0.00300	mg/L	0.00300	0.00021		X952011	AS	01/03/20 11:05	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.00014		X952011	AS	01/03/20 11:05	
EPA 200.8	Selenium	< 0.0030	mg/L	0.0030	0.0002		X952011	AS	01/03/20 11:05	
EPA 200.8	Thallium	< 0.00100	mg/L	0.00100	0.00008		X952011	AS	01/03/20 11:05	

Metals (Filtered)

EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.000093		X953023	JFB	01/02/20 15:10	
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Classical Chemistry Parameters

Calculation	Nitrogen, Total as N	1.69	mg/L	0.600	0.381		N/A		12/31/19 16:38	
EPA 351.2	TKN	< 0.50	mg/L	0.50	0.31		X952170	DT	12/31/19 16:38	
SM 2320 B	Total Alkalinity	78.4	mg/L as CaCO3	1.0			X951065	KAG	12/20/19 14:06	
SM 2540 C	Total Diss. Solids	3900	mg/L	100			X951195	TL	12/20/19 12:40	D2
SM 2540 D	Total Susp. Solids	11.0	mg/L	5.0			X951196	TL	12/20/19 12:40	
SM 4500-P-E	Orthophosphate as P	0.016	mg/L	0.010	0.004		X951177	MH	12/19/19 15:56	
SM 4500-P-E	Phosphorus	0.018	mg/L	0.010	0.003		X952095	MH	12/26/19 12:47	

SVL holds the following certifications:

AZ:0538, CA:2080, ID:ID00019 & ID00965 (Microbiology), NV:ID000192007A, UT(TNI):ID000192015-1, WA:C573

Work order Report Page 4 of 18



Aspect Consulting
123 E Yakima Avenue Suite 200
Yakima, WA 98901

Project Name: Routine / No Project
Work Order: **X9L0363**
Reported: 10-Feb-20 16:45

Client Sample ID: **MB1-GW-191218**
SVL Sample ID: **X9L0363-02 (Ground Water)**

Sampled: 18-Dec-19 13:00
Received: 19-Dec-19
Sampled By: JS

Sample Report Page 2 of 2

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Anions by Ion Chromatography										
EPA 300.0	Chloride	2140	mg/L	50.0	35.0	250	X951160	RS	12/19/19 17:39	D2
EPA 300.0	Nitrate as N	1.69	mg/L	0.500	0.430	10	X951160	RS	12/19/19 17:23	D
EPA 300.0	Nitrate/Nitrite as N	1.69	mg/L	0.100	0.074		X951160	RS	12/19/19 17:23	
EPA 300.0	Nitrite as N	< 0.500	mg/L	0.500	0.310	10	X951160	RS	12/19/19 17:23	D
EPA 300.0	Sulfate as SO4	23.7	mg/L	3.00	1.80	10	X951160	RS	12/19/19 17:23	D

Cation/Anion Balance and TDS Ratios

Cation Sum: 60.9 meq/L Anion Sum: 62.6 meq/L C/A Balance: -1.34 % Calculated TDS: 3406 TDS/cTDS: 1.14

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Connor Williams
Project Manager



Aspect Consulting
123 E Yakima Avenue Suite 200
Yakima, WA 98901

Project Name: Routine / No Project
Work Order: **X9L0363**
Reported: 10-Feb-20 16:45

Client Sample ID: **ND-SW-191218**

SVL Sample ID: **X9L0363-03 (Surface Water)**

Sample Report Page 1 of 2

Sampled: 18-Dec-19 15:00
Received: 19-Dec-19
Sampled By: JS

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
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Metals (Total)

EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.000093		X953018	JFB	01/02/20 16:56	
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Metals (Total Recoverable--reportable as Total per 40 CFR 136)

EPA 200.7	Antimony	< 0.020	mg/L	0.020	0.004		X952158	KH	01/03/20 14:55	
EPA 200.7	Beryllium	< 0.0020	mg/L	0.0020	0.0004		X952158	KH	01/03/20 14:55	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0008		X952158	KH	01/03/20 14:55	
EPA 200.7	Calcium	9.84	mg/L	0.100	0.035		X952158	KH	01/03/20 14:55	
EPA 200.7	Chromium	< 0.0060	mg/L	0.0060	0.0010		X952158	KH	01/03/20 14:55	
EPA 200.7	Copper	< 0.0100	mg/L	0.0100	0.0014		X952158	KH	01/03/20 14:55	
EPA 200.7	Iron	0.464	mg/L	0.100	0.028		X952158	KH	01/03/20 14:55	
EPA 200.7	Magnesium	2.23	mg/L	0.50	0.04		X952158	KH	01/03/20 14:55	
EPA 200.7	Nickel	< 0.0100	mg/L	0.0100	0.0012		X952158	KH	01/03/20 14:55	
EPA 200.7	Potassium	1.48	mg/L	0.50	0.09		X952158	KH	01/03/20 14:55	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0010		X952158	KH	01/06/20 12:49	
EPA 200.7	Sodium	7.64	mg/L	0.50	0.06		X952158	KH	01/03/20 14:55	
EPA 200.7	Zinc	< 0.010	mg/L	0.010	0.003		X952158	KH	01/03/20 14:55	
EPA 200.8	Arsenic	< 0.00300	mg/L	0.00300	0.00021	2	X952008	AS	01/03/20 12:07	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.00014	2	X952008	AS	01/03/20 12:07	
EPA 200.8	Selenium	< 0.0030	mg/L	0.0030	0.0002	2	X952008	AS	01/03/20 12:07	
EPA 200.8	Thallium	< 0.00100	mg/L	0.00100	0.00008	2	X952008	AS	01/03/20 12:07	

Metals (Dissolved)

EPA 200.7	Antimony	< 0.020	mg/L	0.020	0.009		X952154	KH	01/03/20 15:32	
EPA 200.7	Beryllium	< 0.0020	mg/L	0.0020	0.0008		X952154	KH	01/03/20 16:36	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0016		X952154	KH	01/03/20 16:36	
EPA 200.7	Chromium	< 0.0060	mg/L	0.0060	0.0020		X952154	KH	01/03/20 15:32	
EPA 200.7	Copper	< 0.0100	mg/L	0.0100	0.0027		X952154	KH	01/03/20 15:32	
EPA 200.7	Iron	0.164	mg/L	0.100	0.056		X952154	KH	01/03/20 15:32	
EPA 200.7	Nickel	< 0.0100	mg/L	0.0100	0.0023		X952154	KH	01/03/20 15:32	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0019		X952154	KH	01/03/20 15:32	
EPA 200.7	Zinc	< 0.010	mg/L	0.010	0.005		X952154	KH	01/03/20 15:32	
EPA 200.8	Arsenic	< 0.00300	mg/L	0.00300	0.00021		X952011	AS	01/03/20 11:08	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.00014		X952011	AS	01/03/20 11:08	
EPA 200.8	Selenium	< 0.0030	mg/L	0.0030	0.0002		X952011	AS	01/03/20 11:08	
EPA 200.8	Thallium	< 0.00100	mg/L	0.00100	0.00008		X952011	AS	01/03/20 11:08	

Metals (Filtered)

EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.000093		X953023	JFB	01/02/20 15:12	
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Classical Chemistry Parameters

Calculation	Nitrogen, Total as N	< 0.600	mg/L	0.600	0.381		N/A		12/31/19 16:39	
EPA 351.2	TKN	< 0.50	mg/L	0.50	0.31		X952170	DT	12/31/19 16:39	
SM 2320 B	Total Alkalinity	42.6	mg/L as CaCO3	1.0			X951065	KAG	12/20/19 14:10	
SM 2540 C	Total Diss. Solids	125	mg/L	10			X951195	TL	12/20/19 12:40	
SM 2540 D	Total Susp. Solids	< 5.0	mg/L	5.0			X951196	TL	12/20/19 12:40	
SM 4500-P-E	Orthophosphate as P	0.039	mg/L	0.010	0.004		X951177	MH	12/19/19 15:56	
SM 4500-P-E	Phosphorus	0.046	mg/L	0.010	0.003		X952095	MH	12/26/19 12:47	



Aspect Consulting
123 E Yakima Avenue Suite 200
Yakima, WA 98901

Project Name: Routine / No Project
Work Order: **X9L0363**
Reported: 10-Feb-20 16:45

Client Sample ID: **ND-SW-191218**
SVL Sample ID: **X9L0363-03 (Surface Water)**

Sampled: 18-Dec-19 15:00
Received: 19-Dec-19
Sampled By: JS

Sample Report Page 2 of 2

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Anions by Ion Chromatography										
EPA 300.0	Chloride	3.34	mg/L	0.20	0.14		X951160	RS	12/19/19 17:54	
EPA 300.0	Nitrate as N	0.102	mg/L	0.050	0.043		X951160	RS	12/19/19 17:54	
EPA 300.0	Nitrate/Nitrite as N	0.102	mg/L	0.100	0.074		X951160	RS	12/19/19 17:54	
EPA 300.0	Nitrite as N	< 0.050	mg/L	0.050	0.031		X951160	RS	12/19/19 17:54	
EPA 300.0	Sulfate as SO4	4.60	mg/L	0.30	0.18		X951160	RS	12/19/19 17:54	

Cation/Anion Balance and TDS Ratios

Cation Sum: 1.05 meq/L Anion Sum: 1.05 meq/L C/A Balance: 0.05 % Calculated TDS: 55 TDS/cTDS: 2.26

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Connor Williams
Project Manager



Aspect Consulting
123 E Yakima Avenue Suite 200
Yakima, WA 98901

Project Name: Routine / No Project
Work Order: **X9L0363**
Reported: 10-Feb-20 16:45

Client Sample ID: **MB-S-03**
SVL Sample ID: **X9L0363-04 (Soil)**

Sampled: 21-Oct-19 00:00
Received: 19-Dec-19
Sampled By: JS

Sample Report Page 1 of 1

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	Calcium	1810	mg/kg dry	20.8	5.1		X952139	KH	01/03/20 10:07	M2,R2B
EPA 6010D	Magnesium	3550	mg/kg dry	104	12.5		X952139	KH	01/03/20 10:07	
EPA 6010D	Phosphorus	298	mg/kg dry	5.2	2.2		X952139	JFB	01/06/20 12:34	M1,M2,R2B
EPA 6010D	Potassium	1480	mg/kg dry	52.1	15.6		X952139	JFB	01/06/20 12:34	M2
EPA 6010D	Sodium	< 52.1	mg/kg dry	52.1	14.6		X952139	KH	01/03/20 10:07	
Anions by Ion Chromatography										
EPA 300.0	Chloride	< 2.1	mg/kg dry	2.1	1.4		X951182	RS	12/31/19 16:24	
EPA 300.0	Nitrate as N	< 0.52	mg/kg dry	0.52	0.22		X951182	RS	12/31/19 16:24	
EPA 300.0	Sulfate as SO4	6.0	mg/kg dry	3.1	2.6		X951182	RS	12/31/19 16:24	
Percent Solids / Percent Moisture										
Percent Solids	% Solids	96.0	%	0.1			X006231	WW/NT	02/10/20 07:45	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Connor Williams
Project Manager



Aspect Consulting
123 E Yakima Avenue Suite 200
Yakima, WA 98901

Project Name: Routine / No Project
Work Order: **X9L0363**
Reported: 10-Feb-20 16:45

Client Sample ID: **ND-S-03**
SVL Sample ID: **X9L0363-05 (Soil)**

Sampled: 23-Oct-19 00:00
Received: 19-Dec-19
Sampled By: JS

Sample Report Page 1 of 1

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	Calcium	1980	mg/kg dry	20.4	5.0		X952139	KH	01/03/20 10:17	
EPA 6010D	Magnesium	4190	mg/kg dry	102	12.3		X952139	KH	01/03/20 10:17	
EPA 6010D	Phosphorus	420	mg/kg dry	5.1	2.1		X952139	JFB	01/06/20 12:45	
EPA 6010D	Potassium	2520	mg/kg dry	51.1	15.3		X952139	JFB	01/06/20 12:45	
EPA 6010D	Sodium	65.8	mg/kg dry	51.1	14.3		X952139	KH	01/03/20 10:17	
Anions by Ion Chromatography										
EPA 300.0	Chloride	< 2.0	mg/kg dry	2.0	1.3		X951182	RS	12/31/19 17:14	
EPA 300.0	Nitrate as N	< 0.51	mg/kg dry	0.51	0.21		X951182	RS	12/31/19 17:14	
EPA 300.0	Sulfate as SO4	< 3.1	mg/kg dry	3.1	2.6		X951182	RS	12/31/19 17:14	
Percent Solids / Percent Moisture										
Percent Solids	% Solids	97.9	%	0.1			X006231	WW/NT	02/10/20 07:45	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Connor Williams
Project Manager



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123 E Yakima Avenue Suite 200
Yakima, WA 98901

Project Name: Routine / No Project
Work Order: **X9L0363**
Reported: 10-Feb-20 16:45

Client Sample ID: **ND1-S-45**
SVL Sample ID: **X9L0363-06 (Soil)**

Sampled: 13-Dec-19 00:00
Received: 19-Dec-19
Sampled By: JS

Sample Report Page 1 of 1

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
Metals (Total) by EPA 6000/7000 Methods										
EPA 6010D	Calcium	2640	mg/kg dry	20.6	5.1		X952139	KH	01/03/20 10:20	
EPA 6010D	Magnesium	4240	mg/kg dry	103	12.4		X952139	KH	01/03/20 10:20	
EPA 6010D	Phosphorus	480	mg/kg dry	5.2	2.2		X952139	JFB	01/06/20 12:49	
EPA 6010D	Potassium	3050	mg/kg dry	51.6	15.5		X952139	JFB	01/06/20 12:49	
EPA 6010D	Sodium	100	mg/kg dry	51.6	14.5		X952139	KH	01/03/20 10:20	
Anions by Ion Chromatography										
EPA 300.0	Chloride	< 2.1	mg/kg dry	2.1	1.3		X951182	RS	12/31/19 17:31	
EPA 300.0	Nitrate as N	< 0.52	mg/kg dry	0.52	0.22		X951182	RS	12/31/19 17:31	
EPA 300.0	Sulfate as SO4	< 3.1	mg/kg dry	3.1	2.6		X951182	RS	12/31/19 17:31	
Percent Solids / Percent Moisture										
Percent Solids	% Solids	96.9	%	0.1			X006231	WW/NT	02/10/20 07:45	

This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Connor Williams
Project Manager



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123 E Yakima Avenue Suite 200
Yakima, WA 98901

Project Name: Routine / No Project
Work Order: **X9L0363**
Reported: 10-Feb-20 16:45

Client Sample ID: **SCWR01-191218**
SVL Sample ID: **X9L0363-07 (Water)**

Sampled: 18-Dec-19 13:30
Received: 19-Dec-19
Sampled By: JS

Sample Report Page 1 of 1

Method	Analyte	Result	Units	RL	MDL	Dilution	Batch	Analyst	Analyzed	Notes
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Metals (Total)

EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.000093		X953018	JFB	01/03/20 13:34	
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Metals (Total Recoverable--reportable as Total per 40 CFR 136)

EPA 200.7	Antimony	< 0.020	mg/L	0.020	0.004		X952158	KH	01/03/20 14:57	
EPA 200.7	Beryllium	< 0.0020	mg/L	0.0020	0.0004		X952158	KH	01/03/20 14:57	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0008		X952158	KH	01/03/20 14:57	
EPA 200.7	Calcium	0.104	mg/L	0.100	0.035		X952158	KH	01/03/20 14:57	
EPA 200.7	Chromium	< 0.0060	mg/L	0.0060	0.0010		X952158	KH	01/03/20 14:57	
EPA 200.7	Copper	< 0.0100	mg/L	0.0100	0.0014		X952158	KH	01/03/20 14:57	
EPA 200.7	Iron	< 0.100	mg/L	0.100	0.028		X952158	KH	01/03/20 14:57	
EPA 200.7	Magnesium	< 0.50	mg/L	0.50	0.04		X952158	KH	01/03/20 14:57	
EPA 200.7	Nickel	< 0.0100	mg/L	0.0100	0.0012		X952158	KH	01/03/20 14:57	
EPA 200.7	Potassium	< 0.50	mg/L	0.50	0.09		X952158	KH	01/03/20 14:57	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0010		X952158	KH	01/06/20 12:53	
EPA 200.7	Sodium	< 0.50	mg/L	0.50	0.06		X952158	KH	01/03/20 14:57	
EPA 200.7	Zinc	< 0.010	mg/L	0.010	0.003		X952158	KH	01/03/20 14:57	
EPA 200.8	Arsenic	< 0.00300	mg/L	0.00300	0.00021	2	X952008	AS	01/03/20 12:10	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.00014	2	X952008	AS	01/03/20 12:10	
EPA 200.8	Selenium	< 0.0030	mg/L	0.0030	0.0002	2	X952008	AS	01/03/20 12:10	
EPA 200.8	Thallium	< 0.00100	mg/L	0.00100	0.00008	2	X952008	AS	01/03/20 12:10	

Metals (Dissolved)

EPA 200.7	Antimony	< 0.020	mg/L	0.020	0.009		X952154	KH	01/03/20 15:36	
EPA 200.7	Beryllium	< 0.0020	mg/L	0.0020	0.0008		X952154	KH	01/03/20 16:39	
EPA 200.7	Cadmium	< 0.0020	mg/L	0.0020	0.0016		X952154	KH	01/03/20 16:39	
EPA 200.7	Chromium	< 0.0060	mg/L	0.0060	0.0020		X952154	KH	01/03/20 15:36	
EPA 200.7	Copper	< 0.0100	mg/L	0.0100	0.0027		X952154	KH	01/03/20 15:36	
EPA 200.7	Iron	< 0.100	mg/L	0.100	0.056		X952154	KH	01/03/20 15:36	
EPA 200.7	Nickel	< 0.0100	mg/L	0.0100	0.0023		X952154	KH	01/03/20 15:36	
EPA 200.7	Silver	< 0.0050	mg/L	0.0050	0.0019		X952154	KH	01/03/20 15:36	
EPA 200.7	Zinc	< 0.010	mg/L	0.010	0.005		X952154	KH	01/03/20 15:36	
EPA 200.8	Arsenic	< 0.00300	mg/L	0.00300	0.00021		X952011	AS	01/03/20 11:11	
EPA 200.8	Lead	< 0.00300	mg/L	0.00300	0.00014		X952011	AS	01/03/20 11:11	
EPA 200.8	Selenium	< 0.0030	mg/L	0.0030	0.0002		X952011	AS	01/03/20 11:11	
EPA 200.8	Thallium	< 0.00100	mg/L	0.00100	0.00008		X952011	AS	01/03/20 11:11	

Metals (Filtered)

EPA 245.1	Mercury	< 0.00020	mg/L	0.00020	0.000093		X953023	JFB	01/02/20 15:21	
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This data has been reviewed for accuracy and has been authorized for release by the Laboratory Director or designee.

Connor Williams
Project Manager



Aspect Consulting
123 E Yakima Avenue Suite 200
Yakima, WA 98901

Project Name: Routine / No Project
Work Order: **X9L0363**
Reported: 10-Feb-20 16:45

Quality Control - BLANK Data

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
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Metals (Total)

EPA 245.1	Mercury	mg/L	<0.00020	0.000093	0.00020	X953018	02-Jan-20	
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Metals (Total) by EPA 6000/7000 Methods

EPA 6010D	Calcium	mg/kg	<20.0	4.9	20.0	X952139	03-Jan-20	
EPA 6010D	Magnesium	mg/kg	<100	12.0	100	X952139	03-Jan-20	
EPA 6010D	Phosphorus	mg/kg	<5.0	2.1	5.0	X952139	06-Jan-20	
EPA 6010D	Potassium	mg/kg	<50.0	15.0	50.0	X952139	06-Jan-20	
EPA 6010D	Sodium	mg/kg	<50.0	14.0	50.0	X952139	03-Jan-20	

Metals (Total Recoverable--reportable as Total per 40 CFR 136)

EPA 200.7	Antimony	mg/L	<0.020	0.004	0.020	X952158	03-Jan-20	
EPA 200.7	Beryllium	mg/L	<0.0020	0.0004	0.0020	X952158	03-Jan-20	
EPA 200.7	Cadmium	mg/L	<0.0020	0.0008	0.0020	X952158	03-Jan-20	
EPA 200.7	Calcium	mg/L	<0.100	0.035	0.100	X952158	03-Jan-20	
EPA 200.7	Chromium	mg/L	<0.0060	0.0010	0.0060	X952158	03-Jan-20	
EPA 200.7	Copper	mg/L	<0.0100	0.0014	0.0100	X952158	03-Jan-20	
EPA 200.7	Iron	mg/L	<0.100	0.028	0.100	X952158	03-Jan-20	
EPA 200.7	Magnesium	mg/L	<0.50	0.04	0.50	X952158	03-Jan-20	
EPA 200.7	Nickel	mg/L	<0.0100	0.0012	0.0100	X952158	03-Jan-20	
EPA 200.7	Potassium	mg/L	<0.50	0.09	0.50	X952158	03-Jan-20	
EPA 200.7	Silver	mg/L	<0.0050	0.0010	0.0050	X952158	06-Jan-20	
EPA 200.7	Sodium	mg/L	<0.50	0.06	0.50	X952158	03-Jan-20	
EPA 200.7	Tin	mg/L	<0.050	0.003	0.050	X952158	03-Jan-20	
EPA 200.7	Zinc	mg/L	<0.010	0.003	0.010	X952158	03-Jan-20	
EPA 200.8	Arsenic	mg/L	<0.00300	0.00021	0.00300	X952008	03-Jan-20	
EPA 200.8	Lead	mg/L	<0.00300	0.00014	0.00300	X952008	03-Jan-20	
EPA 200.8	Selenium	mg/L	<0.0030	0.0002	0.0030	X952008	03-Jan-20	
EPA 200.8	Thallium	mg/L	<0.00100	0.00008	0.00100	X952008	03-Jan-20	

Metals (Dissolved)

EPA 200.7	Antimony	mg/L	<0.020	0.009	0.020	X952154	03-Jan-20	
EPA 200.7	Beryllium	mg/L	<0.0020	0.0008	0.0020	X002072	07-Jan-20	
EPA 200.7	Beryllium	mg/L	<0.0020	0.0008	0.0020	X952154	03-Jan-20	
EPA 200.7	Cadmium	mg/L	<0.0020	0.0016	0.0020	X002072	07-Jan-20	
EPA 200.7	Cadmium	mg/L	<0.0020	0.0016	0.0020	X952154	03-Jan-20	
EPA 200.7	Chromium	mg/L	<0.0060	0.0020	0.0060	X952154	03-Jan-20	
EPA 200.7	Copper	mg/L	<0.0100	0.0027	0.0100	X952154	03-Jan-20	
EPA 200.7	Iron	mg/L	<0.100	0.056	0.100	X952154	03-Jan-20	
EPA 200.7	Nickel	mg/L	<0.0100	0.0023	0.0100	X952154	03-Jan-20	
EPA 200.7	Silver	mg/L	<0.0050	0.0019	0.0050	X952154	03-Jan-20	
EPA 200.7	Tin	mg/L	<0.050	0.007	0.050	X952154	03-Jan-20	
EPA 200.7	Zinc	mg/L	<0.010	0.005	0.010	X952154	03-Jan-20	
EPA 200.8	Arsenic	mg/L	<0.00300	0.00021	0.00300	X952011	03-Jan-20	
EPA 200.8	Lead	mg/L	<0.00300	0.00014	0.00300	X952011	03-Jan-20	
EPA 200.8	Selenium	mg/L	<0.0030	0.0002	0.0030	X952011	03-Jan-20	
EPA 200.8	Thallium	mg/L	<0.00100	0.00008	0.00100	X952011	03-Jan-20	

Metals (Filtered)

EPA 245.1	Mercury	mg/L	<0.00020	0.000093	0.00020	X953023	02-Jan-20	
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Classical Chemistry Parameters

EPA 351.2	TKN	mg/L	<0.50	0.31	0.50	X952170	31-Dec-19	
SM 2320 B	Total Alkalinity	mg/L as CaCO3	<1.0		1.0	X951065	20-Dec-19	
SM 2540 C	Total Diss. Solids	mg/L	<10		10	X951195	20-Dec-19	
SM 2540 D	Total Susp. Solids	mg/L	<5.0		5.0	X951196	20-Dec-19	
SM 4500-P-E	Orthophosphate as P	mg/L	<0.010	0.004	0.010	X951177	19-Dec-19	
SM 4500-P-E	Phosphorus	mg/L	<0.010	0.003	0.010	X952095	26-Dec-19	



Aspect Consulting
123 E Yakima Avenue Suite 200
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Project Name: Routine / No Project
Work Order: **X9L0363**
Reported: 10-Feb-20 16:45

Quality Control - BLANK Data (Continued)

Method	Analyte	Units	Result	MDL	MRL	Batch ID	Analyzed	Notes
Anions by Ion Chromatography								
EPA 300.0	Chloride	mg/kg	<2.0	1.3	2.0	X951182	31-Dec-19	
EPA 300.0	Nitrate as N	mg/kg	<0.50	0.21	0.50	X951182	31-Dec-19	
EPA 300.0	Sulfate as SO4	mg/kg	<3.0	2.5	3.0	X951182	31-Dec-19	
EPA 300.0	Chloride	mg/L	<0.20	0.14	0.20	X951160	19-Dec-19	
EPA 300.0	Nitrate as N	mg/L	<0.050	0.043	0.050	X951160	19-Dec-19	
EPA 300.0	Nitrate/Nitrite as N	mg/L	<0.100	0.074	0.100	X951160	19-Dec-19	
EPA 300.0	Nitrite as N	mg/L	<0.050	0.031	0.050	X951160	19-Dec-19	
EPA 300.0	Sulfate as SO4	mg/L	<0.30	0.18	0.30	X951160	19-Dec-19	

Quality Control - LABORATORY CONTROL SAMPLE Data

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
Metals (Total)									
EPA 245.1	Mercury	mg/L	0.00507	0.00500	101	85 - 115	X953018	02-Jan-20	
Metals (Total) by EPA 6000/7000 Methods									
EPA 6010D	Calcium	mg/kg	1860	2000	93.2	80 - 120	X952139	03-Jan-20	
EPA 6010D	Magnesium	mg/kg	1820	2000	91.1	80 - 120	X952139	03-Jan-20	
EPA 6010D	Phosphorus	mg/kg	104	100	104	80 - 120	X952139	06-Jan-20	
EPA 6010D	Potassium	mg/kg	1960	2000	98.2	80 - 120	X952139	06-Jan-20	
EPA 6010D	Sodium	mg/kg	1750	1900	92.2	80 - 120	X952139	03-Jan-20	
Metals (Total Recoverable--reportable as Total per 40 CFR 136)									
EPA 200.7	Antimony	mg/L	1.06	1.00	106	85 - 115	X952158	03-Jan-20	
EPA 200.7	Beryllium	mg/L	1.04	1.00	104	85 - 115	X952158	03-Jan-20	
EPA 200.7	Cadmium	mg/L	1.04	1.00	104	85 - 115	X952158	03-Jan-20	
EPA 200.7	Calcium	mg/L	19.5	20.0	97.3	85 - 115	X952158	03-Jan-20	
EPA 200.7	Chromium	mg/L	1.05	1.00	105	85 - 115	X952158	03-Jan-20	
EPA 200.7	Copper	mg/L	1.02	1.00	102	85 - 115	X952158	03-Jan-20	
EPA 200.7	Iron	mg/L	9.83	10.0	98.3	85 - 115	X952158	03-Jan-20	
EPA 200.7	Magnesium	mg/L	19.8	20.0	99.2	85 - 115	X952158	03-Jan-20	
EPA 200.7	Nickel	mg/L	1.02	1.00	102	85 - 115	X952158	03-Jan-20	
EPA 200.7	Potassium	mg/L	20.7	20.0	104	85 - 115	X952158	03-Jan-20	
EPA 200.7	Silver	mg/L	0.0514	0.0500	103	85 - 115	X952158	06-Jan-20	
EPA 200.7	Sodium	mg/L	18.9	19.0	99.6	85 - 115	X952158	03-Jan-20	
EPA 200.7	Tin	mg/L	1.08	1.00	108	85 - 115	X952158	03-Jan-20	
EPA 200.7	Zinc	mg/L	1.05	1.00	105	85 - 115	X952158	03-Jan-20	
EPA 200.8	Arsenic	mg/L	0.0242	0.0250	96.8	85 - 115	X952008	03-Jan-20	
EPA 200.8	Lead	mg/L	0.0232	0.0250	92.8	85 - 115	X952008	03-Jan-20	
EPA 200.8	Selenium	mg/L	0.0217	0.0250	86.8	85 - 115	X952008	03-Jan-20	
EPA 200.8	Thallium	mg/L	0.0250	0.0250	100	85 - 115	X952008	03-Jan-20	
Metals (Dissolved)									
EPA 200.7	Antimony	mg/L	0.936	1.00	93.6	85 - 115	X952154	03-Jan-20	
EPA 200.7	Beryllium	mg/L	1.01	1.00	101	85 - 115	X952154	03-Jan-20	
EPA 200.7	Beryllium	mg/L	1.00	1.00	100	85 - 115	X002072	07-Jan-20	
EPA 200.7	Cadmium	mg/L	1.03	1.00	103	85 - 115	X952154	03-Jan-20	
EPA 200.7	Cadmium	mg/L	0.998	1.00	99.8	85 - 115	X002072	07-Jan-20	
EPA 200.7	Chromium	mg/L	1.04	1.00	104	85 - 115	X952154	03-Jan-20	
EPA 200.7	Copper	mg/L	0.989	1.00	98.9	85 - 115	X952154	03-Jan-20	
EPA 200.7	Iron	mg/L	8.96	10.0	89.6	85 - 115	X952154	03-Jan-20	
EPA 200.7	Nickel	mg/L	0.935	1.00	93.5	85 - 115	X952154	03-Jan-20	
EPA 200.7	Silver	mg/L	0.0488	0.0500	97.5	85 - 115	X952154	03-Jan-20	



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Project Name: Routine / No Project
Work Order: **X9L0363**
Reported: 10-Feb-20 16:45

Quality Control - LABORATORY CONTROL SAMPLE Data (Continued)

Method	Analyte	Units	LCS Result	LCS True	% Rec.	Acceptance Limits	Batch ID	Analyzed	Notes
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Metals (Dissolved) (Continued)

EPA 200.7	Tin	mg/L	0.977	1.00	97.7	85 - 115	X952154	03-Jan-20	
EPA 200.7	Zinc	mg/L	0.975	1.00	97.5	85 - 115	X952154	03-Jan-20	
EPA 200.8	Arsenic	mg/L	0.0232	0.0250	92.9	85 - 115	X952011	03-Jan-20	
EPA 200.8	Lead	mg/L	0.0244	0.0250	97.5	85 - 115	X952011	03-Jan-20	
EPA 200.8	Selenium	mg/L	0.0222	0.0250	88.7	85 - 115	X952011	03-Jan-20	
EPA 200.8	Thallium	mg/L	0.0250	0.0250	100	85 - 115	X952011	03-Jan-20	

Metals (Filtered)

EPA 245.1	Mercury	mg/L	0.00522	0.00500	104	85 - 115	X953023	02-Jan-20	
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Classical Chemistry Parameters

EPA 351.2	TKN	mg/L	7.82	8.00	97.7	90 - 110	X952170	31-Dec-19	
SM 2320 B	Total Alkalinity	mg/L as CaCO3	102	99.3	103	94.3 - 106	X951065	20-Dec-19	
SM 4500-P-E	Orthophosphate as P	mg/L	0.728	0.743	98.0	90 - 110	X951177	19-Dec-19	
SM 4500-P-E	Phosphorus	mg/L	0.382	0.374	102	90 - 110	X952095	26-Dec-19	D

Anions by Ion Chromatography

EPA 300.0	Chloride	mg/kg	29.9	30.0	99.6	80 - 120	X951182	31-Dec-19	
EPA 300.0	Nitrate as N	mg/kg	20.4	20.0	102	80 - 120	X951182	31-Dec-19	
EPA 300.0	Sulfate as SO4	mg/kg	102	100	102	80 - 120	X951182	31-Dec-19	
EPA 300.0	Chloride	mg/L	3.08	3.00	103	90 - 110	X951160	19-Dec-19	
EPA 300.0	Nitrate as N	mg/L	2.11	2.00	106	90 - 110	X951160	19-Dec-19	
EPA 300.0	Nitrate/Nitrite as N	mg/L	4.79	4.50	106	90 - 110	X951160	19-Dec-19	
EPA 300.0	Nitrite as N	mg/L	2.68	2.50	107	90 - 110	X951160	19-Dec-19	
EPA 300.0	Sulfate as SO4	mg/L	10.5	10.0	105	90 - 110	X951160	19-Dec-19	

Quality Control - DUPLICATE Data

Method	Analyte	Units	Duplicate Result	Sample Result	RPD	RPD Limit	Batch ID	Analyzed	Notes
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Classical Chemistry Parameters

SM 2320 B	Total Alkalinity	mg/L as CaCO3	16.3	15.7	4.0	20	X951065	20-Dec-19	
SM 2540 C	Total Diss. Solids	mg/L	296	291	1.7	10	X951195	20-Dec-19	
SM 2540 D	Total Susp. Solids	mg/L	18.0	17.0	5.7	10	X951196	20-Dec-19	

Percent Solids / Percent Moisture

Percent Solids	% Solids	%	95.3	96.0	0.8	20	X006231	10-Feb-20	
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Quality Control - MATRIX SPIKE Data

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Recovery	Acceptance Limits	Batch ID	Analyzed	Notes
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Metals (Total)

EPA 245.1	Mercury	mg/L	0.00100	<0.00020	0.00100	99.7	70 - 130	X953018	02-Jan-20	
EPA 245.1	Mercury	mg/L	0.00103	<0.00020	0.00100	103	70 - 130	X953018	02-Jan-20	

Metals (Total) by EPA 6000/7000 Methods

EPA 6010D	Calcium	mg/kg	2650	1810	2080	40.5	75 - 125	X952139	03-Jan-20	M2,R2B
EPA 6010D	Magnesium	mg/kg	5300	3550	2080	84.4	75 - 125	X952139	03-Jan-20	
EPA 6010D	Phosphorus	mg/kg	264	298	104	-32.2	75 - 125	X952139	06-Jan-20	M2,R2B
EPA 6010D	Potassium	mg/kg	2990	1480	2080	72.4	75 - 125	X952139	06-Jan-20	M2
EPA 6010D	Sodium	mg/kg	1850	<52.1	1980	91.1	75 - 125	X952139	03-Jan-20	

Metals (Total Recoverable--reportable as Total per 40 CFR 136)

EPA 200.7	Antimony	mg/L	1.06	<0.020	1.00	105	70 - 130	X952158	03-Jan-20	
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Project Name: Routine / No Project
Work Order: X9L0363
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Quality Control - MATRIX SPIKE Data (Continued)

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Recovery	Acceptance Limits	Batch ID	Analyzed	Notes
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Metals (Total Recoverable--reportable as Total per 40 CFR 136) (Continued)

EPA 200.7	Antimony	mg/L	1.53	0.444	1.00	109	70 - 130	X952158	03-Jan-20	D1
EPA 200.7	Beryllium	mg/L	1.01	<0.0020	1.00	101	70 - 130	X952158	03-Jan-20	
EPA 200.7	Beryllium	mg/L	1.22	0.165	1.00	106	70 - 130	X952158	03-Jan-20	D1
EPA 200.7	Cadmium	mg/L	0.960	<0.0020	1.00	96.0	70 - 130	X952158	03-Jan-20	
EPA 200.7	Cadmium	mg/L	3.87	2.82	1.00	105	70 - 130	X952158	03-Jan-20	D1
EPA 200.7	Calcium	mg/L	324	140	20.0	0.30R>S	70 - 130	X952158	03-Jan-20	D1,M4
EPA 200.7	Calcium	mg/L	514	517	20.0	0.30R>S	70 - 130	X952158	03-Jan-20	D2,M4
EPA 200.7	Chromium	mg/L	1.00	0.0068	1.00	99.8	70 - 130	X952158	03-Jan-20	
EPA 200.7	Chromium	mg/L	1.15	0.124	1.00	102	70 - 130	X952158	03-Jan-20	D1
EPA 200.7	Copper	mg/L	1.08	<0.0100	1.00	107	70 - 130	X952158	03-Jan-20	
EPA 200.7	Copper	mg/L	275	278	1.00	0.30R>S	70 - 130	X952158	03-Jan-20	D2,M4
EPA 200.7	Iron	mg/L	10.4	0.936	10.0	94.8	70 - 130	X952158	03-Jan-20	
EPA 200.7	Iron	mg/L	145	133	10.0	117	70 - 130	X952158	03-Jan-20	D1
EPA 200.7	Magnesium	mg/L	175	157	20.0	88.6	70 - 130	X952158	03-Jan-20	
EPA 200.7	Magnesium	mg/L	2360	2270	20.0	0.30R>S	70 - 130	X952158	03-Jan-20	D2,M4
EPA 200.7	Nickel	mg/L	0.953	<0.0100	1.00	94.7	70 - 130	X952158	03-Jan-20	
EPA 200.7	Nickel	mg/L	9.42	8.59	1.00	83.8	70 - 130	X952158	03-Jan-20	D1
EPA 200.7	Potassium	mg/L	32.5	10.0	20.0	113	70 - 130	X952158	03-Jan-20	
EPA 200.7	Potassium	mg/L	23.0	<2.50	20.0	104	70 - 130	X952158	03-Jan-20	D1
EPA 200.7	Silver	mg/L	0.0559	<0.0050	0.0500	112	70 - 130	X952158	06-Jan-20	
EPA 200.7	Silver	mg/L	0.0681	<0.0250	0.0500	106	70 - 130	X952158	06-Jan-20	
EPA 200.7	Sodium	mg/L	37.6	18.1	19.0	103	70 - 130	X952158	03-Jan-20	D1
EPA 200.7	Sodium	mg/L	502	504	19.0	0.30R>S	70 - 130	X952158	03-Jan-20	D2,M4
EPA 200.7	Tin	mg/L	1.01	<0.050	1.00	101	70 - 130	X952158	03-Jan-20	
EPA 200.7	Tin	mg/L	1.09	<0.250	1.00	109	70 - 130	X952158	03-Jan-20	D1
EPA 200.7	Zinc	mg/L	1.08	0.054	1.00	103	70 - 130	X952158	03-Jan-20	
EPA 200.7	Zinc	mg/L	659	667	1.00	0.30R>S	70 - 130	X952158	03-Jan-20	D2,M4
EPA 200.8	Arsenic	mg/L	0.0248	<0.00300	0.0250	94.5	70 - 130	X952008	03-Jan-20	
EPA 200.8	Lead	mg/L	0.0224	<0.00300	0.0250	89.7	70 - 130	X952008	03-Jan-20	
EPA 200.8	Selenium	mg/L	0.0220	<0.0030	0.0250	88.1	70 - 130	X952008	03-Jan-20	
EPA 200.8	Thallium	mg/L	0.0235	<0.00100	0.0250	94.1	70 - 130	X952008	03-Jan-20	

Metals (Dissolved)

EPA 200.7	Antimony	mg/L	0.948	<0.020	1.00	94.8	70 - 130	X952154	03-Jan-20	
EPA 200.7	Beryllium	mg/L	1.03	0.0051	1.00	102	70 - 130	X952154	03-Jan-20	
EPA 200.7	Beryllium	mg/L	1.01	<0.0020	1.00	101	70 - 130	X002072	07-Jan-20	
EPA 200.7	Cadmium	mg/L	1.07	0.0044	1.00	106	70 - 130	X952154	03-Jan-20	
EPA 200.7	Cadmium	mg/L	1.00	<0.0020	1.00	100	70 - 130	X002072	07-Jan-20	
EPA 200.7	Chromium	mg/L	1.02	<0.0060	1.00	102	70 - 130	X952154	03-Jan-20	
EPA 200.7	Copper	mg/L	0.986	<0.0100	1.00	98.3	70 - 130	X952154	03-Jan-20	
EPA 200.7	Iron	mg/L	8.94	<0.100	10.0	89.4	70 - 130	X952154	03-Jan-20	
EPA 200.7	Nickel	mg/L	0.906	<0.0100	1.00	90.3	70 - 130	X952154	03-Jan-20	
EPA 200.7	Silver	mg/L	0.0490	<0.0050	0.0500	98.1	70 - 130	X952154	03-Jan-20	
EPA 200.7	Tin	mg/L	0.963	<0.050	1.00	96.3	70 - 130	X952154	03-Jan-20	
EPA 200.7	Zinc	mg/L	1.00	0.040	1.00	96.2	70 - 130	X952154	03-Jan-20	
EPA 200.8	Arsenic	mg/L	0.0254	<0.00300	0.0250	97.1	70 - 130	X952011	03-Jan-20	
EPA 200.8	Lead	mg/L	0.0216	<0.00300	0.0250	86.6	70 - 130	X952011	03-Jan-20	
EPA 200.8	Selenium	mg/L	0.0263	<0.0030	0.0250	105	70 - 130	X952011	03-Jan-20	
EPA 200.8	Thallium	mg/L	0.0221	<0.00100	0.0250	88.4	70 - 130	X952011	03-Jan-20	

Metals (Filtered)

EPA 245.1	Mercury	mg/L	0.00101	<0.00020	0.00100	101	70 - 130	X953023	02-Jan-20	
EPA 245.1	Mercury	mg/L	0.00094	<0.00020	0.00100	94.1	70 - 130	X953023	02-Jan-20	

Classical Chemistry Parameters

EPA 351.2	TKN	mg/L	8.93	0.84	8.00	101	90 - 110	X952170	31-Dec-19	
EPA 351.2	TKN	mg/L	8.61	0.77	8.00	98.0	90 - 110	X952170	31-Dec-19	



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Project Name: Routine / No Project
Work Order: **X9L0363**
Reported: 10-Feb-20 16:45

Quality Control - MATRIX SPIKE Data (Continued)

Method	Analyte	Units	Spike Result	Sample Result (R)	Spike Level (S)	% Recovery	Acceptance Limits	Batch ID	Analyzed	Notes
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Classical Chemistry Parameters (Continued)

SM 4500-P-E	Orthophosphate as P	mg/L	0.517	0.016	0.500	100	75 - 125	X951177	19-Dec-19	
SM 4500-P-E	Phosphorus	mg/L	0.508	<0.020	0.500	102	75 - 125	X952095	26-Dec-19	D

Anions by Ion Chromatography

EPA 300.0	Chloride	mg/kg	31.2	<2.1	31.3	99.7	75 - 125	X951182	31-Dec-19	
EPA 300.0	Nitrate as N	mg/kg	21.6	<0.52	20.8	102	75 - 125	X951182	31-Dec-19	
EPA 300.0	Sulfate as SO4	mg/kg	109	6.0	104	99.1	75 - 125	X951182	31-Dec-19	
EPA 300.0	Chloride	mg/L	3.68	0.48	3.00	107	90 - 110	X951160	19-Dec-19	
EPA 300.0	Chloride	mg/L	6.60	3.34	3.00	109	90 - 110	X951160	19-Dec-19	
EPA 300.0	Nitrate as N	mg/L	2.19	<0.050	2.00	109	90 - 110	X951160	19-Dec-19	
EPA 300.0	Nitrate as N	mg/L	2.31	0.102	2.00	110	90 - 110	X951160	19-Dec-19	
EPA 300.0	Nitrate/Nitrite as N	mg/L	4.37	<0.100	4.00	109	90 - 110	X951160	19-Dec-19	
EPA 300.0	Nitrate/Nitrite as N	mg/L	4.47	0.102	4.00	109	90 - 110	X951160	19-Dec-19	
EPA 300.0	Nitrite as N	mg/L	2.18	<0.050	2.00	109	90 - 110	X951160	19-Dec-19	
EPA 300.0	Nitrite as N	mg/L	2.16	<0.050	2.00	108	90 - 110	X951160	19-Dec-19	
EPA 300.0	Sulfate as SO4	mg/L	18.5	7.77	10.0	107	90 - 110	X951160	19-Dec-19	
EPA 300.0	Sulfate as SO4	mg/L	15.2	4.60	10.0	106	90 - 110	X951160	19-Dec-19	

Quality Control - MATRIX SPIKE DUPLICATE Data

Method	Analyte	Units	MSD Result	Spike Result	Spike Level	% Rec.	RPD	RPD Limit	Batch ID	Analyzed	Notes
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Metals (Total)

EPA 245.1	Mercury	mg/L	0.00097	0.00103	0.00100	97.4	5.7	20	X953018	02-Jan-20	
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Metals (Total) by EPA 6000/7000 Methods

EPA 6010D	Calcium	mg/kg	3830	2650	2080	97.2	36.4	20	X952139	03-Jan-20	R2B
EPA 6010D	Magnesium	mg/kg	5690	5300	2080	103	7.0	20	X952139	03-Jan-20	
EPA 6010D	Phosphorus	mg/kg	530	264	104	223	67.0	20	X952139	06-Jan-20	M1,R2B
EPA 6010D	Potassium	mg/kg	3650	2990	2080	104	19.8	20	X952139	06-Jan-20	
EPA 6010D	Sodium	mg/kg	1890	1850	1980	93.1	2.1	20	X952139	03-Jan-20	

Metals (Total Recoverable--reportable as Total per 40 CFR 136)

EPA 200.7	Antimony	mg/L	1.07	1.06	1.00	106	0.5	20	X952158	03-Jan-20	
EPA 200.7	Beryllium	mg/L	1.01	1.01	1.00	101	0.4	20	X952158	03-Jan-20	
EPA 200.7	Cadmium	mg/L	0.963	0.960	1.00	96.3	0.3	20	X952158	03-Jan-20	
EPA 200.7	Calcium	mg/L	515	514	20.0	0.30R>S	0.1	20	X952158	03-Jan-20	D2,M4
EPA 200.7	Chromium	mg/L	0.996	1.00	1.00	98.9	0.8	20	X952158	03-Jan-20	
EPA 200.7	Copper	mg/L	1.07	1.08	1.00	106	0.8	20	X952158	03-Jan-20	
EPA 200.7	Iron	mg/L	10.4	10.4	10.0	94.5	0.3	20	X952158	03-Jan-20	
EPA 200.7	Magnesium	mg/L	176	175	20.0	97.5	1.0	20	X952158	03-Jan-20	
EPA 200.7	Nickel	mg/L	0.955	0.953	1.00	94.9	0.2	20	X952158	03-Jan-20	
EPA 200.7	Potassium	mg/L	32.3	32.5	20.0	112	0.6	20	X952158	03-Jan-20	
EPA 200.7	Silver	mg/L	0.0545	0.0559	0.0500	109	2.7	20	X952158	06-Jan-20	
EPA 200.7	Sodium	mg/L	502	502	19.0	0.30R>S	0.0	20	X952158	03-Jan-20	D2,M4
EPA 200.7	Tin	mg/L	1.02	1.01	1.00	101	0.7	20	X952158	03-Jan-20	
EPA 200.7	Zinc	mg/L	1.08	1.08	1.00	103	0.2	20	X952158	03-Jan-20	
EPA 200.8	Arsenic	mg/L	0.0250	0.0248	0.0250	95.5	1.0	20	X952008	03-Jan-20	
EPA 200.8	Lead	mg/L	0.0236	0.0224	0.0250	94.3	5.0	20	X952008	03-Jan-20	
EPA 200.8	Selenium	mg/L	0.0221	0.0220	0.0250	88.2	0.2	20	X952008	03-Jan-20	
EPA 200.8	Thallium	mg/L	0.0251	0.0235	0.0250	100	6.6	20	X952008	03-Jan-20	

Metals (Dissolved)

EPA 200.7	Antimony	mg/L	0.964	0.948	1.00	96.4	1.7	20	X952154	03-Jan-20	
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SVL holds the following certifications:

AZ:0538, CA:2080, ID:ID00019 & ID00965 (Microbiology), NV:ID000192007A, UT(TNI):ID000192015-1, WA:C573



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Project Name: Routine / No Project
 Work Order: **X9L0363**
 Reported: 10-Feb-20 16:45

Quality Control - MATRIX SPIKE DUPLICATE Data (Continued)

Method	Analyte	Units	MSD Result	Spike Result	Spike Level	% Rec.	RPD	RPD Limit	Batch ID	Analyzed	Notes
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Metals (Dissolved) (Continued)

EPA 200.7	Beryllium	mg/L	1.03	1.01	1.00	103	1.7	20	X002072	07-Jan-20	
EPA 200.7	Beryllium	mg/L	1.01	1.03	1.00	101	1.5	20	X952154	03-Jan-20	
EPA 200.7	Cadmium	mg/L	1.02	1.00	1.00	102	1.3	20	X002072	07-Jan-20	
EPA 200.7	Cadmium	mg/L	1.06	1.07	1.00	105	0.9	20	X952154	03-Jan-20	
EPA 200.7	Chromium	mg/L	1.03	1.02	1.00	103	1.1	20	X952154	03-Jan-20	
EPA 200.7	Copper	mg/L	1.00	0.986	1.00	100	1.8	20	X952154	03-Jan-20	
EPA 200.7	Iron	mg/L	9.10	8.94	10.0	91.0	1.9	20	X952154	03-Jan-20	
EPA 200.7	Nickel	mg/L	0.907	0.906	1.00	90.4	0.1	20	X952154	03-Jan-20	
EPA 200.7	Silver	mg/L	0.0505	0.0490	0.0500	101	2.8	20	X952154	03-Jan-20	
EPA 200.7	Tin	mg/L	0.967	0.963	1.00	96.7	0.4	20	X952154	03-Jan-20	
EPA 200.7	Zinc	mg/L	0.998	1.00	1.00	95.8	0.4	20	X952154	03-Jan-20	
EPA 200.8	Arsenic	mg/L	0.0282	0.0254	0.0250	108	10.4	20	X952011	03-Jan-20	
EPA 200.8	Lead	mg/L	0.0244	0.0216	0.0250	97.6	12.0	20	X952011	03-Jan-20	
EPA 200.8	Selenium	mg/L	0.0277	0.0263	0.0250	111	5.3	20	X952011	03-Jan-20	
EPA 200.8	Thallium	mg/L	0.0258	0.0221	0.0250	103	15.4	20	X952011	03-Jan-20	

Metals (Filtered)

EPA 245.1	Mercury	mg/L	0.00101	0.00101	0.00100	101	0.0	20	X953023	02-Jan-20	
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Classical Chemistry Parameters

EPA 351.2	TKN	mg/L	8.94	8.93	8.00	101	0.0	20	X952170	31-Dec-19	
SM 4500-P-E	Orthophosphate as P	mg/L	0.499	0.517	0.500	96.7	3.4	20	X951177	19-Dec-19	
SM 4500-P-E	Phosphorus	mg/L	0.505	0.508	0.500	101	0.6	20	X952095	26-Dec-19	D

Anions by Ion Chromatography

EPA 300.0	Chloride	mg/kg	30.8	31.2	31.3	98.6	1.2	20	X951182	31-Dec-19	
EPA 300.0	Nitrate as N	mg/kg	21.4	21.6	20.8	101	1.0	20	X951182	31-Dec-19	
EPA 300.0	Sulfate as SO4	mg/kg	108	109	104	98.2	0.8	20	X951182	31-Dec-19	
EPA 300.0	Chloride	mg/L	3.78	3.68	3.00	110	2.6	20	X951160	19-Dec-19	
EPA 300.0	Nitrate as N	mg/L	2.27	2.19	2.00	114	3.8	20	X951160	19-Dec-19	M1
EPA 300.0	Nitrate/Nitrite as N	mg/L	4.47	4.37	4.00	112	2.2	20	X951160	19-Dec-19	M1
EPA 300.0	Nitrite as N	mg/L	2.19	2.18	2.00	110	0.6	20	X951160	19-Dec-19	
EPA 300.0	Sulfate as SO4	mg/L	18.8	18.5	10.0	110	1.7	20	X951160	19-Dec-19	



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Yakima, WA 98901

Project Name: Routine / No Project
Work Order: **X9L0363**
Reported: 10-Feb-20 16:45

Notes and Definitions

D	The reported value is from a dilution.
D1	Sample required dilution due to matrix.
D2	Sample required dilution due to high concentration of target analyte.
M1	Matrix spike recovery was high, but the LCS recovery was acceptable.
M2	Matrix spike recovery was low, but the LCS recovery was acceptable.
M4	The analysis of the spiked sample required a dilution such that the spike recovery calculation does not provide useful information. The LCS recovery was acceptable.
R2B	RPD exceeded the laboratory acceptance limit.
LCS	Laboratory Control Sample (Blank Spike)
RPD	Relative Percent Difference
UDL	A result is less than the detection limit
0.30R>S	% recovery not applicable; spike level is less than 30% of the sample concentration
<RL	A result is less than the reporting limit
MRL	Method Reporting Limit
MDL	Method Detection Limit
N/A	Not Applicable

APPENDIX G

**Preliminary MAR Project Design
(Aspect, June 2020)**



MEMORANDUM

Project No. 180249

June 19, 2020

To: Mike Hermanson, Spokane County Environmental Services

From:

Jason Shira, LHG
Project Hydrogeologist
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Erik Pruneda, PE
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Carl Einberger, LHG, CWRE
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**Re: Preliminary Managed Aquifer Recharge Project Design
Bear Creek & Dry Creek
WRIA 55 ESSB 6091/RCW 90.94 Watershed Plan Update**

Introduction

The passage of Engrossed Substitute Senate Bill (ESSB) 6091, as codified by RCW 90.94, requires that an update to the existing Watershed Plan for Water Resource Inventory Area (WRIA) 55, the Little Spokane Watershed, be approved by the Washington Department of Ecology (Ecology) by February 1, 2021. Spokane County Environmental Services is serving as the lead agency for this process. The WRIA 55 Initiating Governments for the watershed planning process are Spokane County, Stevens County, Pend Oreille County, the City of Spokane, and Whitworth Water District. The process is supported by convening the WRIA 55 Planning Unit to review technical tasks and memorandums, policy decisions, and the pending Watershed Plan update. Aspect Consulting, LLC (Aspect) has been contracted by Spokane County to facilitate planning unit meetings, conduct supporting technical tasks, and prepare the Watershed Plan update.

As part of technical tasks associated with the WRIA 55 Watershed Plan update, Aspect assisted with development of water offset projects, including managed aquifer recharge (MAR) projects. An MAR site optimization and selection process was previously conducted in WRIA 55 by Aspect and EarthFX (a consulting group specializing in groundwater modeling). Details of the screening and selection analysis were documented in a December 2019 memorandum that was distributed to the WRIA 55 Planning Unit (Aspect, 2019). Based on the screening criteria discussed in that memorandum, 18 sites were targeted for further evaluation, with three sites ultimately selected for the field investigations. The field investigations concluded that two of the sites, Bear Creek and Dry Creek (Attachment 1), appear viable for design and implementation of MAR facilities (Aspect, 2020).

Aspect and the County recently completed the following work at each MAR site:

- Field investigations and analysis including test pit investigations, infiltration testing to evaluate infiltration rates, monitoring well installation and testing, surface water flow rates, assessment of source water availability, and source water quality sampling.

The purpose of this memorandum is to present the preliminary MAR project designs for the selected sites at Bear Creek and Dry Creek along with determination of project construction and O&M costs and permitting requirements. The following preliminary MAR design elements are presented:

- Methods to limit diversions to periods of high-water availability
- Surface water collection and conveyance structures
- Available infiltration capacity and geotechnical conditions
- Subsurface infiltration galleries
- Electrical power access
- Monitoring requirements
- Operation and maintenance
- Permitting requirements
- Cost estimates for project design, permitting, construction, and implementation

Preliminary Site Assessment and Site Access

A description of the hydrogeologic conceptual model, evaluation of the expected timing and quantity of instream flow benefits, and site access considerations are presented below:

Hydrogeologic Conceptual Model

Aspect completed a field investigation at the Bear Creek and Dry Creek sites in October and December of 2019. The purpose of the field investigation was to evaluate infiltration rates, subsurface conditions at the infiltration sites, water quality, and aquifer characteristics. Results from the field investigation, Ecology's well log database, Washington Department of Natural Resources (DNR) geologic portal, U.S. Geological Society (USGS) reports (Kahle et al., 2013), and the Little Spokane River Watershed Integrated Model Development (West and Earthfx, 2018) were used to develop a hydrogeologic conceptual model of the two sites.

The Bear Creek site is located within the Little Spokane/Deer Creek subbasin. Bear Creek is a tributary located in the western portion of the subbasin that originates from a shallow pass south of Eloika Lake which separates the West Branch of the Little Spokane River from Bear Creek. The Bear Creek valley is relatively flat terrain compared to the eastern portion of the subwatershed, and surrounding subwatersheds (Figure 1). The creek flows in a south-southeasterly direction along a relatively flat stream elevation profile. Bear Creek appears as an underfit stream that occupies a larger valley potentially carved by interglacial streams and/or outburst flooding and filled by glacial outwash deposits. Figure 2 shows the regional surficial geology and the location and orientation of cross-section A-A'.

The paleochannel is bounded by granitic bedrock and filled with primarily fine-grained glacial deposits overlain by a coarse-grained glacial deposit and thin alluvium. Figure 3 shows the cross-sectional view of the Bear Creek site between the infiltration area and Bear Creek. The groundwater flow direction is expected to be predominately southwest from the proposed infiltration gallery toward Bear Creek, with water reaching the creek downstream of the diversion point. The total thickness of the unconsolidated units varies from 85 to 20 feet from east to west with an unsaturated thickness thinning from approximately 70 feet to effectively 0 feet from the infiltration gallery to the stream.

The Dry Creek site is located within the Otter Creek subbasin. Dry Creek is a tributary located in the southeastern portion of the subbasin and originates in the Blanchard Pass area northeast of Mount Spokane. The Dry Creek site is located in an area of relatively steep terrain as the creek flows from east to west from Blanchard Pass to the Little Spokane River as shown on Figure 4. Figure 5 shows the regional surficial geology and the location and orientation of cross-section B-B'.

The creek currently occupies a channel of recent alluvial sediments that overly glacial outburst flood deposits. Figure 6 shows the cross-sectional view of the Dry Creek site between the infiltration area and Dry Creek. No groundwater was intercepted during drilling of the 85 feet deep monitoring well shown on Figure 6. During drilling the unconsolidated material transitioned from fine-grained glacial deposit to gneiss of the similar grain size distribution to hard competent granitic rock. It is expected that infiltrated water will accumulate on top of the low hydraulic conductivity granitic bedrock and flow down the steep topographic gradient toward the stream. The unsaturated thickness varies from greater than 85 feet to effectively 0 feet from the infiltration gallery to the stream.

Expected Timing and Quantities of Instream Flow Benefits

GSFLOW (USGS) modeling investigations were completed for Bear Creek and Dry Creek. Initial modeling was conducted with the following parameters and assumptions:

- One (1) cubic foot per second (cfs) can be recharged (when available in the water source) at the modeled MAR site over the period March, April, and May.
- Streamflow was calculated at the nearest surface water discharge point from the proposed recharge site.
- Modeling was done over a multi-year period (15 years) to provide an indication of longer-term response of groundwater discharge to the recharge process over various hydrologic conditions (wet, dry, drought).

MAR modelling results for Bear Creek and Dry Creek indicate that the sites respond well to MAR modelling simulations. Suitable March to May streamflow was generally available for infiltration, and associated increases in nearby streamflows of up to 0.2+ cfs were apparent in the 8- or 9-month period following the recharge time, including during critical low streamflow periods. Further details on the MAR modelling is presented in the *Managed Aquifer Recharge Site Optimization and Selection WRIA 55 ESSB 6091/RCW 90.94 Watershed Plan Update Memorandum* (Aspect, 2019).

Site Access Considerations

Spokane County owns the land associated with both the Bear Creek and Dry Creek MAR project sites. In addition, Spokane County owns the road right-of-way and diversion (or withdrawal)

location at the Bear Creek site. Access agreements and easements will need to be secured between Spokane County Environmental Services and other County departments, but County discussions indicate that no issue with access is anticipated.

The use of County-owned parcels for a MAR facility requires compensation to the specific department that owns the parcel, whether it be compensation for an easement or an outright purchase of the property. The Bear Creek site is owned by Spokane County Public Works. Public Works has agreed to grant an easement to Environmental Services for the MAR facility at an approximate cost of \$20,000. The Dry Creek site is owned by the Spokane County General Fund. It has not been determined whether an easement or purchase would be pursued. The current assessed value of the parcel is \$47,840. For all project components that will be located in the road right-of-way a Franchise Agreement in accordance with Spokane County Code Title 9 Chapter 55 will be required.

The diversion (or withdrawal) site and a portion of the proposed pipeline alignment at Dry Creek is on private land. An easement will be required for the Dry Creek MAR site for the system components located on private property. The County has had preliminary discussions that indicate potential landowner interest in granting an easement or property purchase to the County. The Dry Creek diversion structure, wet well structure, and approximately 525 linear feet (LF) of forcemain are located on private property. The remaining system components are located on County-owned parcels. The anticipated easement area is approximately 0.27 acres (625 sq-ft per structure and 20-foot wide along forcemain).

Source Water Availability for MAR

This section discusses considerations for source water availability for the Bear Creek and Dry Creek MAR projects.

Background on Little Spokane Rule Closure

Water availability for permitted water uses in WRIA 55, including diversion or withdrawal of source water for MAR projects, is directly affected by limitations in available water supply relative to instream flows adopted by WAC 173-555, the Little Spokane Instream Flow Rule (“the Rule”). The Rule was established with a priority date of January 6, 1976, the proposed beneficial use of source water for MAR purposes, are subject to the rule. Both Bear and Dry Creek are closed to further appropriations from June 1 to October 31 and use of source water for MAR would be prohibited during that period each year. In addition, use of source water for MAR may be subject to curtailment by Ecology outside of the tributary closure period when instream flows are not met in the mainstem of the Little Spokane River. Depending on streamflow and weather conditions, diversion or withdrawal of water for infiltration may also begin in February, but must cease by June 1 when the closure goes into effect each year.

Existing Streamflow Measurements

Available stream discharge data for the proposed MAR sites is limited. Spokane County staff collected monthly stream discharge data from July through February 2020 at Bear Creek and only November through January at Dry Creek (see Table 1). Based on the available data, both Bear Creek and Dry Creek are expected to have sufficient flow to support source water diversions or withdrawals during the typical

project infiltration period of March through May. The County will continue to collect monthly or more frequent flow data with emphasis on the spring runoff season. In addition, the County would install and operate remote sensing equipment to monitor stream flows to help inform the County as to when the pump stations should be operated if the project is constructed.

Table 1. Measured Stream Discharge at Proposed MAR Sites

Date	Bear Creek	Dry Creek
7/25/19	2.44	NM
8/20/19	2.11	NM
9/9/19	2.70	NM
9/17/19	2.88	NM
10/15/19	3.52	NM
11/21/19	3.99	NM
11/26/19	NM	0.48
12/10/19	3.92	0.69
1/23/20	4.42	NM
1/29/20	NM	14.07
2/25/20	5.00	3.74
4/1/20	5.20	6.59
5/20/20	3.62	6.66

Field Investigation Results

Field investigations of the Bear Creek, Dry Creek, and Deadman Creek sites were conducted to evaluate site conditions (infiltration rates, water quality, and aquifer transmissivity) to inform preliminary design and permitting for potential construction of MAR facilities.

Field investigations occurred over three weeks between October and December 2019. The following observations and conclusions were made during the field investigation:

- Infiltration rates of the receptor unit(s) at:
 - The Deadman Creek site are too low (0.01 inches per hour [in/hr]) to feasibly implement surface infiltration; therefore, the alternative Dry Creek site was evaluated.
 - Dry Creek and the Bear Creek site have suitable subsurface conditions for surface infiltration.
- Surface water and groundwater quality and aquifer characteristics at Deadman Creek were not evaluated further due to limited feasibility for surface infiltration.
- Dry Creek was evaluated for surface water parameters only due to unsaturated conditions above a confining unit (competent bedrock). No surface water quality criteria were

exceeded. The thickness of the overlying unconsolidated sand unit (coarse-grained outburst flood deposit) is 52 feet.

- Bear Creek was evaluated for surface water and groundwater quality. No surface water quality criteria were exceeded; however, groundwater quality criteria were exceeded for total dissolved solids (TDS), chloride, and total iron. Groundwater quality has likely been affected by storage of a sand and road salt mixture that is stored on the ground without cover at the County gravel pit.
- The depth to the water table aquifer at Bear Creek is 71 feet below ground surface (bgs). The aquifer transmissivity is estimated at 2,300 square feet per day (feet²/day) based on the aquifer testing conducted in this study. The aquifer thickness is approximately 12 feet resulting in a horizontal hydraulic conductivity of 194 feet/day.

The Bear and Dry Creek sites appear suitable for surficial infiltration of diverted surface water based on the raw infiltration rates and depth to water table or confining units. The groundwater quality at the Bear Creek site is expected to have groundwater quality improvement due to infiltration of surface water combined with implementation of best management practices (BMPs) to prevent further infiltration of road salts.

Aspect recommends that the County continuously monitor groundwater levels in monitoring well MB1 at the Bear Creek site to better understand seasonal changes to the water table aquifer. In addition, surface water quality monitoring at Bear and Dry Creek during peak runoff is recommended to provide additional characterization of the water source for MAR infiltration. Lastly, additional investigation at the Bear Creek site should occur as part of final design work to determine if diversion of surface water with large capacity wells adjacent to the creek is feasible. This would lower project costs by simplifying permitting through elimination of a surface diversion structure, and reduce other infrastructure costs, such as for settling solids from the source water in a tank prior to infiltration.

Managed Aquifer Recharge Permitting Analysis

Several permits are likely to be required for the Bear Creek and Dry Creek MAR projects. These permits include, but may not be limited to, those listed below:

- Grading Permit – Projects that excavate more than 500 cubic yards require a grading permit and submittal of a State Environmental Policy Act (SEPA) checklist. Both the Bear Creek and Dry Creek MAR projects are anticipated to require grading permits as the anticipated excavation work is excess of 1,000 cubic yards. The time it takes to obtain a permit is approximately four to six weeks.
- SEPA – The State Environmental Policy Act process identifies and analyzes environmental impacts associated with projects. The SEPA process ensures that environmental values are considered during decision-making by state and local agencies. Time to complete the SEPA review and receive a determination can vary significantly depending on the project and is estimated at three months.
- Critical Areas / Shoreline Permits – Projects involving work within 250 feet of a shoreline, within 250 feet of a wetland, or within the 100-year flood plain will require a County

Critical Areas / Shoreline Permit. The time it takes to obtain a permit is approximately two to three months.

- Electrical – County electrical permits will be required for the MAR project pump stations and electrical service. These are typically over-the-counter permits that will be acquired by the Contractor during construction.
- Hydraulic Project Approval (HPA) – Work that crosses over a waterbody or includes in-water work may require coverage under an HPA Permit from the Washington Department of Fish and Wildlife (WDFW). An HPA ensures that construction is done in a manner that protects fish and their aquatic habitats. Time to obtain a permit is dependent on the project and type of HPA.
- WA State Underground Injection Control (UIC) Program (WAC 173-218) – Ecology administers the statewide UIC program to protect groundwater by regulating the discharge of fluids from UIC injection wells (drywells, infiltration galleries with perforated pipe, etc.) The proposed infiltration galleries (with perforated pipe) at Bear Creek and Dry Creek will require registration with Ecology’s Water Quality Program. Registration is typically done at the final design stage (prior to construction) and then modified as needed after construction to reflect the as-built condition. Time to complete the registration is approximately one week.
- Cultural Resources Review – Projects involving excavation activities are required to perform a cultural resource review within the project area. Executive Order 05-05 Section 106 of the National Historic Preservation Act requires all state agencies implementing or assisting capital projects using funds appropriated in the State's biennial Capital Budget to consider how future proposed projects may impact significant cultural and historic places. To do so, agencies are required to notify the Department of Archaeology and Historic Preservation (DAHP), the Governor’s Office of Indian Affairs (GOIA), and concerned tribes. and afford them an opportunity to review and provide comments about potential project impacts. A project review form and inadvertent discovery plan will be required to be submitted to Ecology per Executive Order 05-05 Section 106 of the National Historic Preservation Act. Typical review time is 30 days minimum.
- Construction Stormwater General Permit – Projects that disturb 1-acre or more of land and discharge stormwater to surface waters of the State are required to obtain a Construction Stormwater General Permit from the Ecology. A Notice of Intent must be submitted at least 60 days before discharging stormwater from construction activities. Permittees are required to develop and implement a Stormwater Pollution Prevention Plan (SWPPP) through final site stabilization.
- Water Rights Permits – Diversion of water or withdrawal from wells adjacent to the creeks to provide source water for infiltration will require a new water right at each MAR location. In order to be approved by Ecology, the water rights will need to be interruptible, allowing diversion/withdrawal only when instream flows are met. Applications for new water rights will need to be submitted to Ecology, followed by processing of the applications through preparation of Reports of Examination.
- Dredge / Fill Permit (Section 404) – In-water work that will involve dredging or filling in the waterway will require a Section 404 permit from the U.S. Army Corps of Engineers. Time to obtain a permit can be up to one year.

- Endangered Species Act (ESA) Compliance – Section 7 of the ESA requires all Federal agencies to use their authorities to conserve endangered and threatened species in consultation with the U.S. Fish and Wildlife Service (USFWS), the National Oceanic and Atmospheric Administration (NOAA), and the National Marine Fisheries Service (NOAA Fisheries). Projects are required to address direct and indirect impacts to species, as well as direct and indirect impacts to their critical habitat.

Preliminary Managed Aquifer Recharge Project Design

A description of the project operational elements is presented below.

Project Operational Elements (i.e., System Description)

System components associated with the proposed MAR projects at Bear Creek and Dry Creek are described in the sections below. Preliminary MAR project designs are presented in Attachment 2.

Surface Water Collection and Conveyance Structures

Diversion / Fish Screen Structure

Any instream diversion of stream flows will require fish screening. Per the WDFW SalmonScape application, Eastern Brook Trout are present in Bear Creek and Rainbow Trout are present in Dry Creek. Fish screening options considered are shown in Attachment 3 and include:

- Instream pump intake screen
- Paddle wheel driven or solar powered rotary drum screen or rotary wiper screen
- Traveling belt screen
- Vertical plate screen
- Horizontal screen

During the final design phase, it is recommended that an alternatives analysis be completed to identify and select the most appropriate diversion/fish screen structure for each MAR site. The analysis will need to consider the stream characteristics (channel cross-section, gradient, and wetted area for a range of hydrologic conditions), likelihood of success, operation and maintenance requirements, etc. Channel cross sections should be evaluated to determine if water levels will be of sufficient height to divert up to 1 cfs into the diversion structure. If water levels will not be of sufficient height, an in-channel check structure may be needed to raise the water level in the vicinity of the diversion structure.

For the purposes of preliminary design, the proposed diversion structure would consist of an instream structure located on the streambank with vertical plate screen and built-in slide/canal gate to limit diversion to periods of high-water availability (see Figure 7). An instream structure with vertical plate screen was selected based on its ease of maintenance (passive self-cleaning), reliability, and ability to site within space constrained locations. The structure can be easily modified to incorporate a presettling sump to trap/retain larger sediments and a wet well for placement of one or more pumps. In a future design stage, screen material and mesh size will be selected based on current WDFW screening criteria. In addition, approach velocity, sweeping velocity, and minimum screen area will be determined to verify compliance.



**Figure 7. Example Vertical Plate Screen Diversion Structure
(Image Source: WDFW, 2009)**

During the final design phase, it is recommended that shallow wells adjacent to the creek diversion sites be explored as an alternative source of water for the MAR project. If streambank soil conditions are favorable, a series of shallow wells could be located along the streambank to intercept and reliably supply up to 1 cfs of water to the MAR sites. It is recommended, as a part of the final design phase, that additional site hydrogeologic investigations be performed at each MAR diversion site (e.g., test pits or borings) to evaluate if shallow wells would serve as a viable alternative to instream diversion structures. Utilizing shallow wells would avoid in-water work and project permitting associated with an instream diversion structure. Further, the quality of water from shallow wells will be improved over an instream diversion structure, which would eliminate the need for a pre-settling structure to protect the infiltration system and will therefore reduce project capital and annual operation and maintenance costs.

Pump Station

The preliminary design for the pump stations include the following components:

- Wet well integrated into diversion structure or separate concrete wet well adjacent to diversion structure.
- The Bear Creek pump should be sized for a minimum capacity of 449 gpm (1 cfs) with a total dynamic head (TDH) of approximately 135 feet. The Dry Creek pump should be sized for minimum capacity of 449 gpm (1 cfs) with approximately 175 feet TDH. Pump selection will be performed during the final design phase; however, preliminary pump cost estimates are provided with the project cost estimate. Preliminary total dynamic head calculations for pump sizing are included in Attachment 4.
- Pump motor controls will be provided near each pump station housed in watertight enclosures.

- Electrical service will be provided at each pump station. The preliminary Bear Creek pump station is within 200 feet of an existing overhead power line, while the preliminary Dry Creek pump station is 2,000 feet from the nearest existing overhead power line.
- Water measurement equipment (flow meters) installed on the discharge side of the pump to monitor the flow rate and cumulative volume delivered to each infiltration gallery, as well as limit the flow rate to 449 gpm (1 cfs).

Forcemain

The forcemain at each site was sized to handle 449 gpm (1 cfs) at velocities ≤ 5 ft/s. Eight-inch PVC was selected for preliminary design. Preliminary forcemain velocity and friction loss calculations are included in Attachment 4.

Pretreatment – Sedimentation Tank

Springtime flows in Bear Creek and Dry Creek may have the potential to be turbid and protection of the infiltration system from plugging due to siltation will be important to extend the life of the infiltration facilities. In addition to the settling of larger sediment at the proposed diversion structure, an 8-foot wide by 40-foot long by 8-foot deep above-ground sedimentation tank (approx. 19,000 gallons) has been incorporated into the design for additional settling capacity. A sedimentation tank will be situated immediately upstream of each proposed infiltration facility allowing for gravity flow from the sedimentation tank into the infiltration facility. Preliminary sedimentation analysis was completed for the proposed tank size and is included in Attachment 5. The results of the sedimentation analysis indicate that the proposed tank will remove particle sizes 0.028 mm (silt range) and larger.

Additional sedimentation tank design details will be developed during the final design phase. Further, it is recommended that water samples be collected during the spring runoff period and analyzed for Total Suspended Solids (TSS). Based on TSS results, the sedimentation tank size can be revised to settle out the desired particle size.

Infiltration System

Based on recent field investigation and analysis work completed by Aspect, both sites are well suited for infiltration systems (Aspect, 2020). The receptor soil geology at the Bear Creek site consists of gravel with cobbles and boulders, while the Dry Creek MAR site consists of a well graded sand. Infiltration testing was completed at Bear Creek and Dry Creek with long-term design infiltration rates estimated to be 25 in/hr and 15 in/hr, respectively.

The preliminary design for the infiltration systems includes the following components:

- The infiltration system for each MAR site will be a subsurface infiltration gallery consisting of perforated piping encased in washed gravel (similar to an infiltration trench or drain field). To infiltrate 1 cfs at a 25 in/hr infiltration rate, the preliminary Bear Creek infiltration gallery will need to be 30-feet wide by 60-feet long. To infiltrate 1 cfs at a 15 in/hr infiltration rate, the preliminary Dry Creek infiltration gallery will need to be 40-feet wide by 75-feet long.

Preliminary infiltration gallery sizing calculations are provided in Attachment 6.

- The washed rock should be separated from the native soil by a suitable woven geotextile.

- Observation wells (or inspection ports) will be provided at the lower end of each infiltration gallery to monitor water levels, drawdown time, sediment accumulation, and conduct water quality monitoring.
- Given the uncertainty in suspended sediment concentrations during spring runoff and potential loading to the infiltration system over the long-term, capacity for a secondary infiltration system should be considered during the final design phase. Stub outs should be provided to allow for a future connection to a secondary infiltration system in the event that the primary system becomes plugged. In the final design phase, it is recommended that water samples be collected during the spring runoff period and analyzed for Total Suspended Solids (TSS). If the range of sediment concentrations are found to be within the removal capabilities of the pre-treatment system, then the secondary system can be omitted from the final design.

Water Quality Considerations

MAR projects do not require National Pollutant Discharge Elimination System or State Waste Discharge permits; however, water quality anti-degradation rules still apply, and waters of the state must be protected. Surface water quality of Bear and Dry Creek were evaluated during the field investigation. In addition, Ecology and other entities have collected water quality data on the streams. This information is described below to characterize the source water that is infiltrated into the ground. Groundwater at Bear Creek is also evaluated from the perspective as a receiving water to address protection of groundwater quality.

Surface (Source) Water Characterization

Bear Creek has the following current water quality listings:

- Category 5 303d list for dissolved oxygen (Listing ID 47074)
- Category 4a listing for bacteria (Listing ID 45524) and temperature (Listing ID 48337)
- Category 2 listing for dissolved oxygen (Listing ID 77655) for the reach where the point of diversion, or withdrawal, would occur

Dry Creek has the follow current water quality listings:

- Category 5 (303d) list for pH (Listing ID 50373)
- Category 4a for bacteria (Listing ID 45511) and temperature (Listing ID 48329)
- Category 2 listing for dissolved oxygen (Listing ID 47067)

None of the Dry Creek listings occur along the reach where the point of diversion would occur.

The field investigation sampling on December 18, 2019, did not find any excursions of surface water quality criteria for total suspended solids, total nitrogen, total phosphorus, dissolved and total metals (arsenic, cadmium, chromium, zinc, and lead), fecal coliform, and E. coli bacteria, as well as any parameters identified in the 303(d) listing for either Bear Creek nor Dry Creek. Tables 2 and 3 show the results for detected analytes in surface water. Historical data collected by others at the same sampling station show similar general water quality. An apparent exceedance of the fecal coliform criteria occurred in the historical record during the fall. This may be associated with first

rain. Water quality data downloaded from the Environmental Information Management system (EIM) is provided in Table 4.

Two additional sampling events are planned to occur during the proposed period Spokane County would divert surface water to the infiltration gallery.

Groundwater (Receiving Water) Characterization

The surficial aquifer at the Bear Creek site was sampled once for analysis of the:

- Minimum required analytes (total suspended solids, total nitrogen, total phosphorus, dissolved and total metals (arsenic, cadmium, chromium, zinc, and lead) and fecal coliform and E. coli bacteria)
- Major cations (calcium, magnesium, potassium, and sodium) and anions (chloride and sulfate)
- Priority pollutant list metals
- Alkalinity
- Field parameters (temperature, specific conductance, dissolved oxygen, pH, and oxidation-reduction potential)

The groundwater had exceedances of groundwater quality criteria for chloride, total dissolved solids, and total iron. Tables 2 and 3 show the results for detected analytes in groundwater. The high total dissolved solids and chloride appear associated with storage of road deicing sand and salt deicing mixture stored on the ground at the Spokane County gravel pit. Infiltration of source water may improve groundwater quality through dilution of high total dissolved solids concentrations in the surficial aquifer, combined with implementation of best management practices (BMPs) to prevent further infiltration of road salts.

Additional Water Quality Considerations

The MAR projects are designed to operate only during ambient high-water flows. Diversions will not occur during flooding events where the streams are exceeding their banks and picking up additional pollutants from the surrounding land areas. Similarly, stormwater will be excluded from running onto the infiltration galleries or into the conveyances. As mentioned above, sedimentation tanks will be employed in advance of the infiltration galleries.

At the Bear Creek site residential dumping was documented on the property 1,000 feet cross gradient of the proposed infiltration gallery. An expanded groundwater analyte suite was used to determine if the residential dumping has impacted groundwater. Groundwater sample results did not indicate groundwater contamination has occurred from the residential dumping.

Operation & Maintenance

Recommended operation and maintenance for each system component is provided below.

Diversions Structure & Pump Station

Prior to system start-up each year, perform the following inspection and maintenance activities:

- Close pump wet well structure drain valve, conveyance line drain valve, and drain valves on pump(s) and associated appurtenances.
- Inspect for damaged or cracked pipes, valves, and fittings from over-winter storage; repair or replace as needed.
- Open slide/canal gate; exercise gate as needed to ensure proper operation over the full range.
- Maintain records of all inspections, maintenance, and repairs performed.

During system operation, perform the following inspection and maintenance activities:

- Visually inspect fish screen (weekly or more frequently) for accumulation of debris and fine materials; remove debris and clean screen as needed.
- Visually inspect diversion structure and slide/canal gate (weekly or more frequently) for signs of erosion, structural damage, settling, etc. Complete maintenance and repairs as needed.
- Visually inspect pump station (weekly or more frequently) for the following:
 - Check and clean the pump screen.
 - Verify the low-water shutoff/alarm is working.
 - If the pump control panel has an elapsed time meter or a cycle counter, read and record those values. Elapsed time and cycle counts are valuable troubleshooting data if problems occur in the system.
 - Verify flow meter and restriction valving is set such that only 449 gpm (1 cfs) is directed to the infiltration gallery (when available in the creek). Read and record flow meter totalizer for total cumulative volume of water delivered to the infiltration system.

At system shut-down each year, perform the following inspection and maintenance activities:

- Fully close slide/canal gate during non-operational periods (generally June through February).
- Open pump wet well structure drain valve and conveyance line drain valve; fully drain conveyance line, pump(s), and associated appurtenances.
- Access diversion structure pre-settling sump and measure depth of accumulated sediment; remove and properly dispose of accumulated sediment as needed.
- Visually inspect diversion structure for signs of erosion, structural damage, settling, etc. Complete maintenance and repairs as needed.
- Visually inspect the fish screen for: (a) holes or dents in the screen surface or frame that would allow small fish to pass through the screen or be injured by contact with the surface; (b) screen mesh openings that exceed the maximum allowable opening diameter for the type of screen material used; and (c) gaps or spaces between the screen, structural frame, and/or concrete structure. Complete maintenance or repairs as needed following WDFW criteria (WDFW, 2009).

- Contract with qualified service provider to complete full electrical and mechanical inspection of pump controls and electrical system. Complete maintenance or repairs as needed.
- Maintain records of all inspections, maintenance, and repairs performed.

Sedimentation Tank

- Inspect weekly to measure depth of accumulated sediment; remove and properly dispose of accumulated sediment when depth reaches 6 inches.

Infiltration Gallery

- Inspect weekly during periods of system operation when pump station is off for ponded water in the observation wells. Temporary ponding may occur at the end of a pump cycle but should dissipate before the next pump cycle begins. If ponded water resides in an observation well prior to the next pump cycle beginning the infiltration gallery may need to be cleaned. The infiltration gallery can be cleaned by injecting high pressure water into each cleanout port sequentially with other infiltration gallery pipe valves closed. Reinspect after next pump cycle to verify draw down performance.

Operation and Maintenance Funding Approaches

Spokane County acknowledges there will be an ongoing need to fund operation and maintenance of these facilities. The Board of County Commissioners has directed staff to develop funding mechanism proposals for their consideration, but as a first step, has agreed to fund the operation and maintenance of the Bear Creek MAR project¹ from the County General Fund until a funding mechanism is in place.

Preliminary Cost Estimate

The preliminary cost to design, permit, and construct the Bear Creek MAR is estimated to be \$594K, including a 15 percent contingency. The estimated annual operation & maintenance cost is approximately \$22.5K, including a \$5K annual set-aside for future equipment repair and replacement (R&R). Detailed preliminary design cost estimates are provided in Attachment 7.

The preliminary cost to design, permit, and construct the Dry Creek MAR is estimated to be \$616K, including a 15 percent contingency. The estimated annual operation & maintenance cost is approximately \$22.5K, including a \$5K annual set-aside for future equipment R&R. Detailed preliminary design cost estimates are provided in Attachment 7.

Design effort for each MAR site will generally include topographic site survey; geotechnical explorations and construction recommendations related to proposed infrastructure; 60%, 90%, and Final design plans, details, specifications and engineer's estimate of probable cost. The design cost is estimated to be \$100,000 for each MAR site and has been included in the total preliminary cost estimate presented above.

¹ Spokane County is filing a Streamflow Restoration Grant application with Ecology to obtain capital funding to complete design and build the Bear Creek MAR facility. The Board of County Commissioners agreement to fund operation and maintenance for this project is contingent on Ecology capital funding for the project.

As noted previously, at both locations, the design preference is to use shallow wells rather than diversion structures as an alternative source of water for the MAR project. As part of the final design phase of this work, additional site hydrogeologic investigations have been included in the cost estimates for each project to evaluate if shallow wells would serve as a viable alternative to instream diversion structures. Utilizing shallow wells would avoid in-water work and project permitting associated with an instream diversion structure. Further, the quality of water from shallow wells will be improved over an instream diversion structure, which would eliminate the need for a presettling structure to protect the infiltration system and will therefore reduce project capital and annual operation and maintenance costs. As a preliminary estimate, this may result in a cost savings of approximately 10 percent for both capital costs and operation and maintenance costs at each location, should source wells rather than a diversion structure prove feasible.

References

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- West Consultants, Inc (West) and Earthfx Incorporated (Earthfx), 2018, Integrated Groundwater/Surface Water Model for the Little Spokane Watershed – Water Bank Modeling and Decision Support Tool: Model Development and Application Report, December 2018.

Limitations

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

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

Tables: Table 1 - Measured Stream Discharge at Proposed MAR Sites (*in-text*)
 Table 2 - Surface Water and Groundwater Laboratory Results for Detects
 Table 3 - Surface Water and Groundwater Field Parameters
 Table 4 – Bear Creek EIM Water Quality Data

Figures: Figure 1 – Bear Creek Topography and Groundwater Flow Direction
 Figure 2 – Bear Creek Surficial Geology
 Figure 3 – Bear Creek Cross Section A-A'
 Figure 4 – Dry Creek Topography and Groundwater Flow Direction
 Figure 5 – Dry Creek Surficial Geology
 Figure 6 – Dry Creek Cross Section B-B'
 Figure 7 - Example Vertical Plate Screen Diversion Structure (*in-text*)

Attachments: Attachment 1 – MAR Project Location
 Attachment 2 – Preliminary MAR Project Designs
 Attachment 3 – Small Fish Screening Options
 Attachment 4 – Preliminary Hydraulic Calculations
 Attachment 5 – Preliminary Sedimentation Analysis
 Attachment 6 – Preliminary Infiltration Gallery Sizing
 Attachment 7 – Preliminary Cost Estimates

TABLES

Table 2. Surface Water and Groundwater Laboratory Results for Detects

Project No. 180249, Spokane, Washington

						Location Date Sample	MB1-GW 12/18/2019 MB1-GW-191218	MB-SW 12/18/2019 MB-SW-191218	ND-SW 12/18/2019 ND-SW-191218
				Surface Water WAC 173-201A-200 & 240		Groundwater WAC 173-200-040			
Analyte	CAS_RN	Fraction	Unit	Acute	Chronic				
Bacteria									
E.Coli	68583-22-2	N	MPN/100mL	100			< 1.8 U	2	79
Total Coliform	ColiTot	N	MPN/100mL			1	< 1.8 U	350	170
Conventionals									
Alkalinity, Total	ALKT	T	mg/L as CaCO3				78.4	149	42.6
Chloride	16887-00-6	T	mg/L			250	2140	3.91	3.34
Nitrate as Nitrogen	14797-55-8	T	mg/L			10	1.69	1.47	0.102
Nitrate-Nitrite	NO3NO2N	T	mg/L				1.69	1.48	0.102
Nitrogen	7727-37-9	T	mg/L				1.69	1.48	< 0.600 U
Orthophosphate	14265-44-2	T	mg/L				0.016	0.016	0.039
Phosphorus	7723-14-0	T	mg/L				0.018	< 0.010 U	0.046
Sulfate	14808-79-8	T	mg/L			250	23.7	6.46	4.6
Total Dissolved Solids	TDS	T	mg/L	10000	10000	500	3900	172	125
Total Suspended Solids	TSS	T	mg/L				11	< 5.0 U	< 5.0 U
Destination									
Hardness (destination)	Hard_MixZone	N	mg/L				1940	147	33.7
Field Parameters									
Temperature	Temp	N	deg C	17.5			11.4	1	1.6
Specific Conductance	Cond	N	uS/cm			700	5866	289.8	96.2
Dissolved Oxygen	DO	N	mg/L	8.5			9.87	10.64	12.54
pH	pH	N	pH units	6.5-8.5		6.5-8.5	7.65	7.85	7.84
Oxidation Reduction Potential	ORP	N	mV				140.4	234.7	206.1
Turbidity	Turb	N	NTU				10	--	--
Metals									
Calcium	7440-70-2	T	mg/L				517	44.7	9.84
Chromium	7440-47-3	T	mg/L	ND = 0.225; MB = 0.752	ND = 0.073; MB = 0.244	0.05	0.0068	< 0.0060 U	< 0.0060 U
Iron	7439-89-6	D	mg/L				< 0.100 U	< 0.100 U	0.164
Iron	7439-89-6	T	mg/L			0.3	0.936	< 0.100 U	0.464
Magnesium	7439-95-4	T	mg/L				157	8.71	2.23
Potassium	7440-09-7	T	mg/L				10	2.29	1.48
Sodium	7440-23-5	T	mg/L				504	4.85	7.64
Zinc	7440-66-6	D	mg/L	ND = 0.045; MB = 0.159	ND = 0.042; MB = 0.145		0.04	< 0.010 U	< 0.010 U
Zinc	7440-66-6	T	mg/L			5	0.054	< 0.010 U	< 0.010 U

Bold - detected

Blue Shaded - Detected result exceeded Acute Aquatic Life level (if WS) or WAC-173-200 (if WG)

Red Text - Detected result exceeded Chronic Aquatic Life Level

U - Analyte not detected at or above Reporting Limit (RL) shown

D - Dissolved Fraction (filtered) sample result

T - Total Fraction (unfiltered) sample result

N - Fraction Not Applicable

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3/12/2020

V:\180249 WRIA 55 Watershed Plan Update\Deliverables\MAR PrelimDesign\Table 2 - Water Detections with screening levels

Table 2

Preliminary Managed Aquifer Recharge Project Design

Page 1 of 1

Table 3. Surface Water and Groundwater Field Parameters

Project No. 180249, Spokane, Washington

				Location Date Sample	MB1-GW 12/18/2019 MB1-GW-191218	MB-SW 12/18/2019 MB-SW-191218	ND-SW 12/18/2019 ND-SW-191218
Analyte	CAS_RN	Fraction	Unit				
Field Parameters							
Temperature	Temp	N	deg C		11.4	1	1.6
Specific Conductance	Cond	N	uS/cm		5866	289.8	96.2
Dissolved Oxygen	DO	N	mg/L		9.87	10.64	12.54
pH	pH	N	pH units		7.65	7.85	7.84
Oxidation Reduction Potential	ORP	N	mV		140.4	234.7	206.1
Turbidity	Turb	N	NTU		10	--	--

Bold - detected

Table 4. Bear Creek EIM Water Quality Data

Project No. 180249, Spokane, Washington

Date	Alkalinity, Total as CaCO3	Ammonia	Chloride	Conductivity	Dissolved Organic Carbon	Dissolved Oxygen	Fecal Coliform	Flow	Nitrate + Nitrite as N	Ortho-Phosphate
	mg/L	mg/L	mg/L	uS/cm	mg/L	mg/L	/100mL	cfs	mg/L	mg/L
10/28/08	150	0.01	3.15	300	1.6	11		3.2	1.3	0.0037
11/18/08	150	0.01	3.85	306	3.2	11		3.3	1.29	0.0065
01/20/09	168	0.03	4.45	326	7.6	1		5.8	0.584	0.0089
10/01/14	--	--	--	318	--	8	30	--	--	--
11/26/14	--	--	--	302	--	12	152	--	--	--
12/17/14	--	--	--	296	--	15	1	--	--	--
01/13/15	--	--	--	--	--	--	4	--	--	--
02/12/15	--	--	--	271	--	9	1	--	--	--
03/10/15	--	--	--	305	--	12	15	--	--	--
04/14/15	--	--	--	289	--	11	1	--	--	--
05/14/15	--	--	--	298	--	9	27	--	--	--
06/11/15	--	--	--	305	--	8	82	--	--	--
07/29/15	--	--	--	302	--	8	97	--	--	--
10/01/15	--	--	--	302	--	7	130	--	--	--
10/18/15	--	--	--		--	--	--	2.2	--	--
10/27/15	--	--	--	304	--	11	9	--	--	--
12/02/15	--	--	--	307	--	8	3	--	--	--
04/06/16	--	--	--	--	--	--	--	4.7	--	--

Table 4. Bear Creek EIM Water Quality Data

Project No. 180249, Spokane, Washington

Date	pH	Temperature, water	Total Organic Carbon	Total Persulfate Nitrogen	Total Phosphorus	Total Suspended Solids
	SU	deg C	mg/L	mg/L	mg/L	mg/L
10/28/08	7.6	4.7	1.8	1.47	0.0078	2
11/18/08	7.6	3.8	3.6	1.55	0.0072	2
01/20/09	7.0	0.0	8.6	1.08	0.0253	2
10/01/14	8.5	10.9	--	--	--	--
11/26/14	7.7	0.0	--	--	--	--
12/17/14	10.3	1.4	--	--	--	--
01/13/15	--	--	--	--	--	--
02/12/15	7.7	4.2	--	--	--	--
03/10/15	7.6	3.6	--	--	--	--
04/14/15	7.8	8.5	--	--	--	--
05/14/15	8.0	11.5	--	--	--	--
06/11/15	7.7	17.4	--	--	--	--
07/29/15	7.9	14.9	--	--	--	--
10/01/15	7.5	10.1	--	--	--	--
10/18/15	--	--	--	--	--	--
10/27/15	7.9	8.1	--	--	--	--
12/02/15	7.9	0.0	--	--	--	--
04/06/16	--	--	--	--	--	--

Aspect Consulting

3/12/2020

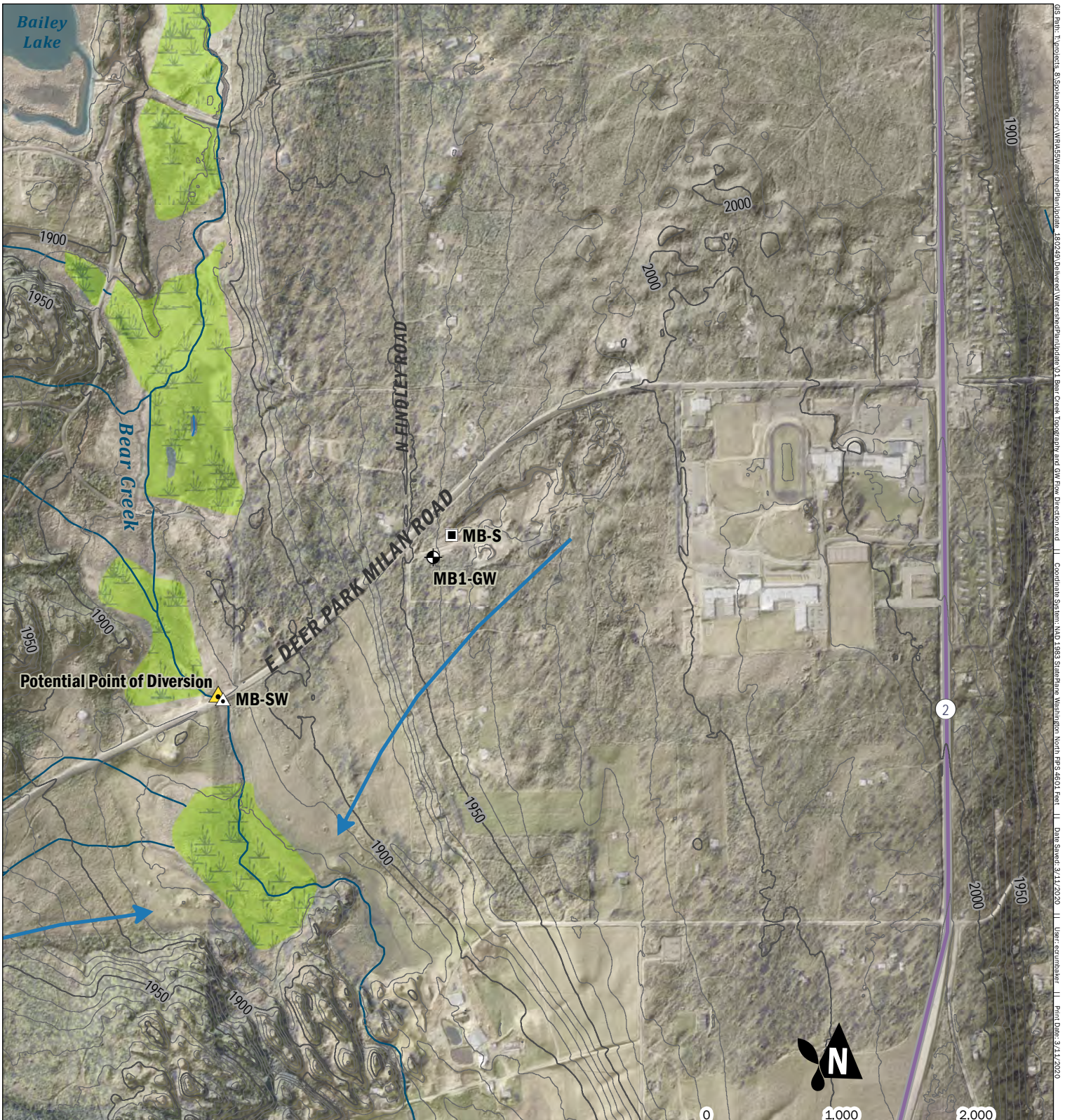
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Table 4

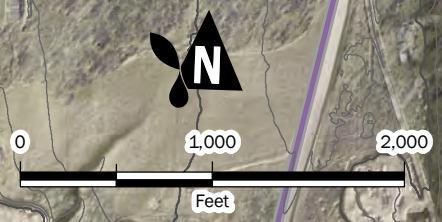
Preliminary Managed Aquifer Recharge Project Design

Page 2 of 2

FIGURES



-  Monitoring Well
-  Pilot Infiltration Test
-  Surface Water Gaging/Sampling Location
-  Potential Point of Diversion
-  Groundwater Flow Direction
-  50-ft Contour (LiDAR, 2019)
-  10-ft Contour (LiDAR, 2019)
-  Marsh

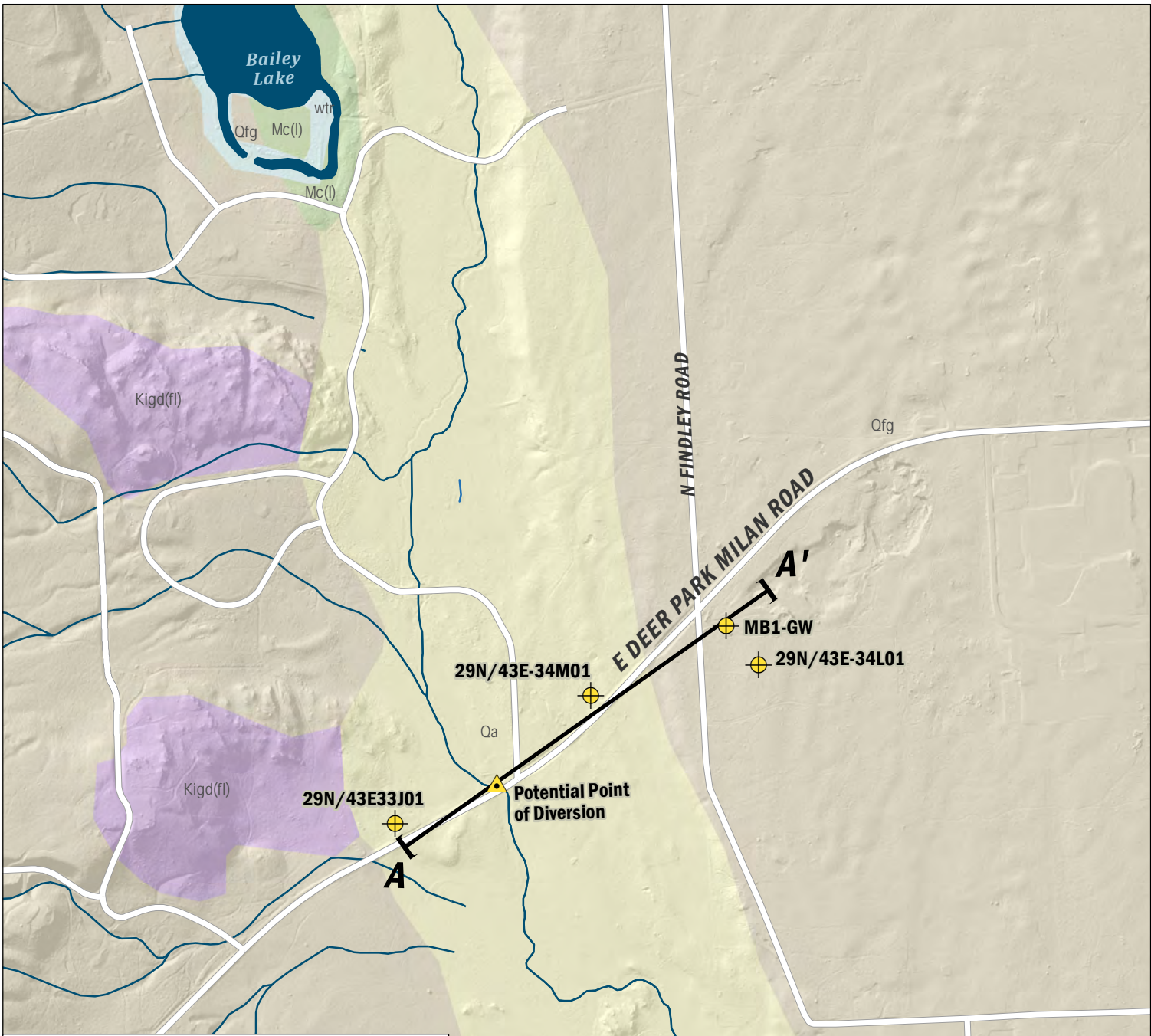









Bear Creek Topography and Groundwater Flow Direction

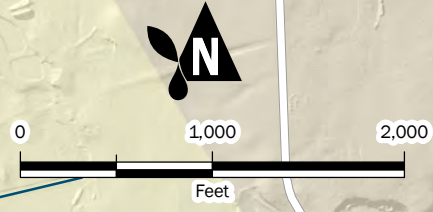
Preliminary Managed Aquifer Recharge Project Design
 Bear Creek & Dry Creek WRIA 55 ESSB 6091/RCW 90.94
 Watershed Plan Update
 Spokane County, Washington

MAR-2020	BY: JS / EAC	FIGURE NO. 1
PROJECT NO. 180249-06	REVISED BY: ---	


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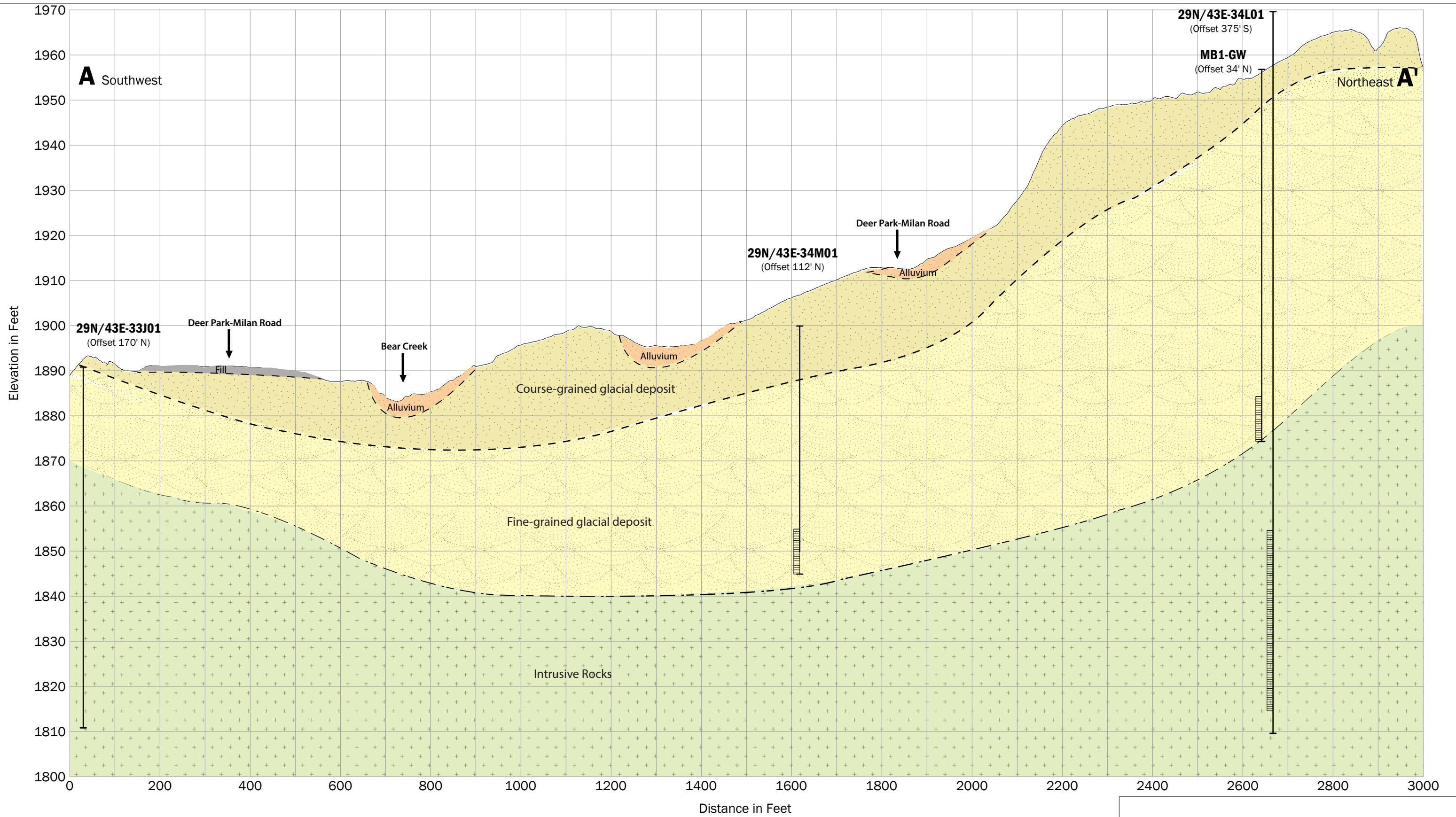


-  Cross Section Well
-  Potential Point of Diversion
- Surfacial Geology (WADNR 1:100,000)**
- Quaternary Rocks and Deposits*
-  Quaternary alluvium
-  Pleistocene outburst flood deposits
- Tertiary Rocks*
-  Tertiary sedimentary rocks and deposits
- Mesozoic Rocks*
-  Mesozoic intrusive rocks
- Water*
-  Water



Bear Creek Surfacial Geology
 Preliminary Managed Aquifer Recharge Project Design
 Bear Creek & Dry Creek WRIA 55 ESSB 6091/RCW 90.94
 Watershed Plan Update
 Spokane County, Washington

	MAR-2020	BY: JS / EAC	FIGURE NO. 2
	PROJECT NO. 180249-06	REVISED BY: ---	



A Southwest

Northeast **A'**

29N/43E-33J01
(Offset 170' N)

29N/43E-34M01
(Offset 112' N)

29N/43E-34L01
(Offset 375' S)

MB1-GW
(Offset 34' N)

Deer Park-Milan Road

Bear Creek

Deer Park-Milan Road

Course-grained glacial deposit

Fine-grained glacial deposit

Intrusive Rocks

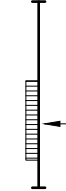
Alluvium

Alluvium

Alluvium

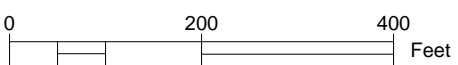
Fill

MW-2 ← Monitoring Well ID



Well Screen Interval

Horizontal Scale: 1" = 200'
Vertical Scale: 1" = 20'
Vertical Exaggeration 10x



Bear Creek Cross Section A-A'

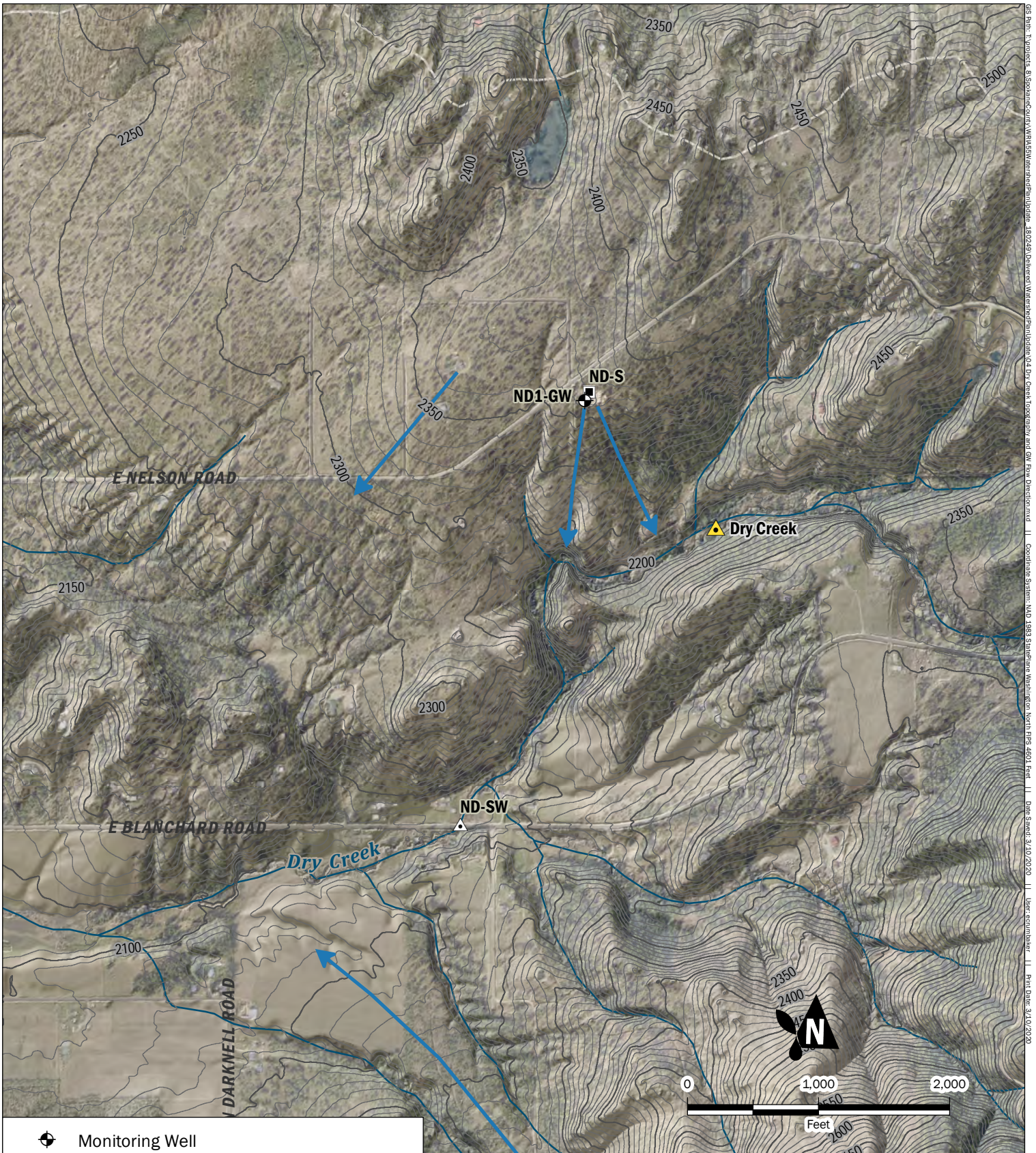
Preliminary Managed Aquifer Recharge Project Design
Bear Creek & Dry Creek WRIA 55 ESSB 6091/RCW 90.94
Watershed Plan Update
Location, Washington










Mar-2020
PROJECT NO.
180249

BY:
JMS/SCC
REVISED BY:
-

FIGURE NO.
3



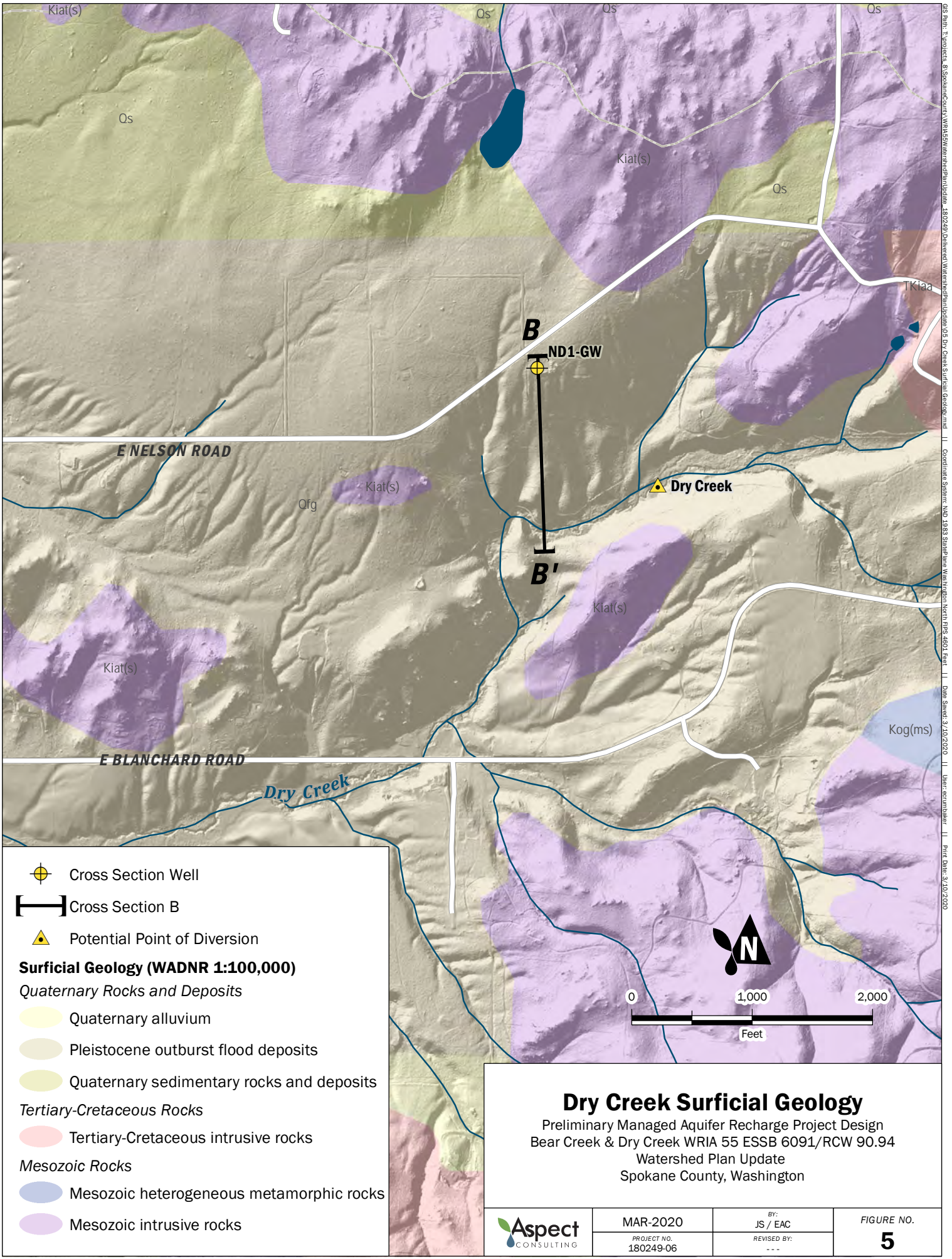
-  Monitoring Well
-  Pilot Infiltration Test
-  Surface Water Gaging/Sampling Location
-  Potential Diversion Site Location
-  Groundwater Flow Direction
-  50-ft Contour (LiDAR, 2016)
-  10-ft Contour (LiDAR, 2016)

Dry Creek Topography and Groundwater Flow Direction










Preliminary Managed Aquifer Recharge Project Design
 Bear Creek & Dry Creek WRIA 55 ESSB 6091/RCW 90.94
 Watershed Plan Update
 Spokane County, Washington

MAR-2020	BY: JS / EAC	FIGURE NO. 4
PROJECT NO. 180249-06	REVISED BY: ---	


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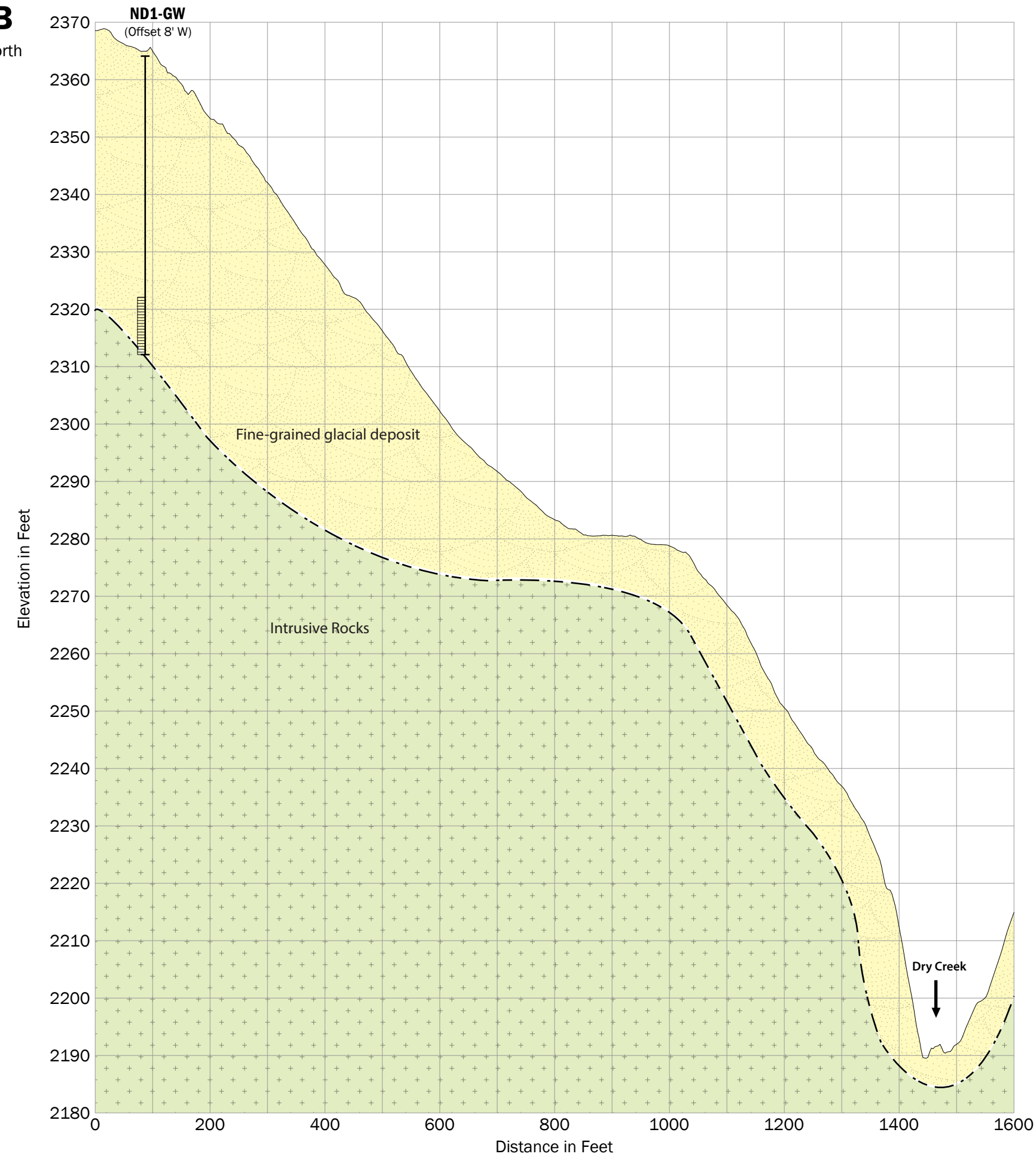
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-  Cross Section Well
-  Cross Section B
-  Potential Point of Diversion
- Surficial Geology (WADNR 1:100,000)**
- Quaternary Rocks and Deposits*
-  Quaternary alluvium
-  Pleistocene outburst flood deposits
-  Quaternary sedimentary rocks and deposits
- Tertiary-Cretaceous Rocks*
-  Tertiary-Cretaceous intrusive rocks
- Mesozoic Rocks*
-  Mesozoic heterogeneous metamorphic rocks
-  Mesozoic intrusive rocks

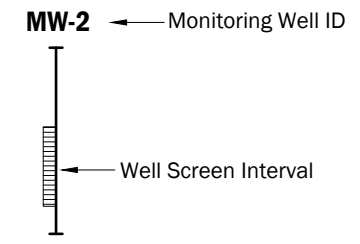
Dry Creek Surficial Geology
 Preliminary Managed Aquifer Recharge Project Design
 Bear Creek & Dry Creek WRIA 55 ESSB 6091/RCW 90.94
 Watershed Plan Update
 Spokane County, Washington

	MAR-2020	BY: JS / EAC	FIGURE NO. 5
	PROJECT NO. 180249-06	REVISED BY: ---	

B
North



B'
South



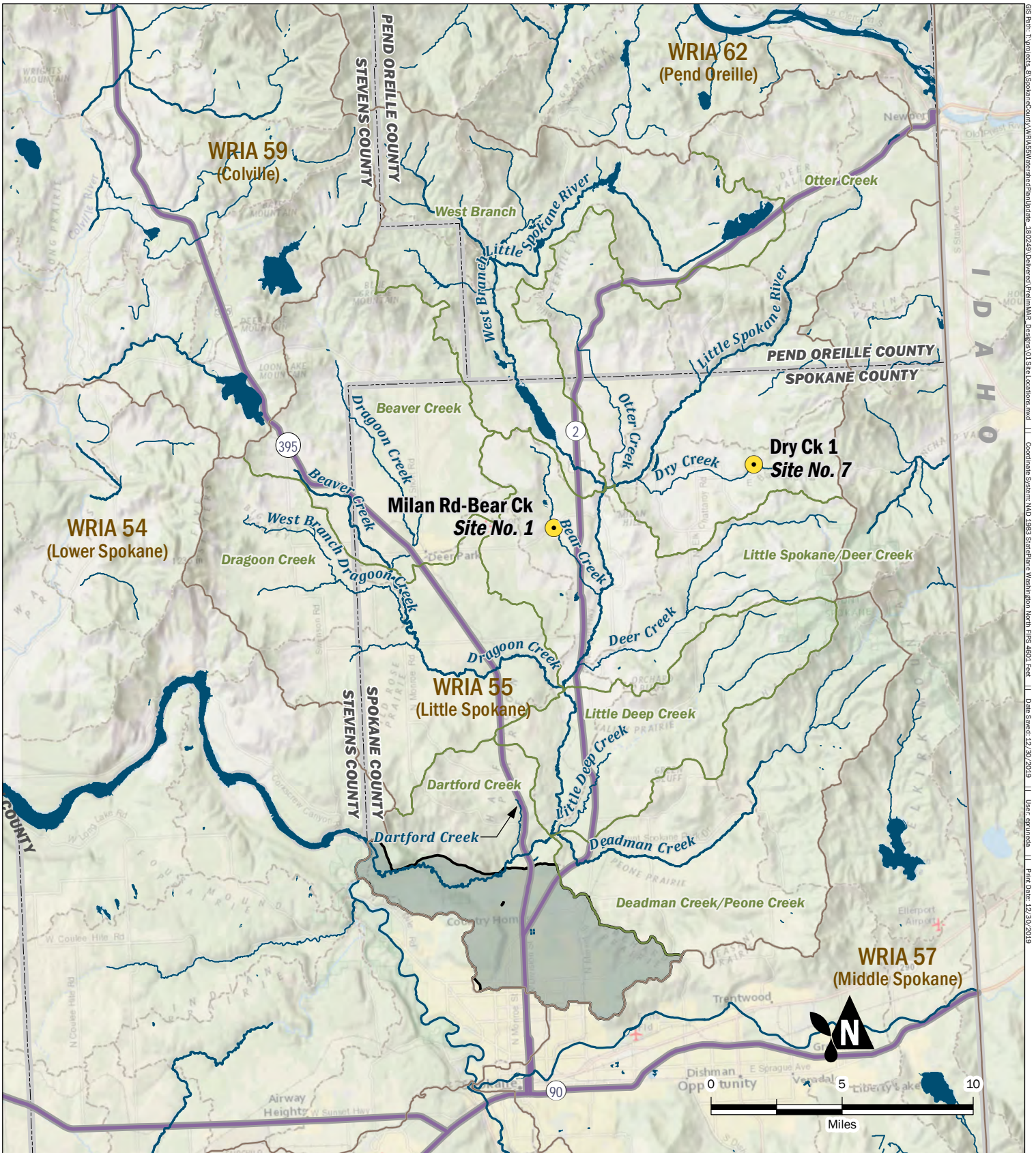
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Vertical Scale: 1" = 20'
Vertical Exaggeration 10x

Dry Creek Cross Section B-B'
Preliminary Managed Aquifer Recharge Project Design
Bear Creek & Dry Creek WRIA 55 ESSB 6091/RCW 90.94
Watershed Plan Update
Location, Washington

	Mar-2020	BY: JMS/SCC	FIGURE NO.
	PROJECT NO. 180249	REVISED BY: -	6

ATTACHMENT 1

MAR Project Location



- MAR Project Location
- WRIA 55 Subbasins

MAR Project Locations

Managed Aquifer Recharge
Preliminary Design Tech Memo
WRIA 55, Washington

	DEC-2019	BY: CME / EAC	ATTACHMENT NO.
	PROJECT NO. 180249	REVISED BY: ---	1

ATTACHMENT 2

Preliminary MAR Project Designs



GFROERER, HEINZ O
34119 N REGAL LN
DEER PARK, WA 99006
PARCEL # 39334.9013

MITCHELL REVOCABLE TRUST
2909 E DEER PARK-MILAN RD
DEER PARK, WA 99006
PARCEL # 39343.9080

YOUNG, JOSEPH M & ROBYN L ADAMS
3105 E DEER PARK-MILAN RD
DEER PARK, WA 99006
PARCEL # 39343.9081

TREJBAL LAND LLC
DEER PARK, WA 99006
PARCEL # 39343.9066

KISH, RICHARD A & SHELLEY R
34421 N FINDLEY RD
CHATTAROY, WA 99006
PARCEL # 39342.9051

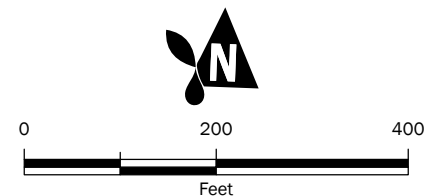
TREJBAL LAND LLC
DEER PARK, WA 99006
PARCEL # 39345.9092

HODGSON, BRUCE R & KRISTINA
34212 N FINDLEY RD
DEER PARK, WA 99006
PARCEL # 39343.9028

SPOKANE COUNTY
DEER PARK, WA 99006
PARCEL # 39342.9072

- Fish Screen/Diversion
- Pump Station
- Sedimentation Tank
- PVC Pipe (Gravity)
- PVC Pipe (Forcemain)
- 5-ft Contour (NED)
- Subsurface Infiltration Gallery
- Spokane County Parcel

Note: Available Bear Creek centerline does not match well with available aerial imagery.



Preliminary MAR Project Design Bear Creek

Managed Aquifer Recharge
Preliminary Design Tech Memo
WRIA 55, Washington



JAN-2020
PROJECT NO.
180249

BY:
EP / EAC
REVISED BY:

ATTACHMENT NO.
2A

GIS Path: I:\projects_8\SpokaneCounty\WRA55\WaterRecharge\PrelimMAR_Design\03 Site Map - Dry Creek Steward || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Data Source: 1/9/2020 || User: gpruneda || Print Date: 1/9/2020



	Fish Screen/Diversion		5-ft Contour (NED)
	Pump Station		Subsurface Infiltration Gallery
	Sedimentation Tank		Spokane County Parcel
	PVC Pipe (Gravity)		
	PVC Pipe (Forcemain)		

Preliminary MAR Project Design

Dry Creek

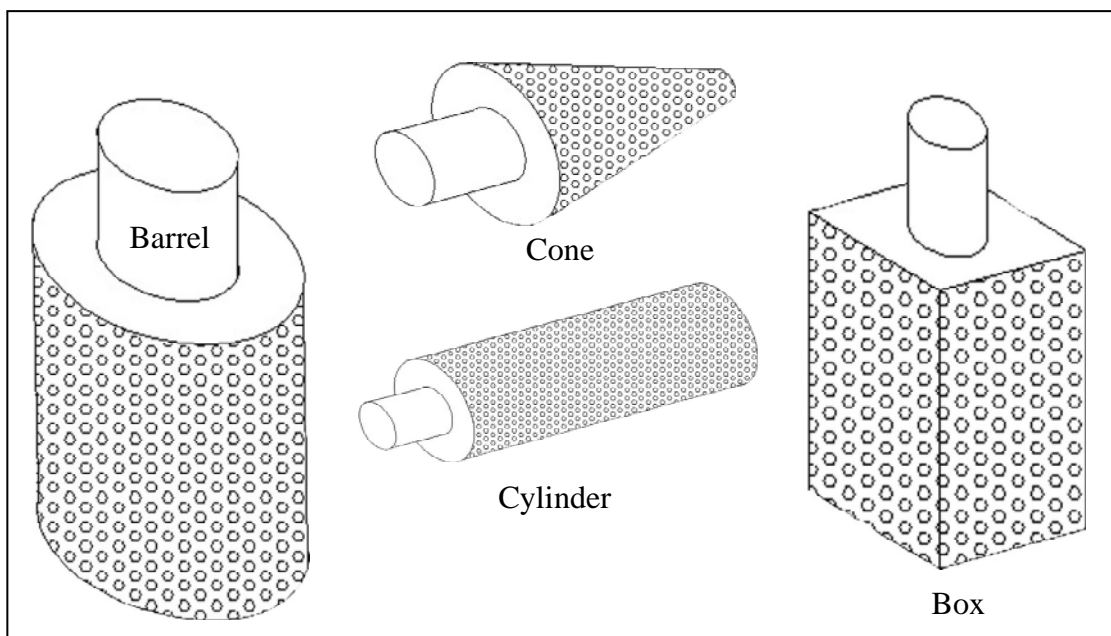
Managed Aquifer Recharge
Preliminary Design Tech Memo
WRIA 55, Washington

	JAN-2020 PROJECT NO. 180249	BY: EP / EAC REVISED BY: ---	ATTACHMENT NO. 2B
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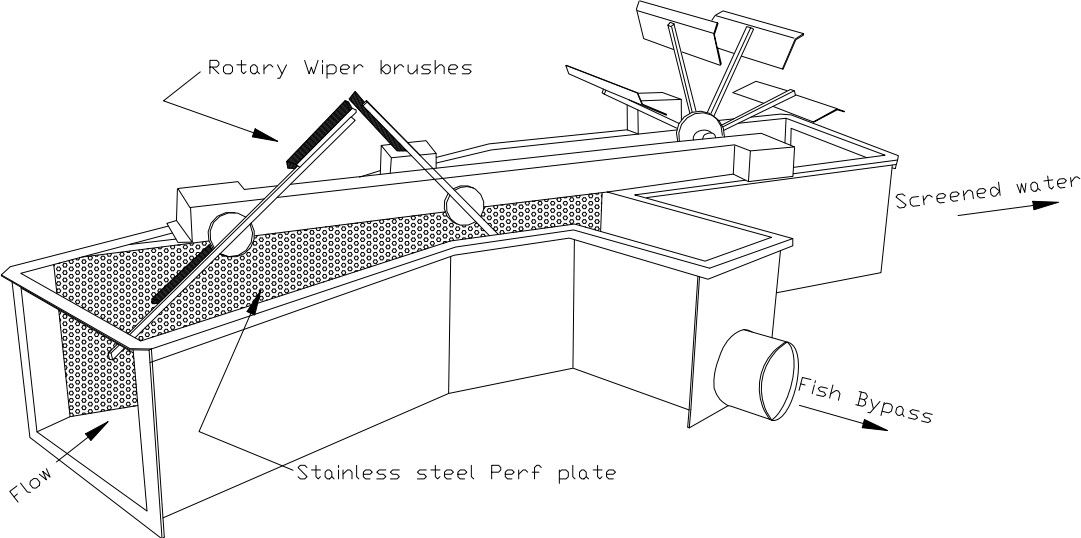
ATTACHMENT 3

Small Fish Screening Options

Screened Pump Intake (WDFW, 2009)



Rotary Wiper Screen (WDFW, 2009)



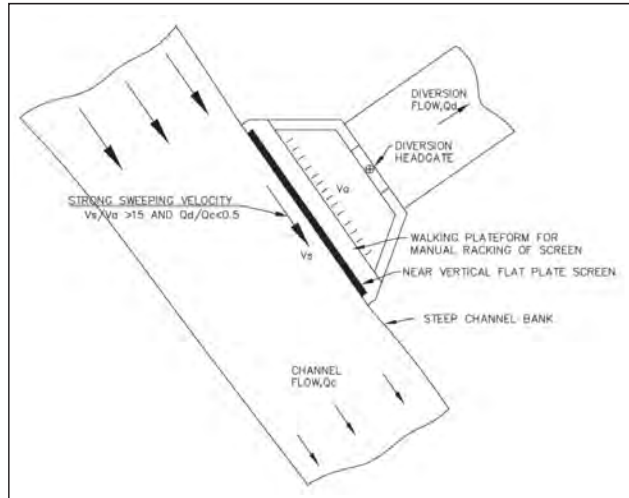
MODULARY PLATE

Traveling Belt Screen (USBR, 2014)



Standard Application	In-stream or in-ditch bank mounted applications.
Strong Points	Belt movement assists in moving debris downstream with bypass flow. Operates well over a wide range of sweeping velocity.
Issues	Relatively new design with short history of operation.
Standard Mounting	Stand alone screen set in vertical guides.
Cleaning	Horizontally rotating screen with scraper bar.
Screen Material	Articulated slotted panels
Power Requirements	Yes, may be run off solar power
Water Surface Drop across the Screen (Head Requirements)	~0.2 ft to 0.5 ft
Fish Bypass Structure	Not required for in-stream installations
Commercially Available	Yes
Search Key Words	Horizontal belt screen, Hydrolox Screens

Fixed Flat Plate Bank Screen (USBR, 2014)



Standard Application	In-stream screen used for gravity diversion or pump sump
Strong Points	Good cleaning characteristics when located on a straight bankline mounted flush with the bank.
Issues	Generally designed as a high V_s/V_a screen. Site requires strong sweeping flow adjacent to bankline. Cleaning effectiveness can be impacted by changes in stream conditions that effect sweeping flow alignment .. A mechanical cleaner is recommended if diversion flow is > 0.5 times the upstream channel flow.
Standard Mounting	Best on straight stream reaches. Screen mounted parallel to stream flow, generally flush with stream bank.
Cleaning	Passive, requires V_s/V_a ratios > ~15 with occasional manual cleaning (see similar screens in air- and water-burst cleaning section)
Screen Material	Wedge-wire, perforated plate
Flow Capacity	0 to >25 ft ³ /s
Power Requirements	None
Water Surface Drop across the Screen (Head Requirements)	~>0.3ft across screen structure
Fish Bypass	None
Commercially Available	Screen fabric only
Search Key Words	Wedge-wire screen, Hendrick Screens, Johnson Screens, Norris Screens, Corrugated Water Screens

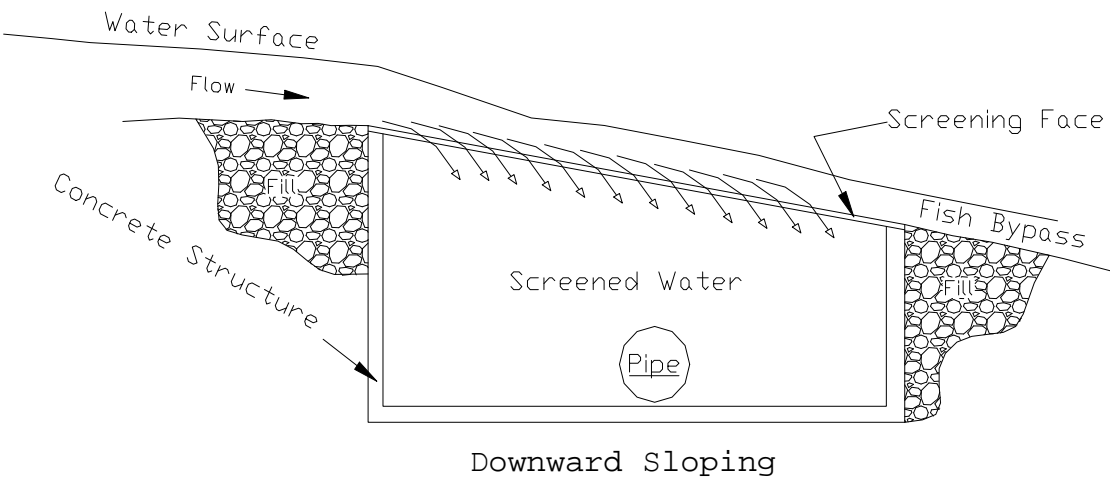
Horizontal Flat Plate Down Ramp (USBR, 2014)



Source: USBR

Standard Application	Flow diversion at an elevation drop.
Strong Points	Passive screen with high diversion capacity. Can be designed using USBR Coanda screen design program. Simpler to construct than a curved Coanda screen.
Issues	Difficult to control bypass flow. Possible dewatering of the screen toe and loss of bypass flow during low flows. Generally not approach velocity NOAA compliant.
Standard Mounting	In line with stream or ditch
Cleaning	Passive
Screen Material	Tilted wire wedge-wire, flat wedge wire or perforated plate
Flow Capacity	Generally $< 1\text{ft}^3/\text{s}/\text{ft}^2$. Best when constructed using tilted wedge wire screen and an upstream acceleration ramp (see figure 9) as specified by the USBR Coanda design guidance program, reference 15.
Power Requirements	None
Water Surface Drop across the Screen (Head Requirements)	Generally >1 ft
Fish Bypass	Fish and debris are transported by additional flow passing over screen.
Commercially Available	Yes
Search Key Words	Corrugated Water Screens, Watson Irrigation

Horizontal Flat Plate Screen (WDFW, 2009)



ATTACHMENT 4

Preliminary Hydraulic Calculations

Attachment 4 - Preliminary Pump Station and Force Main Calculations

Project No. 180249, Bear Creek Dry Creek MAR, Spokane County, WA

Pump Station	Flow Rate (cfs)	Flow Rate (gpm)	Flows To	Pipe Diameter (in)	Pipe Length (ft)	Roughness Coefficient (Hazen-Williams)	Pipeline Friction Head Loss (ft of water)	Minor Head Loss (ft of water)	Pumping Lift (ft)	Total Dynamic Head (ft of water)	Velocity (ft/s)
Bear Creek	1.0	449	Infiltration Gallery	8	2,050	140	7.61	2.12	100	109.73	2.86
Dry Creek	1.0	449	Infiltration Gallery	8	1,850	140	6.87	2.12	140	148.99	2.86

Notes:

1. Pipe lengths, pumping lifts, and minor head losses are based on conceptual design and will be revised during the design process

Attachment 4 - Preliminary Minor Head Loss Calculations

Project No. 180249, Bear Creek Dry Creek MAR, Spokane County, WA

Pump Station	Flow Rate (cfs)	Flow Rate (gpm)	Flows To	Pipe Diameter (in)	Component	Equivalent Pipe Length (ft)	Number of Components	Total Equivalent Pipe Length (ft)	Roughness Coefficient (Hazen-Williams)	Minor Head Loss (ft of water)
Bear Creek	1.0	449	Infiltration Gallery	8	45 Elbow	20	10	200	140	0.74
					90 Elbow	20	10	200	140	0.74
					Tee (Branch Flow)	40	2	80	140	0.30
					Tee (Pass-Through)	13.3	2	27	140	0.10
					Coupler	0	0	0	140	0.00
					Check Valve	33.3	1	33	140	0.12
					Butterfly Valve	30	1	30	140	0.11
					Flow Meter	0	1	0	140	0.00
Total									2.12	
Dry Creek	1.0	449	Infiltration Gallery	8	45 Elbow	20	10	200	140	0.74
					90 Elbow	20	10	200	140	0.74
					Tee (Branch Flow)	40	2	80	140	0.30
					Tee (Pass-Through)	13.3	2	27	140	0.10
					Coupler	0	0	0	140	0.00
					Check Valve	33.3	1	33	140	0.12
					Butterfly Valve	30	1	30	140	0.11
					Flow Meter	0	1	0	140	0.00
Total									2.12	

Notes:

1. Minor head losses based on equivalent pipe length method.
2. Type and quantity of fittings are based on conceptual design and will be revised during the design process.

ATTACHMENT 5

Preliminary Sedimentation Analysis

Attachment 5 - Preliminary Sedimentation Analysis

Project No. 180249, Bear Creek and Dry Creek MAR, Spokane County, WA

Storm Inflow (cfs)	Settling Time (s)	Settling Time (hr)	Particle Diameter (mm)
0.10	25,600	7.11	0.00891
0.15	17,067	4.74	0.01091
0.20	12,800	3.56	0.01260
0.25	10,240	2.84	0.01409
0.30	8,533	2.37	0.01543
0.35	7,314	2.03	0.01667
0.40	6,400	1.78	0.01782
0.45	5,689	1.58	0.01890
0.50	5,120	1.42	0.01992
0.55	4,655	1.29	0.02089
0.60	4,267	1.19	0.02182
0.65	3,938	1.09	0.02271
0.70	3,657	1.02	0.02357
0.75	3,413	0.95	0.02440
0.80	3,200	0.89	0.02520
0.85	3,012	0.84	0.02597
0.90	2,844	0.79	0.02673
0.95	2,695	0.75	0.02746
1.00	2,560	0.71	0.02817
1.05	2,438	0.68	0.02887
1.10	2,327	0.65	0.02955
1.15	2,226	0.62	0.03021
1.20	2,133	0.59	0.03086
1.25	2,048	0.57	0.03150
1.30	1,969	0.55	0.03212
1.35	1,896	0.53	0.03273
1.40	1,829	0.51	0.03334
1.45	1,766	0.49	0.03393
1.50	1,707	0.47	0.03451
1.55	1,652	0.46	0.03508
1.60	1,600	0.44	0.03564
1.65	1,552	0.43	0.03619
1.70	1,506	0.42	0.03673
1.75	1,463	0.41	0.03727
1.80	1,422	0.40	0.03780
1.85	1,384	0.38	0.03832
1.90	1,347	0.37	0.03883
1.95	1,313	0.36	0.03934
2.00	1,280	0.36	0.03984

Assumptions:

Vault Volume (cf) = 2,560 (8' wide x 40' long x 8' deep)
 Settling Time (s) = Pond Volume / Storm Inflow
 Particle Settling Time = Particle Settling Distance / $k * (\text{Particle Diameter})^2$
 Particle Diameter = $(\text{Particle Settling Distance} / k * \text{Settling Time})^{0.5}$
 Settling Distance (m) = 1.8288
 $k (m^{-1} s^{-1}) = 900,000$

<u>Descriptive Term</u>	<u>Size Range and Sieve Number</u>
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

ATTACHMENT 6

Preliminary Infiltration Gallery Sizing

Attachment 6 - Preliminary Infiltration Gallery Sizing

Project No. 180249, Bear Creek Dry Creek MAR, Spokane County, WA

Infiltration Gallery	Inflow Rate (ft ³ /s)	Inflow Rate (ft ³ /hr)	Length (ft)	Width (ft)	Long-Term Design Infiltration Rate (in/hr)	Long-Term Design Infiltration Rate (ft/hr)	Facility Infiltration Rate (ft ³ /hr)	Facility Infiltration Rate (ft ³ /s)
Bear Creek	1.00	3,600	60	30	25	2.08	3,750	1.04
Dry Creek	1.00	3,600	75	40	15	1.25	3,750	1.04

ATTACHMENT 7

Preliminary Cost Estimates

Bear Creek MAR			Preliminary Capital Cost Estimate	
DESCRIPTION OF ITEM	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED AMOUNT
General Construction				
Mobilization	LS	1	\$ 30,000.00	\$ 30,000.00
SPCC Plan	LS	1	\$ 1,000.00	\$ 1,000.00
Project Temporary Traffic Control / Signage	LS	1	\$ 20,000.00	\$ 20,000.00
Erosion / Water Pollution Control	FA	EST	\$ 5,000.00	\$ 5,000.00
In-Water Work Preparations	FA	EST	\$ 10,000.00	\$ 10,000.00
			<i>Subtotal</i>	\$ 66,000.00
In-Water Diversion Structure				
Diversion Structure with Fish Screen	EA	1	\$ 15,000.00	\$ 15,000.00
Slide/Canal Gate Valve	EA	1	\$ 3,000.00	\$ 3,000.00
Structure Excavation Class B	CY	33	\$ 20.00	\$ 660.00
Remote Monitoring Equipment	LS	1	\$ 5,000.00	\$ 5,000.00
			<i>Subtotal</i>	\$ 23,660.00
Electrical				
Power Service Extension	LF	200	\$ 15.00	\$ 3,000.00
			<i>Subtotal</i>	\$ 3,000.00
Pump Station				
Structure Excavation Class B	CY	54	\$ 20.00	\$ 1,080.00
Solid Wall PVC Pipe 12 In. Diam.	LF	40	\$ 25.00	\$ 1,000.00
Pump Wet Well Structure	EA	1	\$ 5,000.00	\$ 5,000.00
8 In. Drain Valve	EA	1	\$ 1,500.00	\$ 1,500.00
Power and Pump Control Enclosure	EA	1	\$ 5,000.00	\$ 5,000.00
Pump Panel, Floats	EA	1	\$ 2,500.00	\$ 2,500.00
Pump and Motor	EA	1	\$ 35,000.00	\$ 35,000.00
Flow Meter Vault	EA	1	\$ 2,500.00	\$ 2,500.00
Flow Meter	EA	1	\$ 5,000.00	\$ 5,000.00
Flow Control Valve	EA	1	\$ 1,000.00	\$ 1,000.00
Air Release Valve	EA	1	\$ 5,000.00	\$ 5,000.00
			<i>Subtotal</i>	\$ 64,580.00
Force Main				
Structure Excavation Class B	CY	912	\$ 20.00	\$ 18,240.00
Solid Wall PVC 8 In. Diam.	LF	2,050	\$ 28.00	\$ 57,400.00
			<i>Subtotal</i>	\$ 75,640.00
Pre-Treatment & Infiltration Gallery				
Structure Excavation Class B	CY	267	\$ 20.00	\$ 5,340.00
Sedimentation Tank	EA	1	\$ 25,000.00	\$ 25,000.00
Perforated PVC Pipe 4 In. Diam.	LF	120	\$ 18.00	\$ 2,160.00
Cleanout Ports	EA	4	\$ 500.00	\$ 2,000.00
Monitoring Ports	EA	2	\$ 500.00	\$ 1,000.00
4 In. Infiltration Gallery Pipe Valves	EA	2	\$ 500.00	\$ 1,000.00
Infiltration Gallery Rock	CY	140	\$ 50.00	\$ 7,000.00
Woven Geotextile for Underground Drainage	SY	440	\$ 5.00	\$ 2,200.00
Gravel Backfill for Pipe Zone Bedding	CY	371	\$ 40.00	\$ 14,840.00
			<i>Subtotal</i>	\$ 60,540.00
			SUBTOTAL	\$ 293,420.00
			Construction Management (10%)	\$ 29,342.00
			WA State Sales Tax (8.1%)	\$ 23,767.02
			CONSTRUCTION TOTAL	\$ 346,529.02
			Easement	\$ 20,000.00
			Engineering Design and Supporting Field Investigations (Survey, Geotech/Hydrogeo, Civil)	\$ 120,000.00
			Permitting (Water Rights, In-Water Work, Other)	\$ 30,000.00
			PROJECT SUBTOTAL	\$ 516,529.02
			Contingency (15%)	\$ 77,479.35
			PROJECT TOTAL	\$ 594,008.37

Bear Creek MAR			Preliminary Annual O&M Cost Estimate	
DESCRIPTION OF ITEM	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED AMOUNT
Pump Station Annual Power (3 Months per Year)	HR	2,160	\$ 2	\$ 4,320
MAR System Operation & Maintenance	HR	60	\$ 50	\$ 3,000
Ground & Surface Water Sampling, Stream Gaging	HR	60	\$ 50	\$ 3,000
Data Analysis & Reporting	HR	40	\$ 50	\$ 2,000
Analytical	EA	7	\$ 300	\$ 2,100
Pump Contractor	HR	15	\$ 200	\$ 3,000
Equipment Repair & Replacement Reserve	LS	1	\$ 5,000	\$ 5,000
ANNUAL O&M TOTAL				\$ 22,420

Dry Creek MAR			Preliminary Capital Cost Estimate	
DESCRIPTION OF ITEM	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED AMOUNT
General Construction				
Mobilization	LS	1	\$ 30,000.00	\$ 30,000.00
SPCC Plan	LS	1	\$ 1,000.00	\$ 1,000.00
Project Temporary Traffic Control / Signage	LS	1	\$ 2,500.00	\$ 2,500.00
Erosion / Water Pollution Control	FA	EST	\$ 5,000.00	\$ 5,000.00
In-Water Work Preparations	FA	EST	\$ 10,000.00	\$ 10,000.00
			<i>Subtotal</i>	\$ 48,500.00
In-Water Diversion Structure				
Diversion Structure with Fish Screen	EA	1	\$ 15,000.00	\$ 15,000.00
Slide/Canal Gate Valve	EA	1	\$ 3,000.00	\$ 3,000.00
Structure Excavation Class B	CY	33	\$ 20.00	\$ 660.00
Remote Monitoring Equipment	LS	1	\$ 5,000.00	\$ 5,000.00
			<i>Subtotal</i>	\$ 23,660.00
Electrical				
Power Service Extension	LF	2,000	\$ 15.00	\$ 30,000.00
			<i>Subtotal</i>	\$ 30,000.00
Pump Station				
Structure Excavation Class B	CY	54	\$ 20.00	\$ 1,080.00
Solid Wall PVC Pipe 12 In. Diam.	LF	40	\$ 25.00	\$ 1,000.00
Pump Wet Well Structure	EA	1	\$ 5,000.00	\$ 5,000.00
8 In. Drain Valve	EA	1	\$ 1,500.00	\$ 1,500.00
Power and Pump Control Enclosure	EA	1	\$ 5,000.00	\$ 5,000.00
Pump Panel, Floats	EA	1	\$ 2,500.00	\$ 2,500.00
Pump and Motor	EA	1	\$ 37,000.00	\$ 37,000.00
Flow Meter Vault	EA	1	\$ 2,500.00	\$ 2,500.00
Flow Meter	EA	1	\$ 5,000.00	\$ 5,000.00
Flow Control Valve	EA	1	\$ 1,000.00	\$ 1,000.00
Air Release Valve	EA	1	\$ 5,000.00	\$ 5,000.00
			<i>Subtotal</i>	\$ 66,580.00
Force Main				
Structure Excavation Class B	CY	823	\$ 20.00	\$ 16,460.00
Solid Wall PVC 8 In. Diam.	LF	1,850	\$ 28.00	\$ 51,800.00
			<i>Subtotal</i>	\$ 68,260.00
Pre-Treatment & Infiltration Gallery				
Structure Excavation Class B	CY	445	\$ 20.00	\$ 8,900.00
Sedimentation Tank	EA	1	\$ 25,000.00	\$ 25,000.00
Perforated PVC Pipe 4 In. Diam.	LF	225	\$ 18.00	\$ 4,050.00
Cleanout Ports	EA	6	\$ 500.00	\$ 3,000.00
Monitoring Ports	EA	3	\$ 500.00	\$ 1,500.00
4 In. Infiltration Gallery Pipe Valves	EA	3	\$ 500.00	\$ 1,500.00
Infiltration Gallery Rock	CY	230	\$ 50.00	\$ 11,500.00
Woven Geotextile for Underground Drainage	SY	720	\$ 5.00	\$ 3,600.00
Gravel Backfill for Pipe Zone Bedding	CY	339	\$ 40.00	\$ 13,560.00
			<i>Subtotal</i>	\$ 72,610.00
			SUBTOTAL	\$ 309,610.00
			Construction Management (10%)	\$ 30,961.00
			WA State Sales Tax (8.1%)	\$ 25,078.41
			CONSTRUCTION TOTAL	\$ 365,649.41
			Easement	\$ 20,000.00
			Engineering Design and Supporting Field Investigations (Survey, Geotech/Hydrogeo, Civil)	\$ 120,000.00
			Permitting (Water Rights, In-Water Work, Other)	\$ 30,000.00
			PROJECT SUBTOTAL	\$ 535,649.41
			Contingency (15%)	\$ 80,347.41
			PROJECT TOTAL	\$ 615,996.82

Dry Creek MAR			Preliminary Annual O&M Cost Estimate	
DESCRIPTION OF ITEM	UNIT	ESTIMATED QUANTITY	UNIT PRICE	EXTENDED AMOUNT
Pump Station Annual Power (3 Months per Year)	HR	2,160	\$ 2	\$ 4,320
MAR System Operation & Maintenance	HR	60	\$ 50	\$ 3,000
Ground & Surface Water Sampling, Stream Gaging	HR	60	\$ 50	\$ 3,000
Data Analysis & Reporting	HR	40	\$ 50	\$ 2,000
Analytical	EA	7	\$ 300	\$ 2,100
Pump Contractor	HR	15	\$ 200	\$ 3,000
Equipment Repair & Replacement Reserve	LS	1	\$ 5,000	\$ 5,000
ANNUAL O&M TOTAL				\$ 22,420.00

APPENDIX H

Offset Project Supporting Information

**WRIA 55 Watershed Restoration
Grant Application Excerpts**

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

WRSRP-2020-SCUWRS-00006

General Information

Project Title	Little Spokane - Bear Creek Managed Aquifer Recharge
Project Short Description	<p>The Bear Creek Managed Aquifer Recharge (MAR) project will increase flow in Bear Creek and Little Spokane River during critical low flow months by infiltrating surface water during high flow conditions that will return later as groundwater baseflow. The project will divert 1 cfs over a 3-month period for a total of 182 AFY. Hydrogeologic modeling, field investigations, feasibility, and preliminary design have been completed. This project includes final design, permitting, and construction.</p>
Project Long Description	<p>The Bear Creek Managed Aquifer Recharge (MAR) project will increase flow in Bear Creek and the Little Spokane River during critical low flow months by infiltrating surface water during high flow conditions that will return later as groundwater baseflow. This project will offset future permit exempt domestic water use in WRIA 55 as required by RCW 90.94, and improve flow and habitat conditions for native interior redband trout, a U.S. Fish and Wildlife species of special concern.</p> <p>On January 6, 1976 the Little Spokane River Instream Flow rule (WAC 173-555) was adopted. It set baseflows on an 80% exceedance curve, meaning that 8 out of 10 years the stream flow would exceed the established baseflow. Since that time the 7-day low flow at the USGS gage at Dartford has been below the minimum flow of 115 cfs 27 of 43 years, which means that the base flow exceeds the minimum flow 3 out of every 10 years. The 7-day low flow since 1947 also shows a declining trend (Figure 1). The projected impacts of climate change will only exacerbate the problem. Spokane County recently completed a project to develop a transient integrated ground and surface water model for WRIA 55 using the USGS model GSFLOW (http://www.spokanewatersheds.org/wria-55-57-current-projects). A scenario based on projected climate change with no increased demand shows a change in stream flow during July, August, and September ranging from -13.40 and -30.72 cfs.</p> <p>MAR is a key strategy in WRIA 55 to offset future permit exempt domestic water use. Over the next twenty years new consumptive water use from domestic permit exempt wells in WRIA 55 is estimated at 2,127 acre-feet per year (AFY) as shown in the uploaded memorandum Evaluation of Future Exempt Well Demand. The portfolio of projects approved by the WRIA 55 Planning Unit includes 9 MAR projects to provide an estimated 1,640 AFY of offset. The use of MAR projects also allows for distribution of offsets throughout the basin.</p> <p>The Bear Creek MAR site was identified using the Little Spokane Integrated Ground and Surface Water Model (http://www.spokanewatersheds.org/wria-55-57-current-projects). A link is provided given the size of the model report and figures. The process to identify the site is detailed in the technical memo – Managed Aquifer Recharge Site Optimization and</p>

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

WRSRP-2020-SCUWRS-00006

General Information

Selection, which has been uploaded as a support document. In short, a model scenario was run over a 17-year period in which 182 AFY of surface water from Bear Creek was diverted and infiltrated over a 3-month period and 79 AFY returned back to Bear Creek one mile downstream of the diversion location in the subsequent 9 month period. Bear Creek is closed to further appropriations from June 1 to October 31 and use of the source water for MAR is proposed outside of that period, primarily during the high flow period of March, April, and May. Based on the hydraulic connection of the aquifer in which the water will be infiltrated to the Little Spokane River mainstem there are likely streamflow benefits to the mainstem Little Spokane River that may not show up immediately in Bear Creek.

The components of an MAR Feasibility Study have been completed and are documented in two technical memorandums: 1. Little Spokane River (WRIA 55) Managed Aquifer Recharge Field Investigation, and 2. Preliminary Managed Aquifer Recharge Project Design. Both memorandums have been uploaded as support documents. The findings of these studies indicate:

1. The site is suitable for surficial infiltration of diverted surface water based on the raw infiltration rates and depth to water table;
2. Initial water quality results indicate surface water infiltration will not adversely impact groundwater quality;
3. Sufficient surface water is available for diversion. A preliminary meeting with Ecology Eastern Region Water Resources staff indicate that a water right for the project is feasible;
4. Hydraulic parameters used in modeling are consistent with the field investigation results which confirms the modeled results; and
5. It is feasible to construct facilities for surface diversion, transmission of water, and infiltration of water.

The project will be located within the County road right-of-way and on property owned by Spokane County Public Works. The surface water withdrawal will be located adjacent to a bridge over Bear Creek. The source water transmission line will follow Deer Park-Milan Rd up to a retired gravel pit that is utilized to stage road maintenance materials (e.g. sand for winter driving) where the infiltration gallery will be located. Public Works has agreed to provide a permanent easement to Environmental Services to locate and operate the MAR facility at the gravel pit property.

The proposed project includes:

1. Supplemental field work – A geotechnical and hydrogeological investigation to determine if subsurface conditions will support collection of water from groundwater adjacent to the creek (i.e. shallow groundwater extraction wells or a Ranney collector system) rather than a direct surface water diversion, confirm aquifer conditions at a midpoint between the creek and infiltration gallery, and to support project design. Surveying will also be completed to support project design and construction.
2. Project Design – Design plans and specifications will be provided at the 60%, 90%, and 100% completion level for technical review. This task will produce final

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

WRSRP-2020-SCUWRS-00006

General Information

bid-ready plans and specifications, opinion of construction cost, construction schedule, preparation and issuance of bid packages, administration of bid solicitation and contractor selection.

3. Project Permitting – This includes water rights permitting, hydraulic project approval, cultural resources review, critical area/shoreline permit, construction stormwater permitting, a grading permit, SEPA, an electrical permit, and UIC registration. Initial consultations with Ecology Eastern Region Water Resources staff indicate that it will be feasible to obtain a non-consumptive water right permit to divert water from Bear Creek during the proposed time period, and initial evaluation of other permitting requirements does not indicate any unusual permitting concerns that would prevent the project from being implemented.

4. Project Construction –A project cost estimate is provided in the preliminary design memo. This estimate assumes a surface water diversion, rather than a groundwater collection system adjacent to the creek. If a groundwater collection system adjacent to the creek is utilized a sedimentation tank may not be needed and the diversion structure cost will be reduced. An initial estimate indicates that this could provide a 10% reduction in cost, although there is the potential for more cost savings, depending on subsurface conditions adjacent to the creek.

5. Construction Management and Inspection – This task includes activities related to managing project construction and ensuring the project is built as designed and meets all specifications.

6. Project Operation and Maintenance – This task includes start up and testing of the MAR facility and development of operation and maintenance procedures. The Spokane County Board of County Commissioners has agreed to pay costs associated with ongoing operation and maintenance after project completion, with that work conducted by Spokane County Environmental Services.

In addition to providing instream flow and habitat benefits this project will serve as a pilot project in the design, construction and operation of an MAR facility. Since MAR is a key strategy to improve streamflow in WRIA 55 and meet the requirements of RCW 90.94 this will be an important first step in implementing the WRIA 55 Watershed Plan Update.

Total Cost \$656,517.00* Total Eligible Cost \$656,517.00*

Effective Date 10/1/2020 Expiration Date 12/31/2022

Ecology Program Water Resources

Project Category ✓ Streamflow Restoration Grants

Will Environmental Monitoring Data be collected? Yes

If Yes, a Quality Assurance Project Plan (QAPP) will be required as a deliverable and environmental data may

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

WRSRP-2020-SCUWRS-00006

General Information

need to be entered into Ecology's Environmental Information Management (EIM) database.

Overall Goal

The goal of this project is to design and construct an MAR facility on Bear Creek within WRIA 55 to offset future permit exempt domestic water use in WRIA 55 as required by RCW 90.94, and improve flow and habitat conditions for native interior redband trout, a U.S. Fish and Wildlife species of special concern. Additionally, this project will serve as a pilot project for the design, construction and operation of an MAR facility in WRIA 55.

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

WRSRP-2020-SCUWRS-00006

Scope of Work - Task 1 Project Admin: 1

Task Number	1		
Task Title	Project Administration	Task Cost	\$26,500.00
Task Description	<p>A. The RECIPIENT will administer the project. Responsibilities will include, but not be limited to: maintenance of project records; submittal of requests for reimbursement and corresponding backup documentation, progress reports and recipient closeout report; submittal of required performance items; and compliance with applicable procurement and contracting requirements.</p>		

B. The RECIPIENT will develop and maintain tracking systems to monitor and measure all project objectives and activities. The RECIPIENT shall maintain these systems throughout the project period and measure accomplishments against project objectives at the end of the grant period.

C. The RECIPIENT will, along with each request for reimbursement, prepare and submit a progress report to ECOLOGY's project manager. The reports shall include, at a minimum, the following information:
 A comparison of actual accomplishments to the objectives established for the reporting period .The reasons for any delays if the project does not meet established objectives.Plan and schedule of activities for the upcoming two months.Analysis and explanations of any cost overruns.Any additional pertinent information.

D. The RECIPIENT shall submit a Final Project Report encompassing the entire project with their last payment request. The RECIPIENT shall include the Final Project Report with the last monthly/quarterly project report. The RECIPIENT shall submit the final payment request and final report within 30 days of the end of this agreement.

E. The RECIPIENT must manage and carry out this project in accordance with any completion dates outlined in this agreement.

Task Goal Statement	Properly managed project that meets agreement and Ecology administrative requirements.		
Task Expected Outcomes	<p>* Timely and complete submittal of requests for reimbursement, quarterly progress reports and recipient closeout report.</p> <p>*Properly maintained project documentation</p>		

Recipient Task Coordinator	Mike Hermanson
Deliverables	

Deliverable #	Description	Due Date	Received?	EIM Study ID	EIM	Latitude	Loc Address
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WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

WRSRP-2020-SCUWRS-00006

Scope of Work - Task 1 Project Admin: 1

		(ECY Use Only)	Sys Link
1.1	Quarterly payment request and progress report		
1.2	Quarterly payment request and progress report		

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

WRSRP-2020-SCUWRS-00006

Scope of Work - Additional Tasks: 2 - Project Management

Task Number	2							
Task Title	Project Management	Task Cost	\$15,000.00*					
Task Description	The purpose of this task is to manage all aspects of the project including grant management, consultant selection, consultant contract management, coordination with Ecology staff, communication with stakeholders, and any other associated activities.							
Task Goal Statement	The goal of this task is to effectively manage the project such that project timelines and budgets are met , deliverables meet expectations, and the project is successfully permitted and constructed.							
Task Expected Outcomes	The expected outcome is that the grant will be effectively managed such that grant tasks are completed , deliverables are produced, and the project is successfully permitted and constructed.							
Recipient Task Coordinator	Mike Hermanson							

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
2.1	Quarterly Reports							

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

WRSRP-2020-SCUWRS-00006

Scope of Work - Additional Tasks: 3 - Supplemental Site Investigation

Task Number	3		
Task Title	Supplemental Site Investigation	Task Cost	\$75,342.00*
Task Description	<p>The purpose of this task is to complete supplemental geotechnical and hydrogeologic field investigations and data analysis to support design, permitting, and construction. Additionally, one or more borings drilled during the investigation will be completed as monitoring wells for ongoing monitoring during operation. One of the borings may also be converted to a source water production well, depending on the results of hydraulic testing. The supplemental field work will include both surveying, geotechnical/hydrogeologic investigations, and monitoring well installation.</p> <p>Surveying services will provide design information and mapping necessary for preliminary and final project design including the boundary of the right-of-way's utilized for the project components and topographic survey for project design.</p> <p>Investigation and analysis will be conducted to characterize subsurface conditions for project design, including an investigation of withdrawal location to determine if alternate methods from installing a diversion structure for direct surface water withdrawal, such as a groundwater extraction wells or a Ranney collector system should be included in the final design. Excavation and/or borings will be conducted along the conveyance pipe alignment to provide geotechnical data for design and construction. A monitoring well will also be installed between the infiltration site and Bear Creek, to provide more information on aquifer conditions and the response to infiltration downgradient of the infiltration gallery. This monitoring well, combined with a monitoring well previously installed at the infiltration site as part of the preliminary design work, will provide performance data following project implementation.</p>		
Task Goal Statement	<p>The goal of this task is to conduct the necessary site investigations to support final project design, permitting, and construction. Monitoring well(s) completed during these investigations will be used to monitor project operation and performance after construction is complete.</p>		
Task Expected Outcomes	<p>It is expected that this task will result in providing data and analysis that will support subsequent tasks including final design, permitting, and construction.</p>		

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

WRSRP-2020-SCUWRS-00006

Scope of Work - Additional Tasks: 3 - Supplemental Site Investigation

Recipient Task Coordinator Mike Hermanson

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
3.1	Field Investigation QAPP	2/28/2021						
3.2	Topographic Survey	4/30/2021						
3.3	Geotechnical/Hydro geologic Investigation Technical Memorandum	6/30/2021						

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

WRSRP-2020-SCUWRS-00006

Scope of Work - Additional Tasks: 4 - Project Design

Task Number	4		
Task Title	Project Design	Task Cost	\$71,631.00*

Task Description

This task will produce final plans and specifications for the MAR facility and address other design considerations, including:

- Plans and specifications presented at the 60%, 90%, and final design completion level for technical review.
- Preparation of a design report.
- Preparation of draft plans and specification in APWA/WSDOT format.
- Preparation of final bid-ready plans and specifications in APWA/WSDOT format.
- Preparation of an opinion of construction cost.
- Development of a construction schedule.
- Preparation and issuance of bid packages.
- Responding to bid questions and issuance of addenda
- Conducting a pre-bid conference.
- Review of bid award.

Task Goal Statement

The goal of this task is to complete a final design allowing construction bids to be submitted and the MAR facility to be constructed and put into operation.

Task Expected Outcomes

Final design allowing construction bids to be submitted and the MAR facility to be constructed and put into operation.

Recipient Task Coordinator

Mike Hermanson

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
4.1	60% design	8/31/2021						

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

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Scope of Work - Additional Tasks: 4 - Project Design

	drawings, specifications, probably construction costs, and report	
4.2	Response to 60% design report comments	9/30/2021
4.3	90% design drawings/specificati ons/probable costs	10/31/2021
4.4	Response to 90% design comments	11/30/2021
4.5	Final design drawings/specificati ons/probable costs and bid package	1/31/2022

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Scope of Work - Additional Tasks: 5 - Project Permitting

Task Number	5		
Task Title	Project Permitting	Task Cost	\$39,783.00*
Task Description	<p>Several permits are likely to be required for the Bear Creek MAR project. This task covers the effort and costs of obtaining required permit authorizations. These permits include, but may not be limited to, the following:</p> <ul style="list-style-type: none">- Grading Permit – Projects that excavate more than 500 cubic yards require a grading permit and submittal of a State Environmental Policy Act (SEPA) checklist.- SEPA – The State Environmental Policy Act process identifies and analyzes environmental impacts associated with significant projects.- Critical Areas/Shoreline Permits – Projects involving work within 250 feet of a shoreline, within 250 feet of a wetland, or within the 100-year flood plain will require a County Critical Areas/Shoreline Permit.- Electrical – County electrical permits will be required for the MAR project pump stations and electrical service.- Hydraulic Project Approval (HPA) – Work that crosses over a waterbody or includes in-water work may require coverage under an HPA Permit from the Washington Department of Fish and Wildlife (WDFW).WA State Underground Injection Control (UIC) Program (WAC 173-218) – The proposed infiltration galleries (with perforated pipe) will require registration with Ecology’s Water Quality Program.- Cultural Resources Review – Projects involving excavation activities are required to perform a cultural resource review within the project area.- Construction Stormwater General Permit – Projects that disturb 1-acre or more land and discharge stormwater to surface waters of the State are required to obtain a Construction Stormwater General Permit from the Ecology.- Water Rights Permits. Diversion of water or withdrawal from wells adjacent to Bear Creek to provide source water for infiltration will require a new water right.- Dredge/Fill Permit (Section 404) – In-water work that will involve dredging or filling in the waterway will require a Section 404 permit from the U.S. Army Corps of Engineers.- Endangered Species Act (ESA) Compliance – Projects are required to address direct and indirect impacts to species, as well as direct and indirect impacts to their critical habitat, and consult with U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA).		
Task Goal Statement	The goal of this task is to assess project permitting needs, develop a strategy for project permitting, consult		

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

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Scope of Work - Additional Tasks: 5 - Project Permitting

with appropriate permitting entities, prepare permit applications, and support securing all necessary permits to implement the MAR project.

Task Expected Outcomes The expected outcome of this task is obtaining all necessary permits and approvals for project implementation.

Recipient Task Coordinator Mike Hermanson

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
5.1	Water right pre-application meeting and application filing	8/31/2021						
5.2	SEPA determination documentation	10/31/2021						
5.3	Completion of other associated permitting applications	1/31/2022						

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

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Scope of Work - Additional Tasks: 6 - Construction Inspection and Management

Task Number	6						
Task Title	Construction Inspection and Management					Task Cost	\$40,496.00*
Task Description	<p>This task includes activities related to managing project construction and ensuring the project is built as designed and meets all specifications. Construction inspection and management may include the following:</p> <ul style="list-style-type: none"> • Conducting a pre-construction conference. • Review and approval of materials and plan submittals as needed. • Provision of on-site personnel to provide on-the-job day-to-day observation of construction, preparation of periodic progress reports, verification of completed items for payment, determination of substantial completion, preparation of punch lists, monitoring of startup activities and preparation of record drawings. • Providing and reviewing laboratory materials testing as needed. • Conducting weekly construction progress meetings. • Preparation of and/or review of vendor operation and maintenance manuals. • Preparation of Record Drawings. • Construction administration including review of payroll/wage certifications, EEO statements, affirmative action plans and monthly utilization reports, conducting wage interviews, negotiation of scope and cost of any necessary contract change orders, and preparation of contract change orders and pay estimates. 						
Task Goal Statement	The goal of this task is to provide sufficient oversight and management of construction to ensure successful project implementation.						
Task Expected Outcomes	Successful construction and startup of the MAR project.						
Recipient Task Coordinator	Mike Hermanson						

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
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WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

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Scope of Work - Additional Tasks: 6 - Construction Inspection and Management

6.1 Project Record 12/31/2022 Only)
Drawings

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

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Scope of Work - Additional Tasks: 7 - Project Construction

Task Number	7		
Task Title	Project Construction	Task Cost	\$387,765.00*
Task Description	<p>This task includes construction of all project elements required to complete the project:</p> <ul style="list-style-type: none"> • Construction of the diversion structure and associated fish screen (or groundwater extraction system if that is proven to be a viable, cost-effective alternative) • Installation of the pump station with associated pump and pump controller and metering equipment • Installation of conveyance pipe from the source water location to the infiltration gallery • Excavation and installation of the infiltration gallery and associated equipment, including a sedimentation tank (if needed), associated backfill, and final site grading. • Installation of necessary and required monitoring equipment 		
Task Goal Statement	The goal of this task is to complete construction and startup of the Bear Creek MAR project.		
Task Expected Outcomes	The expected outcome of this task is a fully operational MAR system at the Bear Creek site that successfully enhances instream flows in Bear Creek and the Little Spokane River.		
Recipient Task Coordinator	Mike Hermanson		

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
7.1	Project completion report	12/31/2022						

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

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Scope of Work Summary

Task Title	Task Cost
Project Administration	\$26,500.00
Project Management	\$15,000.00
Supplemental Site Investigation	\$75,342.00
Project Design	\$71,631.00
Project Permitting	\$39,783.00
Construction Inspection and Management	\$40,496.00
Project Construction	\$387,765.00
Total	\$656,517.00

Total Eligible Costs

(from the General Information Form)

\$656,517.00

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

WRSRP-2020-SCUWRS-00044

General Information

Project Title	Little Spokane – Eloika Lake Water Storage & Wetland Restoration
Project Short Description	The purpose of this project is to conduct the necessary field investigations, preliminary design, property owner outreach and coordination, permitting, and final design to construct a water level control structure at the outlet of Eloika Lake and restore and enhance 100 acres of wetland at the south end of the lake. The outlet control structure will allow storage of approximately 1,400 acre-feet of water and release of an additional 10 cfs over a period of 70 days during low flow periods.
Project Long Description	<p>Eloika Lake is a unique surface water storage opportunity. Approximately 1,400 acre-ft of water can be stored for release during low flow periods while still operating within the natural range of lake levels experienced each year. During the period of 2007 to 2017 lake levels always reached maximum elevation of at least 1,907 feet mean sea level (msl) during the spring and with one exception never fell below 1,905 feet msl (in 2007 the lake level fell to 1904.77 feet msl). Figure 1-Eloika Lake Level 2007-2017 was uploaded with this application. This project proposes to construct a control structure near the outlet of Eloika Lake that would hold the lake level at an elevation of 1,907 msl until mid-summer, thereby increasing flow in the West Branch Little Spokane and Little Spokane River by 10 cfs over a 70 day late summer low-flow period. This project also includes restoration of 100 acres of wetland at the south end of the lake, near the outlet, to enhance wildlife habitat, aquatic habitat, and water quality.</p> <p>On January 6, 1976 the Little Spokane River Instream Flow rule (WAC 173-555) was adopted. It set base flows on an 80% exceedance curve, meaning that 8 out of 10 years the stream flow would exceed the established base flow. Since that time the 7-day low flow at the USGS gage at Dartford has been below the minimum flow of 115 cfs 27 of 43 years, which means that the base flow has only exceeded the minimum flow approximately 3 out of every 10 years. The 7-day low flow since 1947 also shows a declining trend. Figure 2-Little Spokane River 7-day low flow was also uploaded with this application. The projected impacts of climate change will only exacerbate the problem. Spokane County recently completed a project to develop a transient integrated ground and surface water model for WRIA 55 using the USGS model GSFLOW (http://www.spokanewatersheds.org/wria-55-57-current-projects). A scenario based on projected climate change with no increased demand shows an average change in stream flow during July, August, and September ranging from -13.40 and -30.72 cfs.</p> <p>In addition to current streamflow declines during low flow periods and the projected impacts of climate change, over the next twenty years new consumptive water use from domestic permit exempt wells in WRIA 55 is estimated at 2,127 acre-feet per year. This project would provide a significant streamflow restoration offset for new domestic permit exempt use as required by RCW 90.94 and reduce the projected impacts from climate change.</p>

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

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General Information

There has been significant investigation into the feasibility of a water storage and wetland restoration project on Eloika Lake through watershed planning funding. In April 2009 PBS&J completed a surface water storage investigation in WRIA 55 and identified Eloika Lake as a potentially feasible surface water storage opportunity and recommended further investigation. In June of 2009 PBS&J completed the Eloika Lake In-Depth Surface Water Storage and Wetland Restoration Feasibility study which concluded that constructing a water control structure at the outlet of Eloika Lake was a viable option for creating downstream flow benefits. The feasibility study identified the following key action items to move forward:

1. Identification of land impacts around the lake including flooding extent and duration;
2. Discussion with and consensus of landowners regarding acceptable lake level impacts on their property;
3. Hydrologic and hydraulic analysis for various lake level management scenarios;
4. Identify specific location of control structure and complete control structure design;
5. Complete a detailed survey of the lake shore including the entire southern end wetland area;
6. Following the development of a lake level management strategy and assessment of potential impacts, communicate with all potentially impacted lake shore property owners to explore options for making the project acceptable;
7. Evaluate potential phosphorus loading and downstream temperature impacts from water release under the selected lake management strategy;
8. Reevaluate feasibility of the restoration scenarios upon completion of a site survey and wetland delineation;
9. Identify and address necessary permitting requirements; and
10. Develop a plan for ongoing operation and maintenance.

Both the surface water storage investigation and the feasibility study have been uploaded as support documents.

In 2010 PBS&J was contracted to conduct property owner outreach, since property owner acceptance of the project is a key component to move forward. PBS&J met with 6 key property owners at the south end of the lake and held a public meeting to describe the project. PBS&J concluded that landowner meetings suggest that none are completely against the project but that some will need to see clear benefits to ensure their support. PBS&J concluded from the public meeting that most landowners seemed to understand that the project was a benefit to the watershed and lake as a whole as well as to them individually. They noted that many individuals at the public meeting made encouraging comments to the group as a whole and in separate discussions with PBS&J personnel.

Since the completion of the feasibility study and landowner outreach the project has been on hold while additional funding has been sought, and the goals of the

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

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General Information

Streamflow Restoration Grant Program are a perfect fit for funding this important project. This project proposes to move forward with the key action items identified in the feasibility study, including further assessment of benefits and impacts to lakeshore properties if the lake level were managed differently, preliminary design to meet the needs of the project goals and property owners, property owner and stakeholder outreach, assessments to support permitting and design, final design, necessary permitting and development of a long-term operation and maintenance plan.

Prior to developing this grant application Spokane County consulted the owner of a significant amount of property at the south end of the lake, which includes the probable location of a control structure and confirmed that he has an interest in the project. He has provided the landowner acknowledgement form to allow geotechnical and survey work to be conducted as part of this project, which has been uploaded. Additionally, the grant application was presented to the Eloika Lake Association and they have provided a letter of support.

Total Cost \$600,000.00* Total Eligible Cost \$600,000.00*

Effective Date 10/1/2020 Expiration Date 9/30/2022

Ecology Program Water Resources

Project Category ✓ Streamflow Restoration Grants

Will Environmental Monitoring Data be collected? Yes

If Yes, a Quality Assurance Project Plan (QAPP) will be required as a deliverable and environmental data may need to be entered into Ecology's Environmental Information Management (EIM) database.

Overall Goal The goal of this project is to complete the necessary studies, assessment, design and permitting to construct a control structure at the outlet of Eloika Lake and restore 100 acres of wetlands at the south end of the lake. Once completed this project will store 1,400 acre-feet and provide 10 cfs of additional streamflow over a 70-day late summer low-flow period, and restore of 100 acres of wetland at the south end of the lake to enhance wildlife habitat, aquatic habitat, and water quality. The project will include extensive landowner and stakeholder communication and collaboration to design a project that meets the needs of impacted landowners while significantly improving streamflow and restoring habitat.

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

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Project Characterization

Project Themes

Select a primary and secondary theme that best describes the work to be achieved during this project.

Primary Theme: Water Supply

Secondary Theme(s): Storage
Riparian Restoration Planning and/or
Implementation

Project Website

If your project has a website, please enter the web address below. After entering a website and saving, another blank row will appear. Up to three websites may be provided.

Website Title/Name

Web Address

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

WRSRP-2020-SCUWRS-00044

Scope of Work - Task 1 Project Admin: 1

Task Number 1
 Task Title Project Administration Task Cost \$25,500.00
 Task Description

A. The RECIPIENT will administer the project. Responsibilities will include, but not be limited to: maintenance of project records; submittal of requests for reimbursement and corresponding backup documentation, progress reports and recipient closeout report; submittal of required performance items; and compliance with applicable procurement and contracting requirements.

B. The RECIPIENT will develop and maintain tracking systems to monitor and measure all project objectives and activities. The RECIPIENT shall maintain these systems throughout the project period and measure accomplishments against project objectives at the end of the grant period.

C. The RECIPIENT will, along with each request for reimbursement, prepare and submit a progress report to ECOLOGY’s project manager. The reports shall include, at a minimum, the following information:
 A comparison of actual accomplishments to the objectives established for the reporting period .The reasons for any delays if the project does not meet established objectives.Plan and schedule of activities for the upcoming two months.Analysis and explanations of any cost overruns.Any additional pertinent information.

D. The RECIPIENT shall submit a Final Project Report encompassing the entire project with their last payment request. The RECIPIENT shall include the Final Project Report with the last monthly/quarterly project report. The RECIPIENT shall submit the final payment request and final report within 30 days of the end of this agreement.

E. The RECIPIENT must manage and carry out this project in accordance with any completion dates outlined in this agreement.

Task Goal Statement Properly managed project that meets agreement and Ecology administrative requirements.
 Task Expected Outcomes * Timely and complete submittal of requests for reimbursement, quarterly progress reports and recipient closeout report.
 *Properly maintained project documentation

Recipient Task Coordinator Mike Hermanson
 Deliverables

Deliverable #	Description	Due Date	Received?	EIM Study ID	EIM	Latitude	Loc Address
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WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

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Scope of Work - Task 1 Project Admin: 1

		(ECY Use Only)	Sys Link
1.1	Quarterly payment request and progress report		
1.2	Quarterly payment request and progress report		

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Scope of Work - Additional Tasks: 10 - Project Permitting

Task Number	10		
Task Title	Project Permitting	Task Cost	\$77,760.00*
Task Description	<p>The purpose of this task is to obtain the necessary permits to implement the project including:</p> <ul style="list-style-type: none">• Permitting Approach and Strategy Memorandum<ul style="list-style-type: none">- Preparation of a summary of a recommended approach to completing environmental permits for the project including recommended strategies for permitting the project as quickly and efficiently as possible .• Agency Coordination<ul style="list-style-type: none">- Consultation with the regulatory agencies.- Coordination of the design with the regulatory agencies to ensure that the design meets permitting requirements.• Prepare Permit Applications. Likely permit applications and approvals include:<ul style="list-style-type: none">- Joint Aquatic Resource Permit Application (JARPA)- Hydraulic Permit Approval (HPA)- State Environmental Policy Act (SEPA) Process- Endangered Species Act (ESA) Consultation- Shoreline Code Compliance- Critical Areas Review- Local Clearing/Floodplain Development Permit• Preparation of design drawings to support permit applications.<ul style="list-style-type: none">• Dam Safety Consultation, Dam Construction Permit<ul style="list-style-type: none">- Initiate consultation with Ecology DSO during the Preliminary Design Phase of the project.- Preparation of the Dam Construction Permit Application and supporting documentation , including the following:<ul style="list-style-type: none">? -Hydrology and Hydraulics Report? -Geotechnical Report? -Final Design Drawings? -Final Technical Specifications? -Emergency Action Plan? -Construction Inspection Plan? -Operations and Maintenance Plan- Consultation with Ecology DSO to review design documents		

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

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Scope of Work - Additional Tasks: 10 - Project Permitting

- Water Right Permit
 - Completion of water right applications for the project, including a water right for beneficially using the water supply made available for mitigation, and a reservoir storage water right.
 - Preparation of draft Reports of Examinations for the project to support Ecology's processing of the water rights.

Task Goal Statement The goal of this task is to assess project permitting needs, develop a strategy for project permitting, consult with appropriate permitting entities, and prepare permit applications.

Task Expected Outcomes The expected outcome of this task is a permitting approach that will enable successful project implementation and meet all appropriate regulatory requirements, and completed permit applications and associated documentation.

Recipient Task Coordinator Mike Hermanson

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
10.1	Permitting Approach and Strategy Memorandum	7/31/2021						
10.2	Completed Permit Applications and Drawings	10/15/2021						
10.3	Dam Construction Permit Application	9/30/2022						
10.4	Supporting Reports for Dam	9/30/2022						

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Organization: Spokane County Utilities - Water Resources Section

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Scope of Work - Additional Tasks: 10 - Project Permitting

	Construction Permit	
10.5	Water Right Applications	9/30/2021
10.6	Reports of Examination	9/30/2022

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

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Scope of Work - Additional Tasks: 2 - Project Management

Task Number	2		
Task Title	Project Management	Task Cost	\$11,250.00*
Task Description	The purpose of this task is to manage all aspects of the project including grant management, consultant selection, consultant contract management, coordination with Ecology staff, communication with stakeholders, and any other associated activities.		
Task Goal Statement	The goal of this task is to effectively manage the project such that project timelines and budgets are met and deliverables meet expectations.		
Task Expected Outcomes	The expected outcome is that the grant will be effectively managed such that grant tasks are completed , deliverables are produced, and the overall goal of the grant is met.		
Recipient Task Coordinator	Mike Hermanson		

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
2.1	quarterly progress reports							

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Organization: Spokane County Utilities - Water Resources Section

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Scope of Work - Additional Tasks: 3 - Stakeholder and Property Owner Outreach

Task Number	3		
Task Title	Stakeholder and Property Owner Outreach	Task Cost	\$21,848.00*
Task Description	<p>This task will be completed in two phases. The first phase of stakeholder and property owner outreach will take place at the beginning of the project. We will communicate with each property owner likely to be impacted. This outreach will describe the technical studies to be conducted to determine the hydrology of the contributing watershed, flow rates into and out of the lake, lake elevations, impacts and benefits for specific parcels, water quality impacts and benefits and wetland restoration opportunities.</p> <p>At the conclusion of the technical studies, a second phase of outreach will occur. We will communicate the results of the studies and discuss the development of project designs and operational plans, and how stakeholder and property owner input can be incorporated into the process. Land or easement acquisition will be discussed and negotiated as needed. At this time we will seek endorsement of the project by impacted property owners.</p> <p>We anticipate this task will include a combination of public meetings, correspondence and individual meetings.</p>		
Task Goal Statement	<p>The goal of this task is to successfully communicate and receive endorsement of the project from impacted property owners and other interested stakeholders, successfully negotiate necessary land or easement acquisition, and work collaboratively on project design to meet the needs of the property owners and the streamflow restoration goals of the project.</p>		
Task Expected Outcomes	<p>The expected outcome is endorsement of the project and project design by impacted property owners and other interested stakeholders.</p>		
Recipient Task Coordinator	Mike Hermanson		
Deliverables			

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

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Scope of Work - Additional Tasks: 3 - Stakeholder and Property Owner Outreach

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
3.1	Public Meeting Agendas, Sign in sheets, and meeting summaries	12/15/2021						

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Scope of Work - Additional Tasks: 4 - Site Investigations

Task Number	4		
Task Title	Site Investigations	Task Cost	\$155,236.00*
Task Description	<p>This task includes field and site investigations necessary to support the assessment of hydrology, hydraulics and project design. Investigations include:</p> <ul style="list-style-type: none">• Preparation of a Quality Assurance Project Plan (QAPP), as required by Ecology, for collecting and evaluating data as part of the site investigations with Ecology review and approval.• Topographic survey of the lake shoreline and areas near the lake outlet that will be impacted by the proposed control structure and wetland restoration.• Bathymetric survey of the lake to a depth needed to better understand lake storage volumes and inform design of the proposed outlet control structure.• Geotechnical investigation of the proposed outlet control structure area, including:<ul style="list-style-type: none">- Completion of at least two borings, drilled to a depth of at least 20 feet.- Collection of at least three soil samples in each boring and laboratory analysis to determine key engineering properties.- Desktop analysis of available geology maps and other pertinent information.- Completion of a geotechnical engineering report to summarize recommendations for construction of an outlet control structure at Eloika Lake.• Wetland delineation, including:<ul style="list-style-type: none">- Review of previous wetland reports and mapping;- Preparation of a summary of wetland area and functions potentially impacted by project.- Review of previous wetland mitigation reports and assessment of whether proposed mitigation is adequate and suitable for the proposed project.- Wetland delineation to identify and map wetland extents on the properties at the outlet of Eloika Lake that will be impacted by the project.- Summarize the wetland delineation in a memorandum		
Task Goal Statement	The goal of this task is to collect all necessary data to support technical studies, project design, and permitting.		
Task Expected Outcomes	It is expected that this task will result in providing data and analysis that will support subsequent tasks including completion of technical studies, project design, and project permitting.		

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

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Scope of Work - Additional Tasks: 4 - Site Investigations

Recipient Task Coordinator Mike Hermanson

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
4.1	QAPP	12/31/2020						
4.2	Topographic/Bathy metric Survey	5/31/2021						
4.3	Geotechnical Engineering Report	7/31/2021						
4.4	Wetland Delineation Memorandum	7/31/2021						

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Scope of Work - Additional Tasks: 5 - Technical Studies to Support Preliminary Design

Task Number	5		
Task Title	Technical Studies to Support Preliminary Design	Task Cost	\$123,100.00*
Task Description	<p>This task includes technical studies to support preliminary project design and permitting including:</p> <ul style="list-style-type: none">• Preliminary Hydrology and Hydraulics Analysis and Report, including:<ul style="list-style-type: none">- Delineation of the lake watershed boundary.- Hydrologic calculations to estimate lake inflows and compare against recorded inflow data.- Completion of hydraulic analysis to estimate flow rates, velocities, and water surface elevations at the lake outlet under both existing and proposed conditions (with the proposed outlet structure).- Completion of hydraulic analysis to evaluate potential impact to downstream water surface elevations. Analysis will evaluate hydraulic conditions from lake outlet to 200 feet downstream of the proposed outlet structure.- Preparation of a report summarizing lake hydrology and hydraulics in a format that will satisfy Ecology Dam Safety Office (DSO) requirements.• Preliminary Operations Plan Analysis, including:<ul style="list-style-type: none">- Development of a water balance spreadsheet model to estimate flows to and from the lake on a monthly time step based on estimated inflows and control with the proposed outlet structure.- Preparation of preliminary recommendations for operation of outlet gates and controls.- Preparation of a memorandum summarizing the water balance and operating recommendations.• Water Quality Evaluation<ul style="list-style-type: none">- Preparation of a predictive water quality model using CE-QUAL-W2 or another approved water quality model to assess the impact of the lake outlet structure on the temperature, dissolved oxygen, and pH of water released from the lake. Use available data from TMDL work in the development of the model and coordinate with Ecology and others in the preparation of the model.- Preparation of a memorandum summarizing the results of the water quality (temperature, dissolved oxygen, and pH) modeling.• Cultural Resources Review<ul style="list-style-type: none">- Preparation of a preliminary assessment of potential cultural resource issues through review of existing documents at Washington State Department of Archeology and Historic Preservation.- Completion of a cultural resources field survey to determine whether the project will have any impact on cultural and historical resources.		

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

WRSRP-2020-SCUWRS-00044

Scope of Work - Additional Tasks: 5 - Technical Studies to Support Preliminary Design

- Preparation of a short memorandum summarizing the findings of the cultural resources review.
- Assessment of Benefits and Impacts
 - Evaluation of the potential benefits of the proposed project on the availability of water to offset future out-of-stream domestic water use.
 - Evaluation of the benefits and impacts of the proposed project on adjacent landowners, including extent and timing of inundation.
 - Evaluation and characterization of the potential benefits and impacts of the proposed project on instream flows, fish habitat, and fish passage. The evaluation will be based on prior work done to characterize instream flows and fish habitat and passage conditions.
 - Identification and evaluation of wetland benefits and impacts and potential wetland mitigation.
 - Preparation of a short memorandum summarizing potential benefits and impacts of the project.

Task Goal Statement The goal of this task is to complete the technical studies necessary to support preliminary project design, stakeholder and property owner collaboration, final design and permitting.

Task Expected Outcomes Completion of technical studies necessary to support preliminary project design, stakeholder and property owner collaboration, final design and permitting.

Recipient Task Coordinator Mike Hermanson

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
5.1	Preliminary Hydraulics and Hydrology Report	7/31/2021						
5.2	Preliminary Operations Plan	7/31/2021						
5.3	Water Quality	8/31/2021						

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

WRSRP-2020-SCUWRS-00044

Scope of Work - Additional Tasks: 5 - Technical Studies to Support Preliminary Design

Summary

Memorandum

5.4 Preliminary Benefits 8/31/2021
and Impacts

Memorandum

5.5 Cultural Resources 7/31/2021
Review

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

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Scope of Work - Additional Tasks: 6 - Preliminary (30%) Design

Task Number	6		
Task Title	Preliminary (30%) Design	Task Cost	\$63,961.00*
Task Description	<p>Preliminary (30%) Design Drawings: Prepare preliminary design drawings, including:</p> <ul style="list-style-type: none">• Cover sheet• General Notes, Legends, Abbreviations• Overall Site Plan• Existing Conditions Plans (Outlet and Wetland Area)• Construction Access Plan• Site Plans (Outlet and Wetland Mitigation Area)• Outlet Control Structure Plan• Outlet Control Structure Sections• Wetland Mitigation Plans• Wetland Mitigation Sections <p>Preliminary Design Report: Prepare a preliminary design report with the following information:</p> <ul style="list-style-type: none">• An overview of the project• A summary of the key findings from the technical studies prepared as part of Technical Studies Task• The cost information and permitting summary<ul style="list-style-type: none">• Recommendations for further design development• Preliminary Design Drawings and Calculations• Figures, Maps, Exhibits• Other pertinent references and information <p>Costs and Implementation</p> <ul style="list-style-type: none">• Preparation of an opinion of the probable construction cost to reflect the preliminary design of the project.• Complete a preliminary (desktop) review of potential environmental impacts and prepare a short memorandum summarizing potential impacts and likely permitting and regulatory requirements.		
Task Goal Statement	<p>The goal of this task is to complete a 30% project design, prepare a preliminary design report, develop an opinion of probable cost, and complete a permitting assessment. The preliminary design will be done in collaboration with property owners and stakeholders so that the direction of the design is acceptable to all interested parties.</p>		

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

WRSRP-2020-SCUWRS-00044

Scope of Work - Additional Tasks: 6 - Preliminary (30%) Design

Task Expected Outcomes The expected outcome is a 30% design, design report, opinion of probable cost, and permitting assessment that is acceptable to interested parties and is feasible to construct.

Recipient Task Coordinator Mike Hermanson

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
6.1	Preliminary Design Drawings	9/30/2021						
6.2	Preliminary Design Report	9/30/2021						
6.3	Preliminary Opinion of Probable Construction Costs	9/30/2021						
6.4	Preliminary Environmental Permitting Summary	9/30/2021						

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

WRSRP-2020-SCUWRS-00044

Scope of Work - Additional Tasks: 7 - 60% Design

Task Number	7		
Task Title	60% Design	Task Cost	\$48,298.00*
Task Description	<p>The purpose of this task is to achieve 60% project design, and includes the following:</p> <ul style="list-style-type: none"> • Written responses to comments on the preliminary design. • Update the hydrology and hydraulics with new design information, as follows: <ul style="list-style-type: none"> - Refine the hydrologic and hydraulic analyses developed as part of the Technical Studies Task . - Update the water balance spreadsheet model developed as part of the Technical Studies Task . • Preparation of 60% complete design drawings, including refinement of the preliminary design drawings to the 60% complete level and addition of the following drawings: <ul style="list-style-type: none"> - Clearing and Demolition Plan - Outlet Control Structure Details - Wetland Mitigation Details • Preparation of an outline of technical specifications to be developed for the project. This task assumes that specifications will be developed in APWA/WSDOT format. • Preparation of an updated opinion of the probable construction cost to reflect the 60% design of the project. 		
Task Goal Statement	The goal of this task is to complete a 60% project design.		
Task Expected Outcomes	The expected outcome of this task is a 60% project design.		
Recipient Task Coordinator	Mike Hermanson		

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
7.1	Response to Preliminary Design	10/31/2021						

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Organization: Spokane County Utilities - Water Resources Section

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Scope of Work - Additional Tasks: 7 - 60% Design

7.2	Comments 60% Design	3/31/2022
7.3	Drawings 60% Technical Specifications	3/31/2022
7.4	Outline 60% Opinion of Probable Construction Costs	3/31/2022

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

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Scope of Work - Additional Tasks: 8 - 90% Design

Task Number	8		
Task Title	90% Design	Task Cost	\$38,084.00*

Task Description

The purpose of this task is to achieve 90% project design, and includes the following:

- Written responses to comments on the 60% design.
- Preparation of 90% complete design drawings, including refinement of the 60% drawings to the 90% complete level and addition of the following drawings:
 - Survey Control Plan
 - Temporary Erosion and Sediment Control Plans
 - Temporary Erosion and Sediment Control Notes
 - Temporary Erosion and Sediment Control Details
- Preparation of draft technical specifications for the project in APWA/WSDOT format.
- Preparation of an updated opinion of the probable construction cost to reflect the 90% design of the project.

Task Goal Statement The goal of this task is to complete a 90% project design.

Task Expected Outcomes The expected outcome of this task is a 90% project design.

Recipient Task Coordinator Mike Hermanson

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
8.1	Response to 60% Design Comments	4/30/2022						
8.2	90% Design Drawings	7/31/2022						
8.3	90% Draft Technical	7/31/2022						

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

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Scope of Work - Additional Tasks: 8 - 90% Design

8.4	Specifications 90% Opinion of Probable Construction Costs	7/31/2022
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WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Scope of Work - Additional Tasks: 9 - Final Design and Design Report

Task Number	9		
Task Title	Final Design and Design Report	Task Cost	\$34,963.00*
Task Description	<p>The purpose of this task is to complete a final design and design report including:</p> <ul style="list-style-type: none">• Finalize Technical Studies: Update the following technical Studies Prepared during the Technical Studies and Preliminary Design tasks of the project to reflect the final design of the project.<ul style="list-style-type: none">- Preliminary Hydraulics and Hydrology Report- Preliminary Operations Plan- Water Quality (Temperature) Summary Memorandum- Preliminary Benefits and Impacts Memorandum- Environmental Permitting Summary Memorandum• Final Design Report: Prepare a final design report with the following information:<ul style="list-style-type: none">- An overview of the project- A summary of the key findings from the technical studies finalized as part of this task- The final technical studies (as appendices)- The final opinion of probable construction costs- Recommendations for permitting and implementation- Final Design Drawings and Calculations- Figures, Maps, Exhibits- Other Pertinent References and Information• Final Design<ul style="list-style-type: none">- Comment Responses: Provide written responses to comments provided by the County on the 90% design.- Final (100%) Design Drawings: Prepare final (100% complete) design drawings, including refinement of the 90% drawings to the 100% complete level.- Technical Specifications: Prepare final technical specifications for the project in APWA/WSDOT format.- Opinion of Probable Cost: Prepare an updated opinion of the probable construction cost to reflect the final (100% complete) design of the project.		
Task Goal Statement	<p>The goal of this task is to finalize the technical studies, design report and project design drawings and specifications so that the project is ready for bidding and construction.</p>		

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

WRSRP-2020-SCUWRS-00044

Scope of Work - Additional Tasks: 9 - Final Design and Design Report

Task Expected Outcomes The expected outcome of this task is a final design package that is ready for bidding and construction.

Recipient Task Coordinator Mike Hermanson

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
9.1	Final Design Report	9/15/2022						
9.2	Response to 90% Design Comments	8/15/2022						
9.3	Final Design Drawings	9/30/2022						
9.4	Final Technical Specifications	9/30/2022						
9.5	Final Opinion of Probable Construction Costs	9/30/2022						

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane County Utilities - Water Resources Section

WRSRP-2020-SCUWRS-00044

Scope of Work Summary

Task Title	Task Cost
Project Management	\$11,250.00
Project Administration	\$25,500.00
Stakeholder and Property Owner Outreach	\$21,848.00
Site Investigations	\$155,236.00
Technical Studies to Support Preliminary Design	\$123,100.00
Preliminary (30%) Design	\$63,961.00
60% Design	\$48,298.00
90% Design	\$38,084.00
Final Design and Design Report	\$34,963.00
Project Permitting	\$77,760.00
Total	\$600,000.00

Total Eligible Costs

(from the General Information Form)

\$600,000.00

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Whitworth Water District #2

WRSRP-2020-WhiWD-00128

General Information

Project Title	Whitworth Water District Source Substitution
Project Short Description	Whitworth Water District (WWD), with the support of the Little Spokane River (LSR) Watershed Planning Unit, seeks funding to provide 400 acre-feet of future permit-exempt domestic offsets and ecological benefits. WWD proposes to construct infrastructure improvements that allow it to rely more on the Spokane Valley Rathdrum Prairie Aquifer (SVRP) and less on the LSR watershed. This Project will assist the Planning Unit to achieve a portion of the 20-year domestic well offsets.
Project Long Description	<p>WWD's Source Substitution Project (Project) will provide instream flow benefits and help offset future permit-exempt domestic groundwater withdrawals by reducing the amount of groundwater currently withdrawn in the LSR Watershed (WRIA 55). WWD is a municipal water provider serving a 55 square-mile area stretching from Spokane to Chattaroy. WWD serves approximately 11,000 active connections providing water service to approximately 30,000 customers. WWD's system includes 15 groundwater wells (see attached map). WWD's wells labeled with the numbers 8 and 9 are wells that withdraw groundwater in continuity with the LSR Watershed (these wells and the water conveyance system is generally referred to as "Zone 8" of WWD). The wells labeled with the prefix number 1, 2, and 3 (1, 1A, etc) are located in the southern part of the LSR watershed but withdraw water from the SVRP aquifer, which is a more prolific aquifer (these wells and the water conveyance system is generally referred to as "Zone 3" of WWD). The SVRP aquifer is interconnected with the Spokane River (WRIA 57/54). WWD's proposed Project seeks a new mitigated water right permit to withdraw up to 400 acre-feet (AF) of water annually from the SVRP aquifer in exchange for donating the equivalent amount of water rights to the State Trust Water Right Program from the LSR watershed that predate the Instream Flow Rule. In order to implement this Project, WWD is seeking a cost-share of approximately 25 percent from the Department of Ecology (Ecology) under a grant agreement. WWD will commit to securing other funding for the additional hydrogeologic analysis, permitting and remaining construction costs.</p> <p>WWD's Project proposes to provide 400 acre-feet of instream flow benefits and permit-exempt domestic groundwater use offsets during the irrigation season. The Project proposes to cease pumping for the irrigation season, as defined by the Washington Irrigation Guide (May 15 to October 10) (153 days or approximately 2.6 AF/day) (400 AF /153 day irrigation season = 2.614 AF/day). WWD has undergone preliminary analysis to more definitively quantify the potential benefits and impacts of the Project in coordination with the WRIA 55 planning unit and the Ecology. WWD has received preliminary modeling reports on the potential benefits of the Project on the LSR watershed and the potential impacts on the SVRP aquifer.</p> <p>The Project will provide benefits to the LSR by retiring the withdrawal of 400 acre-feet annually. In the Fall of 2019, WWD asked EarthFx (consultants) for the</p>

General Information

LSR Integrated Model to calculate the benefits of the Project. (West and Earthfx, Integrated Groundwater/Surface Water Model for the Little Spokane Watershed). The model was developed to be a tool to simulate changes in surface water flows and groundwater reservoirs resulting from mitigation projects (such as source substitutions), and development of new water supplies (such as new permit-exempt domestic water uses). This model was specifically developed for the WRIA 55 watershed planning process for mitigation of domestic exempt wells. The preliminary run of the EarthFx WRIA 55 model, which incorporated the proposed reduction of 400 acre-feet of production from WWD LSR wells, was conducted in a model run that also considered managed aquifer recharge projects proposed by Spokane County within the WRIA 55 watershed. The model run showed that the proposal to reduce groundwater withdrawals from the two closest wells to the LSR would result in an immediate ecological benefit to flows both downstream and upstream of the withdrawal points. WWD reviewed this model projection with Ecology hydrogeologists and will be seeking another run of the model to focus on the direct benefits of this Project. There is consensus that the Project will provide benefits to the LSR because WWD's Zone 8 wells are in hydraulic continuity with the LSR. The current estimate is that the Project will provide a benefit to streamflow (approximately 1.3 cfs) (WWD Project Summary, 2020). WWD is committed to working with Ecology to more definitively identify the quantity and the benefited reach through an additional run of the LSR Integrated Model.

WWD has also conducted a model analysis of potential impacts to the SVRP Aquifer. Current modeling efforts, reviewed by Ecology's hydrogeologist, identify an attenuated impact of approximately 20 to 30-acre-feet annually (0.066 to 0.099 cfs) on the Spokane River (SVRP Model, 2020). WWD relied on the SVRP Aquifer Pumping Effects Spreadsheet (D.R. Ralston, G.S. Johnson and S. Taylor, 2015) as modified by Gene St.Godard, Professional Geologist, Licensed Hydrogeologist, Certified Water Right Examiner. The purpose of the model is to provide estimates of the effects of changes in groundwater pumping on the flow of the Spokane River at the Spokane River gage. The model performs calculations based on results of simulations performed with the SVRP model developed by the U.S. Geological Survey in cooperation with the Idaho Department of Water Resources, Washington Department of Ecology, the University of Idaho, and Washington State University. Initial evaluation has shown that the impact to the Spokane River from pumping 400 AF/y from the SVRP aquifer is approximately 0.066 to 0.099 cfs during the irrigation season (153 days), dependent on which Zone 3 wells are utilized. Further refinement of the potential impacts will be conducted during the ongoing feasibility of the Project. This will include running various scenarios from the different WWD wells to determine which wells, over what time frame, would have the least effect on the Spokane River. WWD will purchase a portion of a water right to serve as mitigation for the impacts to the Spokane River.

In order to implement the Project, WWD needs to make conveyance system upgrades. Specifically, intertie its Zone 3 (a SVRP water source) with Zone 8

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Whitworth Water District #2

WRSRP-2020-WhiWD-00128

General Information

(historically an LSR water source). The Zone 3 to Zone 8 intertie will consist of constructing the final phase of a three phased project, an estimated three miles of 24-inch transmission main from the vicinity of Dartford Road and Mill Road to Midway Road in Spokane County. (Refer to attached map of the proposed alignment.) WWD's Zone 3 water service area is generally located south of the LSR and utilizes groundwater source from the SVRP Aquifer. WWD's Zone 8 water service area is generally located north of the LSR and utilizes groundwater source from the LSR aquifer. This Project allows WWD to reduce withdrawals from the LSR by developing and utilizing SVRP source(s) in Zone 3 and conveying the water via pipeline to the Zone 8 water service area.

WWD's Project is supported by the WRIA 55 planning unit, consistent with RCW 90.94.020, timely, and reasonable in cost. The WRIA 55 planning unit has included the WWD Project in its list of projects to offset future permit-exempt domestic water uses in WRIA 55 (Aspect, Feb. 26, 2020). This Project will provide water for water mitigation to provide offsets of future permit-exempt domestic water users and multiple ecological benefits. The Project is anticipated to be completed by early 2023, providing instream flows and timely offsets for LSR. In order to implement the WWD Project, WWD will need to also secure the necessary permitting, additional mitigation, State Environmental Policy Act (SEPA) review and construction implementation. WWD has included these actions in the enclosed scope of work but is only seeking Ecology's funding of 25 percent of the cost (approximately \$1.14 million). WWD will provide funding for 75 percent of the Project (approximately \$4.6 million).

Total Cost	\$5,772,148.85*	Total Eligible Cost \$1,143,898.80*
Effective Date	9/30/2020	Expiration Date 3/31/2023
Ecology Program	Water Resources	
Project Category	✓ Streamflow Restoration Grants	

Will Environmental Monitoring Data be collected? No

If Yes, a Quality Assurance Project Plan (QAPP) will be required as a deliverable and environmental data may need to be entered into Ecology's Environmental Information Management (EIM) database.

Overall Goal The overall goal of the WWD's Project is to provide a sustainable, cost-effective and locally supported project to offset the impacts of future permit-exempt domestic groundwater uses in the WRIA 55 while also providing ecological benefits. The Project will provide 400 acre-feet of water annually to offset permit-exempt domestic groundwater use in accordance with RCW 90.94.020. WWD proposes a timeline that would provide offsets and instream benefits by 2023. WWD will

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Whitworth Water District #2

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General Information

continue to work closely with Ecology, other WRIA 55 Initiating Governments and interested parties to integrate the Project into the WRIA 55 Watershed Planning update process in accordance with RCW 90.94.020.

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Whitworth Water District #2

WRSRP-2020-WhiWD-00128

Scope of Work - Task 1 Project Admin: 1

Task Number	1						
Task Title	Project Administration		Task Cost	\$15,917.00			
Task Description	<p>A. The RECIPIENT will administer the project. Responsibilities will include, but not be limited to: maintenance of project records; submittal of requests for reimbursement and corresponding backup documentation, progress reports and recipient closeout report; submittal of required performance items; and compliance with applicable procurement and contracting requirements.</p> <p>B. The RECIPIENT will develop and maintain tracking systems to monitor and measure all project objectives and activities. The RECIPIENT shall maintain these systems throughout the project period and measure accomplishments against project objectives at the end of the grant period.</p> <p>C. The RECIPIENT will, along with each request for reimbursement, prepare and submit a progress report to ECOLOGY’s project manager. The reports shall include, at a minimum, the following information: A comparison of actual accomplishments to the objectives established for the reporting period .The reasons for any delays if the project does not meet established objectives.Plan and schedule of activities for the upcoming two months.Analysis and explanations of any cost overruns.Any additional pertinent information.</p> <p>D. The RECIPIENT shall submit a Final Project Report encompassing the entire project with their last payment request. The RECIPIENT shall include the Final Project Report with the last monthly/quarterly project report. The RECIPIENT shall submit the final payment request and final report within 30 days of the end of this agreement.</p> <p>E. The RECIPIENT must manage and carry out this project in accordance with any completion dates outlined in this agreement.</p>						
Task Goal Statement	Properly managed project that meets agreement and Ecology administrative requirements.						
Task Expected Outcomes	* Timely and complete submittal of requests for reimbursement, quarterly progress reports and recipient closeout report. *Properly maintained project documentation						
Recipient Task Coordinator	Tim Murrell						

Deliverables							
Deliverable #	Description	Due Date	Received?	EIM Study ID	EIM	Latitude	Loc Address

Scope of Work - Task 1 Project Admin: 1

		(ECY Use Only)	Sys Link
1.1	Quarterly payment request and progress report		
1.2	Quarterly payment request and progress report		

Scope of Work - Additional Tasks: 2 - Additional Hydrogeologic Modeling

Task Number	2		
Task Title	Additional Hydrogeologic Modeling	Task Cost	\$0*
Task Description	<p>This task will encompass two subtasks: 1) modeling of the reduction of 400-acre feet from WWD Zone 8 wells, and 2) additional modeling of the SVRP withdrawal from the WWD Zone 1-2-3 wells to define impairment to the Spokane River which require mitigation. WWD will retain EarthFX to conduct an independent analysis of ceasing the withdrawal of 400 acre-feet of from WWD's wells in hydraulic continuity with the LSR using the LSR (WRIA 55) Integrated Model. This task will require updating the baseline scenario analyses and conducting one or more well retirement scenarios that solely incorporate the WWD Project with all model parameters consistent. The WWD will utilize the services of hydrologist Gene St. Goddard to run additional SVRP model scenarios using the SVRP Aquifer Pumping Effects Spreadsheet, developed by Ralston Hydrologic Services (D.R. Ralston, G.S. Johnson and S. Taylor) for the Idaho Water Resource Board and the Idaho Department of Water Resources (February, 2015).</p>		
Task Goal Statement	<p>The goal of the assessment is to further define the reach within the LSR which will achieve the ecological benefit from the transfer of the groundwater withdrawal. The modeling will also quantify the benefits both downstream and upstream of the WWD wells. The SVRP modeling will define the required amount of mitigation water needed to transfer the withdrawal from the LSR to the SVRP aquifer. The end goal of the Project is to demonstrate the ecological benefits achieved for the public by moving this withdrawal from the LSR to the SVRP aquifer.</p>		
Task Expected Outcomes	<ul style="list-style-type: none"> • Describe the changes in groundwater levels and changes in streamflows in the main stem and nearby tributaries to the LSR. Changes will be determined by comparison to the groundwater levels and streamflow under baseline conditions. Results will be presented as figures showing simulated heads and streamflow under each scenario, maps of drawdown, and absolute and percent change in flow, and comparative hydrographs. Results will also be presented in terms of change of streamflow with respect to the change in pumping to verify that the model results are reasonable. • These model runs will be conducted to run over the 153-day irrigation season when increased demand of the 400 acre-feet due to irrigation occurs. The model runs will also be conducted to develop the maximum impairment value to the Spokane River which may require a water right to be purchased for mitigation. • A technical memorandum will be prepared describing the task analysis, results of model runs, and recommendations for quantity of water rights that may be required for purchase to mitigate the impacts to the 		

Scope of Work - Additional Tasks: 2 - Additional Hydrogeologic Modeling

Spokane River.

- Prepare technical memorandum summarizing the information compiled under Tasks 2.1 and 2.2 and identify the quantity of water rights that may be required for purchase to mitigate the impacts to the Spokane River.

Recipient Task Coordinator Tim Murrell

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
2.1	<ul style="list-style-type: none"> • A technical memorandum will be prepared describing the tasks listed above and presenting model inputs, outputs, and analysis of results. Tables and figures described above will be provided. • Describe model inputs and assumptions made for each scenario including the breakdown of withdrawals distributed between 	4/22/2021						

Scope of Work - Additional Tasks: 2 - Additional Hydrogeologic Modeling

the wells on a monthly basis. Pumping rates to be used will be determined in consultation with WWD.

- 2.2 Conduct numerous model scenario runs from the various WWD Zone 3 wells (Well 1, 1A, 2A, 2B, 3, 3B, 3C and 4) to determine which well(s) will have the smallest effects on the Spokane River when withdrawing the transferred 400-acre feet of groundwater. 4/22/2021

Scope of Work - Additional Tasks: 3 - Water Right Use Authorizations

Task Number	3		
Task Title	Water Right Use Authorizations	Task Cost	\$0*
Task Description	<p>This task will encompass two subtasks: 1) identification and substantiation of the identified water right to provide mitigation to the SVRP and 2) preparation and submittal of water right use authorizations for the Project. After completion of the hydrogeologic analysis, WWD will identify a water right to mitigate for impacts for use of the SVRP aquifer. WWD will work closely with Ecology in identifying a water right that can provide a suitability mitigation source for impacts to the SVRP aquifer. This task will also include analysis and consideration of additional mitigation needed to offset impacts to SVRP aquifer and legal analysis as needed on the permitting pathway and mitigation obligations. A summary of key tasks is provided below. WWD will: prepare an application for water right change; a new water right application integrating the additional hydrogeologic analysis conducted under Tasks 2.1 and 2.2; compile the necessary information to facilitate the transfer of WWD’s existing water right to the State Trust Water Right Program; and seek a new mitigated water right permit if required.</p>		
Task Goal Statement	<p>The goal is to identify and purchase, if necessary, a water right that will effectively mitigate the determined quantity of water for the WWD proposed transfer. The goal will be to purchase a water right that is close to the mainstem Spokane River to maximize the effects of mitigation.</p>		
Task Expected Outcomes	<ul style="list-style-type: none"> • After the hydrogeologic modeling, WWD will prepare the necessary applications, in coordination with Ecology’s Water Resources Program staff, to effectuate the Project’s proposed source substitution from Zone 8 wells to the Zone 3 wells. • WWD will identify and begin negotiations to purchase a quantity of mitigation water within the SVRP. <ul style="list-style-type: none"> • Deliverables will include the change application and a mitigation plan. • WWD will identify and begin negotiations to purchase a quantity of mitigation water within the SVRP watershed. <ul style="list-style-type: none"> • Conduct a model scenario run from the water right to determine if it is in hydraulic continuity with the SVRP aquifer and Spokane River. • Meeting with Ecology’s hydrogeologist to determine if the targeted water right is a viable mitigation water right. • Prepare a summary memo describing the proposed water right to be purchased and its mitigation offset potential. 		

Scope of Work - Additional Tasks: 3 - Water Right Use Authorizations

- Submit change of use application and related materials of the mitigation water source or other action as directed by Ecology Water Resources permitting staff.

Recipient Task Coordinator Tim Murrell

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
3.1	Identify additional mitigation water right, conduct a model scenario to consider mitigation benefits, and review information with Ecology.	5/24/2021						
3.2	Prepare change of use applications and other applications as directed by Ecology to effectuate the source substitution. Prepare and negotiate for the purchase of the additional mitigation water right.	5/24/2021						

Scope of Work - Additional Tasks: 4 - Design and Construction

Task Number	4		
Task Title	Design and Construction	Task Cost	\$1,026,853.40*
Task Description	<p>WWD will develop the necessary evaluation of proposed environmental impacts of the Project in accordance with the State Environmental Policy Act, including the consideration of cultural resources in the project area and an inadvertent discovery plan.</p> <p>WWD will develop Project plans, and specifications with its engineers while working closely with all permitting agencies (including but not limited to Ecology, Department of Health, Department of Transportation and Spokane County).</p> <p>Following the required approvals, WWD will bid the construction in accordance with applicable local and state law.</p> <p>This task will encompass the construction of the necessary infrastructure as more particularly described in the budget and project map. The task will be managed by WWD. This task will also encompass construction management of the Project. This task will include the: preparation and management of a construction quality assurance plan and inspection; pre-construction meeting minutes; project schedule; revised cash flow estimates; change orders; and facility operation and maintenance plan.</p>		
Task Goal Statement	<p>The goal of this task is to design and construct the Project to allow WWD the physical ability to move water from the SVRP to their Zone 8 service area and reduce reliance on their existing Zone 8 sources that pull water from the LSA.</p>		
Task Expected Outcomes	<ul style="list-style-type: none"> • SEPA checklist, and environmental determination, including a cultural resources assessment and inadvertent discovery plan, and related follow up work. • Engineers preliminary design work, including geotechnical analysis, and response to comments from permitting agencies and interested parties. • 90 percent design plans, specifications and estimate, including design plans and response to comments from permitting agencies and interested parties. • Prepare and seek permits for Project implementation. • Prepare bid package for contractors and orchestrate the bid review and award process. 		

Scope of Work - Additional Tasks: 4 - Design and Construction

- Conduct all necessary public notice.
- Construction Quality Assurance Plan and Inspections
- Pre-Construction Meeting Minutes
- Project Schedule and Management
- Revised Cash Flow Estimates
- Change Order processing, as needed
- Facility Operation and Maintenance Plan
- Construction Contract Documents, including advertisements, notice of award, executed contracts and notice to proceed.
- Construction of the project including mobilization, site control, traffic control, pavement/concrete demolition, installation of waterline, waterline bridge crossing and boring.
 - Waterline testing
- Road restoration, final cleanup and completion.

Recipient Task Coordinator Tim Murrell

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
4.1	Design - Planning, Environmental, Engineering: Prepare Environmental review, cultural resources assessment, inadvertent discovery plan,	12/2/2021						

Scope of Work - Additional Tasks: 4 - Design and Construction

	preliminary design, final design plans, specifications and estimate, identify permits, propose construction schedule and prepare final bid package.	
4.2	Prepare and distribute construction contract documents including advertisement, notice of award, execution of contracts and notice to proceed all in compliance with state and local laws.	2/15/2022
4.3	Construction Implementation: Including construction management, construction contract management, and implementation	12/22/2022

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Whitworth Water District #2

WRSRP-2020-WhiWD-00128

Scope of Work - Additional Tasks: 5 - Project Report for WRIA 55 Watershed Plan Update

Task Number	5						
Task Title	Project Report for WRIA 55 Watershed Plan Update					Task Cost	\$0*
Task Description	WWD will prepare a report to summarize the offsets and ecological benefits of the Project based on the analysis completed in Task 2 and the water use authorization and mitigation provided under the work described in Task 3.						
Task Goal Statement	WWD will summarize the benefits of the project including the quantity of water offset and benefitted reach based on the model results and implementation of the Project.						
Task Expected Outcomes	WWD will prepare a report for Ecology and the WRIA 55 planning unit summarizing the implementation and benefits of the Project. This report will include the analysis conducted under Task 2 and the benefits of the project as constructed.						
Recipient Task Coordinator	Tim Murrell						

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
5.1	Prepare and submit a report summarizing the implementation and benefits of the Project	7/21/2021						

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Whitworth Water District #2

WRSRP-2020-WhiWD-00128

Scope of Work - Additional Tasks: 6 - Public Meetings and Outreach

Task Number	6		
Task Title	Public Meetings and Outreach	Task Cost	\$0*
Task Description	WWD will conduct outreach with WRIA 55 planning unit members and Ecology to understand the basis and implementation for the Project. WWD will present the modeling reports and respond to comments.		
Task Goal Statement	WWD's goal is to facilitate the Project in a way that is transparent to the WRIA 55 planning unit and other partners.		
Task Expected Outcomes	WWD will present modeling data and response to comments from Ecology and planning unit members.		
Recipient Task Coordinator	Tim Murrell		

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
6.1	Conduct meetings with Ecology and the WRIA 55 planning unit to describe the modeling information, water use authorizations and implementation of the Project	6/30/2021						

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Whitworth Water District #2

WRSRP-2020-WhiWD-00128

Scope of Work - Additional Tasks: 7 - Mitigation Water Right Purchase

Task Number	7		
Task Title	Mitigation Water Right Purchase	Task Cost	\$101,128.40*
Task Description	WWD will work to purchase a mitigation water right as identified in accordance with the work under Tasks 2 and 3. WWD will negotiate and implement a purchase and sale agreement and facilitate the permanent transfer of the water right into the State Trust Water Right Program to adequately mitigate for the impacts identified in Task 2 to the SVRP aquifer and Spokane River.		
Task Goal Statement	The goal of this task is to purchase a water right and transfer the water right to the State Trust Water Right Program to mitigate for impacts from the Project to the SVRP aquifer.		
Task Expected Outcomes	WWD will acquire and permanently transfer of a water right to the State Trust Water Right Program in order to adequately mitigation for the impacts identified in Task 2 to the SVRP aquifer and Spokane River.		
Recipient Task Coordinator	Tim Murrell		

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
7.1	Prepare the purchase and sale agreement, deed and other matters related to closing on the purchase of the water right and transferring the water right to the State Trust Water	5/24/2021						

Scope of Work - Additional Tasks: 7 - Mitigation Water Right Purchase

7.2	Right Program. Purchase the water right (as currently estimated)	5/24/2021
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WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Whitworth Water District #2

WRSRP-2020-WhiWD-00128

Scope of Work - Additional Tasks: 8 - Project Contingency for Construction Contract

Task Number	8		
Task Title	Project Contingency for Construction Contract	Task Cost	\$0*
Task Description	WWD has included a project contingency into its budget for the overall project.		
Task Goal Statement	WWD's goal is to keep the budget within or below the identified values, however, it has built in a prudent contingency for its funding estimate.		
Task Expected Outcomes	WWD expects to not use its contingency funding. WWD will continue to assess its project design and implementation plans to avoid the need to use contingency funding.		
Recipient Task Coordinator	Tim Murrell		

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
8.1	The intent is to not use the contingency funding. However, if it is needed, WWD will notify Ecology of the reason and description of use.							

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Whitworth Water District #2

WRSRP-2020-WhiWD-00128

Scope of Work Summary

Task Title	Task Cost
Project Administration	\$15,917.00
Additional Hydrogeologic Modeling	\$0
Water Right Use Authorizations	\$0
Design and Construction	\$1,026,853.40
Project Report for WRIA 55 Watershed Plan Update	\$0
Public Meetings and Outreach	\$0
Mitigation Water Right Purchase	\$101,128.40
Project Contingency for Construction Contract	\$0
Total	\$1,143,898.80

Total Eligible Costs

(from the General Information Form)

\$1,143,898.80

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Washington State Department of Fish and Wildlife

WRSRP-2020-WaSDFW-00067

General Information

Project Title WRIA 55 Barrier Assessment and Prioritization

Project Short Description A full scale fish passage barrier assessment within the Little Spokane Watershed Inventory Area, WRIA 55.

Project Long Description There has been a minimal effort to identify and assess stream crossing structures and fish passage barriers within the Little Spokane Watershed Inventory Area (WRIA 55). Data collected from the various entities and managed by WDFW shows that there are 84 known barriers within WRIA 55; there are large gaps in the fish passage data. The goal of this project is to inventory all areas of WRIA 55 that have not been previously surveyed and prioritize for removal/replacement. This information will be provided to the WRIA 55 Watershed Plan Update for use in the future Net Ecological Benefit Projects.

A jurisdictional, road-based approach will be used for the inventory as described in WDFW's Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual (2019). All stream crossings associated with roads (both closed and open roads) and trails on fish bearing streams within WRIA 55 will be recorded and evaluated. Open roads will be surveyed using a vehicle, closed roads and trails on foot. Streams and segments of streams will be determined to be "fish bearing" if they meet any of the following criteria:

- Have an ordinary high-water width of >3 feet and a stream gradient <20%
- Are identified as "fish bearing" by WDFW's PHS or other fish distribution database
- Are identified as Type F by DNR
- Have documented salmonid use determined by visual observation, electrofishing, or verification by local biologists.

GIS analysis will be used to estimate potential habitat gain for each barrier utilizing natural barrier data and the sources listed above to determine extent of fish bearing habitat.

After the data is prioritized and the top 5 barriers are known, WDFW will compose 25% design criteria for these barriers. This data will afford a more substantial Net Ecological Benefit project pool, as fish passage barrier correction has an immediate positive affect on access to habitat, i.e. potential miles of stream opened.

This would be a collaborative effort between many potential stakeholders to include; Spokane County, Spokane County Conservation District, The Washington Department of Natural Resources, Stevens County, Pend Oreille County, State Parks, Spokane Tribe of Indians and private landowners.

Total Cost \$371,458.00*

Total Eligible Cost \$371,458.00*

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Washington State Department of Fish and Wildlife

WRSRP-2020-WaSDFW-00067

General Information

Effective Date 4/1/2021 Expiration Date 5/1/2023

Ecology Program Water Resources

Project Category ✓ Streamflow Restoration Grants

Will Environmental Monitoring Data be collected? No

If Yes, a Quality Assurance Project Plan (QAPP) will be required as a deliverable and environmental data may need to be entered into Ecology's Environmental Information Management (EIM) database.

Overall Goal The purpose of the project is to determine number, location, prioritization of fish passage barriers. The project will produce a priority list of passage barriers that if corrected would produce the greatest net ecological benefit (NEB).

An action plan for fish passage barrier removal/replacement in WRIA 55 will be developed. The plan will identify and prioritize projects for implementation under the veil of NEB projects (fish passage restoration) on the WRIA 55 Watershed Update Plan. In addition, WDFW will provide conceptual designs and cost estimates for the top five ranked barrier removal projects.

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Washington State Department of Fish and Wildlife

WRSRP-2020-WaSDFW-00067

Project Characterization

Project Themes

Select a primary and secondary theme that best describes the work to be achieved during this project.

Primary Theme: Water Supply

Secondary Theme(s): Riparian Restoration Planning and/or
Implementation

Project Website

If your project has a website, please enter the web address below. After entering a website and saving, another blank row will appear. Up to three websites may be provided.

Website Title/Name

Web Address

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Washington State Department of Fish and Wildlife

WRSRP-2020-WaSDFW-00067

Scope of Work - Task 1 Project Admin: 1

Task Number 1
 Task Title Project Administration Task Cost \$17,042.00

Task Description
 A. The RECIPIENT will administer the project. Responsibilities will include, but not be limited to: maintenance of project records; submittal of requests for reimbursement and corresponding backup documentation, progress reports and recipient closeout report; submittal of required performance items; and compliance with applicable procurement and contracting requirements.

B. The RECIPIENT will develop and maintain tracking systems to monitor and measure all project objectives and activities. The RECIPIENT shall maintain these systems throughout the project period and measure accomplishments against project objectives at the end of the grant period.

C. The RECIPIENT will, along with each request for reimbursement, prepare and submit a progress report to ECOLOGY’s project manager. The reports shall include, at a minimum, the following information:
 A comparison of actual accomplishments to the objectives established for the reporting period .The reasons for any delays if the project does not meet established objectives.Plan and schedule of activities for the upcoming two months.Analysis and explanations of any cost overruns.Any additional pertinent information.

D. The RECIPIENT shall submit a Final Project Report encompassing the entire project with their last payment request. The RECIPIENT shall include the Final Project Report with the last monthly/quarterly project report. The RECIPIENT shall submit the final payment request and final report within 30 days of the end of this agreement.

E. The RECIPIENT must manage and carry out this project in accordance with any completion dates outlined in this agreement.

Task Goal Statement Properly managed project that meets agreement and Ecology administrative requirements.

Task Expected Outcomes
 * Timely and complete submittal of requests for reimbursement, quarterly progress reports and recipient closeout report.
 *Properly maintained project documentation

Recipient Task Coordinator Renée Kinnick

Deliverable #	Description	Due Date	Received?	EIM Study ID	EIM	Latitude	Loc Address
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WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Washington State Department of Fish and Wildlife

WRSRP-2020-WaSDFW-00067

Scope of Work - Task 1 Project Admin: 1

		(ECY Use Only)	Sys Link
1.1	Quarterly payment request and progress report		
1.2	Quarterly payment request and progress report		

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Washington State Department of Fish and Wildlife

WRSRP-2020-WaSDFW-00067

Scope of Work - Additional Tasks: 2 - Initial Office Prep

Task Number 2

Task Title Initial Office Prep **Task Cost** \$11,361.00*

Task Description Washington Department of Fish and Wildlife will setup the initial inventory of WRIA 55. This will involve GIS mapping of all sub basins to assemble aerial images and maps; identify road crossings, data collection prep work; gathering data from partners and previous surveys, and hiring and training a field crew.

Task Goal Statement To create a plan of action for new hires to follow.

Task Expected Outcomes Have all sub basins within the WRIA prioritized and have a crew trained and prepared to start field work.

Recipient Task Coordinator Renée Kinnick

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
2.1	Have all sub basins within the WRIA prioritized and have a crew trained and prepared to start field work.	4/1/2021						2315 N Discovery Pl, Spokane Valley WA 99216

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Washington State Department of Fish and Wildlife

WRSRP-2020-WaSDFW-00067

Scope of Work - Additional Tasks: 3 - Field Work Component

Task Number	3		
Task Title	Field Work Component	Task Cost	\$297,000.00*
Task Description	<p>A jurisdictional, road-based approach will be used for the inventory as described in WDFW’s Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual (2019). All stream crossings associated with roads (both closed and open roads) and trails on fish bearing streams within WRIA 55 will be recorded and evaluated. Open roads will be surveyed using a vehicle, closed roads and trails on foot. Streams and segments of streams will be determined to be “fish bearing” if they meet any of the following criteria:</p> <ul style="list-style-type: none"> • Have an ordinary high-water width of >3 feet and a stream gradient <20% • Are identified as “fish bearing” by WDFW’s PHS or other fish distribution database • Are identified as Type F by DNR • Have documented salmonid use determined by visual observation, electrofishing, or verification by local biologists <p>GIS analysis will be used to estimate potential habitat gain for each barrier utilizing natural barrier data and the sources listed above to determine extent of fish bearing habitat.</p>		
Task Goal Statement	The goal of this project is to inventory all areas of WRIA 55 that have not been previously surveyed and prioritize for removal and replacement of crossing that are classified as fish passage barriers.		
Task Expected Outcomes	Data will be collected and reviewed. The top 5 barriers will be identified.		
Recipient Task Coordinator	Renée Kinnick		

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
3.1	survey work	10/3/2022						

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Washington State Department of Fish and Wildlife

WRSRP-2020-WaSDFW-00067

Scope of Work - Additional Tasks: 4 - Data Analysis and Preliminary Design

Task Number 4

Task Title Data Analysis and Preliminary Design **Task Cost** \$46,055.00*

Task Description After the data is prioritized and the top 5 barriers are known, WDFW will compose 25% design criteria for these barriers. This data will afford a more substantial Net Ecological Benefit project pool, as fish passage barrier correction has an immediate positive affect on access to habitat, i.e. potential miles of stream opened.

Task Goal Statement The project will produce a priority list of passage barriers that if corrected would produce the greatest net ecological benefit.

Task Expected Outcomes Final report is complete and 25% design is completed for top 5 barriers.

Recipient Task Coordinator Renée Kinnick

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
4.1	Final report and 25% design plans	4/3/2023						2315 N Discovery PI, Spokane Valley WA 99216

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Washington State Department of Fish and Wildlife

WRSRP-2020-WaSDFW-00067

Scope of Work Summary

Task Title	Task Cost
Project Administration	\$17,042.00
Initial Office Prep	\$11,361.00
Field Work Component	\$297,000.00
Data Analysis and Preliminary Design	\$46,055.00
Total	\$371,458.00

Total Eligible Costs

(from the General Information Form)

\$371,458.00

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane Conservation District

WRSRP-2020-SpoCoD-00063

General Information

Project Title	WRIA 55 Fish Barrier Removal Project	
Project Short Description	This project will replace a stream crossing located on Deer Creek that is classified as a zero percent passable fish barrier. This barrier blocks salmonid migration to more than 9.44 miles of excellent spawning and rearing habitat. The project will the replacement of the existing culvert with a pre-fabricated steel bridge superstructure set on pre-cast concrete abutments, with pre-cast concrete end-wall closures and a gravel driving surface.	
Project Long Description	The proposed project consists of replacing a stream crossing located on Deer Creek, a tributary to the Little Spokane River, that has been evaluated and classified as a zero percent passable fish barrier. The existing culvert is over-sloped (1.03%) and undersized, causing an impoundment upstream of the crossing and excessive velocities through the culvert. The bankfull width of the creek at this location is measured at 10.5 feet and according to Washington State standards for fish passage, the total conveyance width for the crossing should be greater than 14.6 feet (1.2xBankfull Width+2.0') to allow for natural stream function. This fish passage barrier blocks salmonid migration to more than 9.44 miles of spawning and rearing habitat upstream of the crossing location. The upstream and downstream salmonid habitat are classified as excellent, but with some localized stream bank erosion and heavy siltation as a result of upstream crossing washouts that occurred during a heavy run-off event in 2017. This stream crossing is located just one parcel downstream from the recently funded State of Washington Fish Barrier Removal Project #09-1708, scheduled for correction in the Fall of 2020, through the Family Forest Fish Passage Program (FFFPP). The proposed fish passage restoration approach for this site shall be the replacement of the existing culvert with a pre-fabricated steel bridge superstructure set on pre-cast concrete abutments, with pre-cast concrete end-wall closures and a gravel driving surface, similar to several other State funded fish passage restoration projects that have been completed by the Spokane Conservation District within this sub-basin through the Family Forest Fish Passage Program.	
Total Cost	\$130,250.00*	Total Eligible Cost \$130,250.00*
Effective Date	7/1/2020	Expiration Date 12/31/2021
Ecology Program	Water Resources	
Project Category	✓ Streamflow Restoration Grants	

Will Environmental Monitoring Data be collected? No

If Yes, a Quality Assurance Project Plan (QAPP) will be required as a deliverable and environmental data may need to be entered into Ecology's Environmental Information Management (EIM) database.

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane Conservation District

WRSRP-2020-SpoCoD-00063

General Information

Overall Goal Remove one fish barrier and restore access to over 9.44 miles of spawning habitat to resident salmonids.

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane Conservation District

WRSRP-2020-SpoCoD-00063

Scope of Work - Task 1 Project Admin: 1

Task Number	1	Task Cost	\$5,000.00
Task Title	Project Administration		
Task Description	<p>A. The RECIPIENT will administer the project. Responsibilities will include, but not be limited to: maintenance of project records; submittal of requests for reimbursement and corresponding backup documentation, progress reports and recipient closeout report; submittal of required performance items; and compliance with applicable procurement and contracting requirements.</p> <p>B. The RECIPIENT will develop and maintain tracking systems to monitor and measure all project objectives and activities. The RECIPIENT shall maintain these systems throughout the project period and measure accomplishments against project objectives at the end of the grant period.</p> <p>C. The RECIPIENT will, along with each request for reimbursement, prepare and submit a progress report to ECOLOGY’s project manager. The reports shall include, at a minimum, the following information: A comparison of actual accomplishments to the objectives established for the reporting period .The reasons for any delays if the project does not meet established objectives.Plan and schedule of activities for the upcoming two months.Analysis and explanations of any cost overruns.Any additional pertinent information.</p> <p>D. The RECIPIENT shall submit a Final Project Report encompassing the entire project with their last payment request. The RECIPIENT shall include the Final Project Report with the last monthly/quarterly project report. The RECIPIENT shall submit the final payment request and final report within 30 days of the end of this agreement.</p> <p>E. The RECIPIENT must manage and carry out this project in accordance with any completion dates outlined in this agreement.</p>		
Task Goal Statement	Properly managed project that meets agreement and Ecology administrative requirements.		
Task Expected Outcomes	* Timely and complete submittal of requests for reimbursement, quarterly progress reports and recipient closeout report. *Properly maintained project documentation		
Recipient Task Coordinator	Cori Turntine		

Deliverables							
Deliverable #	Description	Due Date	Received?	EIM Study ID	EIM	Latitude	Loc Address

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane Conservation District

WRSRP-2020-SpoCoD-00063

Scope of Work - Task 1 Project Admin: 1

			(ECY Use Only)	Sys Link
1.1	Quarterly payment request and progress report	12/31/2021		
1.2	Quarterly payment request and progress report	12/31/2021		

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane Conservation District

WRSRP-2020-SpoCoD-00063

Scope of Work - Additional Tasks: 2 - Project Development & Design

Task Number	2		
Task Title	Project Development & Design	Task Cost	\$30,000.00*
Task Description	<p>This task will mainly consist of hiring an engineer (bid process) and developing the approach and layout for the project. The engineer will work together with the SCD to prepare the designs and required materials to submit for permit approval. The SCD will work with all local, state, and federal permitting entities to make them aware of the project and to acquire necessary permits for construction and monitoring. This will include one or more site visits with entities. The SCD will also work with the appropriate Ecology Project Officer to develop a project outline/timeline, riparian restoration plan, and submit proper documents to conduct a cultural resources review of the proposed site.</p>		
Task Goal Statement	<p>The goals for this task include bringing awareness of the project to all local, state, and federal permitting entities, submitting designs for the necessary permits, and complete cultural resources review for site.</p>		
Task Expected Outcomes	<ul style="list-style-type: none"> 1 Engineer hired 1 bio-engineered design to submit for permit approval 1 or more site visits 1 outline/timeline for project completion 1 cultural resource review 1 riparian restoration planting plan 		
Recipient Task Coordinator	Dan Ross		

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
2.1	1 Engineering contract and project	12/31/2020						

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane Conservation District

WRSRP-2020-SpoCoD-00063

Scope of Work - Additional Tasks: 2 - Project Development & Design

2.2	design 1 site visit, project timeline	12/31/2020
2.3	1 cultural resource review	3/15/2021
2.4	1 riparian restoration plan	3/15/2021

WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane Conservation District

WRSRP-2020-SpoCoD-00063

Scope of Work - Additional Tasks: 3 - Project Construction

Task Number 3

Task Title Project Construction **Task Cost** \$95,250.00*

Task Description Project Construction starts with a bid proposal to hire a contractor for the job. Once selected, the contractor will work with the SCD and the engineer to order materials according to approved design. All permitting will be completed and a construction timeline will be developed. It is anticipated that construction would occur in July/August of 2021. Following construction, the SCD would complete the riparian restoration plans for the fall. Photographs before, during and post construction would be completed as well.

Task Goal Statement The goal is to have the project construction completed by August of 2021.

Task Expected Outcomes
 1 bid process for hiring contractor
 1 SCD/contractor contract
 All applicable permits approved
 project photographic documentation
 1 completed project (crossing and riparian restoration)

Recipient Task Coordinator Dan Ross

Deliverables

Deliverable #	Description	Due Date	Received? (ECY Use Only)	EIM Study ID	EIM System Link	Latitude	Longitude	Location Address
3.1	1 SCD/contractor contract	4/25/2021						
3.2	project permits approved	6/30/2021						
3.3	1 Project completed	10/31/2021						

Scope of Work - Additional Tasks: 3 - Project Construction

3.4	project photographic documentation	10/31/2021
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WATER RESOURCES STREAMFLOW RESTORATION PROGRAM

Organization: Spokane Conservation District

WRSRP-2020-SpoCoD-00063

Scope of Work Summary

Task Title	Task Cost
Project Administration	\$5,000.00
Project Development & Design	\$30,000.00
Project Construction	\$95,250.00
Total	\$130,250.00

Total Eligible Costs

(from the General Information Form)

\$130,250.00

**Project Summaries Submitted
to WRIA 55 Planning Unit**

**DRAFT WRIA 55 STREAMFLOW RESTORATION PLANNING
PRELIMINARY PROJECT PROPOSAL**

The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use and achievement of a Net Ecological Benefit in WRIA 55 for evaluation under RCW 90.94. The information provided in this proposal will be presented to the WRIA 55 Planning Unit and considered for inclusion in the WRIA 55 Watershed Plan Update. When complete, please submit to Carl Einberger (ceinberger@aspectconsulting.com) by January 31, 2020

1. Title: Deer Creek Fish Barrier Removal Project

**2. Proposal Preparer(s): Daniel Ross, Lindsay Chutas
Spokane Conservation District (SCD)**

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

The proposed project consists of replacing a stream crossing located on Deer Creek, a tributary to the Little Spokane River, that has been evaluated and classified as a zero percent passable fish barrier. The existing culvert is over-sloped (1.03%) and undersized, causing an impoundment upstream of the crossing and excessive velocities through the culvert. The bankfull width of the creek at this location is measured at 10.5 feet and according to Washington State standards for fish passage, the total conveyance width for the crossing should be greater than 14.6 feet (1.2xBankfull Width+2.0') to allow for natural stream function. This fish passage barrier blocks salmonid migration to more than 9.44 miles of spawning and rearing habitat upstream of the crossing location. The upstream and downstream salmonid habitat are classified as excellent, but with some localized stream bank erosion and heavy siltation as a result of upstream crossing washouts that occurred during a heavy run-off event in 2017. This stream crossing is located just one parcel downstream from the recently funded State of Washington Fish Barrier Removal Project #09-1708, scheduled for correction in the Fall of 2020, through the Family Forest Fish Passage Program (FFFPP). The proposed fish passage restoration approach for this site shall be the replacement of the existing culvert with a pre-fabricated steel bridge superstructure set on pre-cast concrete abutments, with pre-cast concrete end-wall closures and a gravel driving surface, similar to several other State funded fish passage restoration projects that have been completed by the Spokane Conservation District within this sub-basin through the Family Forest Fish Passage Program.

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

a. Existing Water Right b. Groundwater c. Surface Water d. Other
This is a Net Ecological Benefit Project.

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

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

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

c. Tributary (name) or Mainstem Little Spokane River and Location(s):
Deer Creek, Tributary to LSR, Lat. 47.961291, Long. -117.210268
Site Address: 14650 E. Laurel Rd., Elk WA 99009

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

Restoration of natural stream function by removal of the impoundment caused by the undersized culvert will result in a stable channel habitat, a reduction of sediment inputs and improvement of population connectivity for all in-stream organisms. A site restoration planting component will result in long-term stability of stream banks and approximately 1 acre of riparian habitat restoration within the affected project area of the reach. The net result of restoring fish passage at this site, in combination with the upstream State funded FFFPP Project #09-1708, would be 9.44 miles of spawning and rearing habitat made accessible upstream of the crossing location.

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

The unknowns for the project are the outcome of a required Cultural Resource Review and the specific dimensions of the proposed pre-fabricated steel bridge and pre-cast materials. A design engineer will be hired by the SCD as a part of the project cost and employed throughout the course of the project for design and construction oversight services.

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

a. Project Development and Design: Engineering/Design - **\$17,500**; Administrative - **\$8,500**; Permitting/CR Review - **\$2,500**

b. Project Construction: Materials - **\$42,500**; Installation Contractor - **\$42,500**; Site Restoration - **\$4,500**; Construction Oversight/Travel - **\$5,750**

c. Project Annual O&M: Once the project has been completed, the operation and maintenance is expected to be negligible. 2nd Year Planting Replacements, as needed - **\$1,000**

Total Estimated Project Budget: \$124,750

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

No other known potential funding sources.

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

N/A

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

The proposed project has negligible O&M costs, a willing landowner and a very experienced project management/design/installation team. This proposed project will have immediate impacts to restoring natural stream function and will become an important part of other work that is planned and has already been completed in this sub-basin.

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

None known.

12. Estimated Time Frame to Implement Project?

The typical timeline for a project of this nature is 4-6 months for Planning/Design/Permitting, 1-2 months for Bidding/Contracting and 1-2 months for Construction/Site Restoration.

**DRAFT WRIA 55 STREAMFLOW RESTORATION PLANNING
PRELIMINARY PROJECT PROPOSAL TEMPLATE**

The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use and achievement of a Net Ecological Benefit in WRIA 55 for evaluation under RCW 90.94. The information provided in this proposal will be presented to the WRIA 55 Planning Unit and considered for inclusion in the WRIA 55 Watershed Plan Update. When complete, please submit to Carl Einberger (ceinberger@aspectconsulting.com) by January 31, 2020

1. Title:
Dartford Floodplain Reconnection

2. Proposal Preparer(s):
Lindsay Chutas

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

This project aims to reconnect the floodplain, correct a fish barrier, and reestablish in-stream vegetation and habitat on Dartford Creek. This project is part of a multi-year phased approach, habitat restoration effort, which is adjacent to a no-till farm field. The creek has a headcut with a 5 foot drop, with disconnected upstream and downstream reaches and fish populations. Phase one of the restoration, which involved planting the upland habitat and installing a 50 ft riparian forest buffer, was completed in 2019. The proposed project would be the second and final phase of restoration. The objectives of the project would be to reconnect the floodplain to the creek, installing 5, 1 foot drops with 20 ft pools step system of weirs and pools, augmented by plantings and large woody debris, to remove the fish barrier at the head cut and reconnect the reaches. Finally, the banks will be pulled back from vertical to a more appropriate 1:1 ratio, and improve the in-stream habitat by installing vegetation within the riparian zone. A cultural resource survey was completed during phase one and there are no concerns for the project location. Additionally, this streamside restoration is part of a larger land management effort taking place on this property. The upland agricultural practices were converted in recent years to a direct seed operation to improve soil health and decrease soil erosion in this generally steep topography.

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

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

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

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

b. Timeframe(s) or Season of Use:
NA

c. Tributary (name) or Mainstem Little Spokane River and Location(s):
Dartford Creek
Site address: 4322 W Ballard Rd, Spokane, WA

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

This project will restore the natural stream and reconnect the reach, which is in a degraded state due to conversion of the land from its natural forest to agriculture. This will result in a stable channel habitat, reduction of sediment inputs and improve population connectivity for all in-stream organisms. Rainbow Trout, Eastern Brook Trout, and Longnose Dace were identified as native species in Dartford Creek through the JSAP project in the early 2000's. The primary genetic reports at the time of this report suggest that there is little genetic influence of hatchery stocked rainbow trout on the Dartford Creek fish, which suggests that the population that will be affected by these restoration efforts is native redbands. The in stream and near stream restoration component will result in long-term stability of the stream banks and 0.5 acres of riparian habitat restoration within the project area. Additionally, the addition of pools and slowing the velocity of the water from the headcut will increase aquifer recharge by increasing bank and pool storage and creating a slower release of water from this particular reach, which will help with groundwater infiltration. While the amount of this effect has not been calculated, it is another benefit consistent with the goals of the WRIA 55 streamflow restoration goals of slowing the flow, increasing residence time of water in the system, and encouraging water storage.

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

The unknowns for this project are dimension refinements that will be clarified by a design engineer, to be hired by the SCD as a part of the project cost, and employed throughout the course of the project for design and construction oversight services.

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

a. Project Development and Design: Engineering/Design: \$10,000, Administrative: \$4500

b. Project Construction: Materials: \$24,000 Installation Contractor: \$17,000 Construction Oversight Travel: \$3500

c. Project Annual O&M: Once the project has been completed the operation and maintenance is expected to be negligible. 2nd year planting replacements as needed \$1000

Total Estimated Project Budget: \$60,000

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

No other potential funding sources are known at this time. The Spokane County Voluntary Stewardship program funded phase 1 of this project, but this funding source is not appropriate for phase 2.

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

NA

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

The proposed project has negligible O&M costs, a willing landowner and a very experienced project management/design/installation team. This proposed project will have immediate impacts to restoring natural stream function and will become an important part of other work that is planned and has already been completed in this sub-basin.

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

None known

12. Estimated Time Frame to Implement Project?
A typical timeline for a project of this scope is approximately 6 months for planning/design, 1-2 months for bidding and contracting, and 1-2 months for construction and site restoration.

A typical timeline for a project of this scope is approximately 6 months for planning/design, 1-2 months for bidding and contracting, and 1-2 months for construction and site restoration.

**DRAFT WRIA 55 STREAMFLOW RESTORATION PLANNING
PRELIMINARY PROJECT PROPOSAL TEMPLATE**

The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use and achievement of a Net Ecological Benefit in WRIA 55 for evaluation under RCW 90.94. The information provided in this proposal will be presented to the WRIA 55 Planning Unit and considered for inclusion in the WRIA 55 Watershed Plan Update. When complete, please submit to Carl Einberger (ceinberger@aspectconsulting.com) by January 31, 2020

1. Title:
Dartford Creek Habitat Restoration

2. Proposal Preparer(s):
Lindsay Chutas

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

The proposed project includes 320 feet of stream habitat restoration on Dartford Creek. This project proposal is downstream from a recent 2019 SCD riparian project that implemented a 50 ft riparian buffer. The completion of these two projects will reconnect 700 feet of habitat at these sites. This project would install a 50 ft riparian buffer, utilizing native species found in an analogous forest 500 feet upstream. In addition to the buffer installation, a series of Post Assisted Log Structures (PALS) will be installed to improve habitat, induce sinuosity, and increase turbulence which will lead to an increase in dissolved oxygen content. These positive effects are outlined in the proposed LSR TMDL for DO, pH and turbidity, which is under review at this time.

The stream habitat in this area has been degraded over the years, as the land was converted from a forest upstream to agricultural lands in the 20th century. Additionally, this streamside restoration is part of a larger land management effort taking place on this property. The upland agricultural practices were converted in recent years to a direct seed operation to improve soil health and decrease soil erosion in this generally steep topography.

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

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

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

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

b. Timeframe(s) or Season of Use:
NA

c. Tributary (name) or Mainstem Little Spokane River and Location(s):
Dartford Creek
Site address: 4206 W Ballard Rd, Spokane, WA

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

This project will restore the natural stream vegetation and improve aquatic species habitat, which is in a degraded state due to conversion of the land from forest to agriculture in the 20th century. This will result in a stable channel habitat, reduction of sediment inputs, and improve population connectivity for all in-stream organisms. The instream and near stream restoration component will result in long-term stability of the stream banks, reduce headcutting, and provide 0.5 acres of riparian habitat restoration within the project area. Additionally, the addition of the PALS, inducing sinuosity and lightly introducing pools and riffles will improve the water quality by increasing the dissolved oxygen level as well as increase aquifer recharge in this particular reach. While the amount of the effect of the recharge has not been calculated, as this is primarily a habitat restoration project, it is a side benefit consistent with the goals of the WRIA 55 streamflow restoration goals.

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

This project has not had a cultural resource survey conducted on site, although the neighboring parcel has a current survey that was conducted in 2019. It is located in a potentially sensitive area and we anticipate the local tribes may want a survey completed prior to any plantings. We have added this as a project cost and anticipate the survey will add one month to the project timeline if needed.

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

a. Project Development and Design: \$3000 cultural resources, \$4000 oversight/admin/design
b. Project Construction: \$5000 plants and supporting planting materials. (plants, hydrosorb, repellent, mulch). \$3000 labor
c. Project Annual O&M: \$1000 watering supplies to be watered by landowner on volunteered time. Once the project has been completed the operation and maintenance is expected to be negligible. 2nd year planting replacements as needed \$1000
Total Estimated Project Budget: \$17,000

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

No other potential funding sources are known at this time.

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

NA

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

The proposed project has negligible O&M costs, a willing landowner and a very experienced project management/design/installation team. This proposed project will have immediate impacts to restoring natural stream function and will become an important part of other work that is planned and has already been completed in this sub-basin.

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

None known

12. Estimated Time Frame to Implement Project?

A typical timeline for a project of this scope is approximately 6 months for planning/design, 1-2 months for bidding and contracting, and 1-2 months for construction and site restoration.



Pend Oreille
Conservation District

FROM: David Marcell
POCD Director
PO BOX 465
Newport, WA 99156
(509) 447-1155
www.pocd.org

TO: WRIA 55 Planning
Committee

WRIA 55 Planning Committee

All, please see the attached submissions for streamflow restoration / habitat improvement projects. To summarize, both projects are in South Pend Oreille County on the Little Spokane River. Proposed practices (verified as eligible in the ECY streamflow restoration guidelines) include: Livestock Exclusion Fencing, Native Tree and Shrub Establishment and Large Woody Debris Placement.

Project 1

(850 feet) Fencing estimated cost	\$1,778.00
(3acrea, 200+)Planting estimated cost.....	\$5,763.00

Project 2

(QTY27)Large Woody Debris Placement estimated cost.....	\$40,500.00
(QTY 1150)Planting estimated cost.....	\$ 5,750.00

TOTAL.....\$53,791.00

Looking forward to discussing further in March. Take care.

Sincerely,
David Marcell

Pend Oreille CD

**DRAFT WRIA 55 STREAMFLOW RESTORATION PLANNING
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1. Title: Westover
Stream Flow Restoration
Project.

2. Proposal Preparer(s):

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

BMP 1 See Attachments
BMP 2
BMP 3
BMP 4

Resource Concern:

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

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

5. Quantity/Timing/Location of Water Instream: ^① Estimate average amount of water, when and where ^② can project be considered at various sizes (flow outputs) and/or considered in phases?

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

b. Timeframe(s) or Season of Use:

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

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

ID BMDs & main "CADS," applicant benefits:

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

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

a. Project Development and Design:

b. Project Construction:

c. Project Annual O&M:

Based on eas BMD.

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

FFFP? ECV?

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

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

"Have the BMDs chosen are the most sustainable option?"

11. Potential Project Barriers: Briefly explain potential barriers to completing the project (e.g.

landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)

↳ problem? ↳ what's needed?
↳ railroad? Co. SMP + HPA?

↓
Property
Presets

12. Estimated Time Frame to Implement Project?

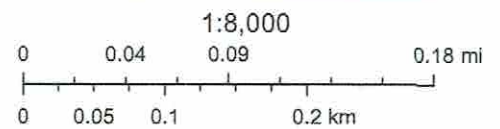
Westover Property Boundary Map via PCC-GIS20200103

4



1/3/2020, 11:14:46 AM

Parcels



Pend Oreille County GIS

Pend Oreille County GIS
Pend Oreille County GIS

Westover, Bert 941 Pines Rd.

Landowner: Bert Westover

Landowner Id: 17641

Mailing Address: 941 Pines Rd. Newport, WA 99156

Land Use: Residential

Land Type: Residential/Lifestlye farm

Conservation District: Pend Oreille

Property Description:

Bert contacted POCD to gather information on practices that could help him achieve his goals of improving the wildlife habitat / function of the 1/2 mile or so of Little Spokane Riverfront he owns. Aside from introducing native trees, shrubs and woody debris to the river's banks, Bert hopes to create an outdoor classroom with the site, eventually to host local students for tours of the restoration work and to help assist with ongoing planting maintenance and so on.

Primary resource concerns:

- 1.) inadequate stream flow, resulting in excess silting of the river bed - degrading habitat.
- 2.) Lack of diverse riparian vegetation, resulting in warmer water temperatures, specifically on section where south side banks are bare.

Unique site aspects:

-This section of the LSR is adjacent to an old railway. The straightening of the river channel seems to be influenced by this feature. Thus the need for large woody debris is necessary to reduce velocity and stream complexity.

-There is currently a FFFPP project in the works to replace two undersized culverts down stream with a bridge. We had included this culvert replacement in our initial plan, but discovered that a neighbor is already working on a replacement.

BMP Cost Estimates:

612 Tree and Shrub Est. (2700 ft. of bank, riparian zone 10 feet wide (5 feet each side) = total planting area of 27000 sq. ft.) Divide this by 25 sq. ft. (the area needed to space trees and shrubs at 10 feet on Center)= 1080 Trees / Shrubs Needed. I added an additional 70 plants due to quantities in which they must be ordered, rounding it out to 1,150 plants needed. At Approx \$5 / plant = \$5,750.00

Large Woody Debris Placement (2700 ft. of river, 1 log every 100 feet = 27 total. At 1500 ea. = \$40,500.00

Resource Concerns

Water Quality Degradation - Excessive Sediment in Surface Water

Fish and Wildlife - Inadequate Habitat - Cover/Shelter

Fish and Wildlife - Inadequate Habitat - Water

Resource Concern Description:

Fish and Wildlife - Inadequate Habitat - Cover/Shelter : Lack of woody debris in a straightened channel.

Water Quality Degradation - Excessive Sediment in Surface Water +Fish and Wildlife - Inadequate Habitat - Water : Lack of riparian vegetation resulting in excessive water temps, low dissolved oxygen, and erosion prone banks.

BMP Funding

LWD Structure(1) 2804-3938-9550

Program	Fund Source	Agency	Grant Number	Proposed Amount	Awarded Amount
Centennial Clean Water Fund	State	Ecology	TBD	\$30,375.00	\$0.00
Landowner Match	Local	CD	TBD	\$10,125.00	\$0.00
Total:				\$40,500.00	

Tree/Shrub Establishment(1) 2804-3938-9550

Program	Fund Source	Agency	Grant Number	Proposed Amount	Awarded Amount
Landowner Match	Local	CD		\$1,437.50	\$0.00
Centennial Clean Water Fund	State	Ecology	TBD	\$4,312.50	\$0.00
Total:				\$5,750.00	

Funding Summary

BMP	Program	Proposed Amount	Awarded Amount
LWD Structure	Centennial Clean Water Fund	\$30,375.00	
LWD Structure	Landowner Match	\$10,125.00	
Total:		\$40,500.00	
Tree/Shrub Establishment	Centennial Clean Water Fund	\$4,312.50	
Tree/Shrub Establishment	Landowner Match	\$1,437.50	
Total:		\$5,750.00	

Best Management Practices

Name: Tree/Shrub Establishment
Code: 612
Status: Ready for Funding
Start Date: 4/30/2020

Completion Date:

Planned Implementation Measurements

Measurements	Value	Units
Number of trees/shrubs/cuttings planted	1150	Number
Quantity of BMP	11.00	Acres

Closeout Actual Measurements

Measurements	Value	Units
Quantity of BMP	11.00	Acres

Name: LWD Structure
Code: SCC26
Status: Ready for Funding
Start Date: 4/30/2020

Completion Date:

Planned Implementation Measurements

Measurements	Value	Units
Length of stream (one side) protected	2700	Feet
Quantity of BMP	27.00	Number

Closeout Actual Measurements

Measurements	Value	Units
Quantity of BMP	27.00	Number

Before Photos



Pend Oreille C.D.

**DRAFT WRIA 55 STREAMFLOW RESTORATION PLANNING
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1. Title: "Cygnet"
Habitat Enhancement
along the Little Spokane River

2. Proposal Preparer(s):
Alex Case-Cohen, Pend Oreille Cons. District
David Marcell, "

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

See Attachments A: E

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

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

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

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

b. Timeframe(s) or Season of Use:

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

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

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

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

a. Project Development and Design:

b. Project Construction:

c. Project Annual O&M:

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

None.

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

No.

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

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

12. Estimated Time Frame to Implement Project?



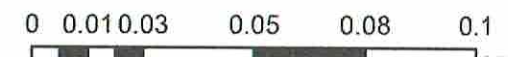
Cygiel Property Map
 282 Meadow Lane
 Newport, WA 99156



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Created By: Alex Case-Cohen
 Date Exported:

Total Acreage: 30





Dawn & Gary Cygiel
 282 Meadow Lane Newport, WA 99156
 November 2019 Potential Project Map



Source: Esri, DeLorme, Globe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Perimeter Maps
 Cygiel Railroad
 Cygiel Property

Point Data
 Spring
 Project Name
 Fence along Little Spokane
 Pasture boundary fence

Project Name
 Thinning/Pruning/Brush Management
 Permaculture Garden
 Riparian Planting
 Rotational Grazing

By: Alex Case-Cohen
 Date Exported: 12/4/2019 5:29 PM
 Scale: 1:3,602



①

25%

Cygnet Best Management Practice Implementation Summary											
IM Year	Practice Code	Practice Name	Component	Unit Type	Unit Cost	Total Area/Length /number (acres/feet)	Estimate w/ NRCS rates	POCD Estimate NRCS X 1.5	Cost Share Portion	Landowner Portion	Notes
2020	315	Herbaceous Weed Treatment	Mechanical Treatment	acres	\$ 40.25	8	\$ 322.00	\$ 483.00	\$ 362.25	\$ 120.75	Mechanical treatment (unless Herbicide is desired)
2020	340	Cover Crop	Multi-Species	acres	\$ 73.55	5	\$ 367.75	\$ 551.63	\$ 413.72	\$ 137.91	Year 1: plant cereal rye after plowing to aid in weed suppression. Terminate at appropriate stage
2020	382	Fence	Woven Wire	feet	\$ 4.52	850	\$ 3,842.00	\$ 5,763.00	\$ 4,322.25	\$ 1,440.75	fencing applicable for VSP cost share applies to protecting/enhancing critical areas (i.e. riparian areas only)
2020	614	Spring Development	with headwall	Ea.	\$ 3,372.46	1	\$ 3,372.46	\$ 5,058.69	\$ 3,794.02	\$ 1,264.67	develop spring for livestock access to water
2020	490	Tree/Shrub Site Preparation	Mechanica, Shredding, Light vegetation	acres	\$ 514.51	3	\$ 1,543.53	\$ 2,315.30	\$ 1,736.47	\$ 578.82	site preparation for critical area planting along Little Spokane River
2020	612	Tree/Shrub Establishment	Conservation, Hand Planting, Browse Protection	acres	\$ 395.08	3	\$ 1,185.24	\$ 1,777.86	\$ 1,333.40	\$ 444.47	planting 200+ native riparian trees and shrubs along the Little Spokane River
2021	315	Herbaceous Weed Treatment	Mechanical Treatment	acres	\$ 40.25	8	\$ 322.00	\$ 483.00	\$ 362.25	\$ 120.75	Mechanical treatment (unless Herbicide is desired)
2021	512	Forage & Biomass Planting	Small acreage, non-native high seeding rate	acres	\$ 315.19	5	\$ 1,575.95	\$ 2,363.93	\$ 1,772.94	\$ 590.98	Inter-mountain west mix (orchardgrass, alfalfa, smooth bromegrass, fescue and clover)
2021	516	Watering Facility	Frost Free Trough	gallons	\$ 1,000.00	1	\$ 1,000.00	\$ 1,500.00	\$ 1,125.00	\$ 375.00	5-10 gallon ball free-proof tank for sheep
2021	561	Heavy Use Protection Area	Rock/Gravel with Geotextile	sq. feet	\$ 1.10	100	\$ 110.00	\$ 165.00	\$ 123.75	\$ 41.25	heavy use protection area for watering facility to protect soil from compaction
2021	642	Livestock Pipeline	PVC 1-2 inch diameter	feet	\$ 2.11	150	\$ 316.50	\$ 474.75	\$ 356.06	\$ 118.69	
2022	528	Prescribed Grazing	Targeted Grazing, Herbaceous Weed Control	acres	\$ 636.21	5	\$ 3,181.05	\$ 4,771.58	\$ 3,578.68	\$ 1,192.89	Implement prescribed grazing 1 year after re-planting your pastures
Totals							\$ 17,138.48	\$ 25,707.72	\$ 19,280.79	\$ 6,426.93	

Eligible "CCY Stream Flow" BMPs.

TTL:
 ~\$ 7,541"
 = 850 ft. Livestock Fence
 + 3acres (1,720) Trees + shrubs @ 5 ft. Spacing.



Cygiel, Gary & Dawn 282 Meadow Lane

Landowner: Gary & Dawn Cygiel

Landowner Id: 17575

Mailing Address: 282 Meadow Lane Newport, WA 99156

Land Use: Residential

Land Type: Residential/Lifestlye farm

Conservation District: Pend Oreille

Property Description:

The Cygiel property is at least 30 acres in size and has direct access to the Little Spokane River. The family does not yet have livestock, though they plan to install a fence before bringing livestock onto their property. They have a few acres of riparian area, a small wetland, a pasture in need of restoration, and a densely vegetated forest with steep slopes throughout.

Resource Concerns

Soil Erosion - Sheet and Rill Erosion

Soil Quality Degradation - Organic Matter Depletion

Soil Quality Degradation - Compaction

Soil Quality Degradation - Subsidence

Excess Water - Seeps

Water Quality Degradation - Nutrients in Surface water

Water Quality Degradation - Excess Pathogens and Chemicals from Manure, Bio-solids or Compost Applications in Surface Water

Degraded Plant Condition - Undesirable Plant Productivity and Health

Degraded Plant Condition - Inadequate Structure and Composition

Degraded Plant Condition - Excessive Plant Pest Pressure

Degraded Plant Condition - Wildfire Hazard, Excessive Biomass Accumulation

Fish and Wildlife - Inadequate Habitat - Food

Fish and Wildlife - Inadequate Habitat - Cover/Shelter

Fish and Wildlife - Inadequate Habitat - Water

Livestock Production Limitation - Inadequate Feed and Forage

Livestock Production Limitation - Inadequate Water

Resource Concern Description:

Soil: Due to steep slopes in the forested area, it is essential that vegetative cover is maintained. It is possible that compaction exists in the pasture due to previous over-grazing and over-stocking. A test is required to confirm this. Organic matter depletion is also likely, due to the pasture's previous history. If improperly treated, the wetlands along the Little Spokane River may be at risk to subsidence due to a high level of organic matter.

Water: Large amounts of groundwater result in a few springs and seeps found throughout the property, especially in the wetland and along the riparian area. Once livestock are introduced to the pasture, the risk of nutrient loading in the Little Spokane is high.

Plant: Plant health in both the pasture and the forest require improvement. In the pasture, lack of management and previous over-grazing may result in lack of organic matter, compaction, and a weed pressures, including Knapweed. Along the riparian area, Reed Canary Grass dominates native plant species. In the forest, poor structure and composition have resulted in an increased risk to wildfire as well as poor forest and tree health.

Wildlife: The presence of Reed Canary Grass along the Little Spokane River prevents native vegetation from growing. These plants prevent native shrubs and trees from shading the river, which degrades fish habitat. In addition, dense vegetation renders the forests impassable by many wildlife species.

Livestock: Current conditions on the pasture are not ideal for livestock. In addition, fencing off the Little Spokane River will prevent livestock access to water.

**DRAFT WRIA 55 STREAMFLOW RESTORATION PLANNING
PRELIMINARY PROJECT PROPOSAL TEMPLATE**

The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use and achievement of a Net Ecological Benefit in WRIA 55 for evaluation under RCW 90.94. The information provided in this proposal will be presented to the WRIA 55 Planning Unit and considered for inclusion in the WRIA 55 Watershed Plan Update. When complete, please submit to Carl Einberger (ceinberger@aspectconsulting.com) by January 31, 2020

1. Title:
Beaver Dam Analogues on Deadman Creek

2. Proposal Preparer(s):
Amanda Parrish, The Lands Council

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

The Deadman Creek subwatershed is a priority watershed for habitat restoration for both the WRIA 55 Watershed Plan Update and the Little Spokane River TMDL Update. We proposed to install beaver dam analogues (BDAs) in the creek to trap sediment, slow the flow, and improve habitat. In addition to the BDAs, we will plant the riparian area with a mix of willow cuttings and potted native trees. While no landowner agreements are in place, a property owner at S13 T27N R44E is interested in working with us and will help us reach out to neighboring properties as well. The placement and design of the BDAs will be done with help from the Department of Ecology and installed by The Lands Council.

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

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

Deadman Creek

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

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

b. Timeframe(s) or Season of Use:

year round, especially helpful during summer low flows

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

Deadman Creek, S13 T27N R44E

<p>6. Net Ecological Benefit: <i>Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)</i></p>
<p>This project will provide both channel and riparian restoration.</p>
<p>7. Data Gaps: <i>Describe major unknowns or studies that would need to be completed.</i></p>
<p>Once property owners are selected, placement and structure design can take place.</p>
<p>8. Cost Estimates: <i>Provide known and estimated costs to develop and implement the project.</i></p>
<p>a. <u>Project Development and Design:</u> \$5,000</p> <p>b. <u>Project Construction:</u> \$20,000</p> <p>c. <u>Project Annual O&M:</u> \$1,500/year for the first two years to help riparian plants establish</p>
<p>8. Existing or Potential Funding: <i>List sources and approximate amounts if known.</i></p>
<p>Potential Funding from EPA 319 grants.</p>
<p>9. Mitigation Requirements: <i>Is any part of the project associated with other federal or state mitigation requirements (i.e., FERC, BiOp, etc)?</i></p>
<p>n/a</p>
<p>10. Project Advantages: <i>In addition to helping address RCW 90.94 requirements, briefly explain other potential benefits (e.g. reduced O&M costs, cropping flexibility, etc)</i></p>
<p>This project is relatively low maintenance and low cost. Construction materials can come from local sources such as logs in the vicinity, old Christmas trees, and harvested willow whips. This area is also identified as a priority region for restoration by the Little Spokane River TMDL update.</p>
<p>11. Potential Project Barriers: <i>Briefly explain potential barriers to completing the project (e.g. landowner willingness, site access, permitting requirements, increased O&M costs, legal implications)</i></p>
<p>Much of this stretch of Deadman Creek is on private property, so finding willing landowners needs to occur before implementation can.</p>
<p>12. Estimated Time Frame to Implement Project?</p>
<p>Planning will take 4-6 months, implementation can be done in 1 week, and riparian plants will be watered once per week during the first two summers following implementation.</p>

**DRAFT WRIA 55 STREAMFLOW RESTORATION PLANNING
PRELIMINARY PROJECT PROPOSAL TEMPLATE**

The purpose of this document is to provide project background and to summarize characteristics that contribute toward offset of future permit-exempt domestic use and achievement of a Net Ecological Benefit in WRIA 55 for evaluation under RCW 90.94. The information provided in this proposal will be presented to the WRIA 55 Planning Unit and considered for inclusion in the WRIA 55 Watershed Plan Update. When complete, please submit to Carl Einberger (ceinberger@aspectconsulting.com) by January 31, 2020

1. Title: Waikiki Springs Fish Habitat Project

2. Proposal Preparer(s): Todd Dunfield – Inland Northwest Land Conservancy and Conor Giorgi – Spokane Tribe of Indians

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

Inland Northwest Land Conservancy (INLC) and the Spokane Tribe of Indians (STI) are partnering to create a new nature preserve along the North shore of the Little Spokane River between the WDFW Fish Hatchery and Dartford, WA. Our mutual goal is to conserve the undeveloped floodplain (95 acres) and over 1,700 feet of shoreline along the Little Spokane River for salmon reintroduction activities, habitat protection, and facilitation of public access. The future nature preserve lies in the Little Spokane River corridor, an area of relatively intact high functioning riparian habitat immediately adjacent to major North Spokane neighborhoods such as Fairwood I and Fairwood II, which contain over a thousand homes. Protecting this property and preserving the value it provides is of utmost importance for maintaining the ecology of the Little Spokane.

The INLC is a regional land trust that has successfully protected over 21,000 acres and over 41 miles of shoreline. INLC comes into this partnership with STI with expertise to conserve the lands and shoreline through the usual vehicles of conservation, such as fee land ownership, conservation easements, and the creation of nature preserves common to land trusts. The STI comes into this partnership with vigor and expertise from their Division of Fisheries and Water Resources to accelerate the reintroduction of native anadromous species historically found in the waters of the Inland Northwest and the Little Spokane River. The property is perfectly positioned for the Tribe’s next steps planned to reintroduce anadromous fish to the region. Through previous analyses the Tribe determined there are significant amounts of high-quality habitat in the proposed project area. Coupled with relatively easy access, this property is well situated for releases of juvenile and adult salmon and the studies that will accompany their release.

The proposed Waikiki Springs preserve, when established, will ensure that existing ecological function is not only retained, but is also bolstered through the reintroduction of keystone species to their historic range.

Western Parcel: 26014.9007 Listed as 35.82 Acres of land
Eastern Parcel: 36063.9123 Listed as 58.58 Acres of land

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

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

N/A

<p>5. Quantity/Timing/Location of Water Instream: <i>Estimate average amount of water, when and where. Can project be considered at various sizes (flow outputs) and/or considered in phases?</i></p>
<p>a. <u>Acre-feet and/or Cubic-feet-per-second:</u></p> <p>N/A</p>
<p>b. <u>Timeframe(s) or Season of Use:</u></p> <p>Year-round use for public with intense seasonal use for fish rearing and release as well as antenna monitoring movement of fish.</p>
<p>c. <u>Tributary (name) or Mainstem Little Spokane River and Location(s):</u></p> <p>Mainstem of Little Spokane River – Approximate river mile 9.5</p>
<p>6. Net Ecological Benefit: <i>Describe the factors that may contribute to Net Ecological Benefit (i.e., fish passage restoration; channel, riparian, and/or floodplain restoration and/or protection; upland improvements)</i></p>
<p>The proposed nature preserve includes designated wetlands within the floodplain as well as a forested bench of ponderosa pine forest above the Little Spokane River. This area along the Little Spokane River’s north bank has seen limited to no development and includes a productive bald eagle nest, plethora of gopher snakes, and megafauna such as moose. The site also includes an abundance of cold clean water from the springs located just upstream along the southern facing shore from this property. Even during hot summer months the stream water temperatures remain conducive to supporting fish populations, due to the broad leaf vegetation along the shores of the Little Spokane River as well as the ground water discharging into the Little Spokane River. These unique geological and ecological qualities make these lands and shoreline optimal for native fish species as well as salmon reintroduction.</p> <p>The return of salmon, in various life stages, is an ecological restoration that will support instream and upland productivity through the deposition of marine-derived nutrients. It will also immediately increase the biological diversity of the river, restoring components of the fish community that have been blocked due to hydroelectric dam development.</p>
<p>7. Data Gaps: <i>Describe major unknowns or studies that would need to be completed.</i></p>
<p>For decades during the latter part of the 20th century a small sized sewage treatment facility was in operation on these lands and were subsequently remediated and filled. These remediation actions need to be confirmed by reviewing previous documentation and performing both and a Phase 1 and Phase 2 environmental study.</p>
<p>8. Cost Estimates: <i>Provide known and estimated costs to develop and implement the project.</i></p>
<p>a. <u>Project Development and Design:</u></p> <p>No further development is expected at this time. Small antennas instream or along the bank may be installed at a later date to facilitate the study of reintroduced fish species; however the aesthetic and ecological impact of these is negligible.</p>

b. Project Construction: Currently the 95 acres of land is listed by an agent for sale at \$1.6 million. INLC and STI are pursuing a WA State RCO grant. This will require an appraisal to be made by an independent appraiser. This appraisal may be higher, lower, or very close to the asking price.

c. Project Annual O&M: Depending on the level of temporary or permanent infrastructure needed for fish reintroduction, O&M is expected to be relatively low cost. Funding to support the operation and maintenance of related equipment will be sourced independently of WA State RCO grant funding.

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

WA State RCO funding. The next grant application deadline is May 1, 2020 and the grant would match 50% of the sale price of the land. The remainder 50% will need to be raised locally through other funding vehicles such as private philanthropy.

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

No, this project proposal is not associated with *required* federal or state mitigation, however protection of this property and accompanying salmon reintroduction efforts are consistent with mitigation and other restoration plans. This project, by facilitating reintroduction, is consistent with the 2014 Columbia River Basin Fish and Wildlife Program, put forth by the Northwest Power and Conservation Council. It's also consistent with the joint Fish Passage & Reintroduction plan developed by Columbia River Basin Tribes and Canadian First Nations; plans developed by the State of Washington for recovering Southern Resident Orca; and the Columbia Basin Partnership Task Force lead by NOAA.

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

This project presents a unique advantage, as shoreline access is difficult to find or acquire along the Little Spokane River. The acquisition of this property will support preservation of riparian habitat and access for the Spokane Tribe of Indians and their partners to perform the necessary studies to further inform salmon reintroduction. It will also allow access by the general public to use and appreciate this unique area and its habitats.

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

There are at least three potential barriers to this project. The first being that the land in question could sell to a different buyer prior to our ability to agree on a purchase and sale agreement with the seller. This property is currently zoned as RCV-Rural Conservation and would support a single residence per 10 acre parcel. Potential buyers include developers, which would put the land and associated water resources at risk. The second being the willingness of landowner to agree on the appraised price, which is a RCO Grant restriction. Lastly, there is a chance that our RCO grant proposal will not rank favorably enough to be chosen for funding in the 2020 application period.

12. Estimated Time Frame to Implement Project?

Preliminary Timeline: 2020-2022

May 1, 2020 RCO Grant Application Due

Fall 2020 Grant acceptance known

Winter 2021 Appraisal conducted, followed by a purchase and sale agreement

Spring 2021 Fundraising

Final Purchase 2021-2022

2022 Fish Reintroduction Activities Begin