Appendices

WRIA 7 Snohomish Watershed

The following appendices are linked to this report as an Appendices file at:
https://apps.ecology.wa.gov/publications/SummaryPages/2211013.html

Appendix A – Final Meeting Summary of the WRIA 7 Committee

Appendix B – Technical Memos

Appendix C – Detailed Project Descriptions

Appendix D – Project Prioritization Guiding Principles used by the WRIA 7 Committee

Appendix E – Policy, Implementation, and Adaptive Management Recommendations Proposed by the WRIA 7 Committee

Appendix A – Final Meeting Summary of the WRIA 7 Committee

Meeting Summary

Snohomish (WRIA 7)
Watershed Restoration and Enhancement Committee meeting
Thursday, April 15, 2021 | 12:30 p.m. - 3:00 p.m. | Committee website

Location	Committee Chair	Handouts
	Ingria Jones Ingria.Jones@ecy.wa.gov 425-466-6005	Plan adoption pathways Final plan Operating Principles and revisions

Attendance

Committee representatives and alternates

Ann House (Snoqualmie Indian Tribe, alternate)
Brant Wood (Snohomish PUD)
Bobbi Lindemulder (Snohomish CD)
Cynthia Krass (Snoqualmie Valley WID)
Daryl Williams (Tulalip Tribes)
David Levitan (City of Lake Stevens)
Denise Di Santo (King County)
Dylan Sluder (MBAKS)
Elissa Ostergaard (Snoqualmie Watershed Forum, ex-officio)
Emily Dick (WWT)
Glen Pickus (City of Snohomish)
Ingria Jones (Ecology)
Keith Binkley (Snohomish PUD, alternate)
Kelsey Taylor (Snoqualmie Indian Tribe, alternate)
Kim Peterson (Town of Index)
Kirk Lakey (WDFW)
Lindsey Desmul (WDFW, alternate)
Liz Ablow (City of Seattle, ex officio)
Matthew Eyer (City of Marysville)
Megan Darrow (City of Monroe)
Mike Remington (City of Duvall)
Mike Wolanek (City of Arlington)
Rebecca Deming (City of North Bend, alternate)
Rich Norris (City of Gold Bar)
Souheil Nasr (City of Everett)
Stacy Vynne McKinstry (Ecology, alternate)
Stephanie Potts (Ecology, alternate)
Steve Nelson (City of Snoqualmie)
Terri Strandberg (Snohomish County)

Not in attendance

Snohomish Basin Salmon Recovery Forum, ex officio

Other attendees

Angela Pietschmann (Cascadia – Info Manager)
Bridget August (GeoEngineers)
Joe Hovenkotter (King County)
John Covert (Ecology)
Kevin Lee (WDFW)
Paulina Levy (Ecology)
Susan O'Neil (ESA – Facilitator)

Introductions & Standing Business

Susan O'Neil (Facilitator) welcomed the group, began introductions, and reviewed the January 14 meeting summary. *The January meeting summary was approved without further changes.*

Ecology updates

- Ecology adopted the remaining 3 plans under section 020 of the streamflow restoration law by the February 1, 2021 deadline (WRIA 22/23: Chehalis; WRIA 49: Okanagan; WRIA 55: Little Spokane). The plan addendums are available on Ecology's streamflow restoration planning webpage.
- The WRIA 9 Committee submitted their locally approved watershed restoration and enhancement plan. Ecology is currently reviewing the plan and will determine by June 30th whether to adopt the plan. The locally approved plan is available on the WRIA 9 Committee webpage.
- Other committees chaired by Ecology have not yet submitted locally approved plans to Ecology. Several committees have votes scheduled for later this month.
- Ecology requested $40 million for the 2021-2023 biennium and $40 million was included in the Governor's Capital budget proposal. Ecology will determine the timing for the next Streamflow Restoration Grant Program round after the Washington State Legislature approves a budget for the 2021-2023 biennium.
- **Committee Membership:** City of Carnation has withdrawn from the WRIA 7 Committee.
- Updated appendix A of Operating Principles: Added list of committee members and entities that declined to participate. Will review proposed changes to the main body of the document later in the meeting.

Steps to Plan Adoption

Ingria Jones (Ecology, Chair) outlined pathways to plan adoption:

If plan is approved and submitted to Ecology with time for review by June 30:

- **State Environmental Policy Act (SEPA) review**: The SEPA review includes the Environmental Checklist and Threshold Determination for a non-project programmatic plan review. After Ecology makes a SEPA determination, we will have a public comment period for the SEPA review and comments will be collected online (minimum of 14 days).
- **Ecology's technical staff** evaluate whether the plan achieves a **Net Ecological Benefit** as described in the Streamflow Restoration law (RCW 90.94.030), the Final NEB Guidance (GUID-2094), and the Streamflow Restoration Policy and Interpretative Statement (POL-2094).
- **Ecology Water Resources Program Management review**: The Water Resources Program reviews the plan and prepares a recommendation to the Director.
- **Ecology Director review and determination**: The Director reviews all materials and makes a determination by June 30, 2021 on whether to adopt the plan.
- **Plan adoption**: The Director of Ecology will issue the results of the plan review and the NEB determination in the form of an order. The Streamflow Restoration law has a June 30, 2021 deadline for adoption by the Director of Ecology. If the Director signs adoption orders by June 30, 2021, the planning process is completed.
- **Adaptive Management**: After plan adoption, the Water Resources Program will review policy, adaptive management, and implementation recommendations across all of the Watershed Plans and make a programmatic decision on where and how to invest resources on recommendation implementation.

If plan is not approved and submitted to Ecology with time for review by June 30:

- **Ecology prepares the plan**: Ecology must prepare a final draft plan and submit it to the Salmon Recovery Funding Board (SRFB) for technical review. Ecology will then consider the SRFB review, prior to finalizing and adopting the plan. Ecology may amend the plan without Committee approval prior to adoption.

- **Plan adoption.** After plan adoption, the Director shall initiate rulemaking within six months to incorporate recommendations into rules adopted under chapter 90.94 or under Chapter 90.22 or 90.54 RCW and shall adopt amended rules within two years of initiation of rulemaking. Ecology's rulemaking is a public process guided by the Administrative Procedure Act (APA), ch. 34.05 RCW, and will be undertaken consistent with the requirements of RCW 90.94.030.
- **There is no timeline identified in the legislation for Ecology to finalize the plan**. Ecology will determine the timeline for plan completion after evaluating the workload based on the number of plans adopted by June 30 and recommendation in plans for rulemaking.
- **There is no role identified in the law for the Committee after June 30, 2021**.

If the plan is not approved today, that doesn't preclude the Committee from continuing to work on the plan or voting again. Best chance of getting a plan reviewed and adopted by June 30th deadline if Committee can submit an approved plan by end of April. There is no "final" deadline, but that would put us on the same review pathway as a number of other plans. Ecology will do everything we can to adopt the plan if the Committee is able to approve it before June 30.

Resources:

- Plan adoption pathways handout

Discussion:

- Mike Wolanek (City of Arlington) asked what the benefits are of approving this plan as a Committee versus allowing Ecology to codify through rulemaking. Would allowing the plan to go through rulemaking offer more authority?
- Ingria Jones (Ecology, Chair) noted that rulemaking is uncertain, includes a statewide public process, and Ecology cannot guarantee any outcomes. If Ecology finalizes the plan, projects will still not have guaranteed funding or guaranteed implementation.
- Daryl Williams (Tulalip Tribes) noted that if the Committee does not approve this plan that was developed over the past two years, this may not be the plan that Ecology moves forward. Ecology has leeway on what goes in a plan without committee approval if we don't approve this plan.
- Mike Wolanek (City of Arlington) noted there is a lot of value in each entity on the Committee supporting the plan, but down the road priorities may not stay the same.

Proposed Revisions to Operating Principles

Ingria Jones (Ecology, Chair) proposed an amendment to the Committee's Operating Principles, Section 6. Current Operating Principles require a quorum (2/3 of Committee present) to vote. Ingria reviewed the proposed revisions, which would allow for a re-vote on plan approval without a quorum.

Resources:

- Proposed Revision to Operating Principles

Discussion:

- The Committee requested that the Chair invite the full Committee in the event that an entity requests a re-vote and Ingria adjusted the proposed text revision accordingly.

Susan O'Neil (ESA – Facilitator) reviewed the process for revising the operating principles:

> *"The Committee may review the operating principles periodically. Any member of the Committee may bring forward a recommendation for an amendment to the operating principles. Amendments will be brought for discussion when a quorum (2/3 of the membership) is present and take effect only if approved unanimously by the full Committee for inclusion in the operating principles."*

Amendment to Operating Principles:

The Committee voted on the following language to "Voting on the final approval of the plan" under Section 6. Decision Making:

> *"The Committee can vote as many times as needed to attempt to approve the plan. If no changes are made to the plan, a quorum is not required for subsequent votes on final approval of the plan. All Committee members will be invited, however only the Chair and the Committee members that change their vote need to be present for the subsequent votes. The Chair will notify the Committee of the result of subsequent votes."*

Decision: Approved. All Committee members agreed to adopt this change to the Operating Principles.

Committee Member Comments

Susan O'Neil (ESA – Facilitator) invited Committee members to provide any statements about the planning process or the final plan to be captured in the meeting summary:

Department of Ecology: No comment.

Snoqualmie Indian Tribe: The Tribe is not approving the plan as of now. The Tribe's state lobbyist is actively working with Ecology through government-to-government meetings. The Tribe is requesting assurances needed in order to sign off on the plan.

Tulalip Tribes: Daryl thanked everyone for their time and effort that went into developing this plan. It's a good plan, and Daryl looks forward to moving it forward; Tulalip plans to approve plan. Tulalip Tribes share some of the same concerns as the Snoqualmie Indian Tribe; however, it is Tulalip's position that not approving this plan will make a bad situation worse.

Department of Fish and Wildlife: Kirk thanked everyone for their time and effort on this plan, including the Ecology team for helping the Committee through this long process.

King County: Denise thanked everyone for all their work on this plan. It was a long effort with additional subcommittee work while folks were also involved in other planning processes.

Snohomish County: Terri thanked everyone for their dedication to this process. The work has been interesting, and Terri enjoyed meeting everyone. She commended the Committee's admirable dedication and consistency for this duration of time on this project.

City of Arlington: Mike Wolanek echoes what others said in terms of gratitude for everyone's participation and the peer relationships developed through this project. This process has been noteworthy, and it has been an honor to get to know you all. Mike believes it is a good plan and not worth disapproving. 20 years from now, if voting on this plan, Mike would not vote for it because he does not think the process is sustainable.

City of Duvall: Mike Remington expressed deep appreciation for (1) Ecology's commitment to this process; and (2) the expertise that was brought to bear on this project. He appreciates the plan's potential to take care of the watershed and hopefully keep it healthy for generations to come.

City of Everett: Souheil thanked everyone for participating in this process and for Ingria's ability to "herd the cats"—it was not an easy task. Hopefully, the plan will be adopted; Everett wholeheartedly supports this plan.

City of Gold Bar: no comments.

Town of Index: Kim noted the Town has had a comment from the beginning of the process: there is language in the plan that might lead a reader to understand that someone drilling a well nearby may prefer to connect to a public water system. Town of Index's water system is at capacity; even though the preference to connect is there, it won't always be possible. Other than that, Town of Index supports the plan.

City of Lake Stevens: no comment.

City of Marysville: no comment.

City of Monroe: no comment.

City of North Bend: no comment.

City of Snohomish: no comment.

City of Snoqualmie: no comment.

Snoqualmie Valley Watershed Improvement District: Cynthia thanked Ingria for leading this complex process. She appreciated Ingria's talents and skills and that Ingria called all Committee members before every meeting. This approach was really effective/refreshing. Agriculture representatives don't often sit at these tables, as water projects are sometimes in conflict protecting farmers. SVWID is ready to roll up our sleeves and do the work to find as much common ground as possible. Significant resource investments/funds were put into this process because it is a core value of SVWID's board leadership. Cynthia thanked everyone for their efforts.

Snohomish Public Utilities District: Brant thanked everyone. It has been an interesting process, and he is impressed with how such a diverse group of interesting folks can come to consensus on this complex plan. SPUD plans to approve the plan.

Master Builders Association of King and Snohomish Counties: Dylan echoed what everyone else has already said. He thanked everyone for their time and effort. It's been great to get to know everyone; while the Committee members don't always agree, the plan is a good result of everyone's opinions. He thanked Ingria and team for all their work and plans to support the plan.

Washington Water Trust: Emily expressed that is has been a huge honor to meet everyone and the Committee has been through an evolution together. WWT believes the WRIA 7 Streamflow Restoration Plan is largely filled with intelligent and collaborative projects and initiatives that we strongly support. Insufficient funding to support the underlying projects seriously jeopardizes the strength of this plan and its ability to meet its imperative of offsetting exempt wells and net ecological benefit. The Department of Ecology has been allocated inadequate funds to enable the success of projects which these plans are founded on. As evidence of the scarcity, in 2021, no such grant funding was available to these projects. We advise strong action to fully fund these plans. Inaction to do so will be detrimental to the water resources we aim to protect and the people who rely on them.

Snohomish Conservation District: Bobbi thanked everyone for allowing the CD to participate in the process and be at the table. As Cynthia noted, it's not always an easy place to fit in, but the CD strives to be collaborative and do its best to come to agreement, while keeping working lands in operation. This group is extremely knowledgeable, and Bobbi has been blown away by what she's learned (big learning curve!). Bobbi appreciates the level of engagement and is grateful for the technical sub committees as lots of their work went into this effort outside of Committee meetings and in the trenches.

City of Seattle, ex officio: Liz appreciated being allowed to participate in this process as an ex-officio member and feel accepted into the group. It has been a great opportunity to work with many entities the City doesn't typically work with. She's appreciated hearing new voices and learning. Seattle Public Utilities sent a letter to Ecology about this process. The City participates on WRIA 8 and 9 Committees as a member (not ex officio) and

the letter speaks more specifically to those WRIAs, but it is also relevant to WRIA 7. Concerns outlined included lack of funding, tracking plan effectiveness, working to create statewide policies, including a broader group of stakeholders / tech experts, and the Streamflow Grant review process. Liz hopes this effort stays present and in the forefront, and that the plan is implemented to make this effort successful and bigger than what we hope it is.

Snoqualmie Watershed Forum, ex officio: Elissa Ostergaard appreciated everyone being interested in including the Snoqualmie Watershed Forum and salmon habitat planning into the process. The Snoqualmie Watershed Forum looks forward to seeing results as the plan is implemented.

Snohomish Basin Salmon Recovery Forum, ex officio: not present.

Letters sent from committee member entities to Ecology are posted on box. This includes letters from WDFW, the City of Seattle, and Snoqualmie Tribe.

Reviewing Edits to Final Plan

Ingria Jones (Ecology, Chair) reviewed minor edits to the final plan since last meeting:

- Figure ES 1, page 9: simplified map symbols
- Section 1.1, page 11: removed placeholder language
- Section 1.2.3, page 16 and 17: added last meeting date, removed placeholder language, added consulting firm names
- Section 2.1.3, page 21: corrected citation for Chinook habitat designation
- Section 5.2.1, page 58: Added footnote that, with the exception of Lochaven Source Switch, water right acquisition projects do not have detailed project descriptions in Appendix H.
- Table 5.1, page 59: Changed project type for Lake Shoecraft to "water storage and retiming" for consistency with Lake Stevens
- Figure 5.1, page 62: Updated for consistent formatting
- Section 5.2.1, page 68: Corrected project number for Surface Water Storage Project to match tables and detailed description; moved to after MAR summary
- Table 5.2: Added Skykomish Mainstem as subbasin location for wetland restoration project (& updated detailed project description in Appendix H accordingly)
- Figure 5.2, page 82: Updated formatting and changed symbols to more easily identify project types
- Section 7.3, page 109: added Wetland Restoration as project located in Skykomish Mainstem
- Figure 7.1, page 131: Updated formatting and changed symbols to more easily identify project types
- Appendix B (Glossary): Updated definitions for Instream Flow, Instream Flow Rule, and Streamflow
- Appendix C (Committee Roster): Added second alternates, re-ordered to match listing in RCW 90.94.030
- Throughout:
    - Corrections for term consistency: new permit-exempt domestic wells
    - Corrected typos and formatting errors

Resources:

- Final WRE Plan-Revised-Redline

Discussion:

- No concerns with above changes.

Vote on WRIA 7 WRE Plan

Susan O'Neil (ESA – Facilitator) reminded the Committee about the process for final approval of the plan:

RCW 90.94 (3) states that *"... all members of a watershed restoration and enhancement committee must approve the plan prior to adoption." This means that each committee member gets a vote (quorum is not applicable for final approval) and that all committee members must vote "yes" in support of a plan in order for it to be approved and provided to Ecology for "net ecological benefit" review and potential adoption."*

Options for the vote on final plan approval are: approve or disapprove. All voting members of the Committee were present and each entity provided their vote verbally.

Roll call (voting members):

- Department of Ecology - **approve**
- Snoqualmie Indian Tribe - **disapprove**
- Tulalip Tribes – **approve**
- Washington Department of Fish and Wildlife - **approve**
- King County – **approve**
- Snohomish County - **approve**
- City of Arlington - **approve**
- City of Duvall - **approve**
- City of Everett- **approve**
- City of Gold Bar- **approve**
- Town of Index- **approve**
- City of Lake Stevens- **approve**
- City of Marysville- **approve**
- City of Monroe- **approve**
- City of North Bend- **approve**
- City of Snohomish- **approve**
- City of Snoqualmie- **approve**
- Snoqualmie Valley Watershed Improvement District, representing the largest irrigation district - **approve**
- Snohomish Public Utility District, representing the largest publicly owned water purveyor that is not a municipality - **approve**
- Master Builders Association of King and Snohomish Counties, representing the residential construction industry - **approve**
- Washington Water Trust, representing environmental interests - **approve**
- Snohomish Conservation District, representing agricultural interests – **approve**

Decision: Not Approved. 21 Committee members voted to approve and 1 Committee member voted disapprove. Approval must be unanimous; therefore the plan is not approved.

Public Comment

No public comment.

Action Items for Chair

Ingria thanked Committee members for their expertise, patience, and commitment throughout the process and reviewed post-meeting action items:

- Ecology to post the final January 14 meeting summary to Committee webpage.
- Ecology to send revised Operating Principles and post to Committee webpage.
- Ecology send draft meeting summary and ask for approval via email.

- Ecology to submit draft plan, letters, and resolutions to management and let them know the plan is not approved at this time. Ecology will not start on the alternate pathway to plan adoption until after June 30, 2021.
- No additional Committee meetings are scheduled at this time. If a Committee member requests a re-vote, the Chair will schedule a meeting and invite Committee members.

Action Items for Committee Members

- Committee members requesting a re-vote should notify the chair as soon as possible.
- Review April 15th draft meeting summary by May 6.

Appendix B – Technical Memos

The following technical memos were developed for the WRIA 7 Committee process. Therefore, final conclusions as presented in this plan may not align with the technical memos.

GeoEngineers

17425 NE Union Hill Road, Suite 250, Redmond, WA 98052 Telephone: 425.861.6000, Fax: 425.861.6050 www.geoengineers.com

Memorandum

To: Ingria Jones
Washington State Department of Ecology

From: Bridget August, LG, LHG and
John Monahan, FP-C

Date: January 6, 2021

File: 0504-161-00

Subject: WRIA 7 Subbasin Delineations

INTRODUCTION

GeoEngineers, Inc. (GeoEngineers) is providing technical support to the Washington State Department of Ecology (Ecology) and the Watershed Restoration and Enhancement (WRE) Committees for Water Resource Inventory Areas (WRIAs) 7, 8 and 9. This memorandum provides a summary of the deliverable for Work Assignment GE0102, Task 2, WRIA 7 Subbasin Delineations.

BACKGROUND AND CONTEXT

The Streamflow Restoration law (Revised Code of Washington [RCW] Chapter 90.94) specifies that by June 30, 2021, Ecology must establish a WRE Committee and adopt a WRE Plan in the Snohomish Watershed (WRIA 7). The Snohomish (WRIA 7) Watershed Restoration and Enhancement Plan (watershed plan) must address impacts on streamflows from consumptive use from new domestic permit-exempt wells (PE wells[1]) anticipated between January 19, 2018 and January 18, 2038. Dividing the WRIA 7 into subbasins is an essential step in developing a plan that complies with the law. RCW 90.94.030(3)(b) states "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." The *Final Guidance for Determining Net Ecological Benefit* (Final NEB Guidance) (Ecology 2019) states that, "Planning groups must divide the WRIA into suitably sized subbasins to allow meaningful analysis of the relationship between new consumptive use and offsets. Subbasins will help the planning groups understand and describe location and timing of projected new consumptive water use, location and timing of impacts to instream resources, and the necessary scope, scale, and anticipated benefits of projects. Planning at the subbasin scale will also allow planning groups to consider specific reaches in terms of documented presence (e.g., spawning and rearing) of salmonid species listed under the federal Endangered Species Act."

WRIA 7 includes the Snohomish River, the Snoqualmie River, the Skykomish River, and associated tributaries. It also includes streams draining directly to Puget Sound between the City of Mukilteo and the City of Everett, on the Tulalip Plateau, and in the Marysville Trough.

The methods used to delineate subbasins in WRIA 7 are summarized below.

[1] "PE wells" is used to refer to new homes associated with new permit-exempt wells and also new homes added to existing wells, including homes on group systems relying on permit-exempt wells.

SUBBASIN DELINEATION METHODS

GeoEngineers worked with the WRIA 7 Committee to delineate subbasins for WRIA 7. The WRIA 7 Committee considered existing subwatershed units for their subbasin delineation, including hydrologic unit codes, King County drainage basins, and the Snohomish Basin Protection Plan's Protection Planning Units.

- Hydrologic unit codes (HUCs) refer to the U.S. Geological Survey (USGS) delineation of watersheds into successively smaller hydrologic units (USGS 2013). The USGS uses a nationwide system based on surface hydrologic features. This system divides the country into 21 regions (2-digit), 222 subregions (4-digit), 370 basins (6-digit), 2,270 subbasins (8-digit), ~20,000 watersheds (10-digit), and ~100,000 subwatersheds (12-digit). A hierarchical HUC consisting of 2 additional digits for each level in the hydrologic unit system is used to identify any hydrologic area. HUC-12 is at the subwatershed level (12-digit) of HUCs and there are over 60 HUC-12 subwatersheds in WRIA 7.
- King County drainage basins are similar in size to HUC-12s, but do not exactly match the HUC-12 boundaries. They are a boundary layer developed by King County using LiDAR technology to delineate drainage basins. There are 23 King County drainage basins in the King County portion of WRIA 7.
- The Snohomish Basin Protection Plan was developed "to identify protection strategies that prevent the degradation of hydrologic processes that support salmon or salmon habitat" and is intended to set a framework for "implementation and accounting of protection efforts by all Basin partners" (Snohomish Basin Salmon Recovery Forum 2015). There are 17 Protection Planning Units in WRIA 7. Protection Planning Units were determined based on critical flows for chinook and focal stream reaches, considering areas with similar hydrology and land uses.

Subbasin Selection Considerations

The WRIA 7 Committee used existing HUC-12s, King County drainage basins, and Protection Planning Units and applied the following guiding principles to develop subbasin delineations:

- Align subbasins with the Protection Planning Units as closely as possible.
- Combine HUC-12s and King County drainage basins with lower projected growth of new homes using PE wells.
- Keep distinct subbasins for HUC-12s and King County drainage basins with higher projected growth of new homes using PE wells.
- Consider important salmon habitat and potential location of offset projects and actions.
- Consider streams with known low flow issues.
- Consider streams with year-round closures[2].

WRIA 7 Subbasin Delineation

The WRIA 7 subbasin boundaries are based on HUC-12 subwatersheds in the Snohomish County portion of the watershed and King County drainage basin boundaries in the King County portion of the watershed.

[2] The following streams have year-round closures in WAC 173-507: Griffen Creek, Harris Creek, Little Pilchuck Creek, May Creek, Patterson Creek, Quilceda Creek, Raging River, and Bodell Creek.

GeoEngineers used existing HUC-12 shapefiles from the USGS (2016) and drainage basin shapefiles from King County (2018) to develop a map and GIS shapefile for the WRIA 7 Committee's subbasins. The following adjustments were made:

- The Allen Creek drainage was added to Quilceda HUC-12.
- The Snoqualmie mainstem King County drainage basin was split where the Tolt River enters the Snoqualmie River.
- Drainage basin boundaries were shifted to align with the boundary between WRIA 7 and WRIA 8.
- HUC-12 boundaries were extended to the Puget Sound.
- Hat Island and Jetty Island, located in Possession Sound within Snohomish County and WRIA 7, were added to the Estuary/Snohomish Mainstem subbasin.

The WRIA 7 subbasin delineations are shown on Figure 1.

WRIA 7 Subbasins

- Tulalip Creek is one subbasin (**Tulalip**).
- The Allen Creek drainage, which is part of the Snohomish River – Frontal Procession Sound HUC-12 subwatershed, is combined with the Quilceda Creek HUC-12 subwatershed to create one subbasin (**Quilceda-Allen**).
- The Snohomish River, Evans Creek, and French Creek are combined (**Estuary/Snohomish Mainstem**).
- Little Pilchuck is one subbasin (**Little Pilchuck**).
- Upper and Lower Pilchuck River are combined (**Pilchuck**).
- Woods Creek is one subbasin (**Woods**).
- Upper, Middle, and Lower Sultan River are combined (**Sultan**).
- Wallace River and Olney Creek are combined (**Lower Mid-Skykomish**).
- Elwell Creek-Skykomish River and McCoy Creek-Skykomish River are combined (**Skykomish Mainstem**).
- The South Fork and North Fork Skykomish tributaries are combined (**Upper Skykomish**). This includes the following HUC-12 subwatersheds and drainage basins:
  - Foss River, Miller River, Tye River, South Fork Skykomish River, Beckler River, Rapid River, Upper Beckler River, Lower South Fork Skykomish River, Lower North Fork Skykomish River, Middle North Fork Skykomish River, and Upper North Fork Skykomish River.
- Cherry Creek and Harris Creek are combined into one subbasin (**Cherry/Harris**).
  - The Committee combined the Cherry and Harris Creek HUC-12 subwatersheds after considering that the hydrologic divide between Cherry Creek and Harris Creek is characterized by wetlands, rather than a distinct divide.
- The northern half of the Snoqualmie mainstem drainage basin is combined with Tuck Creek, Cathcart drainages, and Ames Lake (**Snoqualmie North**).

- The South Fork Tolt, North Fork Tolt, and Lower Tolt drainage basins are combined with nearby drainage basins Tokul Creek, Griffen Creek, and the southern half of the Snoqualmie mainstem drainage basin (**Snoqualmie South**).
- Patterson Creek is one subbasin (**Patterson Creek**).
- The Raging River is one subbasin (**Raging River**).
- The North, Middle, and South Fork Snoqualmie drainage basins are combined (**Upper Snoqualmie**).

NEXT STEPS

- The WRIA 7 Committee agreed to use the proposed 16 subbasins to estimate potential PE well growth and consumptive use by subbasin.

REFERENCES

King County, 2018. GIS Open Data, *Basin boundaries derived from terrain data, King County only / topo basin kc area*. https://gis-kingcounty.opendata.arcgis.com/datasets/basin-boundaries-derived-from-terrain-data-king-county-only-topo-basin-kc-area, December 3, 2018.

Snohomish Basin Salmon Recovery Forum [Snohomish County Surface Water Management, King County Snoqualmie Watershed Forum Staff, and Tulalip Tribes Natural Resources Department], 2015. *Snohomish Basin Protection Plan*. https://www.govlink.org/watersheds/7/pdf/SBPP/SBPP%20December%202015_reduced%20size.pdf.

U.S. Geological Survey (USGS) and U.S. Department of Agriculture, Natural Resources Conservation Service, 2013. Federal Standards and Procedures for the National Watershed Boundary Dataset (WBD) (4 ed.). U.S. Geological Survey Techniques and Methods 11-A3, 63 p.

U.S. Geological Survey (USGS), 2016. USGS National Hydrography Dataset (NHD) Downloadable Data Collection – National Geospatial Data Asset (NGDA) National Hydrography Dataset (NHD): USGS – National Geospatial Technical Operations Center (NGTOC): Rolla, MO and Denver, CO. http://nhd.usgs.gov, http://viewer.nationalmap.gov/.

Washington State Department of Ecology (Ecology), 2019. Final Guidance for Determining Net Ecological Benefit, GUID-2094 Water Resources Program Guidance. Washington State, Department of Ecology, Publication 19-11-079, p. 131. https://fortress.wa.gov/ecy/publications/documents/1911079.pdf

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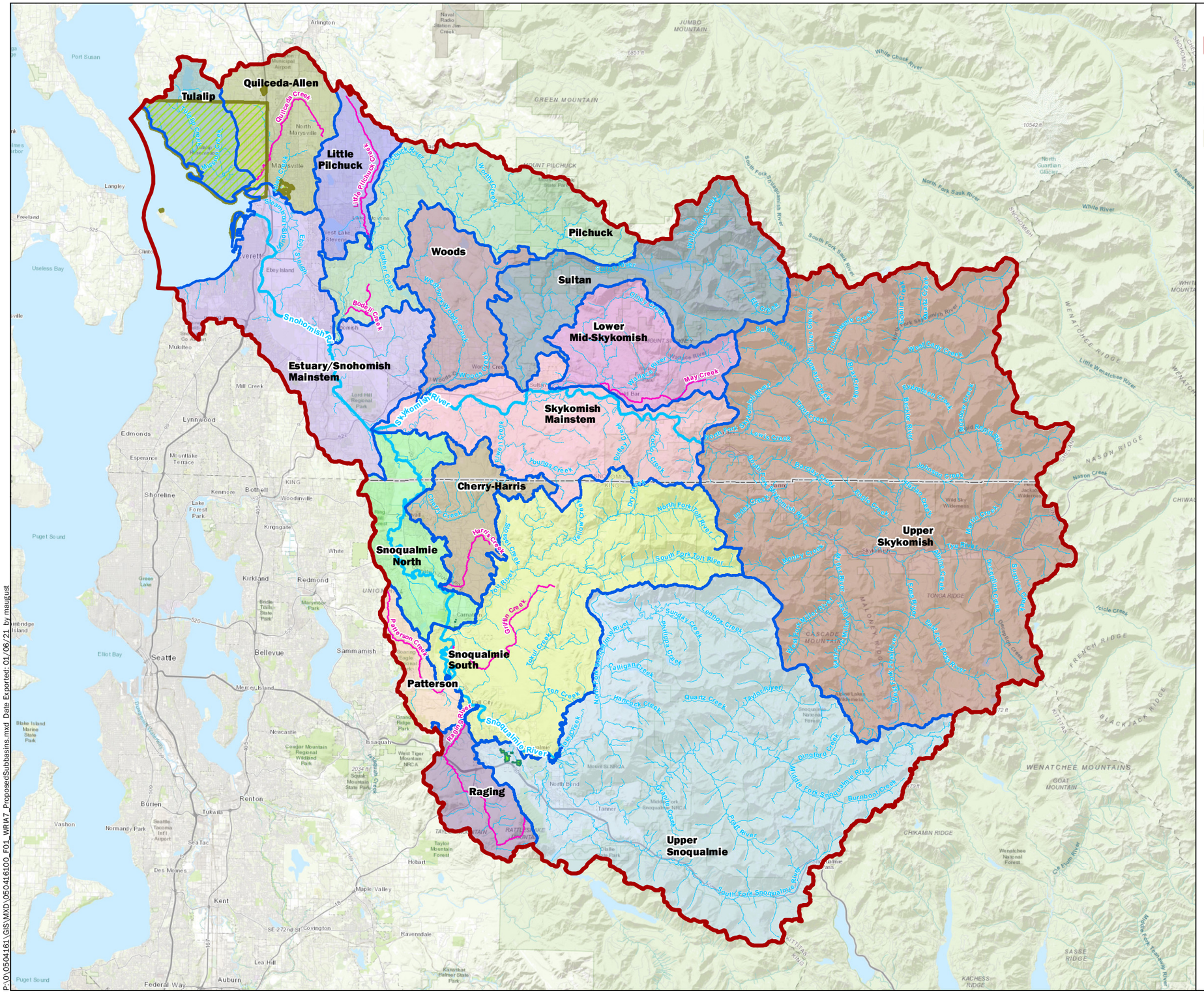
Attachment:
Figure 1. WRIA 7 – Snohomish Subbasin Delineation



Legend

- WRIA 7 Boundary
- Surface Water Closures[3]
- WRIA 7 Subbasin Delineation
- Snoqualmie Tribe Reservation
- Tulalip Tribes Reservation

- Cherry-Harris
- Estuary/Snohomish Mainstem
- Little Pilchuck
- Lower Mid-Skykomish
- Patterson
- Pilchuck
- Quilceda-Allen
- Raging
- Skykomish Mainstem
- Snoqualmie North
- Snoqualmie South
- Sultan
- Tulalip
- Upper Skykomish
- Upper Snoqualmie
- Woods

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. Closed streams represent GeoEngineers' interpretation of the language in WAC 173-507 and this map is to only be used for planning purposes.

Data Source: ESRI Topographic Map Base

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

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WRIA 7 Proposed Subbasins

Watershed Restoration and Enhancement Plan WRIA 7
Snohomish County, Washington

GeoEngineers

Figure 1

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GeoEngineers

Memorandum

17425 NE Union Hill Road, Suite 250, Redmond, WA 98052 Telephone: 425.861.6000, Fax: 425.861.6050 www.geoengineers.com

To: Ingria Jones
Washington State Department of Ecology

From: Bridget August, LG, LHG and
John Monahan, FP-C (GeoEngineers, Inc.)

Date: January 6, 2021

File: 0504-161-00

Subject: WRIA 7 PE Well Projections

INTRODUCTION

GeoEngineers, Inc. (GeoEngineers) is providing technical support to the Washington State Department of Ecology (Ecology) and the Watershed Restoration and Enhancement (WRE) Committees for Water Resource Inventory Areas (WRIAs) 7, 8 and 9. This memorandum provides a summary of the deliverable for Work Assignment GEO102, Task 3, WRIA 7 Growth Projections.

BACKGROUND AND CONTEXT

The Streamflow Restoration law (Revised Code of Washington [RCW] 90.94) specifies that by June 30, 2021, Ecology must establish a WRE Committee and adopt a WRE Plan in the Snohomish Watershed (WRIA 7). The Snohomish (WRIA 7) Watershed Restoration and Enhancement Plan (watershed plan) must address impacts on streamflows from consumptive use from new domestic permit-exempt wells (PE wells[1]) anticipated between January 19, 2018 and January 18, 2038.

The watershed plan must estimate new PE wells in the watershed (growth projections) for January 2018 through January 2038 (at a minimum). Based on the projected PE wells, the plan will estimate the associated consumptive water use.

Ultimately, watershed plan PE well projections need to address the following two primary questions:

1. How many new PE wells could be installed throughout the watershed over the next 20 years?
2. Where could the PE sourced growth occur at the subbasin level?

[1] "PE wells" is used to refer to new homes associated with new permit-exempt wells and also new homes added to existing wells, including homes on group systems relying on permit-exempt wells.

GROWTH PROJECTION METHODS

GeoEngineers worked with the Snohomish WRE Committee (WRIA 7 Committee) to define PE well growth projection methods and PE well growth projections for WRIA 7. The WRIA 7 PE well growth projection methods included using King and Snohomish County historical building permit and year-built data to predict potential PE well growth over the 20-year planning horizon. This methodology assumes that the rate and general location of past growth will continue over the 20-year planning horizon. Using past building permits to predict future growth is one of Ecology's recommended methods (Ecology 2019). Projecting future PE well growth involves accounting for populations that will be served by community water systems and municipalities (Ecology 2019). Due to data availability, King and Snohomish County used different methods to remove those populations from the PE well growth estimates. Snohomish County considered distance to existing water lines, whereas King County considered rates of connection to water service within water service area boundaries[2]. King and Snohomish County completed their analyses in-house and the methods are described in detail in Attachments A and B, respectively, and summarized below.

GeoEngineers also completed an analysis of potential PE well growth within the incorporated and unincorporated Urban Growth Areas (UGAs) using Ecology's Well Report Viewer database. The methods and assumptions are also described below and GeoEngineers data tables are included in Attachment C.

In addition, King County also completed a PE Well Potential Assessment which identified potential parcels where growth could occur within rural King County. Snohomish County completed a similar assessment which they have referred to as a Rural Capacity Analysis. The PE Well Potential Assessment and Rural Capacity Analysis results were used to assess whether a subbasin, as identified by the WRIA 7 Committee (GeoEngineers 2021), has the capacity to accommodate the number of PE wells in the 20-year growth projection. In those areas where the number of projected PE wells exceeded the potential parcels available, the wells were reallocated to the nearest subbasin with similar growth patterns and parcel capacity. The King County PE Well Potential methods and assumptions are described in Attachment A and summarized below. The Snohomish County Rural Capacity Analysis methods and assumptions are described in Attachment B and summarized below.

King County PE Well Projection Methodology

King County does not have a growth target for the unincorporated rural area and therefore decided to use building permit data as its chosen method to assess future growth potential. King County elected to complete the WRIA 7 historic growth analysis for the King County portion of the WRIA in-house using 2000 to 2017 building permit data for new residential structures from the King County Assessor's office. The analysis estimated the number of recently built homes that relied on PE wells as their water source in unincorporated King County, both inside and outside of water service areas. King County used historic rates of connection to water service because the County does not have county-wide information on the location of water lines.

King County used the time period 2000 through 2017 because those data were available. The building permit data for 2000 through 2017 includes both periods of high growth and periods of low growth. King County compared these data with information from Vision 2040 and population data and is confident in using the average of this time period to project into the future.

[2] Water service area boundaries include areas currently served by existing water lines and may also include areas not yet served by water lines.

King County used the results from the historic growth analysis to determine the projected number of PE wells per year and over the 20-year planning horizon for unincorporated King County. GeoEngineers then used the King County historic growth results to project new PE wells per subbasin over the 20-year planning horizon. King County historic growth and PE well projection methods and data tables are provided in Attachment A for reference. This methodology assumes that the rate and location of past growth will continue over the 20-year planning horizon. This method is referred to as the King County Past Trends Analysis and the general methodology used was as follows:

King County:

- Obtain available King County building permit and parcel data for new residential structures (2000 to 2017).
- Use centroid of parcel to determine location relative to other boundaries (e.g. WRIA, inside or outside water district service areas, King County stream basin, WRIA 7 subbasin, etc.).
- Assess the total number of permits and average number of permits per year for the WRIA.
- Link building permit and parcel data layers to determine water source for each building permit/parcel. The parcel database indicates the water source as "public" (pub) for buildings connected to water service, "private" (pvt) for buildings relying on a permit-exempt well, and "other" (unknown/null). The "other" category includes parcels listing their water source as "unknown," referring to parcels with no assigned water source (likely vacant land or unoccupied structure) or "null," referring to building permits that did not link to existing parcels. King County used the "other" category to calculate an error of 6 percent (of the total number of building permits)[3].
- Determine the number of building permits/parcels inside and outside the water service areas that have a water source as:
  - Public water (pub)
  - Private water (PE wells) (pvt)
  - Other (unknown/null)
- Calculate the percentage of building permits for each type of water source (pub, pvt or other) by subbasin and the WRIA overall.
- Use the annual average number of permits per year multiplied by the percentage of permits/parcels on private water (pvt) to determine the projected number of PE wells per year.
- Multiply the number of PE wells per year by 20 to calculate the total PE wells projected over the 20-year planning horizon for unincorporated rural King County.

[3] King County's percent error uses the number of unknown water use type parcels (unknown) plus those permit records that don't match parcel information (null), divided by the total number of permits for that area. The null data type, based on selected assessment of un-joined data, appears to be related to development that is not fully completed/sold. These developments are typically on public water.

GeoEngineers:

- Use the annual average number of permits per year multiplied by the past percentage of growth per subbasin and percentage of building permits using a private water source (well) per subbasin to determine a projected number of PE wells per year for each subbasin.
- Add 6 percent error to projected number of PE wells per year per subbasin (error is based on the "other and null" categories as described above).
- Multiply the number of PE wells per year per subbasin, including the 6 percent error, by 20 to calculate the estimated total of PE wells projected over the 20-year planning horizon for each subbasin.
- Tabulate the total growth projected over the 20-year planning horizon, including the 6 percent error, for each subbasin and sum to get the total of PE wells projected over the 20-year planning horizon in rural unincorporated King County.

Snohomish County PE Well Projection Methodology

Snohomish County elected to complete the WRIA 7 growth projection analysis for the Snohomish County portion of the WRIA in-house. Snohomish County used a different methodology than King County for their past trends analysis. They developed their growth projections by using a geographic information system (GIS) model to identify areas where homes are likely to connect to water service, based on proximity to existing water distribution lines. Areas that were not proximal to existing water distribution lines were assumed to be served by a PE well. For their growth projections, they referred to these areas as "water service areas" and "PE Well Areas" respectively. Snohomish County used this spatial model, in combination with analysis of year-built data for recently built single-family residences, to develop growth scenarios.

Snohomish County developed two growth projection scenarios by: 1) looking at past development trends in PE well areas for each HUC-12[4] within its portion of WRIA 7 and using those trends to estimate the number and location of new homes relying on PE wells over the planning horizon, and 2) using population projections from the Snohomish County 2015 Comprehensive Plan to estimate the number and location of new homes relying on PE wells over the planning horizon. The subbasins in the Snohomish County portion of WRIA 7 generally correspond to individual HUC-12s or an aggregation of multiple HUC-12s (Attachment B) and, for the purpose of growth projections in WRIA 7, the terms are used interchangeably. The term "Housing Unit (HU)" refers to an individual home or single-family residence.

In addition to the growth projection scenarios, Snohomish County developed a Rural Capacity Analysis that identified the total number of parcels that could be developed with a home relying on a PE well in each subbasin. The Rural Capacity Analysis was used to identify whether the number of available parcels that could be developed with homes relying on a PE well could accommodate the projected growth in each subbasin.

At the request of the WRIA 7 Committee, GeoEngineers developed a third growth projection scenario using the population growth rate from the 2012 Office of Financial Management (OFM) high population forecast for Snohomish County.

[4] HUC-12 is a level of Hydrologic Unit Code.

The WRIA 7 Committee discussed the three scenarios and agreed to move forward with the first scenario, the Snohomish County Past Trends Analysis, as the 20-year growth projection method for the Snohomish County portion of WRIA 7. Year-built data was derived from the County's permit data as provided to the Assessor by Snohomish County Planning and Development Services (PDS) and includes all new single-family residences in the WRIA built between 2008 and 2018, located outside of cities, UGAs, national and state forest lands, government property and tribal lands. Snohomish County used the time period 2008 through 2018 because those data were available. This methodology assumes that the rate and location of past growth will continue over the 20-year planning horizon. Snohomish County growth projection methods and data tables are provided in Attachment B for reference. The general methodology is as follows:

- Obtain available year-built data from the Snohomish County Assessor's Office for all single-family residences (i.e. HUs) in the WRIA built between 2008 and 2018.
- Use centroid of parcel to determine location of each HU relative to other boundaries (e.g. WRIA, cities, UGAs, national and state forest lands, government property, tribal lands, subbasin, water lines, zoning, etc.).
- Assign the 2008-2018 HUs to "Public Water Service Areas" or "P_E Well areas" based on the distance to existing water mains (data derived from water system comprehensive plans).
    - HUs designated to "Public Water Service Areas" (i.e. will not rely on a PE well) include:
        - HUs that are not part of a subdivision and any portion of the property boundary is located within 100 feet of a water main.[5]
        - HUs that are part of a rural cluster subdivision (RCS) and located within ¼ mile of a water main.[6]
    - All other HUs designated to "P_E Well areas."
- Estimate the number of HUs per subbasin for each type of water source (Public Water Service Areas and P_E Well Areas).
- Calculate the percentage of HUs per subbasin for each type of water source.
- Divide the total number of HUs for WRIA 7 by 11 to calculate the average number of HUs per year over the past 11 years (2008-2018).
- Multiply the average number of HUs per year by 20 to calculate the estimated total of HUs projected over the 20-year planning horizon for rural unincorporated Snohomish County.
- Apply HU projections to WRIA 7 subbasins based on the past percentage of growth per subbasin and past percentage of HU for each type of water source.
- The projection of HUs located within P_E Well Areas represents the total number of PE wells projected over the 20-year planning horizon in rural unincorporated Snohomish County.

[5] 100 feet is selected due to lot sizes in the rural area, cost to extend water service, buy-in from rural water utilities as a reasonable assumption, and requirements in Snohomish County's draft water code (Attachment B).

[6] As of April 2009, this is a requirement in Snohomish County code for rural cluster subdivisions, however, most RCS that have been built were grandfathered to the previous rules which did not include this requirement to connect to public water (Attachment B).

Urban Growth Area PE Well Projection Methodology

As described above, the King and Snohomish County well projection methods focused on the potential for PE wells to be installed within rural, unincorporated King and Snohomish Counties. The King and Snohomish County methods do not account for potential PE wells in cities or UGAs. However, early in the growth projection planning process, the WRIA 7 Committee recommended looking at the potential for PE well growth within UGAs. GeoEngineers completed an analysis of potential PE well growth within the incorporated and unincorporated UGAs using Ecology's Well Report Viewer database (referred to as the UGA Well Log Spot Check). UGA well log spot check data tables are included in Attachment C. The general methodology used was as follows:

- Obtain tabular and spatial data from Ecology's Well Report Viewer database (1998 through 2018). Ecology's complete Well Report Viewer database was filtered for water wells 6 to 8 inches in diameter and greater than 30 feet deep, which are typical dimensions and depths for domestic wells. PE wells greater than 8 inches in diameter are cost prohibitive and uncommon. Similarly, wells shallower than 30 feet are more susceptible to contamination and are also uncommon, especially in urban areas. Ecology does not have the ability to filter for permit-exempt domestic wells. Information in the database is based on records submitted by the well driller.
- Filter database for wells located within UGAs. Note that well locations were estimated to the nearest quarter-quarter section.
- Review randomly selected water well reports and note the well type (e.g. domestic, industrial, municipal, irrigation, test well, or other), and well location (physical address and/or parcel number).
- Determine the number of wells that were:
  - Domestic (assumed to be PE wells)
  - Irrigation
  - Other (test, municipal, dewatering, industrial, mitigation, underground injection control [UIC], deepened or refurbished wells)
  - Incorrect (location, date, etc.)
- Calculate the percentage of each type of well (domestic, irrigation, other and incorrect).
- Multiply the percentage of spot-checked wells that were identified as domestic wells (assumed to be PE wells) by the total number of wells located within UGAs to estimate the number of domestic wells installed over the past 20-year period within WRIA 7.
- Cross-check the physical address of the wells with the UGA boundary to determine in which subbasin the spot-checked domestic wells were located.
- Use the estimated number of domestic wells per subbasin over the past 20 years to project the number of PE wells located within the UGA over the planning horizon for each WRIA 7 subbasin.

King County PE Well Potential Assessment

King County also completed a PE Well Potential Assessment which evaluated the parcels available for future residential development in unincorporated King County. The purpose of the PE Well Potential Assessment was to determine if there would be enough parcels to accommodate the 20-year growth projection at the WRIA and subbasin level. In those areas where the number of projected PE wells exceeded the potential parcels available,

GeoEngineers reallocated those wells to the nearest subbasin with parcel capacity and similar growth patterns. King County used historic rates of connection to water service because the County does not have county-wide information on the location of water lines. King County PE Well Potential Assessment data tables are included in Attachment A. The general methodology used was as follows:

King County:

- Use assumptions and screening criteria to identify parcels with potential for future growth by subbasin. A list of assumptions made by King County is provided in Attachment A.
- Use centroid of parcel to determine location information (e.g. WRIA, inside or outside water district service areas, WRIA 7 subbasin, etc.).
- Use King County parcel attribute data to determine total number of parcels and dwelling units per subbasin. A dwelling unit (DU) is a rough estimate of subdivision potential based on parcel size and zoning (e.g. a 22-acre parcel zoned RA-5 is assumed to have 4 dwelling units).
- Determine the number of parcels and dwelling units that would be inside or outside water district service boundaries.
- Calculate water source projections for public connections and PE sourced parcels:
  - Public connection parcels would be those located within water district service boundaries and were calculated based on historic rates of connection to public water within each subbasin.
  - The remaining number of parcels located within water district service boundaries that exceeded the historic rate of public water connection were assigned to be PE sourced (e.g. served by a PE well).
  - PE sourced parcels were calculated based on the number of parcels located outside water district service boundaries plus the remaining parcels from "inside" water district boundaries, as described above.
- Calculate the shortfall or surplus of available parcels to be sourced by PE wells by taking the total PE sourced DUs minus the 20-year growth projection from the King County past trends analysis.

GeoEngineers:

- If the projected PE well growth exceeds the total number of available PE sourced parcels, reallocate shortfall to adjacent subbasin with parcel capacity and similar growth patterns.

Snohomish County Rural Capacity Analysis

Snohomish County completed a Rural Capacity Analysis in 2011 that resulted in an assigned future capacity for each parcel in the rural area. Snohomish County updated their 2011 analysis for the purpose of watershed planning to determine if there would be enough parcels to accommodate the 20-year PE well growth projection at the WRIA and subbasin level. In those areas where the number of projected PE wells exceeded the potential parcels available, GeoEngineers reallocated those wells to the nearest subbasin with parcel capacity and similar growth patterns. The parcels included in the Snohomish County Rural Capacity Analysis were selected based on a set of assumptions, which are outlined in Attachment B. The Snohomish County Rural Capacity methods and data tables are also included in Attachment B. The general methodology used was as follows:

Snohomish County:

- Use assumptions and screening criteria to identify parcels with potential for future growth by subbasin. A list of assumptions made by Snohomish County are provided in Attachment B.
- For each parcel, obtain or calculate total acres, buildable acres, percent buildable acres and density based on zoning and land use designation (i.e. HUs per acre).[7]
- Assign development status (e.g. vacant, partially used or re-developable).
- Calculate basic capacity based on development status and density (e.g. if vacant, future capacity = total acres x density).
- Deduct new HUs built after 2011 from the 2011 available capacity to create an estimate of the capacity remaining as of 2019.
- Assign parcels to "Public Water Service Areas" or "P_E Well Areas" per the methodology described in the Past Trends Analysis.
- Aggregate capacity data by subbasin. Parcels located on HUC boundaries were assigned based on the centroid of the parcel.
- Calculate the shortfall or surplus of available parcels to be sourced by PE wells by taking the total PE sourced parcels (P_E Well Areas) minus the 20-year growth projection from the Snohomish County past trends analysis.

GeoEngineers:

- If the projected PE well growth exceeds the total number of available PE sourced parcels, reallocate shortfall to adjacent subbasin with parcel capacity and similar growth patterns.

PE WELL GROWTH PROJECTON RESULTS

The King and Snohomish County Past Trends Analysis and GeoEngineers UGA Well Log Spot Check results were combined to determine the total number of projected PE wells per subbasin within WRIA 7. Using the King County PE Well Potential Assessment and Snohomish County Rural Capacity Analysis, GeoEngineers compared the total available PE sourced parcels (i.e. DUs and HUs) per subbasin with the projected growth per subbasin. In those areas where the number of projected PE wells exceeded the potential parcels available, GeoEngineers reallocated those wells to the nearest subbasin with parcel capacity and similar growth patterns. The results are summarized in Table 1 and shown on Figure 1. GeoEngineers estimates 3,389 new permit-exempt domestic well connections in WRIA 7 over the 20-year planning horizon. The following is a brief summary of the calculations used to complete the WRIA 7 growth projection analysis:

- King County used the average number of building permits per year (104) for the 18-year period from 2000 to 2017, multiplied by the historic percentage of homes using PE wells (44.7 percent) to determine a projected number of new PE wells per year (46) in the WRIA 7 portion of rural unincorporated King County. The number of PE wells per year (46) was then multiplied by 20 to

[7] All subdividable parcels were assumed to develop using the rural cluster option. This option achieves the highest density.

determine the estimated total of PE wells projected over the 20-year planning horizon (926) for rural unincorporated King County. (Note that due to rounding, the total number is 926).

- To estimate the 20-year PE well projection per subbasin, GeoEngineers used the average number of building permits per year (104), multiplied by the historic distribution of growth per subbasin. The average building permits per subbasin was then multiplied by the historic percentage of homes using PE wells to estimate the average number of PE wells per year per subbasin. A 6 percent error was then added to each subbasin total. The number of PE wells per year per subbasin plus the 6 percent error was then multiplied by 20 to calculate the estimated total of PE wells over a 20-year period per subbasin. The total number of estimated PE wells, including the 6 percent error, is 980. See Attachment A for detailed results.
- Snohomish County used the total number of HUs built during the 11-year period from 2008-2018 (2,740), divided by 11 to determine the average number of HUs built per year (249) for rural unincorporated Snohomish County. The average number of HUs per year (249) was multiplied by 20 to estimate the total number of HUs projected over the 20-year planning horizon (4,980) for the rural unincorporated Snohomish County portion of WRIA 7. (Note that due to rounding, the total number is 4,980 vs. 4,981, as shown in Attachment B).
- The total number of HUs (4,980) was then multiplied by the historic percentage of HUs in P_E Well Areas per HUC-12. The number of HUs in P_E Well Areas per HUC-12 was added together to determine the estimated total of PE wells (equivalent to HUs in P_E Well Areas) over a 20-year period in rural unincorporated Snohomish County (2,059).
- GeoEngineers then redistributed the Snohomish County growth projection estimates into the appropriate subbasins. (Note that the values reported in Attachment B are per HUC-12 and the values reported in Table 1 are per subbasin).
    - WRIA 7 Subbasins aligned with HUC-12 sub-watersheds or were aggregates of HUC-12 subwatersheds, with one exception - the Quilceda-Allen subbasin. The Quilceda-Allen subbasin includes Quilceda Creek HUC-12 and the Allen Creek watershed, which is in the Snohomish River-Frontal Possession Sound HUC-12. To redistribute growth projections to the Quilceda-Allen subbasin, GeoEngineers estimated the portion of PE well growth in Snohomish River - Frontal Possession Sound HUC-12 that occurs within the Allen Creek watershed. GeoEngineers then transferred that growth (26 PE wells) from the Snohomish River-Frontal Possession Sound HUC-12 to the Quilceda-Allen subbasin.
- GeoEngineers also completed a UGA Well Log Spot Check for wells from the Ecology Well Report Viewer database that plot within the Urban Growth Area. Of the wells that plotted in WRIA 7, 126 wells were located within the UGA for 1998 through 2018. GeoEngineers checked about 61 percent of the wells by looking at the well logs and noting whether the wells were identified as being for domestic, irrigation, or other purposes (e.g. test, industrial, errors, etc.). According to the well logs, about 30 percent of the wells were for domestic use.
- GeoEngineers took the number and distribution of wells from the 1998-2018 data and projected the same rate and distribution per subbasin for the 20-year planning horizon. The estimated number of PE wells within the UGA over the 20-year period is 38. (Note that due to rounding, the total number is 40 vs. 38). See Attachment C for detailed results.

- King County completed a PE Well Potential Assessment and Snohomish County completed a Rural Capacity Analysis to determine whether a subbasin has capacity for the number of wells in the 20-year projection.
- The PE Well Potential Assessment showed a capacity shortfall of 22 parcels in the Upper Snoqualmie subbasin. Therefore, 22 of the projected PE wells in the Upper Snoqualmie subbasin were reallocated to the adjacent Snoqualmie South subbasin.
- The Snohomish County Rural Capacity Analysis did not show a capacity shortfall in any of the subbasins within the Snohomish County portion of WRIA 7. However, the Snohomish County past trends projection was modified by GeoEngineers based on information provided by Snohomish County, Ecology, and the Tulalip Tribes.
    - GeoEngineers added 284 new PE well areas to Snohomish County's Past Trends Analysis estimate based on the following assumptions:
        - All of the growth forecast for water service areas in the Tulalip subbasin (249) will use PE wells to account for the inability of the Seven Lakes water system to expand service at this time. The total exceeds the PE well areas, since it includes the potential for PE wells in the water service area.
        - Includes estimate of 20 potential new PE wells on Tulalip Tribal owned lands in the Quilceda-Allen subbasin and 15 potential new PE wells on Tulalip Tribal owned lands in the Tulalip subbasin.

TABLE 1. NUMBER OF PE WELLS PROJECTED BETWEEN 2018 TO 2038 FOR THE WRIA 7 SUBBASINS

Subbasins	King County Past Trends[1]	Snohomish County Past Trends[2]	UGA Well Log Spot Check[3]	Total PE Wells[4] per Subbasin[5]
1 - Tulalip	--	468	0	468
2 - Quilceda-Allen	--	330	8	338
3 - Estuary/Snohomish Mainstem	--	322	9	331
4 - Little Pilchuck	--	289	5	294
5 - Pilchuck	--	278	2	280
6 - Woods	--	224	0	224
7 - Sultan	--	53	2	55
8 - Lower Mid-Skykomish	--	60	0	60
9 - Skykomish Mainstem	0	183	2	185
10 - Upper Skykomish	48	53	2	103
11 - Cherry-Harris	200	11	3	214
12 - Snoqualmie North	240	98	0	338
13 - Snoqualmie South	169	0	0	169
14 - Patterson	104	--	0	104
15 - Raging	73	--	2	75
16 - Upper Snoqualmie	146	--	5	151
Totals	980	2,369	40	3,389

Notes:

1 = Based on 20-year estimate of potential new PE wells in unincorporated King County, plus 6% error.

2 = Based on 20-year estimate of potential new PE wells in unincorporated Snohomish County using the "past trends scenario." Assumes half of the projected growth for water service areas in the Quilceda-Allen subbasin (26) will use PE wells (part of the Quilceda area has water provided by Marysville/City of Everett). Assumes all of the growth forecast for water service areas in the Tulalip subbasin (249) will use PE wells to account for the inability of the Seven Lakes water system to expand service at this time. The total exceeds the PE well areas, since it includes the potential for PE wells in the water service area. Includes estimate of 20 potential new PE wells on Tulalip Tribal owned lands in the Quilceda-Allen subbasin and 15 potential new PE wells on Tulalip Tribal owned lands in the Tulalip subbasin.

3 = Based on spot-check of Ecology Well Report Viewer database. Accounts for potential wells within the incorporated and unincorporated Urban Growth Areas (UGAs) over the 20-year planning period.

4 = “PE Wells” is used to refer to new homes associated with new PE wells and also new homes added to existing wells on group systems relying on PE wells.

5 = Includes redistribution of 22 wells from Upper Snoqualmie subbasin to Snoqualmie South subbasin in the King County portion of WRIA 7.

NEXT STEPS

- The WRIA 7 WRE Committee agreed to move forward with the WRIA planning process using 3,389 as the WRIA 7 20-year PE well growth projection to develop consumptive use estimates.

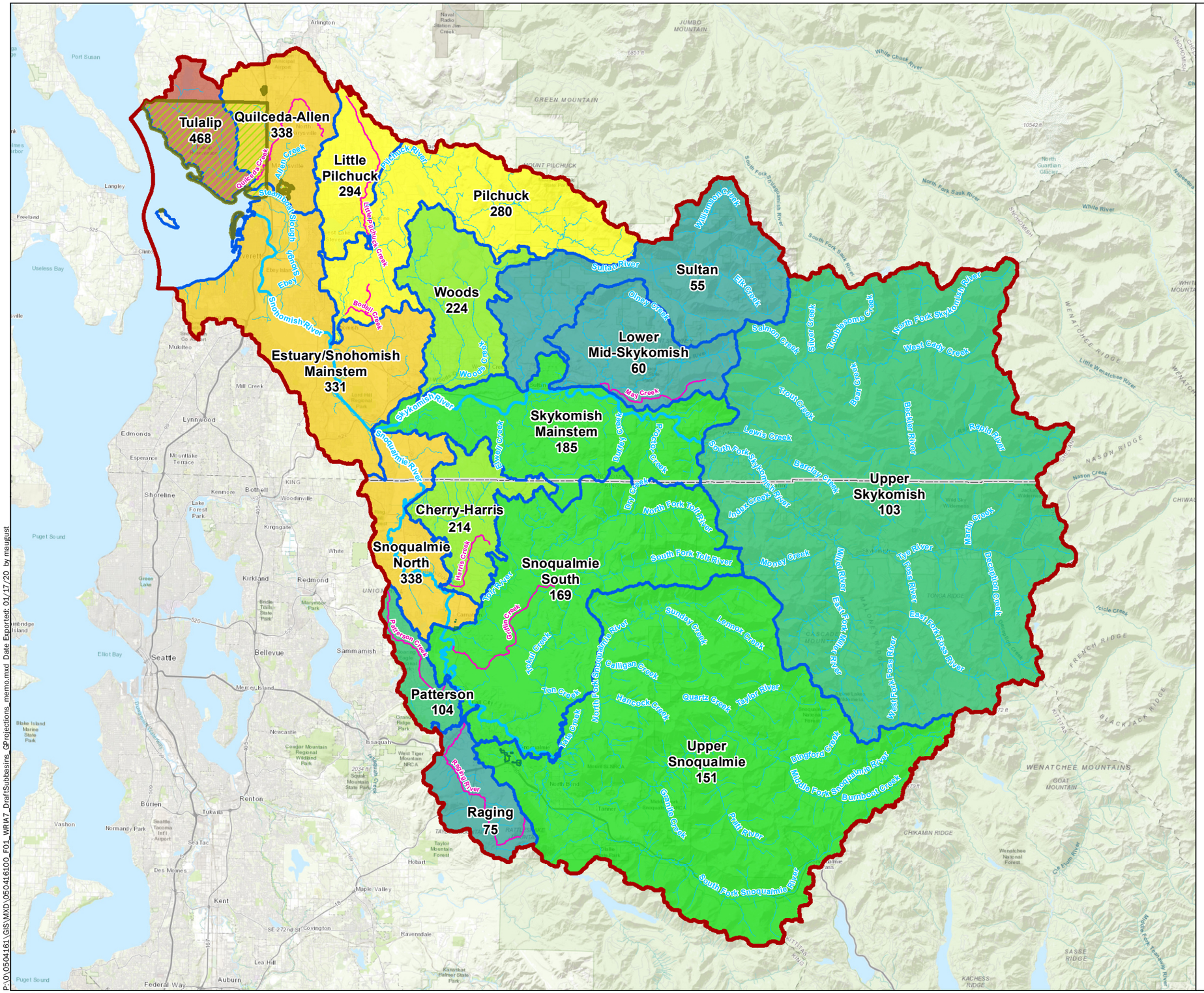
REFERENCES

GeoEngineers, Inc. (GeoEngineers), 2021. WRIA 7 Subbasin Delineations. Technical memorandum prepared for Washington State Department of Ecology. January 2021.

Washington State Department of Ecology (Ecology), 2019. Final Guidance for Determining Net Ecological Benefit, GUID-2094 Water Resources Program Guidance. Washington State, Department of Ecology, Publication 19-11-079, p. 131. https://fortress.wa.gov/ecy/publications/documents/1911079.pdf

BA:JTM:leh

Attachments:
Figure 1. WRIA 7 Distribution of Projected Permit-Exempt Wells 2018-2038
Attachment A. King County PE Well Growth Projections and PE Well Potential Assessment Methods, Assumptions and Data Tables
Attachment B. Snohomish County PE Well Growth Projections and Rural Capacity Analysis Methods, Assumptions and Data Tables
Attachment C. GeoEngineers UGA Well Log Spot Check Data Tables



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Data Source: ESRI Topographic Map Base

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

WRIA 7 Distribution of Projected Permit-Exempt Wells 2018-2038

Watershed Restoration and Enhancement Plan
Snohomish and King Counties, Washington

GeoEngineers | Figure 1

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ATTACHMENT A
King County PE Well Growth Projections and PE Well Potential Assessment Methods, Assumptions and Data Tables

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TECHNICAL MEMORANDUM

December 12, 2019

TO: Stephanie Potts, Ingria Jones, Rebecca Brown, and Stacy Vynne McKinstry, Streamflow Restoration Implementation leads, Water Resources Program, Washington State Department of Ecology

FM: Eric Ferguson, LHG, Science and Technical Support Section, Water and Land Resources Division, Department of Natural Resources and Parks

RE: King County Growth Projections for all Watershed Restorations and Enhancement Committees – WRIAs 7, 8, 9, 10, and 15

This memorandum summarizes the work that King County did in support of generating 20-year growth projections in the rural areas of the county for Watershed Restoration and Enhancement committee (WREC) work. This effort will be incorporated into another technical memorandum that is area specific for each Watershed Resource Inventory Area (WRIA). The additional memorandum will be authored by consultants working for the Washington State Department of Ecology.

Introduction

King County is participating in five WRECs, one for each of the WRIA within its boundary. King County is providing growth projections for each area that assesses a two-part question:

A. How much potential growth could occur during the 20-year (2018-2038) planning period?

B. Where could that growth occur at a sub-basin/watershed scale within each WRIA?

Principles

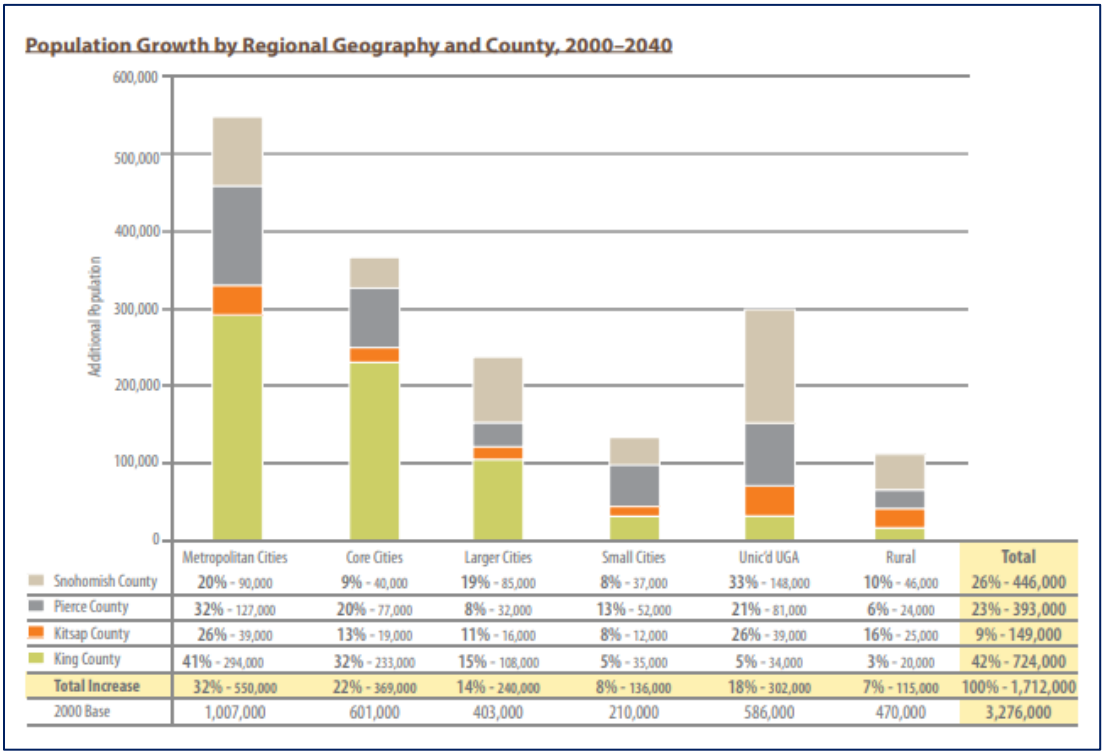
King County does not have growth targets for unincorporated rural areas in the county. All growth targets are for the urban growth area (UGA). No changes to the UGA boundary are intended during the 20-year planning period.

The following are highlights from planning policies:

- Accommodate most recent 20-year population forecast from OFM, and 20-year jobs forecast from Puget Sound Regional Council.
- Plan for growth consistent with Regional Growth Strategy
  - Focus growth in cities with major centers, and in other large cities
  - Limit development in Rural Areas, protect Resource Lands

Source: Policy DP-11 in Countywide Planning Policies, 2012

Population growth in the unincorporated rural area is estimated to be about 20,000 people or ~3% of overall population from Vision2040, Figure 1.



	Metropolitan Cities	Core Cities	Larger Cities	Small Cities	Unic'd UGA	Rural	Total
Snohomish County	20% - 90,000	9% - 40,000	19% - 85,000	8% - 37,000	33% - 148,000	10% - 46,000	26% - 446,000
Pierce County	32% - 127,000	20% - 77,000	8% - 32,000	13% - 52,000	21% - 81,000	6% - 24,000	23% - 393,000
Kitsap County	26% - 39,000	13% - 19,000	11% - 16,000	8% - 12,000	26% - 39,000	16% - 25,000	9% - 149,000
King County	41% - 294,000	32% - 233,000	15% - 108,000	5% - 35,000	5% - 34,000	3% - 20,000	42% - 724,000
Total Increase	32% - 550,000	22% - 369,000	14% - 240,000	8% - 136,000	18% - 302,000	7% - 115,000	100% - 1,712,000
2000 Base	1,007,000	601,000	403,000	210,000	586,000	470,000	3,276,000

Figure 1. Estimated population growth for rural King County from 2000-2040 is 20,000, King County, Vision 2040.

Note: the updated Vision (2050) document is due to be adopted in May 2020. The updated growth for rural King County is planned to be about 1% during 2017–2050 period (or ~6,000 people).

Methods

The first part of the growth projection assessment was performed in order to respond to the question: "How many new single-family permit-exempt well connections will be installed throughout each watershed over the next 20 years?" King County does not have a growth target

for the unincorporated rural area (as noted above) and therefore decided to use building permit data (for new residential structures) as its chosen method to assess future growth potential.

The following is the methodology used to assess the potential growth:

1. Compiled 18 years (2000–2017) of building permit data for new residential structures;
    a. This data was subdivided into two periods: 2000–2009 and 2010–2017, Table 1; each period has a range of low to high growth.

Table 1. Building permits from 2000-2017; new residental structures only

Building permits (unincorporated rural KC)	
2000-2009	4595
2010-2017	1252
Total	5847

2. Used GIS to provide location based information about building permits
    a. Use centroid of the building permit/parcel to assess location relative to other boundaries such as WRIA boundaries, stream basins, water district service areas, sub-basin delineations.
    b. Assess the number of permits per each WRIA, Table 2

Table 2. Building permits by WRIA

WRIA*	Total permits	Permits per year	Percentage of total
7	1864	104	32%
8	1836	102	31%
9	1430	79	24%
10	100	6	2%
15	617	34	11%

* = WRIA boundaries are delineated by Ecology coverage

3. Linked building permits and parcel data layers to assess percentage of parcels using public versus private water with parcel attribute data.
4. Determined the number of building permits/parcels that have a water source as:
    a. Public (pub) water
    b. Private (pvt) water (Permit-Exempt wells)
    c. Other (unknown/null)
        i. “unknown” refers to parcels with no assigned water source (likely unoccupied structure)
        ii. “null” refers to those building permits that did not link to existing parcels.

iii. This category can be used as an "error" since it refers to the amount of information that is undetermined and could potentially be private sourced.

5. Calculated the percentage of building permits for each type of water source (i.e. public, private or other) for entirety of King County as shown in Table 3 below as well as by WRIA and its sub-basin delineations.

Table 3. Water source by parcel/permit

Type of water use	Total permits	Percentage of total
Public	3113	53%
Private	2369	40%
Other -unknown	73	1%
Other - null	292	5%

6. Used the annual average number of permits per year multiplied by the percentage of permits/parcels on private water to determine a projected number of Permit Exempt (PE) wells per year, Table 4.

   Multiplied the number of PE wells per year by 20 to calculate the estimated total of PE wells projected over a 20-year period for unincorporated rural King County, Table 4.

Table 4. Average number of permit exempt well users by WRIA for the planning period.

WRIA*	Permit-exempt well/year^	20-year estimate	Error®
7	46	926	6%
8	35	698	6%
9	29	578	6%
10	4	81	2%
15	18	368	4%

* = WRIA boundaries are delineated by Ecology coverage
^ = WRIA specific percentage of private well users
® = Error calculated from percentage of building permits with "other" water service

Projected number of permit-exempt wells for time period (01/18/2018 to 01/18/2038) for all of King County is 2650. Each WRIA has a series of tables of this specific information, see Tables.

The second part of the growth projection assessment was performed in order to respond to the question: "Where will the well connections be installed?" The PE potential assessment is a GIS assessment of current (2019) parcel data. This work used a series of assumptions to assess potential area of growth within the county, specifically at the sub-basin scale as defined by the WREC for each WRIA.

The following are the assumptions used to refine the parcels:

- Outside Urban Growth Boundary
- Outside Forest Production District
- Outside Agriculture Production District
- Not Encumbered by K`C Parks or TDR conservation easements
- Not enrolled in Farmland Preservation Program
- Not Owned by Public Agencies
- Vacant land (with appraised improvements <$10,000)
- Have at least 1 acres of land outside 100 year Floodway and Severe River Channel Migration Hazard Areas.
- Parcel size – 1 acre or greater.
- Zoning – no exclusion and maximum density allowed by current zoning

7. Used centroid of the refined parcel data to determine location information, similar to step 2 (above).
8. Linked parcel and assessor attribute data to determine total number of parcels and dwelling units per sub-basin. A dwelling unit (DU) is a rough estimate of subdivision potential based on parcel size and zoning (e.g., a 22-acre parcel zoned RA-5 is assumed to have 4 dwelling units).
9. Determined the number of parcels and DUs that are inside or outside water district service boundaries.
10. Calculated water use projections for public connections and PE sourced parcels:
    a. Public connection parcels are located within water district service boundaries and are calculated based on historic rates of connection to public water within each sub-basin, assessed in step 5 (above).

    b. Any remaining number of parcels located within water district service boundaries are assigned to be PE sourced.

    c. PE sourced parcels were calculated based on the number of parcels located outside water district service boundaries plus the remaining parcels from “inside” water district boundaries, as described above, Table 5.

Table 5. Permit exempt (PE) estimate along with PE potential assessment data.

WRIA*	PE 20yr estimate^	Parcel^	DU
7	926	1175	1901
8	698	819	1070
9	578	746	1077
10	81	72	82
15	368	788	888

* = WRIA boundaries are delineated by Ecology coverage
^ = WRIA specific percentage of private well users
DU = Dwelling unit as noted in step 9.

WRIA specific data along with sub-basin assessments can be found in the Tables.

References

King County Countywide Planning Policies
https://www.kingcounty.gov/depts/executive/performance-strategy-budget/regional-planning/CPPs.aspx

https://www.kingcounty.gov/~/media/depts/executive/performance-strategy-budget/regional-planning/CPPs/2012-CPPsAmended062516withMaps.ashx?la=en

Vision 2040 link:
https://www.kingcounty.gov/~/media/depts/executive/performance-strategy-budget/regional-planning/Comp%20Plan/VISION_2040_-_2008.ashx?la=en

King County Growth Projection data tables by WRIA (Watershed Resource Inventory Area)

WRIA 7 - Snohomish *v. 17Oct2019*

WRIA (Ecology Coverage)	(KC building permiting data)			permits
	2000-2009	2010-2017	total	per year
7	1495	369	1864	104

% of county-wide total
32%

WRIA 7 Future Permit-Exempt wells	PE/yr	20 yr est
	46	926

Water District info	2000-2009	2010-2017	total
total	1495	369	1864
wtr dst (within water district)	1349	342	1691
no dst (outside water district)	146	27	173

APD	permits	% of WRIA total
WRIA 7	51	3%

FPD	permits	% of WRIA total
WRIA 7	29	2%

Historic Percentages		
	pub	**0.490**
	pvt	**0.447**

Water service info	(derived from KC parcel attribute data)			
public water system (pub)	762	152		914
well - private water (pvt)	706	127		833
other	27	90		117
total	1495	369		1864

Existing	2000-2009	2010-2017	Total
PE wells	706	127	833
error	2%	24%	6%

WRIA 7 - Snohomish - Historic Growth and Water Use by Sub-basin

Sub-basin delineation *v.17Oct2019*

Sub-basin (# of stream basins)	Number of permits	Distribution of growth
Snoqualmie - North (3)	399	21%
Cherry/Harris (2)	354	19%
Snoqualmie - South (6)	251	13%
Patterson (1)	310	17%
Raging (1)	90	5%
Upper Snoqualmie (4)	412	22%
Upper Skykomish (5)	48	3%
total	1864	100%

Water use by basin

pub	pvt	oth	%pub	%pvt
163	204	32	41%	51%
162	170	22	46%	48%
107	125	19	43%	50%
208	88	14	67%	28%
20	62	8	22%	69%
250	143	19	61%	35%
4	41	3	8%	85%
914	833	117	total	1864

WRIA 7 - 20 year PE Well Projection by Subbasin

permits/year 104

Calculations based on GeoEngineers work:

Permits per year	Wells per year (pvt)	Wells per year + 6% error	Total wells in 20 years	**20 year well total + 6% (rounded)**	Sub-basin	Distribution of PE
22.2	11.3	12.0	240.3	**240**	Snoqualmie - North	24%
19.7	9.4	10.0	200.2	**200**	Cherry/Harris	20%
13.9	6.9	7.4	147.2	**147**	Snoqualmie - South	15%
17.2	4.9	5.2	103.6	**104**	Patterson	11%
5.0	3.4	3.7	73.0	**73**	Raging	7%
22.9	7.9	8.4	168.4	**168**	Upper Snoqualmie	17%
2.7	2.3	2.4	48.3	**48**	Upper Sky	5%
104	46	49	981.1	**980**		

WRIA 7 - Permit-Exempt Well Potential Assessment

Assessment of potential parcels for future growth *v:24Oct2019*

Sub-basin (number of stream basins)	Number of parcels	Number of Dwelling units (DU)	Water district boundaries: located inside parcels	located inside DU	located outside parcels	located outside DU
Snoqualmie - North (3)	348	547	280	453	68	94
Cherry/Harris (2)	421	702	264	409	157	293
Snoqualmie - South (6)	304	627	252	502	52	125
Patterson (1)	223	342	210	323	13	19
Raging (1)	116	141	105	128	11	13
Upper Snoqualmie (4)	251	347	238	331	13	16
Upper Skykomish (5)	163	227	0	0	163	227
total	1826	2933	1349	2146	477	787

total parcels 1826 total DU 2933

Sub-basin	Water Use Projection: public connection parcels	public connection DU	PE sourced parcels	PE sourced DU	20 year well total + 6% (rounded)	Shortfall *(red if present)* in 20 year well projection	**Redistribution - 20 year well projection**	
Snoqualmie - North	114	185	234	362	240	122	240	
Cherry/Harris	121	187	300	515	200	315	200	
Snoqualmie - South	107	214	197	413	147	266	**169**	+22
Patterson	141	217	82	125	104	21	104	
Raging	23	28	93	113	73	40	73	
Upper Snoqualmie	144	201	107	146	168	***-22***	**146**	-22
Upper Skykomish	0	0	163	227	48	179	48	
total	651	1032	1175	1901	980	----------	980	

total parcels 1826 total DU 2933

ATTACHMENT B
Snohomish County PE Well Growth Projections and Rural Capacity Analysis Methods, Assumptions and Data Tables

Snohomish County Methodology – housing unit growth forecasts by WRIA

1) Using year-built statistics from the Assessor database. This data is derived from the county's permit data as provided to the Assessor by Planning and Development Services (PDS).
    a. All new single-family residences (SFRs) in the WRIA (by HUC 12) built between 2008 and 2018, located outside of the cities, UGAs, national and state forest lands, government property and tribal lands.
2) Assigning the 2008-2018 SFRs to "Public Water Service Areas" or to "P_E Well areas"
    a. Depending on distance to existing water main – water main data is derived from system comprehensive plans:
        i. New homes not part of a subdivision located within 100' of a water main.
            1. 100' is selected due to lot sizes in the rural area, cost to extend water service, buy-in from rural water utilities as a reasonable assumption, and requirements in the county's draft water code.
        ii. New homes that were part of a rural cluster subdivision (RCS) within ¼ mile
            1. As of April 2009, this is a requirement in county code for rural cluster subdivisions – (however, most RCS that have been built were grandfathered to the previous rules which did not include this requirement to connect to public water)
3) The distribution of future growth by WRIA and by HUC12 is assumed to mirror the distribution observed from past growth using (1) a straight-line forecast, and (2) a forecast based on an adopted control total. The number of new homes expected over the next twenty years looks at two options:
    a. A straight-line forecast based on the past housing unit change: average annual change 2008-2018 extended out an additional 20 years;
    - or -
    b. Housing Unit forecast based on County-adopted growth targets (2015 comprehensive plan), urban/rural growth share policy and observed (2008-2018) growth shares for each WRIA. Table 1 shows HU forecasts by WRIA for "PE Well Areas" and "Water Service Areas."

Table 1-2015 Comprehensive Plan Growth Forecast: Urban/Rural Growth Share and Projected New Housing Units in PE Well and Water Service Areas by WRIA

2015 Snohomish County Comp Plan			Snohomish County population growth forecast (Pop. Change) 2018 to 2038	2016 Countywide Planning Policy Population Allocation		Rural/Resource growth share by WRIA (Based on rural growth share) 2008-2018		
2011	Adopted Growth Target 2035	Avg. Annual increase 2011-2035		Urban share 92.1%	Rural share 7.9%	WRIA 3 & 5 (33%)	WRIA 7 (62%)	WRIA 8 (5%)
717000	955257	9927	198548	182862	**15685**	5176	9725	784
New Housing Units (HUs) by WRIA 2018-2038: (Rural Avg HU size* = 2.75)						1882	**3536**	**285**
Allocation of NEW HU based on SnoCounty Model for likely "Water Service Areas" and "P-E Well Areas"			Total Available HU Capacity (Sheet 1)				13994	646
			Growth Share in "Water Service Area" (Sheet 1)				59%	52%
			Growth Share in "P-E Well Area" (Sheet 1)				41%	48%
			New HU in "Water Service Area" 2018- 2038				2086	148
			New HU in "P-E Well Area" 2018- 2038				**1450**	**137**

* Rural Avg Housing Unit (HU) size is based on adopted growth targets; based on Population and HU increase 2011-2035.

Parcels included in the future capacity analysis were selected based on the following criteria:

1) All parcels .5 acre or larger marked as “vacant”, or with “0” or “Null” in the improvement value field in the Assessor data base located within the unincorporated rural and resource areas (outside of cities and outside of the unincorporated UGA) –
   a) Includes agricultural areas and private forest lands (non-state and non-federal). Does not include tribal lands within the Tulalip Reservation – development in this area is under Tribal planning and jurisdiction.
   b) The lot size of .5 acre or larger will likely meet requirements for accommodating both a well and a septic system (sewer hook-up is not allowed outside the UGA). Wells and septic systems must be separated from each other a specified distance – this includes separation on a single parcel and from the systems on adjacent parcels. Lots under .5 acre in size are somewhat unusual in the rural area due to zoning code – most likely to occur as lot fragments created by right-of-way or located around lakes due to legacy zoning (Waterfront Beach = WB).
   c) Within cities and UGAs, residential lot sizes are small (typically the minimum necessary to meet front, back and side yard setback requirements) and public water and sewer are available. The likelihood of new permit-exempt wells for domestic use is very low and possibly zero. County data since the state legislation was passed (RCW 90.94) in January 2018, shows that there have been zero new wells inside the unincorporated UGA; 99 new wells outside of the UGA. Cities typically report that new wells for domestic use are not allowed within city limits.
2) All parcels that are underdeveloped and large enough to subdivide (i.e. one house on ten or twenty acres in an R-5-acre zone)

3) All subdividable parcels where assumed to develop using the rural cluster option – this option achieves the highest density.
4) Parcels were assigned to "Public Water Service Areas" or to "P_E Well areas" per the methodology described above.
5) Land capacity analysis conducted in 2011 was used to assign the number of new housing units that could potentially be built on each parcel. This analysis considered future land use designation from the comprehensive plan with reductions for critical areas.
6) Capacity data was aggregated by HUC12 assigning parcels on HUC boundaries according to parcel centroid.
7) At the HUC12 level, new housing units built after 2011 were deducted from the 2011 available capacity to create an estimate of the capacity remaining as of 2019.

2011 Rural Capacity Analysis

The rural capacity analysis conducted using the 2011 Assessor data resulted in an assigned future capacity for each parcel in the rural area. It should be noted that this analysis of the rural area employed a similar, but less robust model than is used to determine future capacity within the UGAs.

The rural land capacity analysis is summarized as follows:

1) For each parcel the following data was obtained or calculated:
    a. Total acres
    b. Buildable acres (total acres less critical areas)
    c. Percent buildable acres (buildable / total) – if percent buildable is less than 35%, additional capacity is reduced per "f" below.
    d. Density based on land use designation (dwelling units per acre)
        i. For land use designations where Rural Cluster Subdivisions are allowed, density assumes maximum potential under RCS.
    e. Development status was assigned:
        i. Vacant = Improvement value less than $2000
        ii. Partially used = existing home and less than 1000 sq ft commercial
        iii. Redevelopable = improvement value / land value ratio is less than 1
    f. Calculate basic capacity:
        i. If vacant, future capacity = total acres * density (dwelling units/acre)
        ii. If partially used or redevelopable, future capacity = total acres * density – existing dwelling units (DUs)
        iii. If buildable area is less than 35% of total area, capacity is reduced to 75% and will be reduced further if buildable area is less than 20% (50% capacity); and further still if less than or equal to 10% (.25%)
        iv. If buildable area is zero, capacity is assigned as 1 (reasonable use criteria per property rights laws)
        v. Old substandard lots over ½ acre not otherwise accounted for in above steps, capacity = 1
        vi. Assign 0 new residential capacity for:
            1. Areas where residential is not allowed
            2. Existing use codes are incompatible with residential

3. Government property
4. Open space or Native Growth Protection Area (NGPA)
5. Land value is less than $500
6. Conservation Futures restrict residential development
7. Other development moratoriums related to potable water availability

vii. Pending project capacity from actual project applications

SNOHOMISH COUNTY WRIA 7 - HUC 12 Name	Growth Forecast Scenarios - New Homes						2019 Available Capacity			Capacity Surplus or Shortfall Current Trends Scenario			Capacity Surplus or Shortfall Comp Plan Targets		
	Current Trends			V 2040 Comp Plan Targets											
	Total	Water Service Areas	P-E Well Areas	Total	Water Service Areas	P-E Well Areas	Total	Water Service Areas	P-E Well Areas	Total	Water Service Areas	P-E Well Areas	Total	Water Service Areas	P-E Well Areas
Little Pilchuck River	525	236	289	373	168	205	2142	834	1308	1617	598	1019	1769	666	1103
Quilceda Creek (1)	302	51	251	214	36	178	1213	466	747	911	415	496	999	430	569
Lower Pilchuck River	789	560	229	560	397	163	2309	1488	821	1520	928	592	1749	1091	658
Woods Creek	713	489	224	506	347	159	1904	1206	698	1191	717	474	1398	859	539
Tulalip Creek - Frontal Possession Sound (1)	453	249	204	321	177	145	603	379	224	150	130	20	282	202	79
French Creek	416	293	124	296	208	88	1093	904	189	677	611	65	797	696	101
Snohomish River - Frontal Possession Sound	480	362	118	341	257	84	574	382	192	94	20	74	233	125	108
Elwell Creek - Skykomish River	149	33	116	106	23	83	593	156	437	444	123	321	487	133	354
Evans Creek - Snohomish River	333	220	113	236	156	80	889	659	230	556	439	117	653	503	150
Peoples Creek - Snoqualmie River	116	18	98	83	13	70	404	50	354	288	32	256	321	37	284
McCoy Creek - Skykomish River	91	24	67	65	17	48	297	60	237	206	36	170	232	43	189
Wallace River	78	18	60	55	13	43	454	182	272	376	164	212	399	169	229
Lower Sultan River	145	93	53	103	66	37	254	82	172	109	-11	119	151	16	135
Upper Pilchuck River	327	278	49	232	197	35	1012	800	212	685	522	163	780	603	177
Lower South Fork Skykomish River	38	0	38	27	0	27	96	0	96	58	0	58	69	0	69
Lower North Fork Skykomish River	15	0	15	10	0	10	70	0	70	55	0	55	60	0	60
Cherry Creek - SnoCo Portion	11	0	11	8	0	8	35	0	35	24	0	24	27	0	27
Olney Creek	0	0	0	0	0	0	5	0	5	5	0	5	5	0	5
Upper Sultan River	0	0	0	0	0	0	2	0	2	2	0	2	2	0	2
Middle North Fork Skykomish River	0	0	0	0	0	0	45	0	45	45	0	45	45	0	45
Total WRIA 7	4981	2924	**2059**	3536	2075	**1463**	13994	7648	6346	9013	4724	4287	10458	5573	4883

(1) Connections to public water are likely to be over-estimated due to capacity issues with Seven Lakes Water Association.

Excluded HUCs: (all urban or all forest) Powder Mill Gulch - Frontal Possession Sound, Middle Sultan River, Upper North Fork Skykomish, Upper Beckler River, Lower Beckler River, Rapid River, Upper North Fork Tolt (SnoCo portion).

SNOHOMISH COUNTY WRIA 8 - HUC 12 Name	Growth Forecast Scenarios - New Homes						2019 Available Capacity			Capacity Surplus or Shortfall - Current Trends Scenario -			Capacity Surplus or Shortfall - Comp Plan Targets -		
	Current Trends			V 2040 Comp Plan Targets											
	Total	Water Service Areas	P-E Well Areas	Total	Water Service Areas	P-E Well Areas	Total	Water Service Areas	P-E Well Areas	Total	Water Service Areas	P-E Well Areas	Total	Water Service Areas	P-E Well Areas
North Creek (2)	0	0	0	0	0	0	7	5	2	7	5	2	7	5	2
Bear Creek - Sammamish River	275	100	175	181	66	115	393	275	118	118	175	-57	212	209	3
Bear Creek	159	126	33	105	83	22	253	145	108	94	19	75	148	62	86
Total WRIA 8	434	226	208	286	149	137	653	425	228	219	199	20	367	276	91

(2) North Creek is located entirely within the county's Southwest Urban Growth Area (SWUGA) where connection to water providers is nearly certain. Providers have verified capacity in their water system comprehensive plans.

Additional changes to forecast not reflected here:

1. Revise allocations in HUCs where forecast exceeds available capacity.
2. Revise allocations within UGAs to add potential for limited number of new wells based on GeoEngineers analysis.
3. Revise connections to public water system in HUCs where public water service is already at capacity due to water rights.
4. Add growth forecasts from Tulalip Planning for WRIA 7.

ATTACHMENT C
GeoEngineers UGA Well Log Spot Check Data Tables

GeoEngineers - WRIA 7 Urban Growth Area PE Well Projection

GeoEngineers - UGA Well Log Spot Check						
Period	Total	Total Spot Checked	Domestic (includes municipal and community wells)	Irrigation	Other (Test, Dewatering, Industrial, Mitigation, UIC, Deepened or Refurbished)	Incorrect (Location, Date, etc.)
1998-2007	80	46	17	2	13	14
2008-2018	46	31	6	6	8	11
Totals	126	77	23	8	21	25
Percent of Total		61%	30%	10%	27%	32%
Potential number of new wells based on percentage of past 20 year total (126)						
WRIA 7			**38**	**13**	**34**	**41**

GeoEngineers - WRIA 7 Urban Growth Area PE Well Projection

	Spot Checked 1998-2007	Spot Checked 2008-2018	Total	Total Potential Wells in UGA in 20 years	**Total Rounded**	City UGA
King County Drainage Basin						
Ames Lake	0	0	0	0.00	**0**	
Cherry Creek*	1	1	2	3.30	**3**	Duvall UGA
Coal Creek (Snoq.)*	0	0	0	0.00	**0**	
Griffen Creek	0	0	0	0.00	**0**	
Harris Creek	0	0	0	0.00	**0**	
Lower Tolt River*	0	0	0	0.00	**0**	
Middle Fork Snoqualmie River*	0	0	0	0.00	**0**	
Miller River	0	0	0	0.00	**0**	
North Fork Snoqualmie River	0	0	0	0.00	**0**	
Patterson Creek*	0	0	0	0.00	**0**	
Raging River*	1	0	1	1.65	**2**	Snoqualmie UGA
Snoqualmie River*	0	0	0	0.00	**0**	
South Fork Skykomish	1	0	1	1.65	**2**	Skykomish UGA
South Fork Snoqualmie River*	2	1	3	4.95	**5**	North Bend UGA
Tokul Creek	0	0	0	0.00	**0**	
Tuck Creek	0	0	0	0.00	**0**	
Snohomish County HUC 12						
Little Pilchuck River	2	1	3	4.95	**5**	Marysville UGA
Quilceda Creek	5	0	5	8.25	**8**	Marysville and Arlington UGAs
Lower Pilchuck River	0	0	0	0.00	**0**	
Woods Creek*	0	0	0	0.00	**0**	
Tulalip Creek - Frontal Possession Sound	0	0	0	0.00	**0**	
French Creek*	1	0	1	1.65	**2**	Monroe UGA
Snohomish River - Frontal Possession Sound	3	1	4	6.60	**7**	Snohomish and Lake Stevens UGAs
Elwell Creek - Skykomish River	0	0	0	0.00	**0**	
Evans Creek - Snohomish River	0	0	0	0.00	**0**	
Peoples Creek - Snoqualmie River	0	0	0	0.00	**0**	
McCoy Creek - Skykomish River	1	0	1	1.65	**2**	Sultan UGA
Wallace River	0	0	0	0.00	**0**	
Lower Sultan River*	0	1	1	1.65	**2**	Sultan UGA
Upper Pilchuck River	0	1	1	1.65	**2**	Granite Falls UGA
Lower South Fork Skykomish River	0	0	0	0.00	**0**	
Lower North Fork Skykomish River	0	0	0	0.00	**0**	
Cherry Creek - SnoCo Portion	0	0	0	0.00	**0**	
Olney Creek	0	0	0	0.00	**0**	
Upper Sultan River	0	0	0	0.00	**0**	
Middle North Fork Skykomish River	0	0	0	0.00	**0**	
Totals	17	6	23	37.95	**40**	

Developed 8/20/2019

Notes:
This tables includes data for wells in Ecology's Well Report database, filtered for a depth greater than 30 feet and diameter 6-8 inches. Ecology does not have the ability to filter for permit-exempt domestic wells. Information in the database is based on records submitted by the driller. Well Report Data and Images released from the Department of Ecology are provided on an "AS IS" basis, without warranty of any kind.
* = a portion of this basin in the urban area

Memorandum

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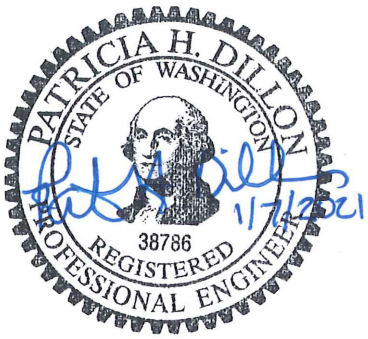
To: Ingria Jones, Washington State Department of Ecology

From: Patty Dillon, Cynthia Carlstad, NHC;
Bridget August, John Monahan, GeoEngineers

Date: January 7, 2021

File: 0504-161-00

Subject: WRIA 7 Consumptive Use Estimates



INTRODUCTION

GeoEngineers, Inc. (GeoEngineers) is providing technical support to the Washington State Department of Ecology (Ecology) and the Watershed Restoration and Enhancement (WRE) Committees for Water Resource Inventory Areas (WRIAs) 7, 8 and 9. This memorandum provides a summary of the deliverable for Work Assignment GEO102, Task 4, WRIA 7 Consumptive Use Estimates.

BACKGROUND AND CONTEXT

The Streamflow Restoration law (Revised Code of Washington [RCW 90.94]) specifies that by June 30, 2021, Ecology must establish a WRE Committee and adopt a WRE Plan in the Snohomish Watershed (WRIA 7). The Snohomish (WRIA 7) Watershed Restoration and Enhancement Plan (watershed plan) must include projects and actions that offset the new consumptive water use (consumptive use) from future domestic permit-exempt wells (PE wellsP0F1P). 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 new permit-exempt domestic wells (Ecology 2019). For watershed planning purposes, consumptive use is water that is drawn from groundwater via a domestic PE well and not replaced through the septic system, irrigation return flow, or other means.

Projections for number and location of new PE wells within WRIA 7 were developed by King County, Snohomish County, and GeoEngineers (GeoEngineers 2021a) for purposes of the watershed plan. This memorandum summarizes the methods used to estimate consumptive use associated with the new PE well connections and provides results for three water use scenarios. Methodology is based on Appendix A of Ecology's Final Guidance for Determining Net Ecological Benefit (Final NEB Guidance) (Ecology 2019) and documented in further detail in the Consumptive Use Estimates Workplan prepared by the GeoEngineers team (GeoEngineers 2019).

[1] "PE wells" is used to refer to new homes associated with new permit-exempt wells and also new homes added to existing wells, including homes on group systems relying on permit-exempt wells.

CONSUMPTIVE WATER USE METHODOLOGY

Measurement of consumptive water use in any setting is difficult, and it is virtually impossible for residential groundwater use, which must account for both indoor and outdoor use. PE wells are generally unmetered, so supply to each home is usually unknown, let alone the amount that is lost to the groundwater system. Therefore, we are limited to estimating consumptive use based on projections of future growth, local patterns and trends in water use, and generally accepted and reasonable assumptions. Water use data from local water purveyors may be useful as a check on calculated estimates but must be used with caution. Homes that pay for municipal water tend to exhibit different water use behaviors, including water saving appliances and reduced landscape watering, that reduce usage compared to homes on wells.

The two categories of household consumptive use are indoor water use and outdoor water use. The methodology used to estimate these quantities for WRIA 7 are described in the following sections.

Indoor Consumptive Use

Indoor consumptive use was estimated using methods and assumptions from the Final NEB Guidance (Ecology 2019), which was based on groundwater monitoring and modeling studies conducted by the U.S. Geological Survey in several areas of Washington. There are two basic elements to estimating indoor consumptive use:

- Amount of total water used. The Final NEB Guidance recommends an assumption of 60 gallons per person per day as a reasonable estimate of indoor water use. To estimate indoor usage per well, the per capita usage was multiplied by the average rural household size, estimated by King County and Snohomish County as 2.73 and 2.75 people per household, respectively. For analysis areas spanning both counties, a weighted value was estimated based on the number of projected PE well connections in each county. Table 1 summarizes the household sizes for each WRIA 7 delineated subbasin with projected PE wells (GeoEngineers 2021b) and for all of WRIA 7.
- Percentage of total water used that is consumptive. The Final NEB Guidance recommends that 10 percent of the total indoor water use is considered consumptive when a home is on a septic system. (All indoor water use is considered consumptive for homes with sewer connections.) Areas projected to be served by PE wells are outside of sewer service areas, so the 10 percent assumption was applied for all projected indoor water use.

TABLE 1. AVERAGE RESIDENTS PER HOUSEHOLD

Subbasin	% Projected Wells by County		Avg. People per Rural Household
	King	Snohomish	
Tulalip	--	100%	2.75
Quilceda-Allen	--	100%	2.75
Estuary/Snohomish Mainstem	--	100%	2.75
Little Pilchuck	--	100%	2.75
Pilchuck	--	100%	2.75
Woods	--	100%	2.75
Sultan	--	100%	2.75
Lower Mid-Skykomish	--	100%	2.75

Subbasin	% Projected Wells by County		Avg. People per Rural Household
	King	Snohomish	
Skykomish Mainstem	--	100%	2.75
Upper Skykomish	49%	51%	2.74
Cherry-Harris	95%	5%	2.73
Snoqualmie North	71%	29%	2.74
Snoqualmie South	100%	--	2.73
Patterson	100%	--	2.73
Raging	100%	--	2.73
Upper Snoqualmie	100%	--	2.73
WRIA Total	**29%**	**71%**	**2.74**

Outdoor Consumptive Use

Outdoor water use is typically the larger portion of domestic single-family residential water use, with irrigation of lawn and garden being the dominant outdoor water use component. The GeoEngineers team conducted a subbasin-specific assessment to determine typical outdoor water use patterns, namely the typical size of irrigated lawn, garden, and landscaping areas associated with newer residential development and irrigation water needs, which vary by crop and climate. The consumptive use estimate assumes that current rural residential landscaping practices and outdoor water use will continue over the 20-year planning horizon.

Irrigated Footprint Analysis

The GeoEngineers team conducted an aerial photo-based analysis of irrigated lawn and garden area for 393 parcels in the 16 WRIA 7 subbasins. Parcels used for the irrigated footprint analysis were selected based on recent (2006-2017) building permits for new single-family residential homes not served by public water. Permits for accessory dwelling units (ADUs) or reconstruction/remodel were excluded. There were nearly 1,600 permits in WRIA 7 meeting these criteria—more than could be reasonably evaluated for this project. A minimum 20-parcel sample per subbasin was targeted as a statistically representative sample size based on statistics from similar analyses in WRIAs 1, 8, and 9. The target sample size is sufficient to ensure that the sample mean is representative over the WRIA within a 95 percent confidence limit. Sample parcels were selected by assigning a random number to each building permit, and then evaluating sites in rank order up to the target sample size. Using a random selection from the permit list avoids the bias that could be introduced if selecting from the imagery.

Each parcel was evaluated visually in Google Earth for irrigated lawn areas. Google Earth's historical imagery collection allowed for clearer identification of irrigated areas by comparing aerial photos spanning multiple seasons and years. Late summer imagery was particularly helpful in determining boundaries of irrigated (green) vs. non-irrigated (brown) grass areas. More often than not, the parcels did not demonstrate such a clear-cut distinction between green and brown spaces. It appears that many homeowners irrigate enough to keep lawns alive but not lush (or comparable to commercial turf grass/golf course green). Delineating these irrigated spaces is subjective, and the GeoEngineers team tried to ensure consistency in the interpretation and results by having one geographic information system (GIS) analyst evaluate all of the selected parcels in the WRIA. The irrigated area was delineated for each parcel based on several key assumptions:

- Landscaped shrub/flower bed areas were included in the irrigated footprint (not just lawn areas).
- Homes that did not show visible signs of irrigation were tracked as zero irrigated footprint.
- Homes or landscaping still under construction in the most recent Google Earth imagery were excluded.
- Native forest or unmaintained grass/pasture were not included in the irrigated footprint.
- Pre-existing agricultural land use was not considered part of the residential irrigation footprint.

Figure 1 shows examples of irrigated area delineation for two representative parcels in the Patterson (left) and Upper Skykomish (right) subbasins. On each photo, the parcel boundary is shown in yellow and the area identified as irrigated in white. Large homes and extensive irrigated lawn and garden areas were much more common in the Patterson, Pilchuck, and Raging subbasins compared to the rest of the WRIA.

Figure 1. Example Irrigated Area Delineations, Patterson subbasin (left) and Upper Skykomish subbasin (right)

Results of the irrigated footprint analysis for all subbasins are summarized in Table 2. Note that more parcels than the target minimum sample were analyzed in each of the subbasins. When identifying the random list for analysis, the GeoEngineers team identified 10 additional sites beyond the target minimum of 20 to allow for dropping parcels that did not meet the analysis criteria (e.g., construction not completed). The full list was analyzed, resulting in a few parcels above the target minimum in each subbasin.

TABLE 2. WRIA 7 IRRIGATED FOOTPRINT SUMMARY

Subbasin	Applicable Permit Parcels	Parcels Analyzed	Total Irrigated Area (ac)	Average Irrigated Area (ac)
Tulalip	116	21	2.0	0.09
Quilceda-Allen	160	26	3.8	0.15
Estuary/Snohomish Mainstem	207	26	7.6	0.29
Little Pilchuck	161	24	4.8	0.20
Pilchuck	153	25	9.1	0.37
Woods	123	28	3.5	0.12
Sultan	29	21	2.4	0.11
Lower Mid-Skykomish	33	22	3.1	0.14

Subbasin	Applicable Permit Parcels	Parcels Analyzed	Total Irrigated Area (ac)	Average Irrigated Area (ac)
Skykomish Mainstem	101	25	3.9	0.16
Upper Skykomish	52	27	1.3	0.05
Cherry-Harris	96	26	4.2	0.16
Snoqualmie North	146	22	4.6	0.21
Snoqualmie South	64	23	4.9	0.21
Patterson	49	23	9.3	0.41
Raging	29	27	11.7	0.43
Upper Snoqualmie	75	27	6.3	0.23
Full Analysis	**1,594**	**393**	**82.5**	**0.21**

Note: The WRIA-aggregated irrigated area in Table 4 is based on subbasin-average lawn sizes weighted by projected PE well connections per subbasin and thus differs slightly from the average irrigated area in Table 2, which is the direct average of irrigated areas from all parcels analyzed.

Crop Irrigation Requirements

The amount of irrigation water required to grow and maintain vegetation depends on the crop, season, and local climate (temperature and precipitation) and thus varies by location throughout the WRIA. The Washington Irrigation Guide (WAIG) (NRCS 1997) includes an appendix listing net irrigation requirements for various common crops for 89 locations throughout Washington, derived from water use and meteorological data from the 1970s and 1980s. Since lawn is a fairly water-intensive crop and the most common target of residential irrigation, irrigation requirements for turf were used to estimate outdoor water needs.

Using the three WAIG stations within WRIA 7 (Everett, Monroe, and Snoqualmie Falls) and surrounding stations to the north and south, the GeoEngineers team spatially interpolated crop irrigation requirements (CIRs) across WRIA 7 by creating a triangulated irregular network (TIN) surface between the WAIG station points. Since there are no stations east of Snoqualmie Falls in the higher-elevation, higher-precipitation eastern subbasins, a lower value was imposed along the Cascade crest to enforce continued reduction in CIR with increasing precipitation. A value of 8 inches per year was used for the boundary value; this is believed to be a conservative value on nearby Cascade foothill station estimates from an unpublished irrigation data set being developed by Washington State University (Peters et al. 2019). Values from the resulting TIN surface were averaged over each subbasin to estimate the irrigation requirement for each subbasin. This analysis was performed for both annual and summer (June-July-August) irrigation requirements to provide information to compare peak summer water use to annual use estimates. Figure 2 shows the locations of WAIG irrigation data stations and the interpolated distribution of annual turf irrigation requirements across WRIA 7. Table 3. WRIA 7 Crop Irrigation Requirements summarizes the average values for both annual and summer CIRs for subbasins with projected PE well connections. Annual values were used for the consumptive use calculations described in this memo.

The CIR is the net amount of external water required by the crop, accounting for precipitation inputs. Since irrigation systems are not 100 percent efficient, additional water must be supplied to ensure that crop needs are met. The application efficiency varies by the type of system (drip irrigation, microsprinklers, pivot sprinklers, etc.). For WRIA 7, the Ecology-recommended value of 75 percent was used to determine the water applied for irrigation (Ecology 2019).

Outdoor water use for each home was then estimated as the applied water for irrigation (computed as a depth) times the average irrigation area. The consumptive use fraction is substantially higher for outdoor use than indoor use (to a septic system) because most of the applied water is taken up by plants or evaporated. Based on the Final NEB Guidance, a consumptive use fraction of 80 percent was applied to the total outdoor water use, meaning that 80 percent of water used for outdoor watering does not return to the local groundwater system (Ecology 2019).

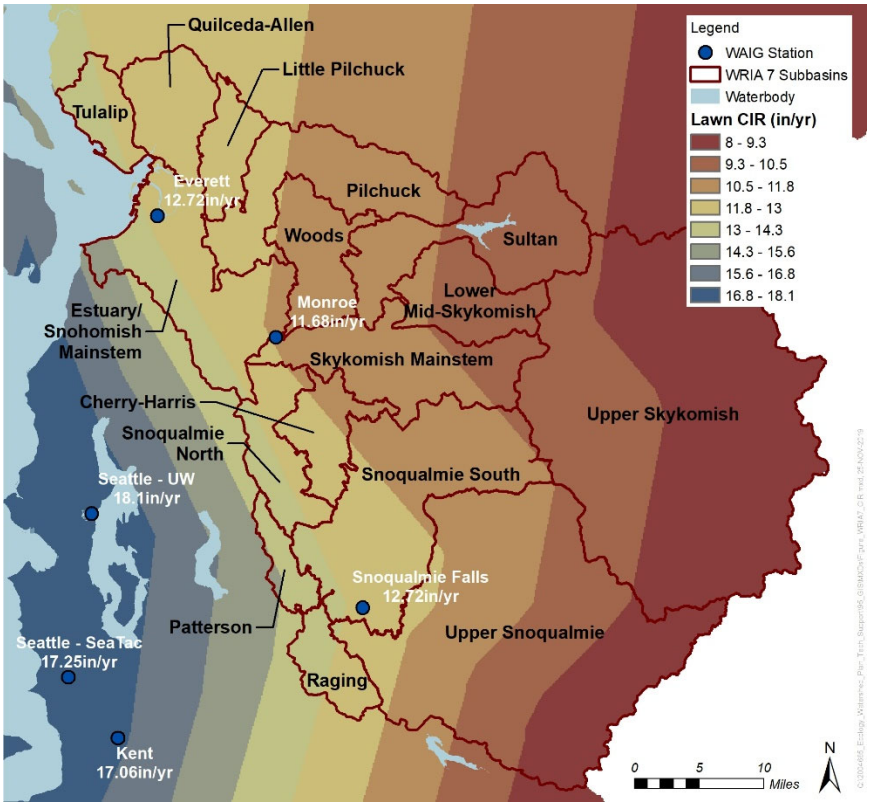


Figure 2. Spatial Distribution of Annual Turf Irrigation Requirement

TABLE 3. WRIA 7 CROP IRRIGATION REQUIREMENTS

Subbasin	Annual Turf CIR (in)	Summer (JJA) Turf CIR (in)
Tulalip	13.22	10.74
Quilceda-Allen	12.40	10.27
Estuary/Snohomish Mainstem	12.85	10.68
Little Pilchuck	12.25	10.16
Pilchuck	11.49	9.93
Woods	11.46	9.93
Sultan	10.22	9.26
Lower Mid-Skykomish	10.27	9.40
Skykomish Mainstem	10.90	9.69
Upper Skykomish	8.89	8.59
Cherry-Harris	11.99	10.46
Snoqualmie North	12.86	10.92
Snoqualmie South	11.78	10.32
Patterson	14.02	11.62
Raging	13.04	11.08
Upper Snoqualmie	10.18	9.35
WRIA Average	**10.66**	**9.57**

TOTAL CONSUMPTIVE USE

The methods described above were used to compute indoor and outdoor consumptive use per PE well connection. Totals for each subbasin were then computed by multiplying per home values by the projected number of PE well connections in each subbasin. The GeoEngineers team developed a consumptive use calculator (Excel spreadsheet) to compute consumptive use for projected PE well connections for each subbasin and the WRIA as a whole. Table 4 summarizes the consumptive use estimate, which assumes one home with the measured subbasin-average yard area per PE well. The WRIA-aggregated irrigated area in Table 4 is based on subbasin-average yard sizes weighted by projected PE well connections per subbasin and thus differs slightly from the average footprint in Table 2, which is the direct average of irrigated areas from all parcels analyzed. The consumptive use estimate for WRIA 7 is 797.4 acre-feet per year, as shown on Figure 3. Note that the consumptive use estimates shown in Figure 3 are rounded.

TABLE 4. ANNUAL CONSUMPTIVE USE FOR ONE HOME WITH SUBBASIN AVERAGE YARD

Subbasin ID	# PE Wells Anticipated in Subbasin	Irrigated Area per Well (ac)	Per Well Consumptive Use (gpd)			Total Consumptive Use (af/yr)
			Indoor	Outdoor	Total	
Tulalip	468	0.09	16.5	94.4	110.9	58.1
Quilceda-Allen	338	0.15	16.5	147.6	164.1	62.1
Estuary/Snohomish Mainstem	331	0.29	16.5	295.7	312.2	115.8
Little Pilchuck	294	0.20	16.5	194.4	210.9	69.5
Pilchuck	280	0.37	16.5	337.3	353.8	111.0
Woods	224	0.12	16.5	109.1	125.6	31.5
Sultan	55	0.11	16.5	89.2	105.7	6.5
Lower Mid-Skykomish	60	0.14	16.5	114.1	130.6	8.8
Skykomish Mainstem	185	0.16	16.5	138.4	154.9	32.1
Upper Skykomish	103	0.05	16.4	35.3	51.7	6.0
Cherry-Harris	214	0.16	16.4	152.2	168.6	40.4
Snoqualmie North	338	0.21	16.4	214.3	230.7	87.4
Snoqualmie South	169	0.21	16.4	196.3	212.7	40.3
Patterson	104	0.41	16.4	456.1	472.5	55.0
Raging	75	0.43	16.4	444.9	461.3	38.8
Upper Snoqualmie	151	0.23	16.4	185.8	202.2	34.2
WRIA 7 Aggregated	**3,389**	**0.20**	**16.5**	**193.6**	**210.0**	**797.4**

Note: Values in table have been rounded.

CONSUMPTIVE WATER USE SCENARIOS

The consumptive use calculator was also used to explore additional consumptive use scenarios. "Default" input parameters and values discussed in the methods section above can be modified to explore the effect of changes or uncertainties in individual assumptions. Based on requests from the technical workgroup and WRIA 7 Committee, two additional scenarios were computed, and annual consumptive use results are summarized in Table 5 and Table 6:

1. One home with legal maximum 0.5-acre irrigated lawn area per PE well. Assumes 60 gallons per day per person indoor use and outdoor use to irrigate 0.5-acre lawn.
2. Legal right to 950 gallons per day (maximum annual average withdrawal) per well connection for indoor and outdoor household use. Assumes 60 gallons per day per person indoor use and remainder to outdoor use.

TABLE 5. ANNUAL CONSUMPTIVE USE FOR ONE HOME WITH 0.5-AC YARD

Subbasin ID	# PE Wells Anticipated in Subbasin	Irrigated Area per Well (ac)	Per Well Consumptive Use (gpd)			Total Consumptive Use (af/yr)
			Indoor	Outdoor	Total	
Tulalip	468	0.50	16.5	524.5	541.0	283.6
Quilceda-Allen	338	0.50	16.5	492.0	508.5	192.5
Estuary/Snohomish Mainstem	331	0.50	16.5	509.8	526.3	195.2
Little Pilchuck	294	0.50	16.5	486.0	502.5	165.5
Pilchuck	280	0.50	16.5	455.9	472.4	148.2
Woods	224	0.50	16.5	454.7	471.2	118.2
Sultan	55	0.50	16.5	405.5	422.0	26.0
Lower Mid-Skykomish	60	0.50	16.5	407.5	424.0	28.5
Skykomish Mainstem	185	0.50	16.5	432.5	449.0	93.0
Upper Skykomish	103	0.50	16.4	352.7	369.1	42.6
Cherry-Harris	214	0.50	16.4	475.7	492.1	118.0
Snoqualmie North	338	0.50	16.4	510.2	526.6	199.4
Snoqualmie South	169	0.50	16.4	467.4	483.7	91.6
Patterson	104	0.50	16.4	556.2	572.6	66.7
Raging	75	0.50	16.4	517.4	533.7	44.8
Upper Snoqualmie	151	0.50	16.4	403.9	420.3	71.1
WRIA 7 Aggregated	**3,389**	**0.50**	**16.5**	**480.0**	**496.5**	**1,884.9**

Note: Values in table have been rounded.

TABLE 6. ANNUAL CONSUMPTIVE USE FOR ANNUAL AVERAGE 950 GPD WATER USE PER CONNECTION

Subbasin ID	# PE Wells Anticipated in Subbasin	Irrigated Area per Well (ac)	Per Well Consumptive Use (gpd)			Total Consumptive Use (af/yr)
			Indoor	Outdoor	Total	
Tulalip	468	0.60	16.5	628.0	644.5	337.9
Quilceda-Allen	338	0.64	16.5	628.0	644.5	244.0
Estuary/Snohomish Mainstem	331	0.62	16.5	628.0	644.5	239.0
Little Pilchuck	294	0.65	16.5	628.0	644.5	212.3
Pilchuck	280	0.69	16.5	628.0	644.5	202.2
Woods	224	0.69	16.5	628.0	644.5	161.7
Sultan	55	0.77	16.5	628.0	644.5	39.7
Lower Mid-Skykomish	60	0.77	16.5	628.0	644.5	43.3
Skykomish Mainstem	185	0.73	16.5	628.0	644.5	133.6
Upper Skykomish	103	0.89	16.4	628.5	644.9	74.4
Cherry-Harris	214	0.66	16.4	628.9	645.3	154.7
Snoqualmie North	338	0.62	16.4	628.7	645.1	244.3
Snoqualmie South	169	0.67	16.4	629.0	645.3	122.2
Patterson	104	0.57	16.4	629.0	645.3	75.2
Raging	75	0.61	16.4	629.0	645.3	54.2
Upper Snoqualmie	151	0.78	16.4	629.0	645.3	109.2
WRIA 7 Aggregated	**3,389**	**0.66**	**16.5**	**628.3**	**644.7**	**2,447.7**

Note: Values in table have been rounded.

Daily usage rates shown in Table 4 through Table 6 represent annual average values. While indoor use generally does not vary much from month to month, outdoor water needs range from zero during the winter rainy season to more than three times the annual average during the peak of the summer. Since streamflows are lowest in late summer for most western Washington streams, the Committee may consider peak summer water use along with annual use when developing the watershed plan. It is important to remember that pumping rates are likely not equivalent to consumptive use impacts on stream depletion. While the Final NEB Guidance recommends considering stream depletion impacts to be a steady-state equivalent, there may be circumstances within a watershed where that is not appropriate.

Total Water Use and Comparison to Water Purveyor Data

Water use data from water purveyors serving rural areas in the central Puget Sound were obtained as one benchmark for comparison with estimated PE well usage. Snohomish County Public Utilities District #1 (Snohomish County PUD), serving about 20,000 customers in central and northern Snohomish County, and Covington Water District, serving about 18,000 customers in southern King County, each provided metered water use data from 2015 and 2017. In addition, Snohomish County compiled annual water demand forecasts from water system plans for 17 water purveyors operating in the county. Table 7 summarizes the available water purveyor data. Reported values are total water use, not consumptive use. For the two metered systems providing data, the average annual use is approximately 220 gallons per day (gpd) per household. About 160 gpd is attributed to indoor uses (year-round) and 50 to 70 gpd (averaged over 12 months) to outdoor uses.

Note that outdoor use is typically concentrated over about 3 months during the summer, which equates to rates of 150 to 200 gpd of outdoor watering for those 3 months.[2]

TABLE 7. WATER PURVEYOR HOUSEHOLD WATER USE DATA

Water Purveyor	Average Annual Water Use (gpd)	Average Winter Water Use (gpd)	Average Summer Water Use (gpd)
Metered Water Use Data†			
Snohomish County PUD‡	237	170	370
Covington Water District	200	150	300
Comprehensive Plan Forecast			
Alderwood	169		
Cross Valley*	234		
Edmonds	201		
Gold Bar	171		
Highland*	200		
Marysville	168		
Monroe	170		
Mukilteo	179		
Olympic View	189		
Roosevelt*	383		
Silver Lake	177		
Snohomish	190		
Snohomish County PUD*	190		
Stanwood	282		
Startup*	250		
Sultan	190		
Three Lakes*	191		
**Average Rural Non-City*	*241*		

Note: Reported values are total water use, not consumptive use.
†Data from 2015 and 2017 ‡Average use for parcels ≥1 acre *Rural water provider

Since most water purveyors charge customers by the amount of water delivered (not just consumptively used)—and in some cases at increased rates as water use goes up—metered water users may exhibit more water conservation behaviors than unmetered users. Total water use breakdowns for the projected PE well scenarios are presented in Table 8. Estimated indoor use of 165 gpd for the PE well scenarios is very consistent with the water purveyor data (based on metered winter water use), between 150 and 170 gpd.

Average annual total use for PE wells estimated from this analysis (see Table 8) are considerably higher, however, due to outdoor use estimates 4 to 6 times greater than average metered use: 240 gpd estimated for PE wells versus 50 to 70 gpd for metered users on an average annual basis or 820 gpd estimated for PE wells versus 150 to 200 gpd[3] for metered users on average during the summer. The magnitude of this difference

[2] 50 gpd over 12 months is equivalent to 200 gpd over 3 months, both totaling about 18,000 gallons
[3] Metered summer usage for several individual homes in the Covington Water District showed outdoor usage ranging from 25 gpd to 2,693 gpd for July-August 2015.

seems unlikely to be accounted for strictly by price pressures and thus suggests that assumptions in this analysis regarding watering behavior are generally conservative. For example, studies have shown that most residential lawn watering is conducted at a deficit level to maintain some growth and green color (Water Research Foundation 2016), versus the assumption of watering for optimal growth of commercial crops (like a sod farm for turf grass) implicit in the WAIG crop irrigation requirements. Because of uncertainty inherent in estimating growth patterns, domestic PE well pumping rates, and potential changes in outdoor watering practices, conservative assumptions for future new household water use, and outdoor water use in particular, are justified.

TABLE 8. ESTIMATED PERMIT-EXEMPT WELL TOTAL WATER USE

Scenario	Average Annual Water Use (gpd)	Average Indoor Use (gpd)	Average Annual Outdoor Use (gpd)	Average Summer Outdoor Use (gpd)
1 home, average measured yard	407	165	242	817
1 home, 0.5 ac yard	765	165	600	2,026
1 home using 950 gpd (annual average)	950	165	785	n/a

Note: Reported values are total water use, not consumptive use.

REFERENCES

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GeoEngineers. 2021a. WRIA 7 PE Well Projection. Technical memorandum prepared for Washington State Department of Ecology. January 2021.

GeoEngineers. 2021b. WRIA 7 Subbasin Delineations. Technical memorandum prepared for Washington State Department of Ecology. January 2021.

Natural Resources Conservation Service (NRCS), 1997. Irrigation Guide. National Engineering Handbook, Part 652. U.S. Department of Agriculture, Natural Resources Conservation Service. Issued September 1997.

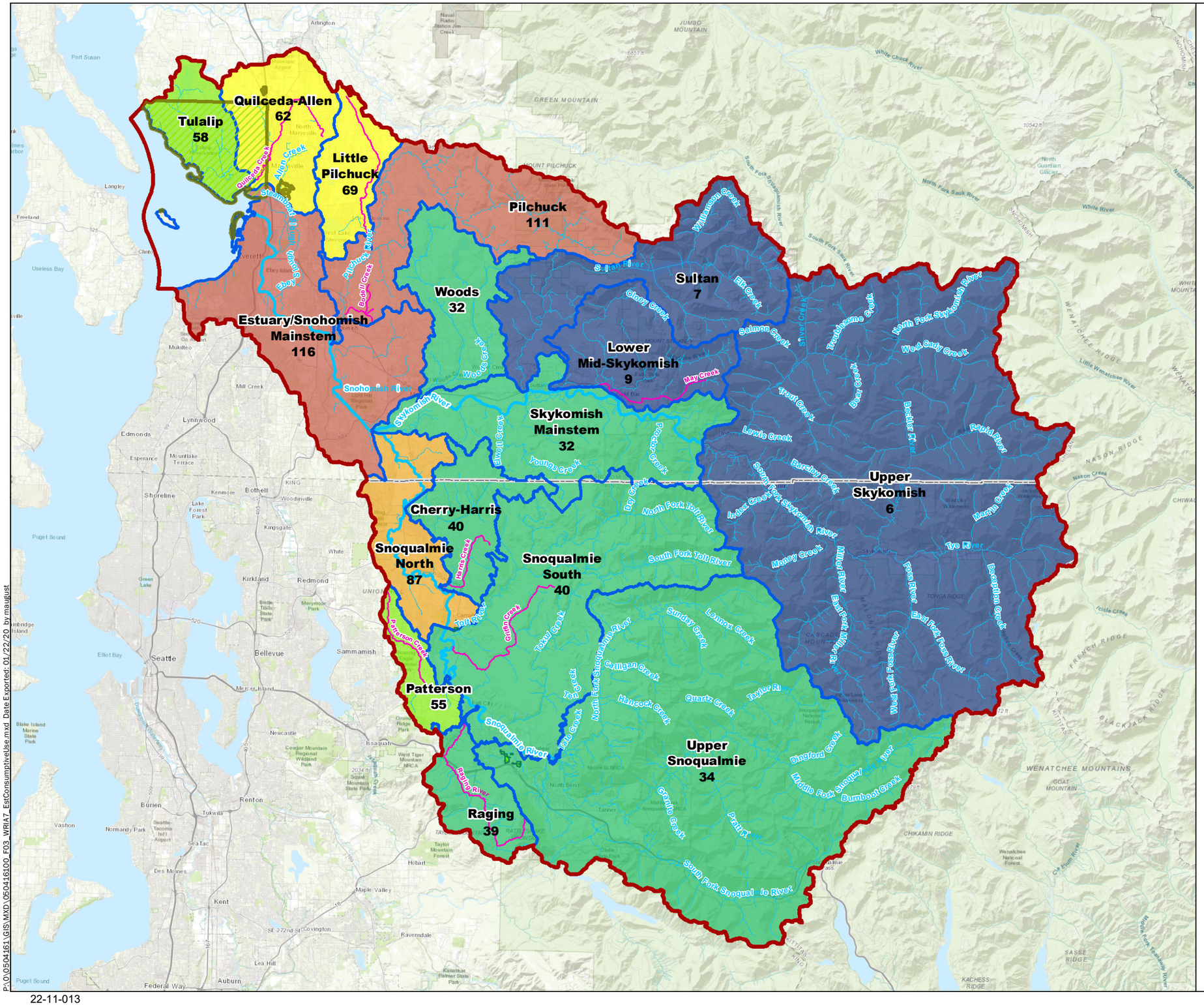
Peters, R.T., L. Nelson, and T. Karimi, 2019. Consumptive Use and Irrigation Water Requirements for Washington. Washington State University Irrigated Agriculture Research and Extension Center. Not yet published, provided 26 September 2019. Associated database: WA Irrigation Water Reqs.mdb.

Washington State Department of Ecology (Ecology). 2019. Final Guidance for Determining Net Ecological Benefit, GUID-2094 Water Resources Program Guidance. Washington State, Department of Ecology, Publication 19-11-079, p. 131. https://fortress.wa.gov/ecy/publications/documents/1911079.pdf.

Water Research Foundation, 2016. Residential End Uses of Water, Version 2. Executive Report. Published April 2016.

Attachment:

Figure 3. WRIA 7 Estimated Consumptive Use from Projected Permit-exempt Wells 2018-2038



Legend

- WRIA 7 Boundary
- WRIA7 Subbasins
- Snoqualmie Tribe Reservation
- Tulalip Tribes Reservation
- Surface Water Closures[3]

Consumptive Water Use Estimate (acre-feet/year)

- 0 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70
- 71 - 80
- 81 - 90
- 91 - 100
- >100

Projected WRIA 7
Consumptive Use Total = 797.4 acre-feet per year

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. Closed stream s represen t GeoEngineers' interpretation of the language in WAC 173-507 and this m ap is to only be used for plan ning purposes.

Data Source: ESRI Topographic Map Base

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

N
W E
S

5 0 5
Miles

WRIA 7 Estimated Consumptive Use from Projected Permit-Exempt Wells 2018-2038

Watershed Restoration and Enhancement Plan
Snohomish and King Counties, Washington

GeoEngineers

Figure 3

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Appendix C – Detailed Project Descriptions

The following project descriptions were developed based on information provided to Ecology prior to December 2021.

WRIA 7 – Project Description
Lake Shoecraft Outlet Modification

Project Name and Number
Lake Shoecraft Outlet Modification (7-T-W1)

WRIA 7 WRE Subbasin
Tulalip

Water Offset
62.5 AFY

Narrative Description
Lake Shoecraft is an approximately 125-acre lake located in the Tulalip Plateau west of Arlington. The lake outlet is currently controlled by a weir with removable stop logs (8-inch height per log). Boards are removed in the winter to pass higher flows and prevent flooding and installed in the summer to increase storage and maintain lake levels. An adjustable slide-gate weir has been proposed to replace the stop logs to add more flexibility in outlet control. This would benefit the downstream Bernie Kai-Kai Gobin Hatchery by allowing greater control of releases from the lake and the opportunity to increase storage in the lake. The changes in operations would be targeted to align with hatchery needs, which vary from year to year. Spring and summer releases could be more tightly controlled to maintain higher lake levels and allow more consistent streamflow releases through the summer.

The hatchery has not actively managed the lake level control structure for purposes of maximizing water supply. Changing the structure to create a finer level of control over the lake level presents opportunities for the hatchery to increase management of lake levels to improve water supply – effectively treating Lake Shoecraft as a reservoir. Exploring the hydraulic connection between Lakes Goodwin and Shoecraft will be necessary to understand if the lake outlet control is the hydraulic control for both lakes. If that is the case, the storage in Lake Goodwin could be managed as well, potentially providing additional streamflow benefit.

The Tribes, WDFW and the Lake Shoecraft Homeowner's Association (LSHA) have a MOA for lake level control at Lake Shoecraft. The origination of the MOA was to allow the Tribes to protect the water supply on the West Fork of Tulalip Creek from being altered without warning by the LHSA. Communication with the Association is limited to requests for adding or subtracting a stop board in the lake level control structure a few times per year. Due diligence is needed to understand LSHA criteria for making requests and determining the acceptable range of lake elevations.

Quantitative or qualitative assessment of how the project will function. Show how offset volume(s) were calculated.
There has been no analysis conducted yet for this project. Very roughly, the volume of water stored over the lake surface behind an eight-inch stop board is 28.6 million gallons (88 acre-feet) (total supply of water for three days running hatchery at 7,000 gpm). Changing the weir to a sliding gate which can be raised or lowered in smaller increments, will give the Hatchery could have greater control over the timing and the amount of water stored and released.

Actively managing the lake level, in coordination with the LSHA, could provide a wider range of flow control of West Fork Tulalip Creek to the Tribes' hatchery. As the project develops, Tulalip envisions

being able to manage lake elevation within an acceptable range throughout the year to maximize downstream benefits at the hatchery.

A preliminary study for a similar outlet modification on Lake Stevens found that an adjustable outlet could modulate lake levels throughout the year and increase summer levels by as much as half a foot compared to an existing stop log weir. If a similar benefit could be achieved for Lake Shoecraft, that would provide a 62.5 acre-foot increase in summer storage. Site specific investigations are needed to determine more accurate estimates. Additional study could also determine if water temperature benefits could be realized by drawing water from a lower elevation in the lake, although it is assumed the lake stratifies at some point in the summer.

The current weir is entering the end phase of its design life. The dam boards are breaking and are in need of replacement. The weir is 10 feet high; it is assumed excavation was necessary to put the original weir in contact with competent rock. Sediment has built up in the channel behind the weir, placing pressure on the boards, which the weir was likely not designed to withstand. It is assumed that excavation of accumulated sediments will be necessary in order to replace the weir and to potentially increase storage at the downstream end of the lake.

Conceptual-level map and drawings of the project and location.

Lake Shoecraft is situated north of the Tulalip Indian Reservation. It is hydraulically connected to Lake Goodwin and both lakes flow into West Fork Tulalip Creek. The lake outlet is located near the southwest corner of the lake. The Tulalip hatchery is south of Lake Shoecraft on Tulalip Creek. See Figure 1 and 2 for a map of the project location and hatchery location, respectively.

Description of the anticipated spatial distribution of likely benefits.

The project is anticipated to increase late spring and summer flow in West Fork Tulalip Creek and provide ability to manage streamflows to support the Tulalip salmon hatchery.

Performance goals and measures.

Lake level, weir gate setting, lake discharge, hatchery flows.

Snohomish County has collected continuous lake level data since 2016. There is a staff gauge at the lake outlet control, and Tulalip maintains a stream gauge on the West Fork Tulalip Creek. Performance goals would be to control releases from the lake to slow spring/summer drawdown and maintain higher outflows through late spring and summer.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The Tulalip Tribes raise summer/fall Chinook, Coho, and Chum at the hatchery. Adult salmon return to the hatchery facilities and each species is reared from egg stage to the appropriate life stage for release. Chinook are reared from September to June, Coho for approximately 18 months from October over a year to the following May/June, and Chum are reared from November to April or May.

The hatchery was originally designed with a water reuse system due to anticipated water shortages due to environmental limitations. As hatchery marking requirements increased, the Tribes' have been holding fish for longer, juggling space and increasing water reuse with limited ability to purify water prior to passing it over fish a second time. Additionally, climatic shifts in precipitation duration, timing and intensity have altered the availability of water during the rearing cycle. Dry late winters or early

springs lead to critical water shortages and water quality issues at the time when the highest biomass is held at the hatchery.

Identification of anticipated support and barriers to completion.

The Tulalip Tribes and Washington Department of Fish and Wildlife (WDFW) are strong supporters of the project. WDFW owns the outlet structure and access to the outlet structure; Tulalip Tribes manages the downstream hatchery. The current weir is managed in cooperation between WDFW, citizen representatives, and Tulalip Tribes. The lake is surrounded by residential land use, so buy-in from lakeside homeowners and citizens currently cooperating on weir management will also be important. Analysis will be needed to demonstrate ability to manage year-round lake levels without increasing winter flood risk. The lake levels in Lake Shoecraft are not adjudicated and there is no reservoir permit or accompanying beneficial use permit for use of water in the lake that would be potential barriers.

Potential budget and O&M costs.

WDFW is responsible for maintenance of the weir. Additional O&M regarding lake level monitoring and release schedules are to be determined.

Anticipated durability and resiliency.

The current weir will need dam boards replaced in the next year due to deterioration that allows leakage. A stainless-steel slide-gate weir would likely be significantly more durable than wood stop logs, though annual operation costs for an adaptively managed outlet may be higher. Replacing with a new outlet would provide greater control over lake levels that would create benefits to the Tribes' hatchery program as well as to LHSA members. A more flexible outlet would also increase resiliency by allowing for adjustment of operations in response to potential future climate change.

Project sponsor(s) (if identified) and readiness to proceed/implement.

This project is still in the concept stage. The Tulalip Tribes, who operate the downstream hatchery, and Washington Department of Fish & Wildlife (WDFW), who owns the lake outlet, are strong proponents of the project. Additional analysis is needed on project feasibility.

Documentation of sources, methods, and assumptions.

Snohomish County. https://snohomishcountywa.gov/5391/Shoecraft

Snohomish County, 2020. Lake Shoecraft 2020 Health Report. https://snohomishcountywa.gov/DocumentCenter/View/63184/Shoecraft_2020?bidId=

Figure 1. Lake Shoecraft vicinity. Blue triangle denotes outlet location.

Figure 2. Hatchery location, south-southeast of Lake Shoecraft

WRIA 7 – Project Description
Coho Creek Relocation and Streamflow Enhancement Project

Project Name and Project Number
Coho Creek Relocation and Stream Flow Enhancement Project (7-QA-W2[1])

WRIA 7 WRE Subbasin
Quilceda-Allen

Water Offset
362 AFY

Narrative Description
This project includes restoration of fish habitat within Coho Creek (WRIA #07-0048), a Type 3 tributary to Quilceda Creek located on the Tulalip Reservation within the Quilceda-Allen subbasin. This work is being proposed by the Tulalip Tribes to relocate and restore stream habitat conditions within Coho Creek and to augment summer low flows using effluent from a Membrane Bioreactor (MBR) Wastewater Treatment Plant adjacent to Coho Creek. In 1999, a culvert that blocked fish passage, just below the project area, was replaced, improving fish access to over two miles of ditch and stream channels. This current project proposes to restore a ditched section of the stream system with a natural channel configuration and to reuse water from the Tribes' MBR plant to increase Coho and Chum Salmon production within the stream system.

Since 2001, 2,500 feet of Coho Creek has been restored resulting in increased spawning and rearing production. Coho and Chum Salmon spawning has averaged 39 and 167 fish annually within Coho Creek. With this proposed project, Tulalip Tribes hope to add substantially to the numbers of Coho and Chum that use the stream system. Tulalip Tribes propose to re-evaluate old channel designs, add a water reuse system adding approximately 0.5 cfs, construct 1,300 feet of new stream channel, and replant approximately three acres of riparian area. The project area will be included in the Tulalip Tribes' annual Coho Creek maintenance and monitoring efforts to track results and needed modifications to ensure success.

Quantitative or qualitative assessment of how the project will function. Show how offset volume(s) were calculated.
Quantitatively, this project will include restoration of up 1,300 feet of Coho Creek through construction of a new stream channel and replant three acres of riparian habitat within the ditched sections of stream to improve spawning and rearing habitat for Coho and Chum Salmon. Native riparian plantings will provide shade along this stream sections to protect water temperatures and directly benefit prey availability of pre-migrant and outmigrating juvenile salmonids.

In addition to channel restoration, this project will augment flows year-round, including during the summer low flow period by an estimated 0.5 cfs for a total of 362 AFY. The 0.5 cfs of streamflow augmentation is a year-round average; discharges are anticipated to fluctuate between 0.2 and 0.75 cfs throughout year. These additional flows would be provided by treated wastewater from the Quil Ceda

[1] Other project numbers associated with this project: 2018-0400; 07-USR-064

Village membrane bio-reactor (MBR) treatment plant and would be available right away. The MBR plant currently discharges treated wastewater through an EPA-approved underground injection control site (UIC) near I-5. The current UIC is reaching capacity and the wastewater utility is looking for other discharge options to manage predicted increases in discharge quantity. Effluent for flow augmentation to Coho Creek would be from expected increases in treated wastewater. Growth is driving new water uses within the Quil Ceda Village and a new casino is under construction that will be served by the MBR facility when it becomes operational. Treated effluent water quality is close to drinking water standards and would receive additional treatment to reduce temperature. It is anticipated that treated effluent will pass through an infiltration gallery and constructed wetland system prior to discharge into Coho Creek.

Quil Ceda Village and additional neighboring developments are supplied with water from the City of Everett, which has sufficient water rights to meet current and future demand associated with this project. Additional wastewater treated at the MBR treatment plant will be used to supplement stream flows in Coho Creek.

A feasibility study is currently underway to predict increases in treated wastewater from Quil Ceda Village and potential new customers, and subsequent streamflow augmentation potential. An estimated one cfs additional streamflow could be provided to Coho Creek, however a conservative offset estimate of 0.5 cfs is applied since feasibility studies are still underway. The proposed project would provide an additional 20 percent of flow during low flows periods. There is currently purple pipe infrastructure in the vicinity of the project area, but additional piping will need to be constructed to bring water to Coho Creek.

A map and drawings of the project location.

The project site is shown in relation to surrounding physical features in Figure 3.

Description of the spatial distribution of likely benefits.

This project includes restoration of 1,300 feet of Coho Creek through construction of a new stream channel and installation of three acres of riparian plantings along the ditched sections of stream to improve rearing and spawning habitat for Coho and Chum Salmon. Coho Creek is a tributary to Quilceda Creek.

Performance goals and measures.

Construction of 1,300 feet of new stream channel, replacing the current ditched channel. Increasing capacity by increasing channel length by 430 feet and increasing summer low flow levels. Tulalip Tribes estimate rearing areas will increase by 33 percent and spawning by 100 percent over existing conditions. The project will also increase habitat quality by providing a pool-riffle channel type with additions of large woody debris (approximately 30 pieces) and a diversified riparian condition. With these improvements, spawning numbers of Coho and Chum to increase by 33 percent within six years of project implementation. Performance will be determined by completing construction according to designs and through monitoring of the riparian condition, and spawning within the constructed reach. Streamflow and water quality will also be monitored to evaluate performance. Monitoring will take place for at least a six year period and will help determine whether the restoration efforts were effective.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

These restoration actions will benefit juvenile and adult Coho and Chum that utilize this stream for spawning and rearing, increasing both the quantity and quality of habitat.

Identification of anticipated support for and barriers to completion.

The Tulalip Tribes support the improvement of salmonid habitat including flow augmentation. Lack of funding, the need for additional assessment and water reuse approval are known barriers to completion that we are aware of. Flow augmentation is still under study, location approach and quantity has yet to be determined.

Estimate of capital costs and reoccurring O&M costs.

The project area is under tribal ownership, a very rough estimated cost for project assessment, design permitting and construction is $950,000. Estimated operation and maintenance costs are $50,000 over 5 years or $10,000/yr.

Project durability and resiliency.

If constructed properly and after five years of maintenance it is hoped the project area will naturally adjust to post construction conditions and function without requiring additional future maintenance. The riparian enhancements will also survive and adjust to existing conditions. Maintenance in the form of weed control and plant replacement are likely and will ensure a high plant survival rate. Monitoring plant survival, native plant/shrub cover and non-native invasive plant cover will be performed for at least the first five years post-implementation. Spawning activity, discharge and water quality will also be monitored within the stream section restored.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Tulalip Tribe. Sponsor contact: Daryl Williams, dwilliams@tulaliptribes-nsn.gov and Kurt Nelson, knelson@tulaliptribes-nsn.gov. The sponsor will be ready to proceed with design and implementation in 2022.

Documentation of sources, methods, uncertainties, and assumptions.

Construction methods and uncertainties and assumptions are based on previous construction efforts and project plans. The current channel designs will be reevaluated especially previous assumptions, issues and changing conditions (e.g. how to do stream restoration with beaver).

Figure 3. Coho Creek Relocation and Streamflow Enhancement Project Site

WRIA 7 – Project Description
Lake Stevens Outlet Structure & Lake Level Management Project

Project Name and Number
Lake Stevens Outlet Structure & Lake Level Management Project (7-LP-W3)

WRIA 7 WRE Subbasin
Little Pilchuck

Water Offset
500 AFY

Narrative Description
This project would replace an outdated weir structure in the Lake Stevens outlet channel that manages the elevation in Lake Stevens to maximize flood storage availability in the winter and maintain summer flows in the channel while keeping lake elevations high for summer recreation. A review of lake management data and historic lake elevations indicated that a replacement weir could improve functionality and summer base flows for fish. The replacement weir would allow for more precise management of lake levels, resulting in increased lake levels and increased streamflow coming out of the lake during the summer and early fall months into Catherine Creek.

Quantitative or qualitative assessment of how the project will function. Show how offset volume(s) were calculated.
Based on preliminary modeling, modification of the weir structure and operations could increase summer (July-October) lake levels by nearly half a foot. This would provide approximately 500 AFY of additional summer storage and increased streamflow releases for the 1,000-acre lake. Figure 4 below shows proposed lake levels (green) compared to existing (blue) for 2016-2018.

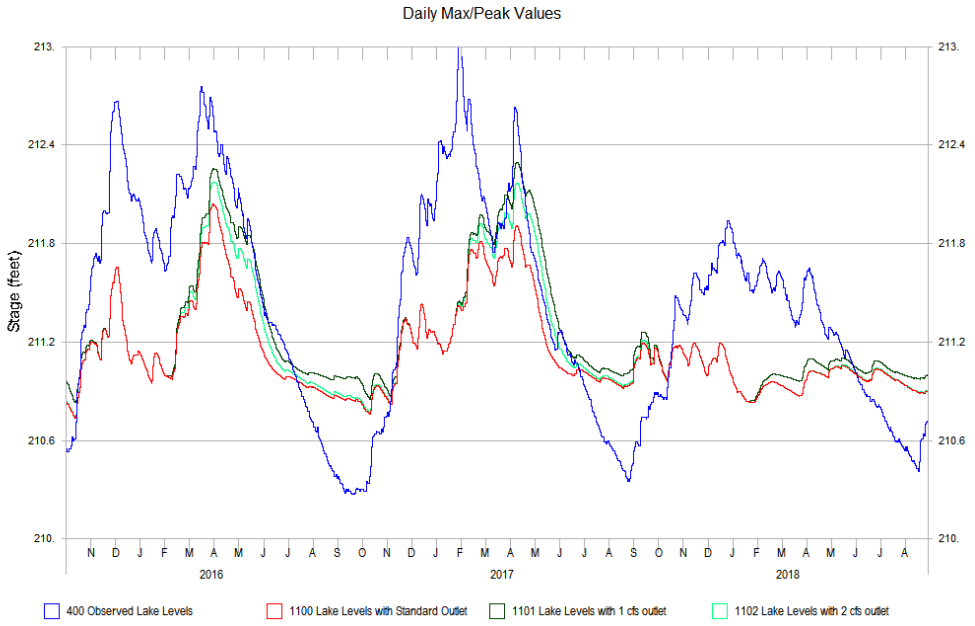

Figure 4. Plot of current and modeled lake levels

Conceptual-level map and drawings of the project and location.

See Figures 5 and Figure 6 below for the location of the Lake Stevens Outlet Channel and project area, respectively.

Figure 5. Lake Stevens Outlet Channel

Figure 6. Lake Stevens outlet management and lake level management project area

Description of the anticipated spatial distribution of likely benefits.

This project would provide additional summer flow in the Lake Stevens outlet channel and Catherine Creek downstream from river mile 1.1, tributary to the Little Pilchuck River, and potential winter flood reduction around Lake Stevens.

Performance goals and measures.

Lake level, weir gate setting, lake discharge, creek flows.

The project is expected to allow the lake level to be managed within a more precise range (as shown in the figure above). Lake level monitoring and flow monitoring in the lake outlet channel and/or Catherine Creek should be initiated prior to weir replacement to provide ability to compare pre- and post-project conditions.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The Lake Stevens outlet stream is listed as being used by Coho Salmon, Cutthroat Trout, steelhead, and Bull Trout by various sources (WDFW 2019, USFWS 2019, and SalmonScape 2019). Kokanee are also present in the lake and inflowing tributaries and may use the outlet channel as well. Of these salmonid fish species, Coho Salmon and Cutthroat Trout are expected to make the most frequent use of the ditch-like outlet stream channel along North Lakeshore Drive and Hartford Drive extending downstream from the lake. Steelhead and Bull Trout use may occasionally occur, but their use is anticipated to be infrequent.

Identification of anticipated support and barriers to completion.

The City of Lake Stevens is the project proponent and sponsor. The City anticipates additional support from lakeside residents, Sound Salmon Solutions, Snohomish County Conservation District, the City's legislative delegation, and several regulatory agencies. Potential regulatory barriers to completion could be the United States Army Corps of Engineers and Department of Archaeology and Historic Preservation (DAHP).

Potential budget and O&M costs.

Preliminary cost estimate: $1.4 million

Estimated O&M costs: $2,000 annual operational costs (i.e., electricity/controls) and $5,000 annual inspection and maintenance costs (i.e., City crew routine inspection and cleaning of weir facility)

Anticipated durability and resiliency.

The proposed outlet control facility will likely be a reinforced concrete weir wall system with corrosion resistant adjustable and possibly automated weir(s) and gate(s). This structure would likely be significantly more durable than the current wood stop log configuration, though annual operation costs for an adaptively managed outlet may be higher. The facility will be designed for decades of use with adjustability for climate change.

Project sponsor(s) (if identified) and readiness to proceed/implement.

The City of Lake Stevens is the identified project sponsor. This project is in early analysis stage. The City of Lake Stevens conducted a preliminary hydrologic/hydraulic modeling analysis to evaluate potential benefits of outlet modifications. The feasibility study has been conducted and the project will be moving into design next.

Documentation of sources, methods, and assumptions.

Davido Consulting Group, Inc., 2020. Lake Stevens Outlet Study Technical Memorandum. Seattle, WA.

WRIA 7 – Project Description
Lochaven Source Switch

Project Name and Number
Lochaven Source Switch (7-P-W4)

WRIA 7 WRE Subbasin
Pilchuck

Water Offset
12.7 AFY

Narrative Description
This project would involve retirement of the water right associated with the Lochaven Estates community (Lochaven) as a basis for increasing flows within the Pilchuck River and downstream areas. Water supply for this community would be transitioned to the Snohomish PUD (PUD) system and Lochaven's existing water right would be protected instream through Ecology's trust water resources program. Lochaven should be eligible to apply for a grant during future grant rounds to be compensated for permanently putting their water right in the trust program.

Lochaven (also referred to as Lochsloy) is located approximately two miles northeast of the City of Lake Stevens, Washington. The 83-home community is situated between State Route 92 (Granite Falls Highway) and the Pilchuck River. The Washington State Department of Health (DOH) indicates that the Lochaven Water System serves a residential population of 225 people with 83 calculated connections (DOH 2020). The community's water source is a shallow (23 feet deep) dug groundwater production well installed in 1968 with a capacity of 200 gpm (DOH 2020). The well is located in the southwest quarter of the southwest quarter of Section 27, Township 30 North, Range 6 East, in the Pilchuck subbasin. The shallow completion depth of the Lochaven Water System groundwater well suggests hydraulic connection with the Pilchuck River is possible. The PUD sources its water primarily from the City of Everett system. The City of Everett primarily sources its water from Spada Lake. Existing PUD transmission lines border Lochaven to the west and north.

Quantitative or qualitative assessment of how the project will function. Show how offset volume(s) were calculated.
The Lochaven Water System's water right consists of the following:

Groundwater Certificate G1-*09986CWRIS – Issued to Evergreen Group No. 3 on August 5, 1971. This certificate specifies an instantaneous quantity (Qi) of 100 gpm and an annual quantity (Qa) of 42 AFY.

According to the Lochaven Water System Water Use Efficiency Reports, the water system's total annual water use during the period from 2010 to 2019 averaged 9,562,481 gallons per year (29 AFY) (DOH 2020). During the last 5 years, the highest annual use occurred during 2018, when annual use was 11,428,300 gallons (35.1 AFY). The estimated water offset to the Pilchuck River is 12.7 AFY, based on the estimated consumptive use. An extent and validity determination by Ecology would be required to determine the actual quantity available for acquisition.

DOH indicates that the Lochaven Water System serves a residential population of 225 people with 83 calculated connections. Utilizing these numbers results in an estimated 15.1 AFY for indoor use (60 gpd x

225 people = 13,500 gpd or 15.1 AFY). Assuming the remaining quantity is used for outdoor use results in an estimated 13.9 AFY for outdoor water use (29 AFY – 15.1 AFY = 13.9 AFY). Consumptive use rates of 10 percent indoor use and 80 percent outdoor use were applied to the respective indoor and outdoor quantities, for a total consumptive use estimate of 12.7 AFY (15.1 AFY indoor use * 0.1 indoor consumptive use rate + 13.9 AFY outdoor use * 0.8 outdoor consumptive use rate = 12.7 AFY).

This project is centered on the cessation of withdrawal from an aquifer in hydraulic connection with the Pilchuck River and a commensurate increase in water obtained from the PUD. Water provided from the PUD to the Lochaven Water System would come from Lake Stevens area groundwater water rights (25 percent) and Spada Reservoir (75 percent).

This estimate assumes that groundwater production from Lochaven is terminated as a result of this project. The estimate also assumes 100 percent streamflow depletion (that is, the amount of water removed from the Skykomish River as a result of pumping is equivalent to the pumping volume, not counting return flows). This estimate is also based on the full amount listed on the water right certificates and would need to be evaluated if this project moves forward.

The reduction in groundwater withdrawal from the water system would presumably require the City of Everett to increase their diversion from certificated rights to supply this community. Everett has sufficient water rights (both inchoate and beneficially used rights) to satisfy this projected volume.

Conceptual-level map and drawings of the project and location.

See Figure 7 for a map of the site location.

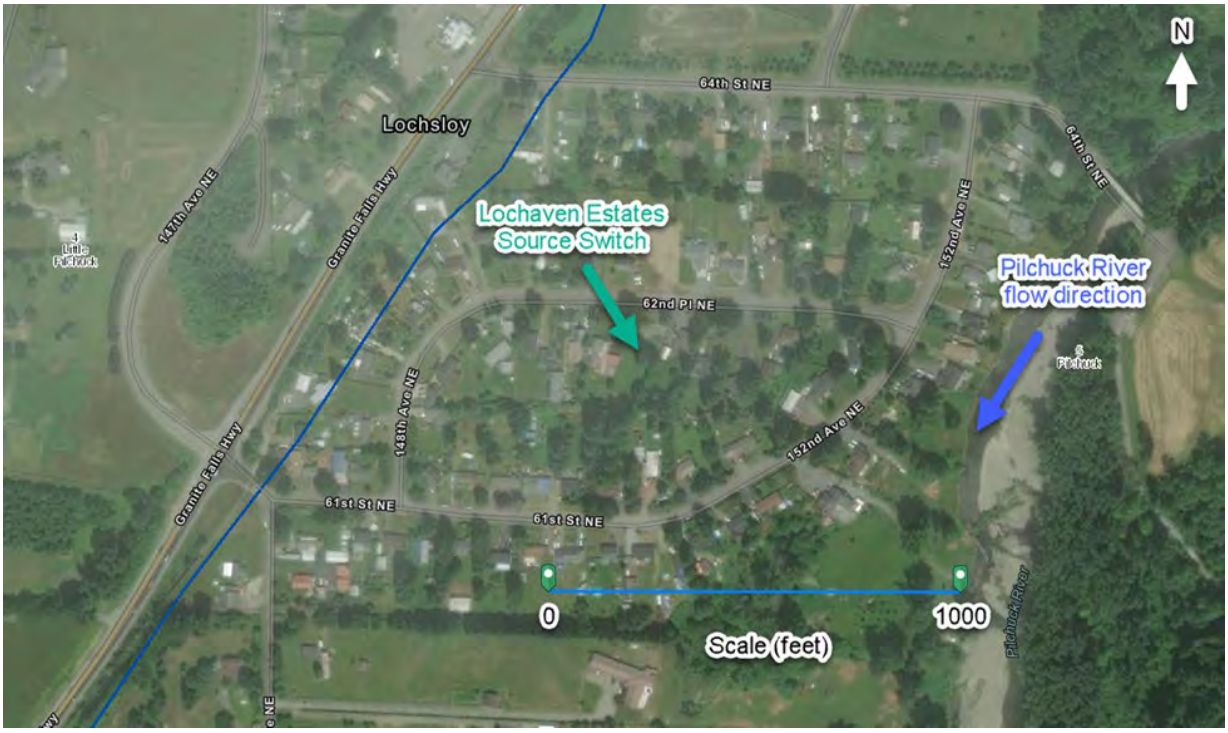

Figure 7. Lochaven Estates

Description of the anticipated spatial distribution of likely benefits.

The project is expected to provide streamflow benefits in the Pilchuck River (including portions of the Little Pilchuck Subbasin) and downstream areas. The project offset is anticipated to occur near River Mile 15, approximately 10.5 linear miles from the confluence with the mainstem Snohomish River.

Performance goals and measures.

The performance goals are to increase streamflow within the Pilchuck River by terminating the pumping of near-river groundwater for water supply. Performance can be directly measured by the quantity of water obtained by the water system from the PUD and the reduction in groundwater pumping by the Lochaven Water System.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The Pilchuck subbasin is inhabited by Chinook, Sockeye, Coho, Chum, Pink, steelhead, Bull Trout, Coastal Cutthroat Trout and rainbow Trout (WDFW 2020a and 2020b). Chinook, steelhead and Bull Trout are priority species, protected by the ESA.

Identification of anticipated support and barriers to completion.

This project is believed to be in alignment with the goals of the Streamflow Restoration Law. Source switch projects are one of the identified project types that could address new consumptive water use and contribute to achieving Net Ecological Benefit.

Barriers to completion include the following:

- Potential reluctance from Lochaven Water System leadership to release their water right and/or control of their water supply.
- Potential reluctance from Lochaven Estates residents to a possible increase in water rates.

Potential budget and O&M costs.

The primary cost associated with this source switch are: (1) the costs associated with connecting the PUD water conveyance to Lochaven; and (2) the cost to purchase the Lochaven system water right for permanent instream flow benefit.

The estimated budget required to connect to the PUD system is between $400,000 and $1.6m depending upon whether the Lochaven system would like to wholesale water from the PUD or have the PUD take over and upgrade the system, respectively. The estimate for the PUD to provide wholesale service to Lochaven would include the cost to install the necessary master meter, pressure reducing valve, complete the connection(s) between the two systems, and payment of the PUD's General Facilities Charge (GFC). The estimate for the PUD to take over the Lochaven system would include the purchase price of the private water system, payment of the GFC, replacement of the system's aging and insufficiently sized two inch distribution lines with new eight inch ductile iron mains, installation of new meters, installation of fire hydrants, and connection into the PUD's mains to the north and southwest side of the Lochaven system.

The water rights owned by Lochaven that could be released as a component of this project have value. A cost evaluation would be required to estimate a value for the Lochaven water right portfolio. For context, WestWater Research (2019) tabulated 11 water right sales in the State of Washington during the period from 2010 to 2017. The unit price per AFY ranged from $1,500 to $6,505. For Lochaven's

Certificate G1-*09986CWRIS and its Qa of 42 AFY, this equates to a value in the range of $63,000 to $273,210.

The primary ongoing cost associated with this source switch for the City is purchase of water from the PUD, which would be dependent on the negotiated rate. Assuming a rate of $3.24 per 100 cubic feet (PUD's existing commodity rate for commercial customers) and an annual volume of 9,562,481 gallons, the associated fee would be about $41,000/yr. This ongoing cost is anticipated to be covered by ratepayers.

Anticipated durability and resiliency.

In this context, durability refers to the capacity of the source switch project to maintain the estimated water offset over time and despite changing external conditions (which could include seasonal variation in streamflow, seasonal and/or long-term fluctuation in regional groundwater elevation, adjacent land use changes, and/or other factors). We anticipate that the planned project will be durable, based on the following:

- The new water source would be reliable, based on a certificated water right, and not subject to interruption.
- The new source is associated with a purveyor with sufficient inchoate water rights to support the source switch on a long-term basis.
- The conveyance would be precisely maintained through engineering controls and conveyed with minimal loss to the end user.
- Seasonal streamflow variation and/or groundwater table fluctuation would have negligible impact on project function.
- Land use changes would have negligible impact on project function.

Herein, resiliency refers to the capacity of the project to maintain the estimated water offset despite the impacts of climate change. Within the watershed, climate change could result in an increase in seasonal temperature, a decrease in summer precipitation, an increase in winter rainfall, a decrease in winter snowfall and/or spring snowpack, an increase in the frequency and/or intensity of storm events, an increase in wildfires, an increase in sea level, or other impacts. We anticipate that the planned project would be resilient to the potential impacts of climate change based on the following:

- The new source will not be impacted by drought or other climatic conditions.
- The project conveyance can be engineered and constructed in a manner that is resilient to flood events.
- Wildfire damage likely would not impact project function and the anticipated water offset.
- Sea level increase would not impact project function.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Snohomish PUD has been identified as the project sponsor and has started conversations with the Lochaven Estates. This project is in the conceptual development stage.

Documentation of sources, methods, and assumptions.

GeoEngineers, Inc. (GeoEngineers) and NHC. 2020. WRIA 7 Consumptive Use Estimates – Final Draft. Technical memorandum prepared for Washington State Department of Ecology. January 2020.

Washington State Department of Fish and Wildlife (WDFW). 2020a. Salmonscape Mapping of Fish Distribution. http://apps.wdfw.wa.gov/salmonscape/

WDFW. 2020b. Statewide Washington Integrated Fish Distribution (SWIFD). http://geo.wa.gov/datasets/4ed1382bad264555b018cc8c934f1c01_0

Washington State Department of Health. 2020. Division of Environmental Health Office of Drinking Water, Sentry Internet Home Page. https://fortress.wa.gov/doh/eh/portal/odw/si/Intro.aspx

WestWater Research. 2019. Valuation of a proposed water release agreement. Final report prepared by WestWater Research, Boise, Idaho for the Washington Department of Ecology and Seattle City Light. January 26.

WRIA 7 – Project Description
Three Forks Potential MAR Site

Project Name and Number
MAR in Snoqualmie Watershed (7-USQ-W10)

WRIA 7 WRE Subbasin
Upper Snoqualmie

Narrative Description
One of the potential MAR sites identified by Ecology is located on King County Parks property near North Bend, Washington. The site is located where the North Fork Snoqualmie River and the Middle Fork Snoqualmie River meet to form the Snoqualmie River. This project would augment stream flows by increasing surficial aquifer discharge (baseflow) to the Snoqualmie River above what occurs under existing conditions. The project concept includes diverting surface water annually from the North Fork or Middle Fork Snoqualmie River during high flow periods when water is available. Diverted water would be conveyed from a collector well adjacent to the river (e.g. Ranney Collector well) or through an instream surface water intake and piped to a constructed MAR facility. This diverted surface water infiltrates into the shallow aquifer, is transported down-gradient, and ultimately discharges back to surface water as re-timed groundwater baseflow. The goal of the project is to increase baseflow to the Snoqualmie River during the low flow period (typically late summer and early fall) by recharging the aquifer adjacent to the North Fork Snoqualmie River and providing additional groundwater discharge to the river through MAR.

The site is located in the Upper Snoqualmie River subbasin and is currently covered by farmland and forest. The downstream baseflow benefit will likely be predominately within the Snoqualmie South subbasin due to subbasin proximity and flow direction. The site is located in Section 34, Township 24 North, Range 8 East (Willamette Meridian) and is bounded to the north by the North Fork Snoqualmie River, to the south by the Middle Fork Snoqualmie River, and to the east by 428th Ave SE. Using the Washington State Department of Ecology's online Well Report Viewer database, no domestic water supply wells were identified within a quarter mile of the site.

The project should be specifically designed to enhance streamflows and to avoid a negative impact to ecological functions and/or critical habitat needed to sustain threatened or endangered salmonids.

Quantitative or qualitative assessment of how the project will function. Show how offset volume(s) were calculated.
The proposed MAR facility will result in streamflow benefits to the Snoqualmie River by diverting and temporarily storing a portion of seasonal high flows into the shallow alluvial aquifer. This project is currently conceptual but, based on historic streamflow data, the project could divert surface water from either the North Fork or Middle Fork Snoqualmie River at a rate of approximately one cubic foot per second (cfs) for approximately 155 days between November and January and again between March and June when water is available for beneficial use. The goal of the project is to increase streamflow. The project could divert up to 198 AFY into the MAR facility. This is a preliminary estimate of the quantity of water diverted and timing of diversion, which needs further analysis through a site specific feasibility study. The U.S. Geological Survey (USGS) STRMDEPL "stream deplete" model was used to estimate monthly streamflow augmentation. Generic aquifer parameters were used for the model, but these will

be determined by field measurements during the feasibility study. The greatest benefit from streamflow augmentation is anticipated to occur during low flow periods (typically late summer and early fall). The results of the 30-year run of the stream deplete model are shown in Table 1 below. Even though infiltration will only seasonally occur during the winter, groundwater baseflow discharge benefits will be year-round. Over time, the annual baseflow discharge volume will approach the infiltration volume. Both are the result of the lag time of water moving through an aquifer.

Month	Acre-feet
January	21.53
February	22.21
March	22.29
April	21.00
May	24.12
June	26.15
July	28.67
August	26.89
September	23.38
October	21.73
November	19.70
December	18.88

Table 1. Three Forks Potential MAR Site Stream Deplete Monthly Results

It is anticipated that the MAR facility would be constructed as a buried infiltration gallery or an above ground infiltration basin which will be determined in the future. Year-round groundwater baseflow will be added to actual streamflow in the Snoqualmie River if this project is developed. The temporal distribution and absolute value of those benefits will be estimated during the feasibility study that has to be conducted before a MAR project can proceed to construction and operation. Those streamflow augmentation benefits will continue to discharge to the river after each year's storage window closes because of the lag time of water moving through an aquifer and the distance of the flow path to the river. The rate at which the infiltrated water re-enters the river will vary based on in-situ aquifer parameters that will be tested and modeled during the feasibility study.

It is assumed that this feasibility study will be conducted pursuant with Appendix B of Ecology's Net Ecological Benefit (NEB) guidance (Ecology 2019a) and Appendix D of the Streamflow Restoration Grant application requirements, if funding from Ecology is pursued during a future grant round (Ecology 2019b). All values presented in this project description are for planning purposes and may not represent actual site conditions.

Conceptual-level map and drawings of the project and location.

The site location is shown below in Figure 8. The specific project site and size would be determined during the feasibility study.

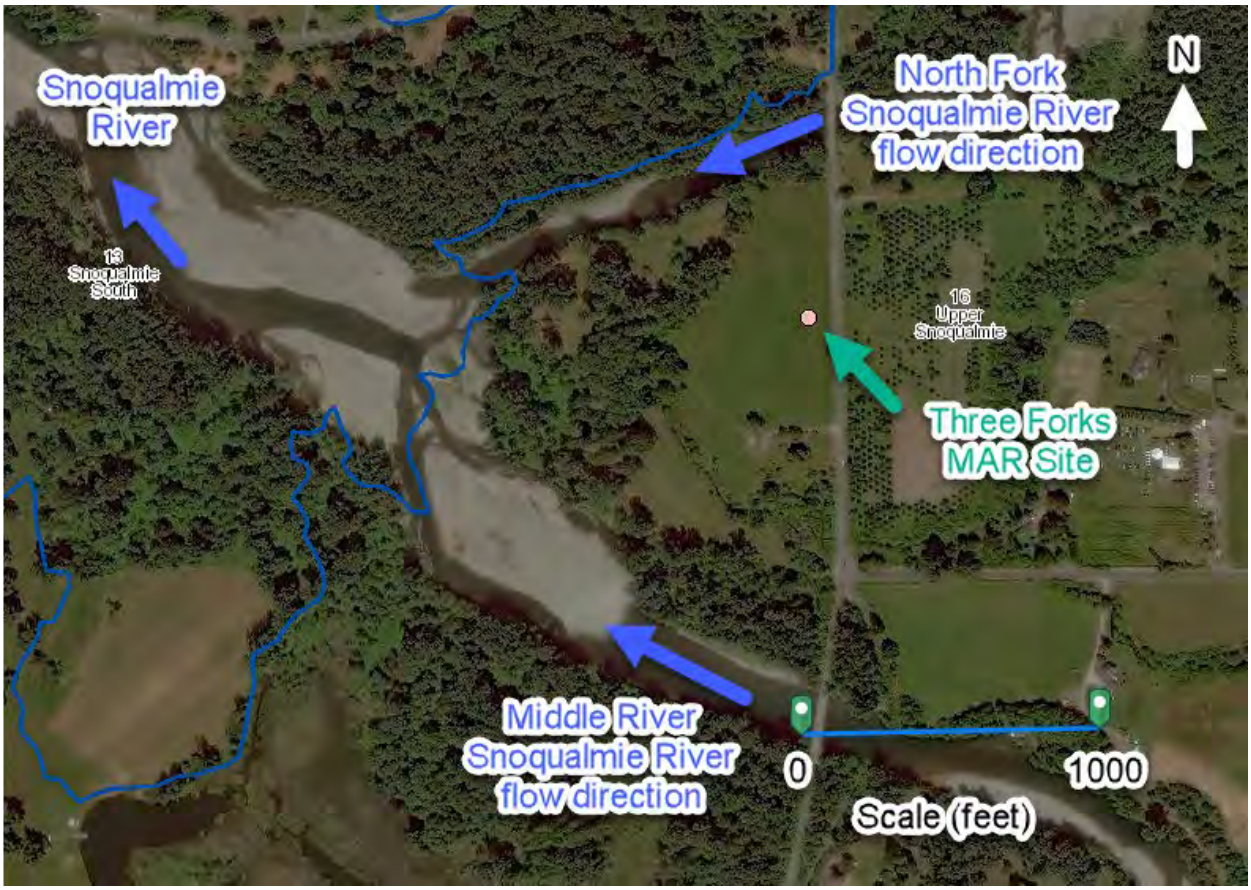

Figure 8. Three Forks MAR Potential Site Location

Description of the anticipated spatial distribution of likely benefits.

The project is expected to provide streamflow benefits in the mainstem of the Snoqualmie River.

Performance goals and measures.

The performance goals are to increase water storage in the alluvial aquifer adjacent to the Snoqualmie River by infiltrating water through the MAR facility to improve baseflow in the Snoqualmie River. The performance measures will be an increase in baseflow in summer in the Snoqualmie River. Specific quantities and timing for surface water diversion would be determined during a feasibility study.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The Upper Snoqualmie River subbasin is inhabited by Coastal Cutthroat Trout and rainbow Trout (WDFW 2020a and 2020b).

Identification of anticipated support and barriers to completion.

This project is believed to be in alignment with the goals of the Streamflow Restoration Law. MAR is one of the identified project types that could address the new consumptive water use and achievement of NEB.

The barriers to completion include funding for feasibility, construction and operation and maintenance costs, and obtaining a water right from the North Fork or Middle Fork Snoqualmie River or the adjacent aquifer for beneficial use at the MAR facility. WWT initiated outreach to the landowner (King County) to

evaluate their level of support for the project and they expressed support for discussing the project concept.

Potential budget and O&M costs.

To be determined.

Anticipated durability and resiliency.

In this context, durability refers to the capacity of the MAR project to maintain the estimated water offset over time and despite changing external conditions (which could include seasonal variation in streamflow, seasonal and/or long-term fluctuation in regional groundwater elevation, adjacent land use changes, and/or other factors). We anticipate that the planned project will be durable, based on the following:

- The water source would be reliable, based on a certificated water right, and while interruptible, the seasonal storage volume should always be available.
- The rate of diversion would be precisely maintained through engineering controls and conveyed with minimal loss to the recharge location.
- Groundwater recharge rate would be maintained through a program of periodic rehabilitation of the infiltration structure(s).
- The subject river reach is perennially gaining and the anticipated range in regional groundwater elevation fluctuation would not impact the groundwater flow field in a manner that significantly reduces the project offset.
- Land use changes external to the project site would have negligible impact on project function.

Herein, resiliency refers to the capacity of the project to maintain the estimated water offset despite the impacts of climate change. Within the watershed, climate change could result in an increase in seasonal temperature, a decrease in summer precipitation, an increase in winter rainfall, a decrease in winter snowfall and/or spring snowpack, an increase in the frequency and/or intensity of storm events, an increase in wildfires, an increase in sea level, and/or other impacts. We anticipate that the planned project would be resilient to the potential impacts of climate change based on the following:

- Diversion would occur during late fall through spring, which generally does not coincide with anticipated (post-climate change) low-streamflow conditions.
- Project function would not be impacted by summer drought conditions.
- The project diversion can be engineered and constructed in a manner that is resilient to flood events.
- Wildfire damage to the MAR site and surrounding area would not impact project function and the anticipated water offset.
- Sea level increase would not impact project function.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Washington Water Trust has been identified as a potential project sponsor.

Documentation of sources, methods, and assumptions.

Department of Ecology. 2019a. Final Guidance for Determining Net Ecological Benefit. GUID-2094 Water Resources Program Guidance. Publication 19-11-079. July 2019.

Department of Ecology. 2019b. Streamflow Restoration Competitive Grants, 2020: Guidance for project applicants. Publication 19-11-089. Revised December 2019. https://fortress.wa.gov/ecy/publications/documents/1911089.pdf

Dragovich, J. D., Littke, H. A., Anderson, M. L., Wessel, G. R., Koger, C. J., Saltonstall, J. H., MacDonald, J. H., Jr., Mahan, S. A., and DuFrane, S. A., 2010, Geologic map of the Carnation 7.5-minute quadrangle, King County, Washington: Washington Division of Geology and Earth Resources, Open File Report 2010-1, scale 1:24,000 https://ngmdb.usgs.gov/Prodesc/proddesc_23051.htm

Geoengineers, Inc. (GeoEngineers). 2020. WRIA 7 Consumptive Use Estimates – Final Draft. Technical memorandum prepared for Washington State Department of Ecology. January 2020.

US Department of Agriculture (USDA), 2020. Web Soil Survey. https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

Washington State Department of Fish and Wildlife (WDFW). 2020a. Salmonscape Mapping of Fish Distribution. http://apps.wdfw.wa.gov/salmonscape/

WDFW. 2020b. Statewide Washington Integrated Fish Distribution (SWIFD). http://geo.wa.gov/datasets/4ed1382bad264555b018cc8c934f1c01_0

WRIA 7 – Project Description
North Bend Potential MAR Site

Project Name and Number
MAR in Snoqualmie Watershed (7-USQ-W10)

WRIA 7 WRE Subbasin
Upper Snoqualmie

Narrative Description
One of the potential MAR sites identified by Ecology is located on City of North Bend property near North Bend, Washington. The site is located on the south side of the South Fork Snoqualmie River about one mile upstream of the confluence with the Snoqualmie River. This project would augment stream flows by increasing surficial aquifer discharge (baseflow) to the South Fork Snoqualmie River above what occurs under existing conditions. The project concept includes diverting surface water annually from the South Fork Snoqualmie River during high flow periods when water is available. Diverted water would be conveyed from a collector well adjacent to the river (e.g. Ranney Collector well) or through an instream surface water intake and piped to a constructed MAR facility. This diverted surface water infiltrates into the shallow aquifer, is transported down-gradient, and ultimately discharges back to surface water as re-timed groundwater baseflow. The goal of the project is to increase baseflow to the South Fork Snoqualmie River during the low flow period (typically late summer and early fall) by recharging the aquifer adjacent to the South Fork Snoqualmie River and providing additional groundwater discharge to the river through MAR.

The site is located in the Upper Snoqualmie subbasin and is currently covered by forest. The site is located in Section 4, Township 23 North, Range 8 East (Willamette Meridian) and is bounded to the north by Mt Si Golf course, to the south by forest and commercial buildings including Calvary Mt Si church and Mt Si gymnastics academy, to the east by the Snoqualmie Valley Trail and to the west by Boalch Avenue NW. Using the Washington State Department of Ecology's online Well Report Viewer database, twelve domestic water supply wells were identified within a quarter mile of the site and are completed at depths ranging between 22 and 129 feet; it is likely that several of the identified wells are located on the opposite side of the South Fork Snoqualmie River (east side) in a nearby housing development.

The project should be specifically designed to enhance streamflows and to avoid a negative impact to ecological functions and/or critical habitat needed to sustain threatened or endangered salmonids.

Quantitative or qualitative assessment of how the project will function. Show how offset volume(s) were calculated.
The proposed MAR facility will result in streamflow benefits to the South Fork Snoqualmie River by diverting and temporarily storing a portion of seasonal high flows into the shallow alluvial aquifer. This project is currently conceptual but, based on historic streamflow data, the project could divert surface water from the South Fork Snoqualmie River at a rate of approximately one cfs for approximately 100 days between November and the end of May when water is available for beneficial use. The goal of the project is to increase streamflow. The project could divert up to 198 AFY into the MAR facility. These are preliminary estimate of the quantity of water diverted and timing of diversion, which needs further analysis through a site specific feasibility study. The USGS STRMDEPL "stream deplete" model was used

to estimate monthly streamflow augmentation. Generic aquifer parameters were used for the model, but these will be determined by field measurements during the feasibility study. The greatest benefit from streamflow augmentation is anticipated to occur during low flow periods (typically late summer and early fall). The results of the 30-year run of the stream deplete model are shown in Table 2 below. Even though infiltration will only seasonally occur during the winter, groundwater baseflow discharge benefits will be year-round. Over time, the annual baseflow discharge volume will approach the infiltration volume; both are the result of the lag time of water moving through an aquifer.

Month	Acre-feet
January	11.65
February	10.61
March	11.37
April	12.76
May	15.83
June	17.47
July	18.35
August	17.32
September	15.54
October	14.84
November	13.73
December	12.39

Table 2. North Bend Potential MAR Site Stream Deplete Monthly Results

It is anticipated that the MAR facility would be constructed as a buried infiltration gallery or an above ground infiltration basin which will be determined in the future. Year-round groundwater baseflow may be added to actual streamflow in the South Fork Snoqualmie River if this project is developed. The temporal distribution and absolute value of those benefits will be estimated during the feasibility study that has to be conducted before a MAR project can proceed to construction and operation. Those streamflow augmentation benefits will continue to discharge to the river after each year's storage window closes because of the lag time of water moving through an aquifer and the distance of the flow path to the river. The rate at which the infiltrated water re-enters the river will vary based on in-situ aquifer parameters that will be tested and modeled during the feasibility study.

It is assumed that this feasibility study will be conducted pursuant with Appendix B of Ecology's Net Ecological Benefit (NEB) guidance (Ecology 2019a) and Appendix D of the Streamflow Restoration Grant application requirements, if funding from Ecology is pursued during a future grant round (Ecology 2019b). All values presented in this project description are for planning purposes and may not represent actual site conditions.

Conceptual-level map and drawings of the project and location.

The site location is shown below in Figure 9. The specific project site and size would be determined during the feasibility study.

Figure 9. North Bend MAR Potential Site Location

Description of the anticipated spatial distribution of likely benefits.

The project is expected to provide streamflow benefits in the South Fork Snoqualmie River and the mainstem of the Snoqualmie River.

Performance goals and measures.

The performance goals are to increase water storage in the alluvial aquifer adjacent to the South Fork Snoqualmie River by infiltrating water through the MAR facility to improve baseflow in the South Fork Snoqualmie River. The performance measures will be an increase in baseflow in summer in the South Fork Snoqualmie River. Specific quantities and timing for surface water diversion would be determined during a feasibility study.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The Upper Snoqualmie subbasin is inhabited by Coastal Cutthroat Trout and rainbow Trout (WDFW 2020a and 2020b).

Identification of anticipated support and barriers to completion.

This project is believed to be in alignment with the goals of the Streamflow Restoration Law. MAR is one of the identified project types that could address the new consumptive water use and achievement of NEB.

The barriers to completion include funding for feasibility, construction and operation and maintenance costs, and obtaining a water right from the South Fork Snoqualmie River or the adjacent aquifer for beneficial use at the MAR facility. GeoEngineers initiated outreach to the landowner (City of North Bend) to evaluate their level of support for the project and they expressed support for discussing the project concept.

Potential budget and O&M costs.

To be determined.

Anticipated durability and resiliency.

In this context, durability refers to the capacity of the MAR project to maintain the estimated water offset over time and despite changing external conditions (which could include seasonal variation in streamflow, seasonal and/or long-term fluctuation in regional groundwater elevation, adjacent land use changes, and/or other factors). We anticipate that the planned project will be durable, based on the following:

- The water source would be reliable, based on a certificated water right, and while interruptible, the seasonal storage volume should always be available.
- The rate of diversion would be precisely maintained through engineering controls and conveyed with minimal loss to the recharge location.
- Groundwater recharge rate would be maintained through a program of periodic rehabilitation of the infiltration structure(s).
- The subject river reach is perennially gaining and the anticipated range in regional groundwater elevation fluctuation would not impact the groundwater flow field in a manner that significantly reduces the project offset.
- Land use changes external to the project site would have negligible impact on project function.

Herein, resiliency refers to the capacity of the project to maintain the estimated water offset despite the impacts of climate change. Within the watershed, climate change could result in an increase in seasonal temperature, a decrease in summer precipitation, an increase in winter rainfall, a decrease in winter snowfall and/or spring snowpack, an increase in the frequency and/or intensity of storm events, an increase in wildfires, an increase in sea level, and/or other impacts. We anticipate that the planned project would be resilient to the potential impacts of climate change based on the following:

- Diversion would occur during late fall through spring, which generally does not coincide with anticipated (post-climate change) low-streamflow conditions.
- Project function would not be impacted by summer drought conditions.
- The project diversion can be engineered and constructed in a manner that is resilient to flood events.
- Wildfire damage to the MAR site and surrounding area would not impact project function and the anticipated water offset.
- Sea level increase would not impact project function.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Washington Water Trust has been identified as a potential project sponsor.

Documentation of sources, methods, and assumptions.

Department of Ecology. 2019a. Final Guidance for Determining Net Ecological Benefit. GUID-2094 Water Resources Program Guidance. Publication 19-11-079. July 2019.

Department of Ecology. 2019b. Streamflow Restoration Competitive Grants, 2020: Guidance for project applicants. Publication 19-11-089. Revised December 2019. https://fortress.wa.gov/ecy/publications/documents/1911089.pdf

Dragovich, J.D., Littke, H.A., Anderson, M.L., Hartog, Renate, Wessel, G.R., DuFrane, S.A., Walsh, T.J., MacDonald, J.H., Jr., Mangano, J.F., and Cakir, Recep. 2009. Geologic map of the Snoqualmie 7.5-minute quadrangle, King County, Washington: Washington Division of Geology and Earth Resources, Geologic Map GM-75. Scale 1:24, 00. https://ngmdb.usgs.gov/Prodesc/proddesc_87491.htm

Geoengineers, Inc. (GeoEngineers). 2020. WRIA 7 Consumptive Use Estimates – Final Draft. Technical memorandum prepared for Washington State Department of Ecology. January 2020.

US Department of Agriculture (USDA), 2020. Web Soil Survey. https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

Washington State Department of Fish and Wildlife (WDFW). 2020a. Salmonscape Mapping of Fish Distribution. http://apps.wdfw.wa.gov/salmonscape/

WDFW. 2020b. Statewide Washington Integrated Fish Distribution (SWIFD). http://geo.wa.gov/datasets/4ed1382bad264555b018cc8c934f1c01_0

WRIA 7 – Project Description
Middle Fork Snoqualmie Potential MAR Site

Project Name and Number
MAR in Snoqualmie Watershed (7-USQ-W10)

WRIA 7 WRE Subbasin
Upper Snoqualmie

Narrative Description
One of the potential MAR sites identified by Ecology is located on Washington State Department of Natural Resources (DNR) State Trust Lands property near Tanner, Washington. The site is located upstream of Tanner along the south side of a bend in the Middle Fork Snoqualmie River. This project would augment stream flows by increasing surficial aquifer discharge (baseflow) to the Middle Fork Snoqualmie River above what occurs under existing conditions. The project concept includes diverting surface water annually during high flow periods water is available. Diverted water would be conveyed from a collector well adjacent to the river (e.g. Ranney Collector well) or through an instream surface water intake and piped to a constructed MAR facility. This diverted surface water infiltrates into the shallow aquifer, is transported down-gradient, and ultimately discharges back to surface water as re-timed groundwater baseflow. The goal of the project is to increase baseflow to the Middle Fork Snoqualmie River during the low flow period (typically late summer and early fall) by recharging the aquifer adjacent to the Middle Fork Snoqualmie River and providing additional groundwater discharge to the river through MAR.

The site is located in the WRIA 7 Upper Snoqualmie subbasin and is currently covered by forest. The site is located in Section 21, Township 21 North, Range 9 East (Willamette Meridian) and is bounded to the north by the Middle Fork Snoqualmie River, to the south by National Forest Development Road NF-5600, to the east by forest, and to the west by sparsely populated single-family homes among forest. Using the Washington State Department of Ecology's online Well Report Viewer database, two domestic water supply wells were identified within approximately a quarter mile of the site and are completed at depths of 272 and 400 feet, respectively.

The project should be specifically designed to enhance streamflows and to avoid a negative impact to ecological functions and/or critical habitat needed to sustain threatened or endangered salmonids.

Quantitative or qualitative assessment of how the project will function. Show how offset volume(s) were calculated.
The proposed MAR facility will result in streamflow benefits to the Middle Fork Snoqualmie River by diverting and temporarily storing a portion of seasonal high flows into the shallow alluvial aquifer. This project is currently conceptual but, based on historic streamflow data, the project could divert surface water from the Middle Fork Snoqualmie River at a rate of approximately one cfs for approximately 100 days between November and the end of May when water is available for beneficial use. The goal of the project is to increase streamflow. The project could divert up to 198 AFY into the MAR facility. These are preliminary estimate of the quantity of water diverted and timing of diversion, which needs further analysis through a site specific feasibility study. The USGS STRMDEPL "stream deplete" model was used to estimate monthly streamflow augmentation. Generic aquifer parameters were used for the model, but these will be determined by field measurements during the feasibility study. The greatest benefit

from streamflow augmentation is anticipated to occur during low flow periods (typically late summer and early fall). The results of the 30-year run of the stream deplete model are shown in Table 3 below. Even though infiltration will only seasonally occur during the winter, groundwater baseflow discharge benefits will be year-round. Over time, the annual baseflow discharge volume will approach the infiltration volume. Both are the result of the lag time of water moving through an aquifer.

Month	Acre-feet
January	8.14
February	7.91
March	14.88
April	21.29
May	26.76
June	23.99
July	19.42
August	15.63
September	12.77
October	11.46
November	10.15
December	8.86

Table 3. Middle Fork Snoqualmie Potential MAR Site Stream Deplete Monthly Results

It is anticipated that the MAR facility would be constructed as a buried infiltration gallery or an above ground infiltration basin which will be determined in the future. Year-round groundwater baseflow may be added to actual streamflow in the Middle Fork Snoqualmie River if this project is developed. The temporal distribution and absolute value of those benefits will be estimated during the feasibility study that has to be conducted before a MAR project can proceed to construction and operation. Those streamflow augmentation benefits may continue to discharge to the river after each year's storage window closes because of the lag time of water moving through an aquifer and the distance of the flow path to the river. The rate at which the infiltrated water re-enters the river will vary based on in-situ aquifer parameters that will be tested and modeled during the feasibility study.

It is assumed that this feasibility study will be conducted pursuant with Appendix B of Ecology's Net Ecological Benefit (NEB) guidance (Ecology 2019a) and Appendix D of the Streamflow Restoration Grant application requirements, if funding from Ecology is pursued during a future grant round (Ecology 2019b). All values presented in this project description are for planning purposes and may not represent actual site conditions.

Conceptual-level map and drawings of the project and location.

The site location is shown below in Figure 10. The specific project site and size would be determined during the feasibility study.

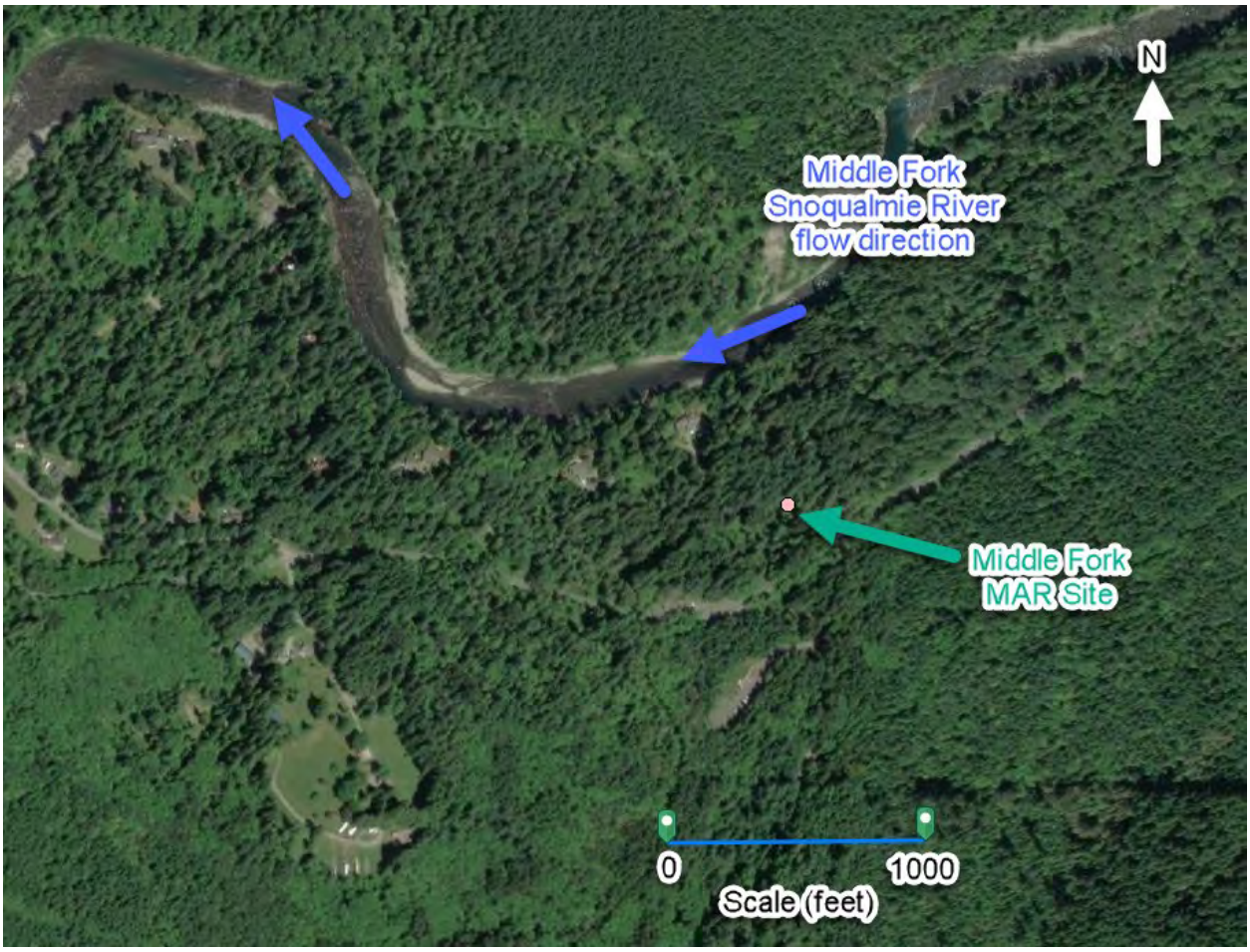

Figure 10. Middle Fork Snoqualmie MAR Potential Site Location

Description of the anticipated spatial distribution of likely benefits.

The project is expected to provide streamflow benefits in the Middle Fork Snoqualmie River.

Performance goals and measures.

The performance goals are to increase water storage in the alluvial aquifer adjacent to the Middle Fork Snoqualmie River by infiltrating water through the MAR facility to improve baseflow in the Middle Fork Snoqualmie River. The performance measures will be an increase in baseflow in summer in the Middle Fork Snoqualmie River. Specific quantities and timing for surface water diversion would be determined during a feasibility study.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The Upper Snoqualmie subbasin is inhabited by Coastal Cutthroat Trout and rainbow Trout (WDFW 2020a and 2020b).

Identification of anticipated support and barriers to completion.

This project is believed to be in alignment with the goals of the Streamflow Restoration Law. MAR is one of the identified project types that could address the new consumptive water use and achievement of NEB.

The barriers to completion include funding for feasibility, construction and operation and maintenance costs, and obtaining a water right from the Middle Fork Snoqualmie River or the adjacent aquifer for beneficial use at the MAR facility. WWT initiated outreach to the landowner (Washington State Department of Natural Resources) to evaluate their level of support for the project and they expressed support for discussing the project concept.

Potential budget and O&M costs.

To be determined.

Anticipated durability and resiliency.

In this context, durability refers to the capacity of the MAR project to maintain the estimated water offset over time and despite changing external conditions (which could include seasonal variation in streamflow, seasonal and/or long-term fluctuation in regional groundwater elevation, adjacent land use changes, and/or other factors). We anticipate that the planned project will be durable, based on the following:

- The water source would be reliable, based on a certificated water right, and while interruptible, the seasonal storage volume should always be available.
- The rate of diversion would be precisely maintained through engineering controls and conveyed with minimal loss to the recharge location.
- Groundwater recharge rate would be maintained through a program of periodic rehabilitation of the infiltration structure(s).
- The subject river reach is perennially gaining and the anticipated range in regional groundwater elevation fluctuation would not impact the groundwater flow field in a manner that significantly reduces the project offset.
- Land use changes external to the project site would have negligible impact on project function.

Herein, resiliency refers to the capacity of the project to maintain the estimated water offset despite the impacts of climate change. Within the watershed, climate change could result in an increase in seasonal temperature, a decrease in summer precipitation, an increase in winter rainfall, a decrease in winter snowfall and/or spring snowpack, an increase in the frequency and/or intensity of storm events, an increase in wildfires, an increase in sea level, and/or other impacts. We anticipate that the planned project would be resilient to the potential impacts of climate change based on the following:

- Diversion would occur during late fall through spring, which generally does not coincide with anticipated (post-climate change) low-streamflow conditions.
- Project function would not be impacted by summer drought conditions.
- The project diversion can be engineered and constructed in a manner that is resilient to flood events.
- Wildfire damage to the MAR site and surrounding area would not impact project function and the anticipated water offset.
- Sea level increase would not impact project function.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Washington Water Trust has been identified as a potential project sponsor for this project.

Documentation of sources, methods, and assumptions.

Department of Ecology. 2019a. Final Guidance for Determining Net Ecological Benefit. GUID-2094 Water Resources Program Guidance. Publication 19-11-079. July 2019.

Department of Ecology. 2019b. Streamflow Restoration Competitive Grants, 2020: Guidance for project applicants. Publication 19-11-089. Revised December 2019. https://fortress.wa.gov/ecy/publications/documents/1911089.pdf

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Geoengineers, Inc. (GeoEngineers). 2020. WRIA 7 Consumptive Use Estimates – Final Draft. Technical memorandum prepared for Washington State Department of Ecology. January 2020.

US Department of Agriculture (USDA), 2020. Web Soil Survey. https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

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WRIA 7 – Project Description
NF-5700 Potential MAR Site

Project Name and Number
MAR in Snoqualmie Watershed (7-USQ-W10)

WRIA 7 WRE Subbasin
Upper Snoqualmie

Narrative Description
One of the potential MAR sites identified by Ecology is located on Washington State Department of Natural Resources (DNR) State Trust Lands property near the headwaters of the North Fork Snoqualmie River. This project would augment stream flows by increasing surficial aquifer discharge (baseflow) to the North Fork Snoqualmie River above what occurs under existing conditions. The project concept includes diverting surface water annually from the North Fork Snoqualmie River during high flow periods when water is available. Diverted water would be conveyed from a collector well adjacent to the river (e.g. Ranney Collector well) or through an instream surface water intake and piped to a constructed MAR facility. This diverted surface water infiltrates into the shallow aquifer, is transported down-gradient, and ultimately discharges back to surface water as re-timed groundwater baseflow. The goal of the project is to increase baseflow to the North Fork Snoqualmie River during the low flow period (typically late summer and early fall) by recharging the aquifer adjacent to the North Fork Snoqualmie River and providing additional groundwater discharge to the river through MAR. This site is located near the headwaters and streamflow benefits would accrue over a large reach of the river. The site is also located at a higher elevation in the watershed, which could mean that cold winter temperatures could reduce its effective recharge period.

The site is located in the WRIA 7 Upper Snoqualmie subbasin and is currently covered by forest. The site is located in Section 11, Township 25 North, Range 9 East (Willamette Meridian) and is bounded to the north by National Forest Development Road NF-5700, to the east by National Forest Development Road NF-5720, and to the south and west by forest. Using the Washington State Department of Ecology's online Well Report Viewer database, no domestic water supply wells were identified within approximately a quarter mile of the site.

The project should be specifically designed to enhance streamflows and to avoid a negative impact to ecological functions and/or critical habitat needed to sustain threatened or endangered salmonids.

Quantitative or qualitative assessment of how the project will function. Show how offset volume(s) were calculated.
The proposed MAR facility will result in streamflow benefits to the North Fork Snoqualmie River by diverting and temporarily storing a portion of seasonal high flows into the shallow alluvial aquifer. This project is currently conceptual but, based on historic streamflow data, to the project could divert surface water from the North Fork Snoqualmie River at a rate of approximately one cfs for approximately 155 days between mid-November and mid-January and again from the end of March to the end of June when water is available for beneficial use. The goal of the project is to increase streamflow. The project could divert up to 307 AFY into the MAR facility. This is a preliminary estimate of the quantity of water diverted and timing of diversion, which needs further analysis through a site specific feasibility study. The USGS STRMDEPL "stream deplete" model was used to estimate monthly

streamflow augmentation. Generic aquifer parameters were used for the model, but these will be determined by field measurements during the feasibility study. The greatest benefit from streamflow augmentation is anticipated to occur during low flow periods (typically late summer and early fall). The results of the 30-year run of the stream deplete model are shown in Table 4 below. Even though infiltration will only occur seasonally, groundwater baseflow discharge benefits will be year-round. Over time, the annual baseflow discharge volume will approach the infiltration volume. Both are the result of the lag time of water moving through an aquifer.

Month	Acre-feet
January	20.27
February	19.74
March	21.37
April	20.58
May	21.17
June	20.87
July	22.36
August	23.11
September	22.47
October	22.80
November	22.09
December	20.62

Table 4. NF5700 Potential MAR Site Stream Deplete Monthly Results

It is anticipated that the MAR facility would be constructed as a buried infiltration gallery or an above ground infiltration basin which will be determined in the future. Year-round groundwater baseflow may be added to actual streamflow in the North Fork Snoqualmie River if this project is developed. The temporal distribution and absolute value of those benefits will be estimated during the feasibility study that has to be conducted before a MAR project can proceed to construction and operation. Those streamflow augmentation benefits will continue to discharge to the river after each year's storage window closes because of the lag time of water moving through an aquifer and the distance of the flow path to the river. The rate at which the infiltrated water re-enters the river will vary based on in-situ aquifer parameters that will be tested and modeled during the feasibility study.

It is assumed that this feasibility study will be conducted pursuant with Appendix B of Ecology's Net Ecological Benefit (NEB) guidance (Ecology 2019a) and Appendix D of the Streamflow Restoration Grant application requirements, if funding from Ecology is pursued during a future grant round (Ecology 2019b). All values presented in this project description are for planning purposes and may not represent actual site conditions.

Conceptual-level map and drawings of the project and location.

The site location is shown below in Figure 11. The specific project site and size would be determined during the feasibility study.

Figure 11. NF5700 MAR Potential Site Location

Description of the anticipated spatial distribution of likely benefits.

The project is expected to provide streamflow benefits in the North Fork Snoqualmie River and may also provide streamflow benefits to Sunday Creek, a tributary to the North Fork Snoqualmie River.

Performance goals and measures.

The performance goals are to increase water storage in the alluvial aquifer adjacent to the North Fork Snoqualmie River by infiltrating water through the MAR facility to improve baseflow in the North Fork Snoqualmie River. The performance measures will be an increase in baseflow in summer in the North Fork Snoqualmie River. Specific quantities and timing for surface water diversion would be determined during a feasibility study.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The Upper Snoqualmie subbasin is inhabited by Coastal Cutthroat Trout and rainbow Trout (WDFW 2020a and 2020b).

Identification of anticipated support and barriers to completion.

This project is believed to be in alignment with the goals of the Streamflow Restoration Law. MAR is one of the identified project types that could address the new consumptive water use and achievement of NEB.

The barriers to completion include funding for feasibility, construction and operation and maintenance costs, and obtaining a water right from the North Fork Snoqualmie River or the adjacent aquifer for beneficial use at the MAR facility. WWT initiated outreach to the landowner (Washington State Department of Natural Resources) to evaluate their level of support for the project and they expressed support for continuing discussions of the project concept.

Potential budget and O&M costs.

To be determined.

Anticipated durability and resiliency.

In this context, durability refers to the capacity of the MAR project to maintain the estimated water offset over time and despite changing external conditions (which could include seasonal variation in streamflow, seasonal and/or long-term fluctuation in regional groundwater elevation, adjacent land use changes, and/or other factors). We anticipate that the planned project will be durable, based on the following:

- The water source would be reliable, based on a certificated water right, and while interruptible, the seasonal storage volume should always be available.
- The rate of diversion would be precisely maintained through engineering controls and conveyed with minimal loss to the recharge location.
- Groundwater recharge rate would be maintained through a program of periodic rehabilitation of the infiltration structure(s).
- The subject river reach is perennially gaining and the anticipated range in regional groundwater elevation fluctuation would not impact the groundwater flow field in a manner that significantly reduces the project offset.
- Land use changes external to the project site would have negligible impact on project function.

Herein, resiliency refers to the capacity of the project to maintain the estimated water offset despite the impacts of climate change. Within the watershed, climate change could result in an increase in seasonal temperature, a decrease in summer precipitation, an increase in winter rainfall, a decrease in winter snowfall and/or spring snowpack, an increase in the frequency and/or intensity of storm events, an increase in wildfires, an increase in sea level, and/or other impacts. We anticipate that the planned project would be resilient to the potential impacts of climate change based on the following:

- Diversion would occur during late fall through spring, which generally does not coincide with anticipated (post-climate change) low-streamflow conditions.
- Project function would not be impacted by summer drought conditions.
- The project diversion can be engineered and constructed in a manner that is resilient to flood events.
- Wildfire damage to the MAR site and surrounding area would not impact project function and the anticipated water offset.
- Sea level increase would not impact project function.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Washington Water Trust has been identified as a potential project sponsor.

Documentation of sources, methods, and assumptions.

Department of Ecology. 2019a. Final Guidance for Determining Net Ecological Benefit. GUID-2094 Water Resources Program Guidance. Publication 19-11-079. July 2019.

Department of Ecology. 2019b. Streamflow Restoration Competitive Grants, 2020: Guidance for project applicants. Publication 19-11-089. Revised December 2019. https://fortress.wa.gov/ecy/publications/documents/1911089.pdf

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US Department of Agriculture (USDA), 2020. Web Soil Survey. https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

Washington State Department of Fish and Wildlife (WDFW). 2020a. Salmonscape Mapping of Fish Distribution. http://apps.wdfw.wa.gov/salmonscape/

WDFW. 2020b. Statewide Washington Integrated Fish Distribution (SWIFD). http://geo.wa.gov/datasets/4ed1382bad264555b018cc8c934f1c01_0

WRIA 7 – Project Description
Snoqualmie River Watershed Surface Water Storage

Project Name and Number
Snoqualmie River Watershed Surface Water Storage (7-USQ-W11)

WRIA 7 WRE Subbasin
Upper Snoqualmie, Snoqualmie South, Cherry/Harris

Water Offset
77 AFY

Narrative Description
In 2018, with funding from the Washington Department of Ecology (Ecology), the Snoqualmie Valley Watershed Improvement District (SVWID) initiated a study of the potential for creating small-scale water storage within the Snoqualmie Valley. SVWID completed an assessment of small-scale surface water storage facilities that would be limited in size, with targeted storage capacities generally smaller than 10 acre-feet. The study focused on the lower Snoqualmie River and its tributaries that flow through the SVWID service area from just upstream of Fall City to just downstream of Duvall. Through that study, the need became apparent for a more robust, Comprehensive Storage Study that would assess the potential for a wide range of surface water storage options, including small to large storage opportunities throughout the watershed. Work on the Snoqualmie River Watershed Comprehensive Storage Study was initiated in January 2020. A screening analysis has been completed as the initial step toward completing the Comprehensive Storage Study. The screening analysis was summarized in a draft report circulated to committee members late in July 2020. The screening analysis included review of mapping and existing data, a weighted GIS overlay of data to identify and evaluate potential surface water storage opportunities, a high-level analysis of each storage site based on a wide range of criteria, and scoring and ranking of the sites based on the criteria identified.

The screening analysis identified and evaluated 20 potential water storage projects, as shown in Figure 12. Basins that are closed to future water right appropriations were not considered. Each site has been evaluated at a high level to estimate potential water storage capacity and scored and ranked each site according to a variety of criteria identified for this evaluation. Ten of these sites were selected for further analysis, including landowner outreach and more detailed analysis of hydrology and capacity (see Table 5).

The ten sites selected for further analysis are located in three subbasins within WRIA 7 and range in storage capacity from 77 AFY to more than 3,311 AFY. The sites include off-channel storage reservoirs, on-channel storage reservoirs near the headwaters of tributaries, and projects that would result in raising the level of an existing lake to create additional storage capacity. For this project, it is assumed that one or more of the sites identified for further analysis will be developed creating 77 AFY of water offset, which is the smallest estimated storage capacity of the ten sites. Water would be released during critical low-flow periods to sustain streamflows in critical reaches of the Snoqualmie River and its tributaries and offset future domestic water uses.

Project ID	Subbasin	Description	Property Owner	Estimated Full Water Surface Area (acres)	Estimated Water Storage Volume (AFY)	Description/Type
NFT4	Snoqualmie South	Snoqualmie Timber - NF Tolt (C)	Snoqualmie Timber, LLC	133.6	1,296	Off-channel, Constructed Impoundment, Timber Area
MFK1	Upper Snoqualmie	DNR - MF Snoqualmie	DNR	173.8	3,311	Off-channel, Constructed Impoundment, Near Tributary
TOK3	Snoqualmie South	Klaus Lake	Campbell Global, LLC	50.6	101	Existing Lake, Raise Water Surface 1 to 2 Feet
NFK2	Upper Snoqualmie	Snoqualmie Timber - NF Snoqualmie (B)	Snoqualmie Timber, LLC	47.3	482	Off-channel, Constructed Impoundment, Timberland
TOK2	Snoqualmie South	Bridges Lake	Snoqualmie Timber, LLC	40.0	80	Existing Lake, Raise Water Surface 1 to 2 Feet
CCK2	Cherry/Harris	Cherry Lake	DNR	22.2	173	Existing Lakes, Expand with Constructed Impoundment
TOK4	Snoqualmie South	Black Lake	Snoqualmie Timber, LLC	38.4	77	Existing Lake, Raise Water Surface 1 to 2 Feet
NFK1	Upper Snoqualmie	Snoqualmie Timber – NF Snoqualmie (A)	Snoqualmie Timber, LLC	47.3	449	Off-channel, Constructed Impoundment, Near Tributary
NFT1	Snoqualmie South	DNR – NF Tolt (B)	DNR	11.6	113	Off-channel, Constructed Impoundment
NFT3	Snoqualmie South	NDR – NF Tolt (D)	DNR	11.5	132	Impoundment on Upstream End of Small Tributary

Table 5. Summary of Potential Storage Sites Identified for Further Analysis

Quantitative or qualitative assessment of how the project will function. Show how offset volume(s) were calculated.

The Snoqualmie River is a critical resource that provides water for multiple needs, including water supply for domestic water use, irrigation water for agriculture, and instream flows that support fish and wildlife. The Snoqualmie River and its tributaries are home to several fish species that are listed as threatened or endangered under the ESA. ESA-listed species include Puget Sound Chinook Salmon (*Oncorhynchus tshawytscha*), Bull Trout (*Salvelinus confluentus*), and Puget Sound steelhead (*Oncorhynchus mykiss*). The river and its tributaries also support a variety of other fish and wildlife species. Preserving and augmenting streamflows is critical to supporting these species.

Like other rivers in western Washington, the Snoqualmie River is influenced by seasonal rains; mountain snowmelt; and a relatively dry, warm summer. Heavy autumn and winter rains cause frequent flooding in the Snoqualmie River Valley. Peak flow rates occur during these warm, heavy rain events. Higher than average flow conditions persist through the late summer and spring, as snowmelt influences the hydrograph throughout the watershed. The late summer brings warmer, drier weather and low-flow conditions that prevail at the time when water is needed most for both instream and out-of-stream uses. With changing climate and shifting weather patterns, the availability of Snoqualmie River flows to meet instream and out of stream needs is not as certain.

Water storage has become an increasingly valuable tool for water resource managers. Water stored during high-flow periods in the autumn, winter, and spring can be released during the late summer, when water is needed to provide additional and more reliable water supply and to augment streamflows to support fish and wildlife. Carefully planned, well-designed water storage allows water resource managers to retime flows to benefit instream flows, address water supply concerns, and improve habitat conditions for fish and other species.

The proposed project would be designed to capture and store water from one of the tributaries of the Snoqualmie River during periods of high flow in the fall, winter, and spring for release during periods of low flow in the late summer. This project will consist of implementation of one or more storage projects identified in the Comprehensive Storage Study. The projects are currently only developed to the conceptual level. Additional work will be required to verify the capacity, release rate, and other key characteristics of specific projects. However, based on the initial work that has been done, it is anticipated that water storage can be implemented to store between 77 AFY and 3,311 AFY for release during the late summer to sustain instream flows and offset future domestic water use. These volumes would allow for release of an average 1.4 cfs to 59.6 cfs if released over a four-week low flow period, or 0.5 cfs to 19.9 cfs if released over a twelve-week low flow period.

Conceptual-level map and drawings of the project and location.

The site location is the Snoqualmie River Watershed. A map of potential storage sites is shown below in Figure 12. Sites elected for further analysis are shown in Table 5 and underlined in yellow on Figure 12.

Figure 12. Overview of potential storage sites

Note: Sites identified for further analysis are underlined in yellow

Description of the anticipated spatial distribution of likely benefits.

The project is expected to provide streamflow benefits in the tributaries and in the mainstem Snoqualmie River downstream of the storage projects that are moved forward through implementation.

Performance goals and measures.

The primary performance goals are to increase surface water storage in the Snoqualmie River Watershed by at least 77 acre-feet of storage that would be released when needed to benefit instream flows and offset domestic water use. The performance measures will be an increase in baseflow in summer in the tributaries and main stem Snoqualmie River downstream of storage projects that are implemented. An additional performance goal is to minimize or mitigate for any impacts on water quality. Impacts on water quality will also be measured in the tributaries and main stem Snoqualmie River downstream of storage projects that are implemented.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The Snoqualmie River and its tributaries are home to several fish species that are listed as threatened or endangered under the ESA. ESA-listed species include Puget Sound Chinook Salmon, Bull Trout, and Puget Sound steelhead. The river and its tributaries also support a variety of other fish and wildlife species. Preserving and augmenting streamflows is critical to supporting these species. Portions of the upper Snoqualmie Subbasin are not accessible to these ESA-listed anadromous species, but do provide habitat for resident fish species, such as Coastal Cutthroat Trout and rainbow Trout (WDFW 2020a and 2020b).

Identification of anticipated support and barriers to completion.

This project is believed to be in alignment with the goals of the Streamflow Restoration Law. Surface water storage has been used as an effective water management tool that allows for water to be captured and stored during high flow periods and release of water to sustain streamflows when water is most needed for both instream and out-of-stream needs.

The barriers or challenges to implementation of this project may include funding, technical feasibility, land acquisition, site accessibility, potential permitting or environmental impact complications, construction and operation and maintenance costs, and the need to secure water rights for the diversion and storage of water.

Potential budget and O&M costs.

Detailed budget and operations and maintenance (O&M) costs are yet to be determined. Initial project implementation costs have been estimated at a very high level based on the concepts developed for the screening analysis. The overall estimated project cost ranges from approximately $1.2 million, for 77 acre-feet of storage, to $112 million, for 3,311 acre-feet of storage. The median estimated project cost of the 20 project sites that were identified by the screening analysis is approximately $33,145 per acre-foot of water stored. The estimated project cost for the largest project evaluated (3,311 acre-feet of storage) is approximately $33,961 per acre-foot of water stored.

Anticipated durability and resiliency.

It is anticipated that the durability of the project, as reflected in its ability to maintain the estimated water offset and flow benefits over time and despite of changing external conditions, will be very strong if storage facilities are well-maintained and carefully operated and maintained to provide those benefits. We anticipate that the proposed project will be very durable, based on the following:

- Selection of water storage projects for implementation will consider the magnitude and variability of water available to fill each reservoir.
- It is anticipated that water storage will be constructed in areas that will have high potential for annual refill.
- The water storage will require a water right to divert and store water. While the water right may be interruptible, storage will take advantage of the seasonal variation of water flow availability, capturing and storing water during times of high flow when it is available, and releasing water when it is critical to supporting other water needs.

It is also anticipated that water storage will improve the resiliency of water resources in the Snoqualmie River Watershed, as reflected in the ability to maintain the estimated water offset and flow benefits over time despite the impacts of climate change. Within the watershed, climate change could result in an increase in seasonal temperature, a decrease in summer precipitation, an increase in winter rainfall, a decrease in winter snowfall and/or spring snowpack, an increase in the frequency and/or intensity of storm events, an increase in wildfires, an increase in sea level, and/or other impacts. We anticipate that the planned project would be resilient and would improve the resiliency of water resources in the Snoqualmie River Watershed, based on the following:

- Diversion and storage of water would occur during late fall through spring, which generally does not coincide with anticipated (post-climate change) low-streamflow conditions.
- Water storage would make additional water available for offset and sustain instream flows during the late summer, when the impacts of climate change are anticipated to have the most significant impact on water resources.
- Water storage may have potential to capture peak flood flows, which already impact the Snoqualmie River Valley and those impacts are anticipated to increase as a result of climate change.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Snoqualmie Valley Watershed Improvement District has been identified as the project sponsor and is engaged in completing the Comprehensive Storage Study.

Documentation of sources, methods, and assumptions.

Anchor QEA (Anchor QEA, LLC), 2018. Draft Memorandum to: Snoqualmie Valley Watershed Improvement District. Regarding: Screening Criteria and Methodology. September 11, 2018.

Anchor QEA, 2019a. Memorandum to: Snoqualmie Valley Watershed Improvement District. Regarding: SVWID Small-Scale Storage Screening Analysis of Potential Storage Sites. March 6, 2019.

Anchor QEA, 2019b. Memorandum to: Snoqualmie Valley Watershed Improvement District. Regarding: SVWID Foster Pond Storage Project – Conceptual Design. October 29, 2019.

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Anchor QEA and Aspect Consulting, 2020. *Comprehensive Storage Study Work Plan*.

Department of Ecology. 2019a. Final Guidance for Determining Net Ecological Benefit. GUID-2094 Water Resources Program Guidance. Publication 19-11-079. July 2019.

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Snohomish Basin Salmon Recovery Forum. 2005. Snohomish County Snohomish River Basin Salmon Conservation Plan. June 2005. Referred to as the Salmon Plan.

WRIA 7 – Project Description
Jones Creek Relocation & Wetland Enhancement

Project Name and Number
Jones Creek Relocation & Wetland Enhancement (7-QA-H1[2])

WRIA 7 WRE Subbasin
Quilceda-Allen

Narrative Description
This project includes water storage, riparian habitat, and fish habitat improvements on Jones Creek near the mouth of the Snohomish River, within the City of Marysville. Jones Creek drains directly into the recently restored 400-acre Qwuloolt Estuary located a quarter-mile downstream of the proposed restoration site. This basin has water impairments associated with local development and is used by critical salmonid species.

This project intends to address issues associated with urbanization including flashy flows, loss of riparian habitat, channelization, poor water quality, and a reduction in summer base flows by creating a 780-foot long meandering channel with large wood debris (LWD) installations to replace the existing channelized and heavily incised stream segment. The project will also include riparian reforestation and the creation of several wetland depressions for water storage and recharge. These restoration actions will benefit documented Chinook, Coho, Chum, and Pink Salmon as well as Bull, Cutthroat, and steelhead trout. Chinook Salmon and Bull Trout are priority species protected under the ESA.

Quantitative or qualitative assessment of how the project will function.
The project will create approximately 780 linear feet of new meandering stream channel, four wetland surface water infiltration ponds (0.1 acres) isolated from the stream, five off-channel rearing water infiltration ponds (0.5 acres) directly connected to the stream, 3.6 acres of restored riparian buffer, and 65 LWD installations. Overall, the project is anticipated to provide a water offset potential of approximately 3.7 AFY. No water offset is assumed for purposes of this watershed plan.

The new channel morphology and LWD installations will create higher quality fish habitat and a more resilient channel, better suited to handle the effects of urbanization. The new channel will have significantly more floodplain interaction, which will buffer high flows by storing and absorbing floodwaters. The addition of LWD will create pools for fish refuge and increase hyporheic interaction, improving summer base flows and acting as a source of cool water input.

The project will add approximately 0.6 acres of constructed wetland. The wetland depressions will have a water depth of approximately 10-12 feet to allow temperature stratification in the summer. Additional LWD will be anchored and submerged in the off-channel wetland areas to provide aquatic habitat for macroinvertebrates and rearing fish. Stream flow inlet and outlet locations will be oriented to always replenish the depressions and to prevent fish stranding. The wetland depressions will improve storage and recharge the shallow aquifer, thereby contributing to summer base flows when the stream no longer receives direct input from precipitation.

[2] Other project numbers associated with this project: 07-USR-034

A map and drawings of the project location.
The project site is shown in relation to surrounding physical features in Figure 13.

Description of the anticipated spatial distribution of likely benefits.
The project site is approximately 11.5 acres. The existing channel currently borders the southern property line, adjacent to several residential properties. As a result, the riparian buffer on the south bank is essentially nonexistent. Relocating the stream to the center of the 11.5 acre parcel and establishing a natural meandering channel with wetlands depressions and LWD will significantly increase the floodplain and hyporheic interaction. The project will create approximately 780 linear feet of new meandering stream channel, four wetland surface water infiltration ponds (0.1 acres) isolated from the stream, five off-channel rearing water infiltration ponds (0.5 acres) directly connected to the stream, 3.6 acres of restored riparian buffer, and 65 LWD installations.

Performance goals and measures.
Performance goals and measures will be based on the length of additional channel added, number of LWD installments, number of trees and shrubs planted, area of restored riparian habitat, and area of constructed wetland depressions.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.
These restoration actions are expected to benefit documented Chinook, Coho, Chum, and Pink Salmon as well as Bull, Cutthroat, and steelhead trout. Chinook Salmon and Bull Trout are priority species protected under the ESA. The project's proposed wetlands and LWD installations are designed to provide aquatic habitat for macroinvertebrates and rearing fish. The riparian plantings will directly benefit prey availability and survival of pre-migrant and outmigrating juvenile salmonids.

Identification of anticipated support and barriers to completion.
Funding is the primary barrier. Sound Salmon Solutions and Adopt-a-Stream Foundation have a history of restoration activities at this site. Both are sponsors of this project. No land acquisition is required. The City of Marysville, another sponsor, owns the property where the restoration work will take place.

Estimate of capital costs and reoccurring O&M costs.
Estimated total cost to design, permit, build the new channel, construct the wetlands, install LWD, and replant the riparian buffer will be approximately $2,190,000. Reoccurring O&M costs will be minimal and limited to plant survival monitoring and invasive species removal.

Anticipated durability and resiliency.
The project is designed to mimic sustainable, pre-settlement conditions and accommodate seasonal hydrologic changes. Once the native plants are installed, maintenance will be required to ensure plant survival. Monitoring of plant survival, native plant replacement, and non-native invasive plant removal will be performed for approximately five years post-construction.

Project sponsor(s) (if identified) and readiness to proceed/implement.
All sponsors are ready to proceed immediately.

- City of Marysville: Jessie Balbiani, Surface Water Specialist, jbalbiani@marysvillewa.gov
- Sound Salmon Solutions: Cameron Hill, Habitat Program Manager, cameron@soundsalmonsolutions.org

- Adopt-a-Stream Foundation: Walter Rung, Senior Ecologist, walterr@streamkeeper.org

Documentation of sources, methods, uncertainties, and assumptions.

Uncertainties pertain to funding. Current design elements and water offset calculations are based on best available knowledge.

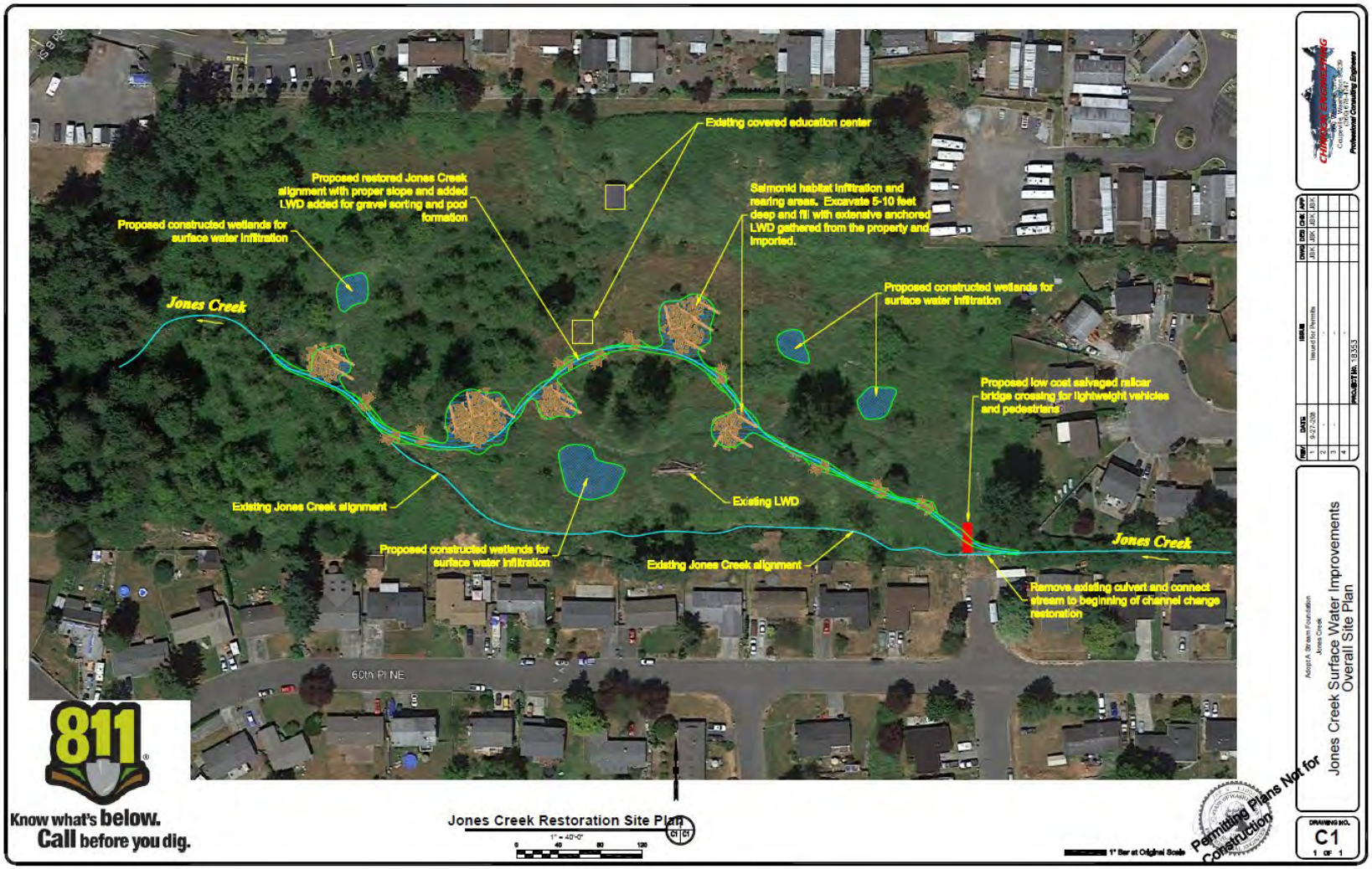

Figure 13. Site Plan for Jones Creek Relocation and Wetland Enhancement Project

WRIA 7 – Project Description
Marysville Stormwater Retrofits

Project Name and Number
Marysville Stormwater Retrofits (Quilceda Stormwater Project) (7-QA-H2)

WRIA 7 WRE Subbasin
Quilceda-Allen

Narrative Description
The objective of these projects is to restore aquifer groundwater in the Allen-Quilceda watershed through infiltration of stormwater runoff. The proposed projects include green stormwater infrastructure in denser urban areas ("depaves"), retrofits of stormwater ponds in older suburban areas, rainfall capture in rural areas, and a comprehensive outreach and education program based on stewardship and low impact water management. Snohomish Conservation District (District) expects to pilot pond retrofits on four existing detention ponds owned by the City of Marysville (specific sites to be determined). De-pave retrofit locations have not yet been identified but are targeted for the corridor east of SR 529.

Quantitative or qualitative assessment of how the project will function.
Infiltration flow rates were computed by the District based on assumed facility footprint and range of plausible infiltration rates. Pond size estimates are based on plans sent to the District by the City of Marysville, who own and operate the ponds. The depave sizes are based on the District's experience and measurements. Estimated net increase in infiltration was computed by multiplying the calculated infiltration rates to the average number of hours with rain in the area, based on Snohomish County's extended Smokey Point precipitation gage record. Based on the precipitation record, there are 816 hours of rain per year on average (water years 1950 through 2012). For the driest ten years, the average drops close to 20 percent to 678 hours per year.

There are a number of existing, undersized stormwater ponds serving older suburban/residential areas of Marysville (yellow area on included map). These ponds could be retrofitted to provide infiltration and additional storage. For pond retrofits, an infiltration footprint of 8,000 square feet was assumed, with potential rates ranging from 0.2 inches per hour (in/hr) to 2 in/hr. Each pond could be expected to infiltrate between 2.5 and 25 AFY on average, depending on native soil infiltration rates. Minimum net increase in infiltration (based on dry years) would be between 2.1 and 21 AFY per pond. No water offset is assumed for purposes of this watershed plan.

Depaves are anticipated to be implemented along the SR 529 corridor in downtown Marysville (green area on map below), where infiltration rates are higher than the pond locations. For depaves, an infiltration footprint of 1,000 square feet was assumed for each project, and the assumed infiltration range was between 0.5 and 5 in/hr. Each project could be expected to infiltrate between 0.8 and eight AFY on average, depending on native soil infiltration rates. Minimum net increase in infiltration (based on dry years) would be between 0.6 and seven AFY per project. No water offset is assumed for purposes of this watershed plan.

The Snohomish Conservation District will partner with farmers in the rural area east of Marysville (orange area on map) to establish a rainwater capture program. This area has a high number of

combined use wells. The District will provide cisterns to store rainwater to replace well water as a source for livestock watering, kitchen garden irrigation, and other current well water applications. No water offset is assumed for purposes of this watershed plan.

Conceptual-level map and drawings of the project and location.

Projects will be located within the City of Marysville and surrounding rural area in the Quilceda and/or Allen Creek watersheds. A map showing targeted areas for pond retrofits (yellow), depaves (green), and cisterns (orange) is included at the end of this description (Figure 14).

Description of the anticipated spatial distribution of likely benefits.

Potential project locations are within the Quilceda and Allen Creek watersheds. Enhanced infiltration would return storm runoff to the ground, delaying flows to the creeks.

Performance goals and measures.

Performance goal is to infiltrate as much stormwater runoff to ponds and depaves as possible. Infiltration is difficult to measure directly; proxy measures include contributing area, added storage volume, and surface outlet discharges. Measures for the cistern program would include number of participants, cisterns per property, and volume of captured rainwater used.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

Salmonids. According to the Salmonscape website, both the creeks are salmon-bearing streams. Species in these creeks include steelhead, Bull Trout, Chum, Cutthroat, Pink, Coho, and Chinook.

Identification of anticipated support and barriers to completion.

Snohomish Conservation District is leading this effort and has support from the City of Marysville, which owns and operates pilot pond retrofit locations, and the Tulalip Tribes. The District has a history of working with homeowners associations on stormwater pond operation and maintenance and has built relationships with farmers to do stormwater collection in the past. Barriers could include identification of suitable depave sites or lack of suitable infiltration.

Potential budget and O&M costs.

Project is currently conceptual and costs will depend on specific sites and facility types to be implemented. Snohomish Conservation District proposed $426,000 toward planning, design, and installation of the program in a prior grant application.

Anticipated durability and resiliency.

Green stormwater infrastructure has a great track record of durability, sustainability, and climate adaptation. In this context, durability refers to the capacity of the project to maintain the estimated net increase in infiltration over time and despite changing external conditions (which could include seasonal variation in stormwater runoff, seasonal and/or long-term fluctuation in regional groundwater elevation, adjacent land use changes, and/or other factors). We anticipate that the planned project will be moderately durable, based on the following:

- Facilities would be designed to typical standards.
- Infiltration rate would be maintained through regular maintenance and periodic rehabilitation of infiltration structures or media.
- Land use changes external to the project site would have negligible impact on project function.

- The water source likely would lack the predictability inherent to other types of aquifer recharge projects because it relies on the timing, rate, and volume of area precipitation and runoff.

Resiliency refers to the capacity of the project to maintain the estimated net increase in infiltration despite the impacts of climate change. Within the watershed, climate change could result in an increase in seasonal temperature, a decrease in summer precipitation, an increase in winter rainfall, an increase in the frequency and/or intensity of storm events, or other impacts. We anticipate that the planned project would be moderately resilient to the potential impacts of climate change based on the following:

- The project water source is not tied to the water right permitting process and is not subject to regulatory or other anthropogenic interruption.
- The project does not remove water from surface water and therefore is not reliant on minimum streamflow requirements.
- The project does not remove water from a groundwater body, and therefore is not subject to well interference.
- Sea level increase would not impact project function.
- Infiltration volume could be impacted by changes in annual precipitation or storm patterns, including increase in the frequency and/or intensity of large storm events, or other climatic factors.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Snohomish Conservation District (District) is the sponsor for this project and is partnered with City of Marysville and the Tulalip Tribes. The District is ready to move forward with feasibility study pending funding.

The District has previously submitted a grant application for potential stormwater projects in the Quilceda and Allen Creek basins in and around the City of Marysville.

Documentation of sources, methods, and assumptions.

Snohomish County. 2015. Snohomish Basin Protection Plan. [Cited 2020, April]. Available from: https://snohomishcountywa.gov/Archive/ViewFile/Item/4402

Snohomish Basin Salmon Recovery Forum. June 2005. Snohomish River Basin Salmon Conservation Plan Snohomish County Department of Public Works, Surface Water Management Division. Everett, WA. Available from: https://snohomishcountywa.gov/ArchiveCenter/ViewFile/Item/2153

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Salmonscape Website [internet]. Washington DOE, c2020. [Cited 2020, April]. Available from: http://apps.wdfw.wa.gov/salmonscape/map.html

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Washington Dept. of Ecology. 2019. Washington State Stormwater Manual. [Cited 2020, April]. Available from: https://fortress.wa.gov/ecy/ezshare/wq/Permits/Flare/2019SWMMWW/Content/Resources/DocsForDownload/2019SWMMWW.pdf

Snohomish Conservation District. 2019. Agriculture Resilience Plan for Snohomish County. [Cited 2020, April]. Available from: https://static1.squarespace.com/static/54933166e4b00173e5357840/t/5ddd7e765e1d641741e5126a/1574796956745/AgricultureResiliencePlan_FINAL_ALL+-+Reduced+File+Size.pdf

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Kitsap County. 2012. Kitsap County Stormwater Pond Retrofit Manual. [Cited 2020, April]. Available from: https://www.kitsapgov.com/pw/Documents/KC_Pond_Retrofit_Manual_2012.pdf

Sanjay Shukla and Fouad H. Jaber. 2018. Stormwater as an Alternative Source of Water Supply: Feasibility and Implications for Watershed Management. [Cited 2020, April]. Available from: https://edis.ifas.ufl.edu/ae398

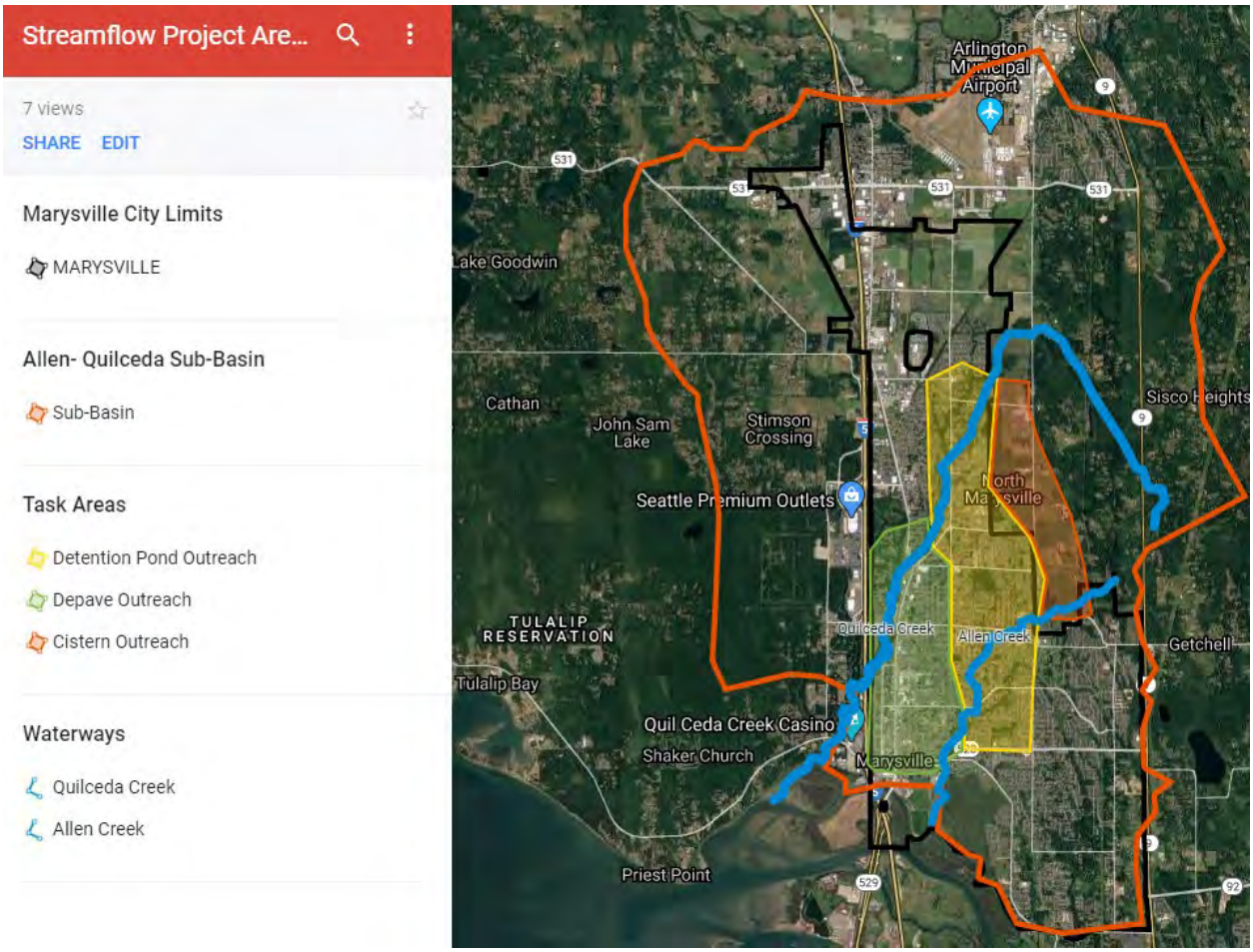


Figure 14. Site Plan Overview: Marysville Stormwater Retrofits Project

WRIA 7 – Project Description
Quilceda 8 Restoration & Potential Water Right Acquisition

Project Name and Number
Quilceda 8 Restoration & Potential Water Right Acquisition (7-QA-H3)

WRIA 7 WRE Subbasin
Quilceda-Allen

Narrative Description
This is a property acquisition proposal of a parcel located on an unnamed tributary to Allen Creek located on the eastern border of the City of Marysville, Washington. This parcel is currently under private ownership and has been managed as farmland since the families' ownership since 1962. The landowners approached Snohomish County with interest in selling the lower floodplain portion of their property to provide restoration opportunities.

This property acquisition has the potential to improve juvenile rearing and adult spawning habitat for two ESA-listed fish: Chinook Salmon and steelhead.

Quantitative or qualitative assessment of how the project will function.
Acquiring this land and underlying water right has the potential to restore hydrologic function to the adjacent unnamed tributary to Allen Creek and the greater Snohomish River. There is potential for riparian restoration actions within the lower floodplain through invasive removal and native species planting. The water right associated with the property has some uncertainties but based on the delineated 16 acres of irrigation and assuming pasture and sprinkler irrigation, 16.8 AFY may be available for acquisition. No water offset is assumed for the purposes of this watershed plan.

A map and drawings of the project location.
The project site is shown in relation to surrounding physical features in Figure 15.

Description of the anticipated spatial distribution of likely benefits.
This property acquisition has the potential to restore hydrologic function to Allen Creek.

Performance goals and measures.
Not applicable for this stage of project.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.
Restoration of hydrologic function of Allen Creek and the proposed future restoration efforts within the lower floodplain have the potential to benefit documented Chinook, Coho and steelhead trout. Chinook Salmon and steelhead trout are priority species protected under the ESA.

Identification of anticipated support and barriers to completion.

Funding is the primary barrier to completion. Additional barriers include landowner willingness to sell the water right associated with the property, limited information on recent beneficial use of the water right, and multiple landowners within the water right's place of use.

Estimate of capital costs and reoccurring O&M costs.

Estimated total cost to purchase this parcel is unknown at this time.

Anticipated durability and resiliency.

Not applicable at this stage of project.

Project sponsor(s) (if identified) and readiness to proceed/implement.

The Tulalip Tribes are the sponsor of this project. The surviving landowner is a few years from moving off the property at which point the land will be available for purchase.

Documentation of sources, methods, uncertainties, and assumptions.

Unknown at this phase of the project.

Figure 15. Quilceda 8 Restoration & Potential Water Right Acquisition Location

WRIA 7 – Project Description
Silver Firs Stormwater Pond Retrofits

Project Name and Number
Silver Firs Stormwater Pond Retrofits (Little Bear Stormwater) (7-ES-H4)

WRIA 7 WRE Subbasin
Estuary/Snohomish Mainstem

Narrative Description
Snohomish County has identified several potential stormwater retrofit projects in the Little Bear Creek basin, including two stormwater pond infiltration retrofits in the Silver Firs subdivision. The two ponds are part of the existing stormwater drainage system; each receives surface storm runoff from about 125 acres of residential development. Retention of stormwater in these ponds are expected to increase infiltration capacity.

The first pond (County CIP site 10) is located in Silver Firs Sector 3 Division 7. The project would involve expanding the existing pond by deepening and increasing pond infiltration potential. This would add 1.09 acre-feet of storage and increase infiltration. The second pond (CIP site 16) is located in Silver Firs Sector 7. This project would increase the existing pond volume by deepening and increase pond infiltration potential. This would add two acre-feet of storage. Neither existing pond was designed as an infiltration facility, but infiltration has been observed to occur. The difference between existing infiltration and infiltration after retrofits will provide a net increase in infiltration into the aquifer.

Quantitative or qualitative assessment of how the project will function.
Hydrological Simulation Program - FORTRAN (HSPF) modeling was conducted as part of Snohomish County's retrofit analysis to quantify benefits of proposed projects. The HSPF model was used to estimate the average annual net increase in infiltration volumes for the two pond projects. The modeling analysis was run over 63 years of historic precipitation data and assumed existing infiltration at 1.2 inches per hour for both ponds, doubling to 2.4 inches per hour with modifications. No water offset is assumed for purposes of this watershed plan.

At Site 10, the model showed a net increase of 38 AFY of infiltration. Additional infiltration at Site 16 was estimated to be 7 AFY. A minimum net increase of infiltration can be estimated by looking at just the driest years in the simulated record. Using the 10 driest years from the 63-year simulation (based on annual precipitation), the minimum net increase in infiltration can be estimated as 25 AFY for Site 10 and two AFY for Site 16. No water offset is assumed for purposes of this watershed plan.

Conceptual-level map and drawings of the project and location.
The Silver Firs development is located at the north end of the Little Bear Creek basin. Previous groundwater studies and watershed modeling (Golder, 2005; King County, 2005; Snohomish County, 2017) suggest that groundwater at the pond sites and tributary areas flows east to the Snohomish River. See Figure 19 for project location map.

Description of the anticipated spatial distribution of likely benefits.

Based on previous groundwater studies and watershed modeling (Golder, 2005; King County, 2005; Snohomish County, 2017), it is believed that groundwater in this area flows east to the Snoqualmie River, rather than locally to Little Bear Creek. Thus, net increase in enhanced infiltration would accrue to WRIA 7 rather than WRIA 8 (though reductions in peak streamflows and stream flashiness would benefit Little Bear Creek).

The closest mapped streams in WRIA 7 to the pond locations are Thomas Creek (approximately 5,000 feet to mapped headwater) and Larimer Creek (approximately 5,500 feet to mapped headwaters). Both streams drain through lowland agricultural drainage systems to the Snohomish River in the vicinity of Ebey Slough. The importance of groundwater to nearby stream channels during the low flow season is coupled to the large areal extent of wetlands along the mainstem of Little Bear Creek. Given these natural recharge sources in Little Bear Creek sustain much of the summer low flow, equally important is the groundwater recharge received by WRIA 7 streams from the proposed stormwater pond retrofits.

Small streams like Larimer Creek, shown in Figure 16 that maintain cold-water refugia throughout the summer have groundwater contribution from beneath thick clay layers that border the edges of the stream. Upper Thomas Creek, shown in Figure 17 has gentle streamside slopes with a thick aggregate of organic materials and soil beneath which groundwater enters the stream. Lower Thomas Creek, shown in Figure 18 maintains cold-water refugia and higher flows. The channel appears to have greater habitat diversity with flows that maintain these conditions. This underscores the importance in maintaining connection with groundwater during low flows and groundwater recharge during high flows. Like Larimer Creek, the summer low flow water temperature is unusually cold. When considered together, these small feeder streams to larger rivers represent important sources of cold groundwater refugia to migrating summer salmonids. Migration of groundwater to these streams may begin during the wet season and reach the WRIA 7 streams during the dry season. An overview figure of the project area is shown on Figure 19.

Figure 16. Larimer Creek

Figure 17. Upper Thomas Creek

Figure 18. Lower Thomas Creek

Performance goals and measures.

Performance goal is to infiltrate as much water from the ponds as possible. Infiltration is difficult to measure directly; proxy measures include area treated, pond water levels, and pond outlet discharges.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The Little Bear Creek system is an important resource for fish, and the following salmonid species are known to be present in the basin: Chinook, Sockeye, kokanee, and Coho Salmon. The WRIA 8 Chinook Salmon Recovery Plan notes that the estimated number of Chinook Salmon spawning in Little Bear Creek averaged 11 fish for many years up to 1998. Coastal Cutthroat Trout and steelhead and rainbow trout have also been observed. Anadromous salmon and Trout access almost all this system, though there are some significant passage barriers to adults during periods of low stream water flows, and to juveniles during high flows.

Identification of anticipated support and barriers to completion.

This project is currently listed in Snohomish County's Little Bear Creek Basin Plan and Snohomish County intends to implement the project, when funding is available.

Potential budget and O&M costs.

CIP Site 10: $600,000 design & construction

CIP Site 16: $815,000 design & construction

Both locations have existing stormwater ponds, so operation and maintenance costs are unlikely to change significantly.

Anticipated durability and resiliency.

In this context, durability refers to the capacity of the project to maintain the estimated net increase in infiltration over time and despite changing external conditions (which could include seasonal variation in stormwater runoff, seasonal and/or long-term fluctuation in regional groundwater elevation, adjacent land use changes, and/or other factors). We anticipate that the planned project will be moderately durable, based on the following:

- Facility would be designed to typical County standards.
- Infiltration rate would be maintained through regular maintenance and periodic rehabilitation of infiltration structures or media.
- Land use changes external to the project site would have negligible impact on project function.
- The water source likely would lack the predictability inherent to other types of aquifer recharge projects because it relies on the timing, rate, and volume of area precipitation and runoff.

Resiliency refers to the capacity of the project to maintain the estimated net increase in infiltration despite the impacts of climate change. Within the watershed, climate change could result in an increase in seasonal temperature, a decrease in summer precipitation, an increase in winter rainfall, an increase in the frequency and/or intensity of storm events, or other impacts. We anticipate that the planned project would be moderately resilient to the potential impacts of climate change based on the following:

- The project water source is not tied to the water right permitting process and is not subject to regulatory or other anthropogenic interruption.
- The project does not remove water from surface water and therefore is not reliant on minimum streamflow requirements.
- The project does not remove water from a groundwater body, and therefore is not subject to well interference.
- Sea level increase would not impact project function.
- Infiltration volume could be impacted by changes in annual precipitation or storm patterns, including increase in the frequency and/or intensity of large storm events, or other climatic factors.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Snohomish County Department of Conservation and Natural Resources would sponsor the project. Snohomish County has identified two stormwater pond retrofit projects in the northern part of the Little Bear Creek basin. The project is currently listed on the County's Capital Improvement Project list and the County would be ready to proceed with design and construction upon funding.

Documentation of sources, methods, and assumptions.

Golder and Associates, 2005. *Little Bear Creek Hydrogeologic Overview*. Prepared for Jones and Stokes and Snohomish County.

King County, 2005. *Brightwater Treatment System Environmental Impact Statement*. Available online: http://www.kingcounty.gov/environment/wtd/Construction/North/Brightwater/Background/Env-Review.aspx

Snohomish County, 2016. Little Bear Creek Basin Planning: Current Conditions Assessment Report.

Snohomish County, 2017. Little Bear Creek Basin Plan. Appendix B: Watershed Modeling Report.

Snohomish County, 2019. Stormwater Treatment CIPs: Final Report of Task 2.07.1 of the Little Bear Creek Basin Plan.

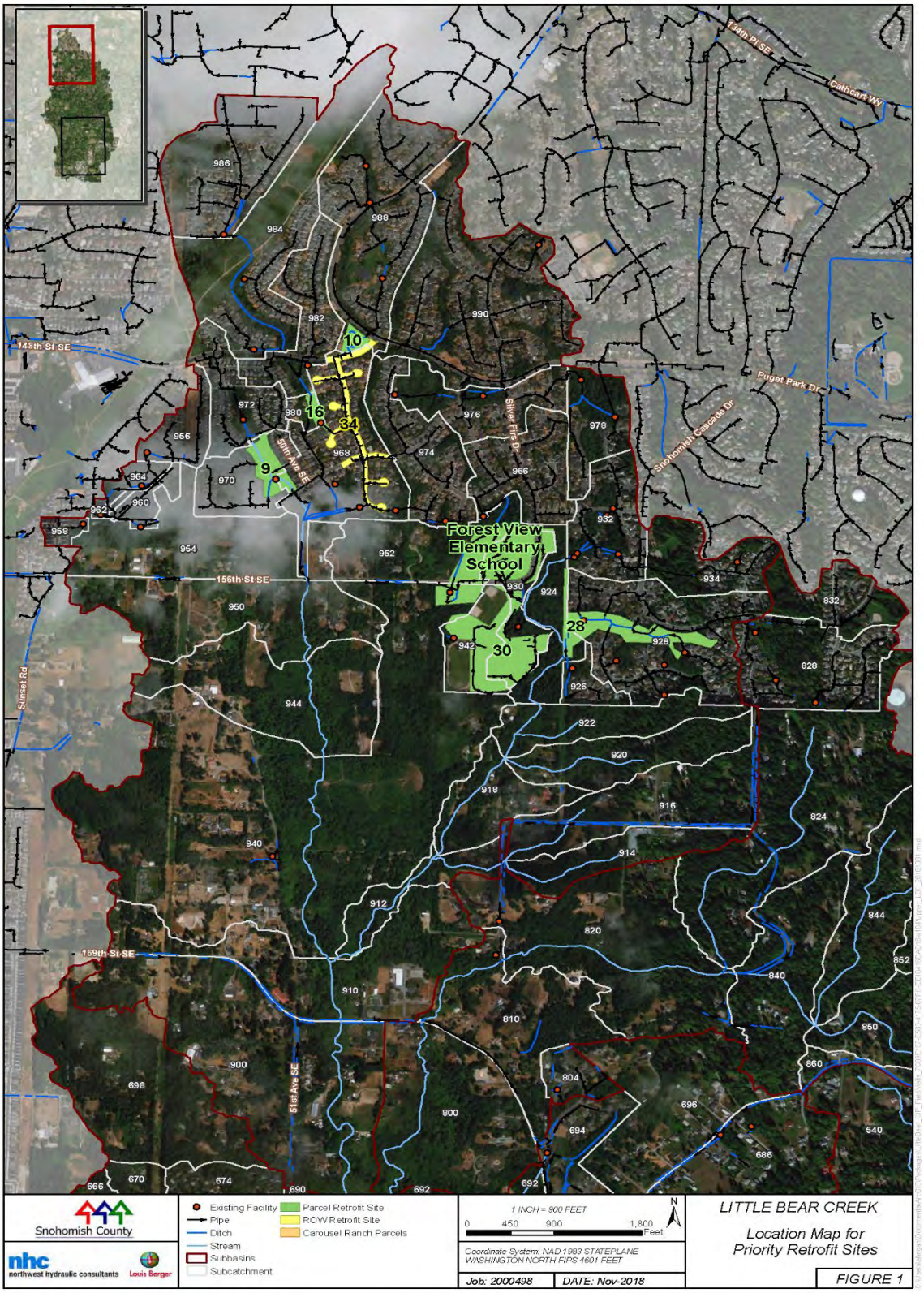


Figure 19. Silver Firs Stormwater Retrofit Site Location

WRIA 7 – Project Description
Thomas' Eddy Hydraulic Reconnection

Project Name and Number
Thomas' Eddy Hydraulic Reconnection (7-ES-H5[3])

WRIA 7 WRE Subbasin
Pilchuck

Narrative Description
The Thomas' Eddy Hydraulic Reconnection Project at Bob Heirman Wildlife Park proposes to remove a minimum of 1,400 feet of remnant, failing levee and bank armor to improve floodplain connection and riverine process to approximately 200 acres of disconnected floodplain of the Snohomish River. The project aims to increase hydrologic connection and salmon access to 1.5 miles of off-channel waterbodies and improve floodplain complexity through a minimum of 30 acres of riparian planting, invasive weed control, floodplain channel construction and installation of floodplain structures (potentially including flood fences, log jams and/or beaver dam analogs.) The preferred design alternatives will incorporate key stakeholder input and will provide improved park user access to the Snohomish River and wildlife viewing areas and protect and enhance habitat for fish, waterfowl and other wildlife that use the site.

These restoration actions will benefit documented Chinook, Coho, Chum, Sockeye and Pink Salmon as well as Bull Trout and Cutthroat, and steelhead trout. Chinook, steelhead and Bull Trout are priority species protected under the ESA.

Quantitative or qualitative assessment of how the project will function.
The project will improve floodplain connection and riverine process to approximately 200 acres of disconnected floodplain. Salmon will have access to 1.5 miles of new off-channel habitat. The installation of a minimum of 30 acres of riparian plantings and floodplain structures will provide additional habitat function.

A map and drawings of the project location.
The project site is shown in relation to surrounding physical features in Figure 20.

Description of the anticipated spatial distribution of likely benefits.
This project proposes to restore 200 acres of disconnected floodplain of the Snohomish River through removal of levee and bank armoring. These efforts will provide salmon access to 1.5 miles of off channel waterbodies.

Performance goals and measures.
The project is currently in design phase. Performance measures will be considered and finalized as design progresses.

[3] Other project numbers associated with this project: 07-MPR-034

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

These restoration actions are expected to benefit documented Chinook, Coho, Chum, Sockeye and Pink salmon as well as Bull Trout and Cutthroat, and steelhead trout. Chinook, steelhead and Bull Trout are priority species protected under the ESA. The project's proposed restoration of floodplain habitat is designed to provide aquatic habitat for macroinvertebrates and rearing fish. The riparian plantings will directly benefit prey availability and survival of pre-migrant and outmigrating juvenile salmonids.

Identification of anticipated support and barriers to completion.

Restoration of the floodplain at Thomas' Eddy has been supported by the Salmon Recovery community since the completion of the Snohomish Basin Salmon Plan but stakeholder opposition to past proposals hindered restoration actions. A primary component of the current design phase is stakeholder outreach. The project sponsor has identified and is in contact with key stakeholders and will work with them during the design process to ensure their concerns are addressed and that the preferred alternative has broad support to move forward to construction. Snohomish County has funding for design work to reconnect floodplain at Thomas Eddy. The 60 percent designs should be done by June 2022.

Estimate of capital costs and reoccurring O&M costs.

Estimated total cost to design, permit, remove levee and bank armor, install the riparian plantings and floodplain structures will be approximately $3.5 million. Reoccurring O&M costs will be minimal and limited to project effectiveness monitoring, plant survival monitoring and invasive species removal.

Anticipated durability and resiliency.

The project is being designed to mimic sustainable, pre-settlement conditions and accommodate seasonal hydrologic changes within constraints of a park with human access requirements. Restoration elements will be monitored and, if necessary, adaptive management actions will be explored. Native plant maintenance will be required to ensure plant survival. Monitoring of plant survival, native plant replacement, and non-native invasive plant removal will be performed for approximately five years post-construction.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Snohomish County, Michael Rustay, mike.rustay@co.snohomish.wa.us. The project will be ready to move to final design and seek construction funding in 2022.

Documentation of sources, methods, uncertainties, and assumptions.

Uncertainties pertain to funding. Current design elements are based on best available knowledge.

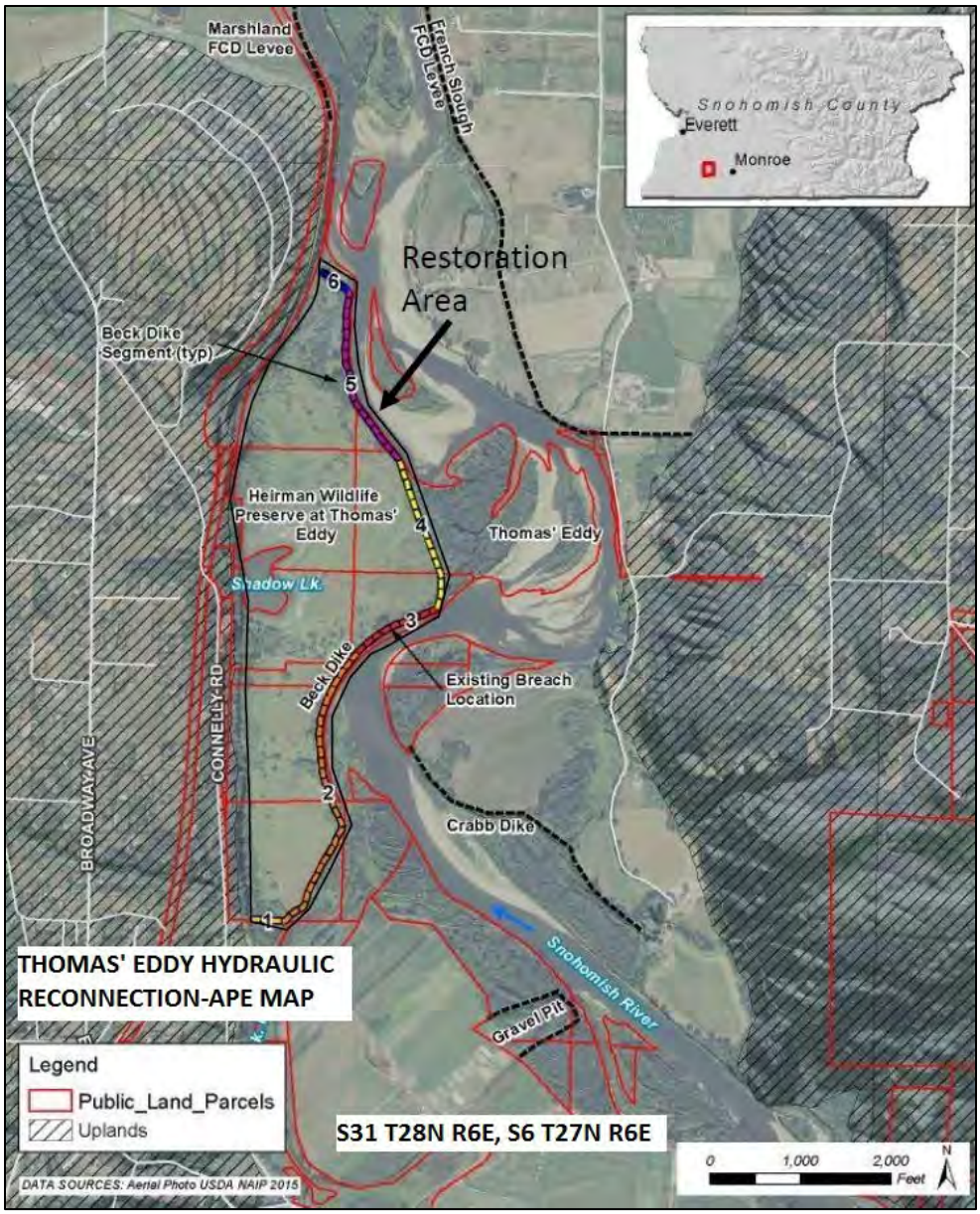


Figure 20. Site Plan for Thomas' Eddy Hydraulic Reconnection Project

WRIA 7 – Project Description
Snohomish Floodplain Acquisitions Phase 1 (Lund Acquisition)

Project Name and Number
Snohomish Floodplain Acquisitions Phase 1 (Lund Acquisition) (7-P-H6)

WRIA 7 WRE Subbasin
Pilchuck

Narrative Description
This project will result in the acquisition of up to 57 acres and over 1.43 miles of riparian and floodplain property adjacent to the Pilchuck River and associated side channels for protection in perpetuity and floodplain forest restoration. The Lund property is located in a key area within the Middle Pilchuck River for salmon conservation efforts. This property contains the mainstem Pilchuck River and several side channels that are ideal for juvenile salmon rearing and flood refugia. There is considerable opportunity for enhancement along the riparian corridor and within the floodplain to establish a functioning floodplain forest. Restoration of functioning riparian and floodplain areas on this property aid in achieving salmon recovery goals. This is a dynamic area of the Pilchuck River, where the river naturally moves across the floodplain. Acquisition and restoration will prevent installation of rock or other impediments to natural process function. The acquisition of riparian property will also facilitate future restoration efforts, while allowing more flexible and nimble adjustment to the anticipated uncertainty of climate change and population growth. By working with the Snohomish Conservation District (District), the project sponsor can benefit from the long term relationship with the landowners, and leverage additional funding opportunities.

Quantitative or qualitative assessment of how the project will function.
Acquisition and restoration of the Lund property will address myriad limiting factors (floodplain/riparian function, water quality, etc.) for both Chinook and other salmonid species at virtually all adult and juvenile freshwater life stages from incubation to rearing and adult holding and spawning.

A map and drawings of the project location.
The project site is shown in relation to surrounding physical features in Figures 21 through 24.

Description of the spatial distribution of likely benefits.
Project implementation will benefit fish populations in the Pilchuck River Watershed. By allowing the landowner to divest in this property, there will be reduced flood and erosional risks to private landowners in this reach of the Pilchuck River.

Performance goals and measures.
- Protection and conservation of up to 57 acres of riparian and floodplain property.
- Protection and conservation of over 1.43 miles of the Pilchuck River and side channels.
- Species benefiting: Chinook, steelhead, Coho, Bull Trout, Chum, Pink, Cutthroat and other fish species.
- Facilitate future restoration/enhancement of Pilchuck River instream habitat.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

Acquisition and restoration of the Lund property will address myriad limiting factors (floodplain/riparian function, water quality, etc.) for both Chinook and other salmonid species at virtually all adult and juvenile freshwater life stages from incubation to rearing and adult holding and spawning. Species benefiting include Chinook (threatened), steelhead (threatened), Coho, Bull Trout (threatened), Chum, Pink, Cutthroat and other fish species.

Identification of anticipated support for and barriers to completion.

Monetary and technical support will be provided by the RCO Salmon Recovery Funding Board, the Snohomish Technical Committee, the Snohomish Conservation District, and the Department of Ecology National Estuary Program.

Barriers to completion could include landowner acceptance of appraised property value and continued interest in pursuing the land transaction. However, the District has a long relationship with the landowner, and we expect to continue moving forward towards acquisition and restoration goals.

Estimate of capital costs and reoccurring O&M costs (order of magnitude costs).

- Acquisition Costs: $900,000
- Restoration Costs: $300,000
- O&M Costs: Minimal

Project durability and resiliency.

Climate change and associated impacts will be factored into all current and future project elements. Acquisition and restoration will maintain and enhance resilience through habitat accessibility, diversity, quantity, and quality. The intent is to pursue natural process based solutions as much as possible to reduce maintenance requirements and ensure long term project function and durability.

Project sponsor(s) (if identified) and readiness to proceed/implement.

The Tulalip Tribes are the proposed project sponsor for this work, and are ready to begin project planning and eventual implementation. Tulalip restoration project managers have extensive experience implementing restoration projects in this region. These projects have had varying scopes from very large, multimillion-dollar acquisition/restoration projects (Qwuloolt) to smaller fish passage and in-stream projects. We will draw from this experience and associated lessons learned while conducting these projects. The Snohomish Conservation District is a project partner who is currently conducting appraisals allowing acquisition in a timely manner.

Documentation of sources, methods, uncertainties, and assumptions.

Methods for acquisition will be those as required per RCO manuals. Planting and maintenance will occur per standard methodologies with a priority towards efficient and economical floodplain forest establishment. Uncertainties are primarily related to appraised land values and associated landowner negotiations.

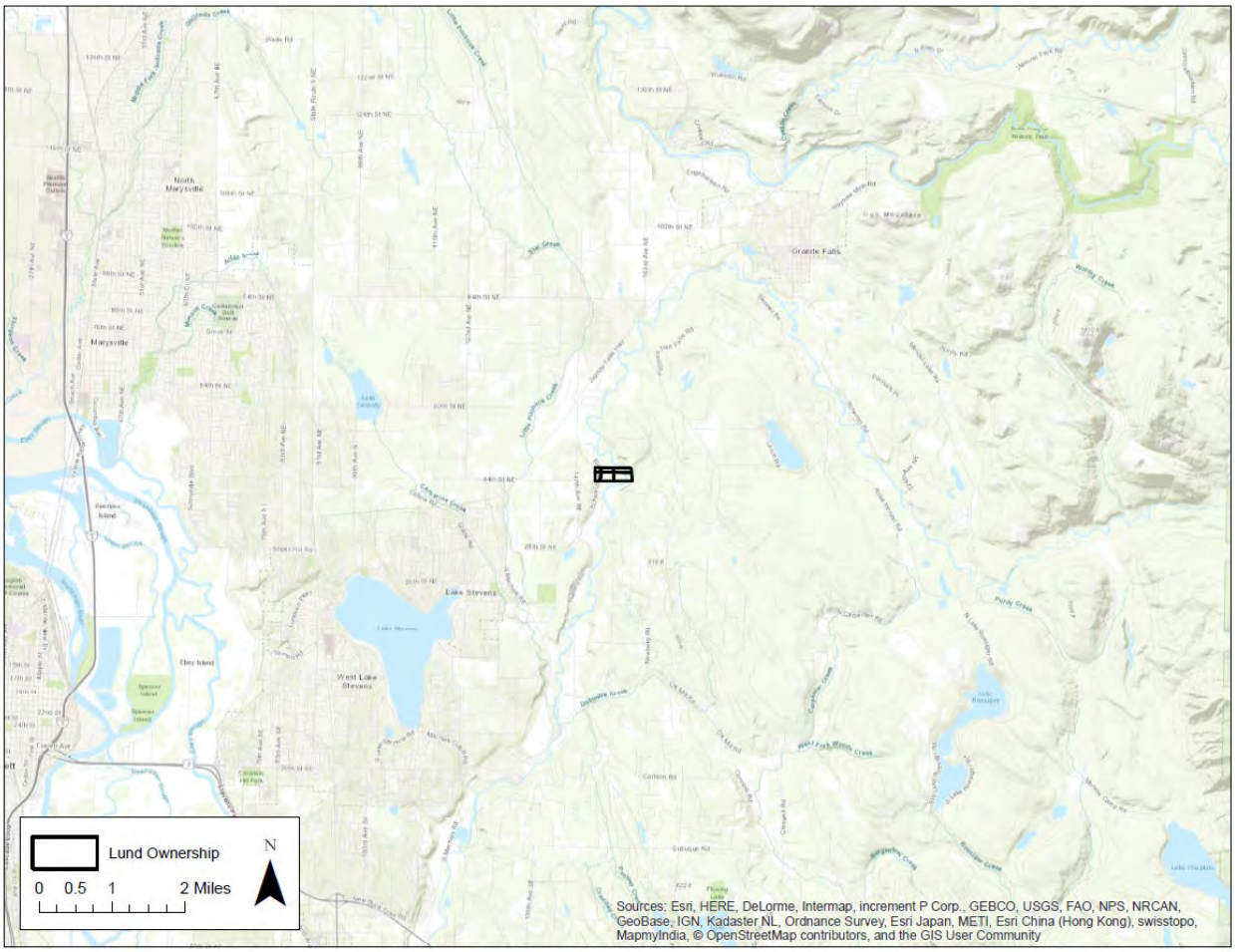


Figure 21. Vicinity Map for Snohomish Floodplain Acquisitions Phase 1 AKA Lund Acquisition

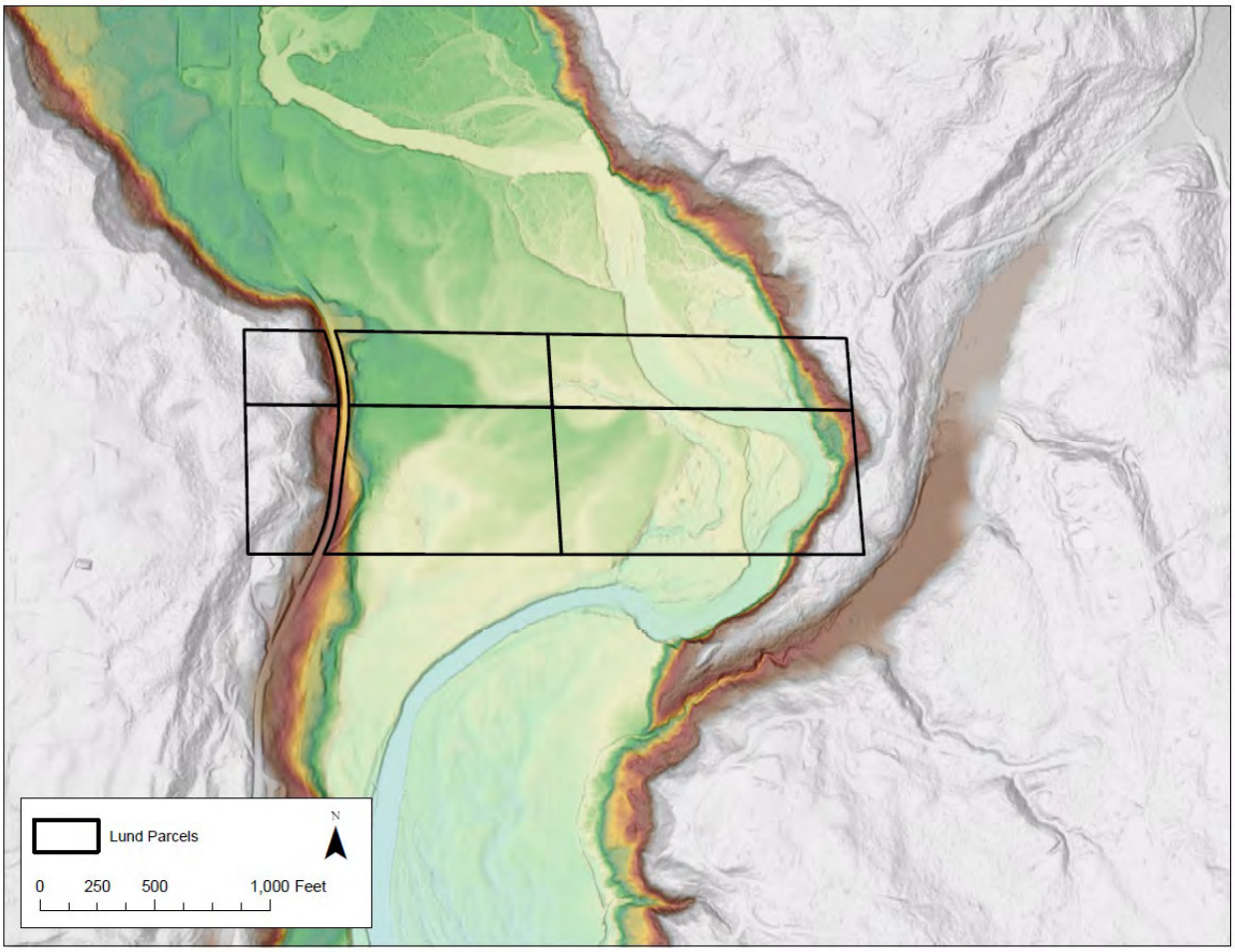


Figure 22. LiDAR for Snohomish Floodplain Acquisitions Phase 1 AKA Lund Acquisition

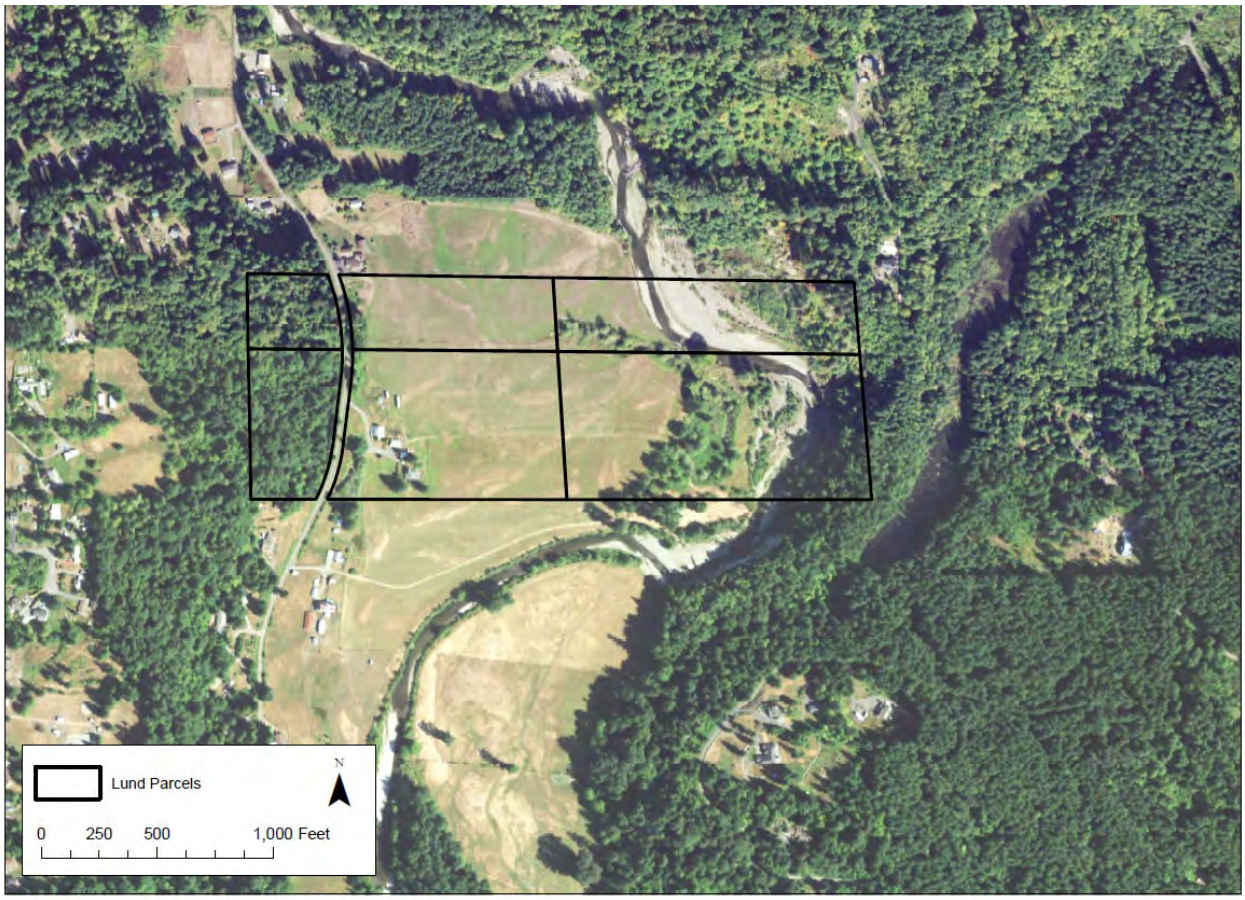


Figure 23. Ortho Image for Snohomish Floodplain Acquisitions Phase 1 AKA Lund Acquisition

Figure 24. Avulsion at the Snohomish Floodplain Acquisitions Phase 1 AKA Lund Acquisition Project Site

WRIA 7 – Project Description
Pilchuck River Armoring Removal and Riparian Restoration

Project Name and Number
Pilchuck River City Bank Armoring Removal (7-P-H7[4])

WRIA 7 WRE Subbasin
Pilchuck

Narrative Description
This project will result in the removal or "softening" of approximately 2,000 linear feet of bank armoring on and downstream of the former City of Snohomish water treatment facility associated with a water transmission main recently made obsolete with the removal of the Pilchuck River Diversion Dam. This bank armoring is located within the Middle Pilchuck subbasin, which has been prioritized for mainstem primary restoration. Restoration of functioning riparian and floodplain areas on this property will aid in achieving salmon recovery goals.

Quantitative or qualitative assessment of how the project will function.
Armoring removal and in-stream restoration will increase connectivity to onsite wetlands and off-channel habitat, increase flood storage, improve riparian conditions, improve in-stream habitat, and improve water quality.

A map and drawings of the project location.
The project site is shown in relation to surrounding physical features in Figure 25, Figure 26, and Figure 27.

Description of the anticipated spatial distribution of likely benefits.
Project implementation will benefit fish populations in the Pilchuck River Watershed, primarily within the Middle Pilchuck Sub Basin.

Performance goals and measures.
- Removal and/or modification of up to 2,000 feet of bank armoring.
- Removal of transmission main under the Pilchuck River Mainstem.
- In-stream habitat improvements including large woody debris installation.
- Riparian enhancement of up to 2,000 feet adjacent to the mainstem Pilchuck River.
- Species benefiting: Chinook, steelhead, Coho, Bull Trout, Chum, Pink, Cutthroat and other fish species.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.
Pilchuck River armoring removal will address myriad limiting factors (floodplain/riparian function, in-stream habitat, water quality, etc.) for both Chinook and other salmonid species at virtually all adult and juvenile freshwater life stages from incubation to rearing and adult holding and spawning. Species benefiting include Chinook (threatened), steelhead (threatened), Coho, Bull Trout (threatened), Chum, Pink, Cutthroat and other fish species.

[4] Other project numbers associated with this project: 07-MPR-265; 2018-0425

Identification of anticipated support for and barriers to completion.

The Tulalip Tribes has a close working relationship with the City of Snohomish who owns easements and the transmission main adjacent to the subject armoring and is open to discussing this proposal. Initial conversations with the landowner (Younce) indicates significant interest in armoring modification and other enhancements on the subject property.

Barriers to completion could include future discussions with the landowner and the City over project designs and outcomes. However, we are confident that we can come to a mutually beneficial outcome with this project. It is helpful that the project would be entirely on City and one other private ownership (Younce).

Estimate of capital costs and reoccurring O&M costs.

- Planning Costs: $200,000
- Restoration Costs: $500,000
- O&M Costs: Minimal

Anticipated durability and resiliency.

Climate change and associated impacts will be factored into all current and future project elements. Restoration will enhance resilience through habitat accessibility, diversity, quantity, and quality. The intent is to pursue natural process based solutions as much as possible to reduce maintenance requirements and ensure long term project function and durability.

Project sponsor(s) (if identified) and readiness to proceed/implement.

The Tulalip Tribes are the proposed project sponsor for this work, and are ready to begin project planning and eventual implementation. Tulalip restoration project managers have extensive experience implementing restoration projects in this region. These projects have had varying scopes from very large, multimillion-dollar acquisition/restoration projects (Qwuloolt) to smaller fish passage and in-stream projects. We will draw from this experience and associated lessons learned while conducting these projects. This project is currently in the scoping phase, though the outreach and design phase could start as soon as funding is secured.

Documentation of sources, methods, uncertainties, and assumptions.

Methods will be determined as part of the initial planning phase of this project. Uncertainties are primarily related to the design considerations and landowner negotiations.

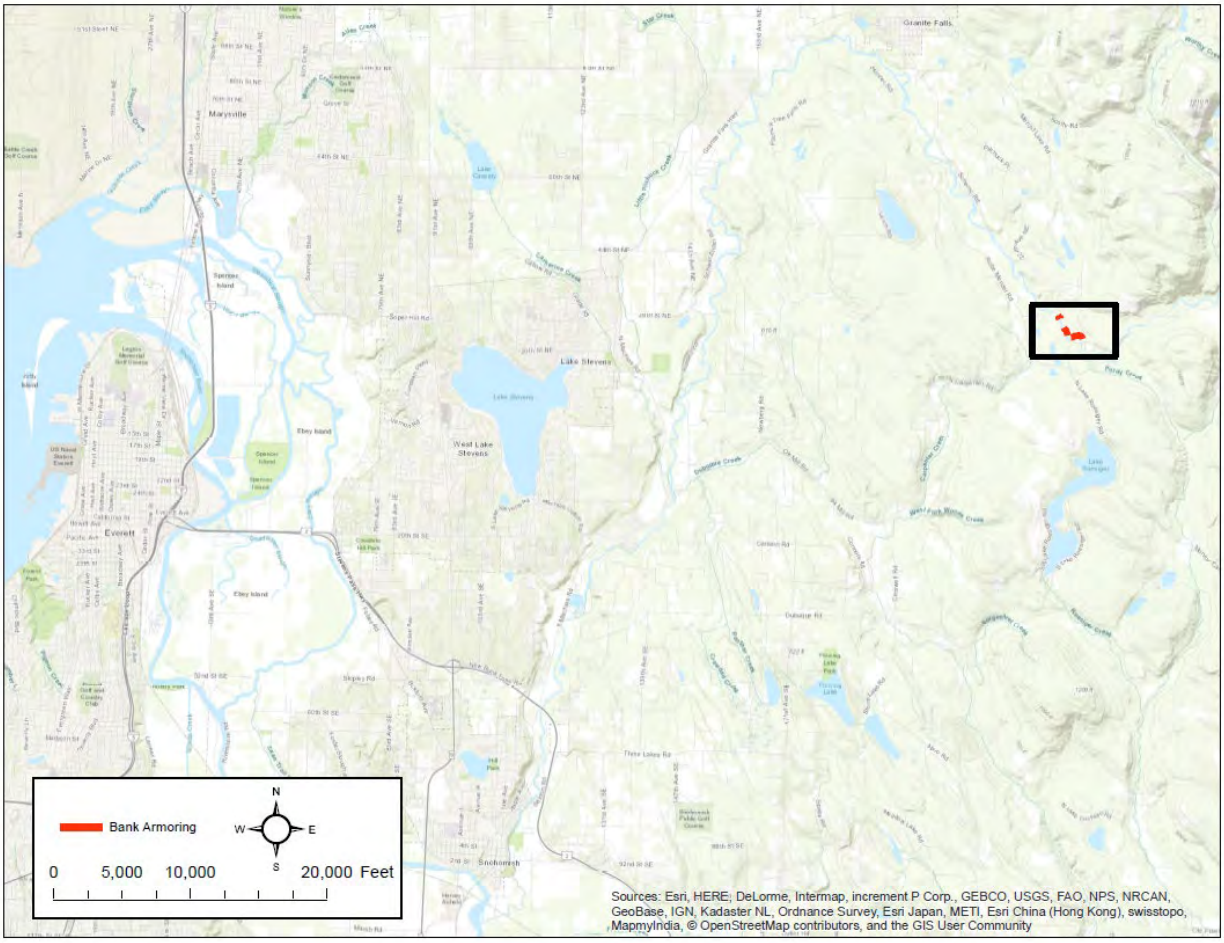


Figure 25. Project Vicinity Map

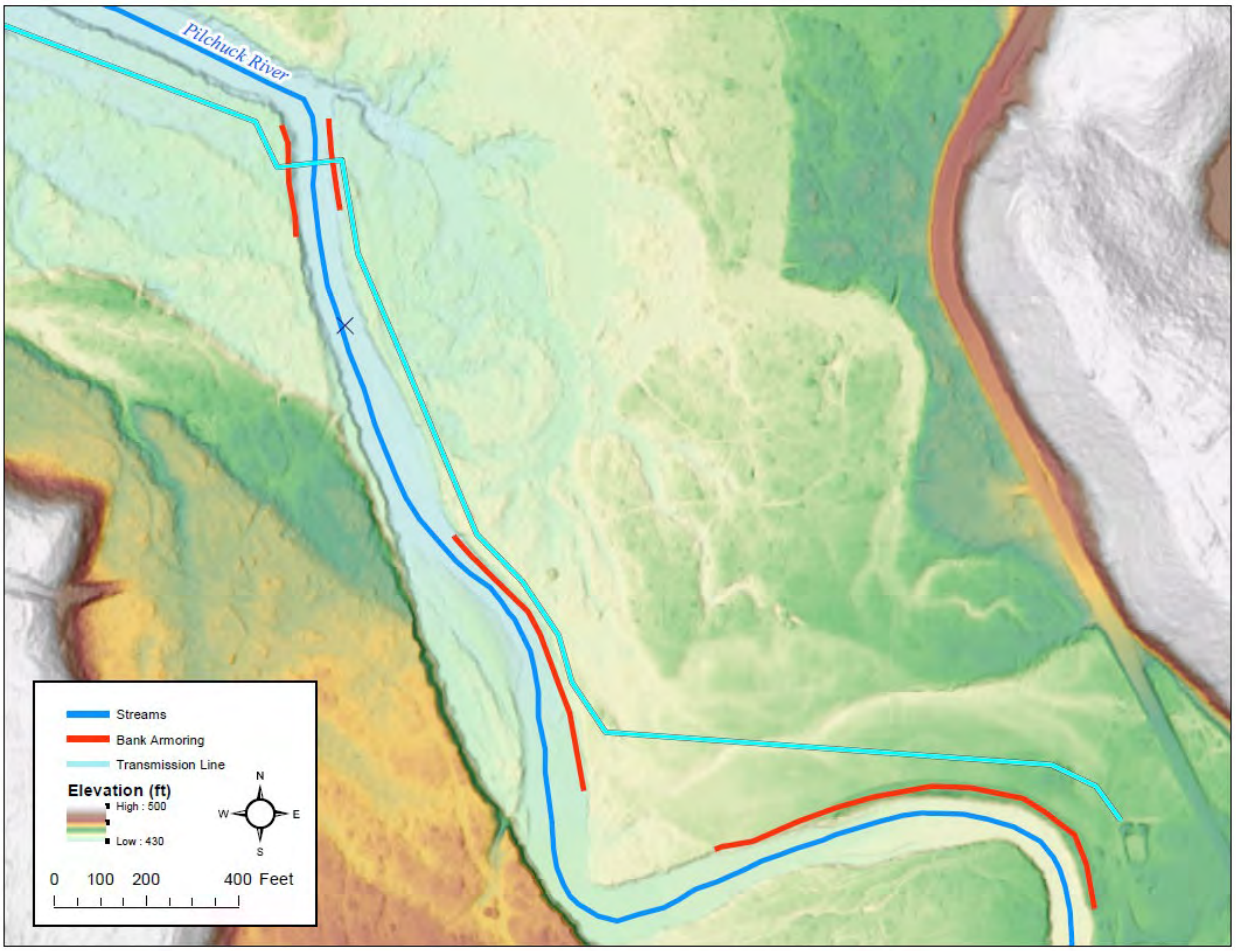


Figure 26. LiDAR for Project Vicinity

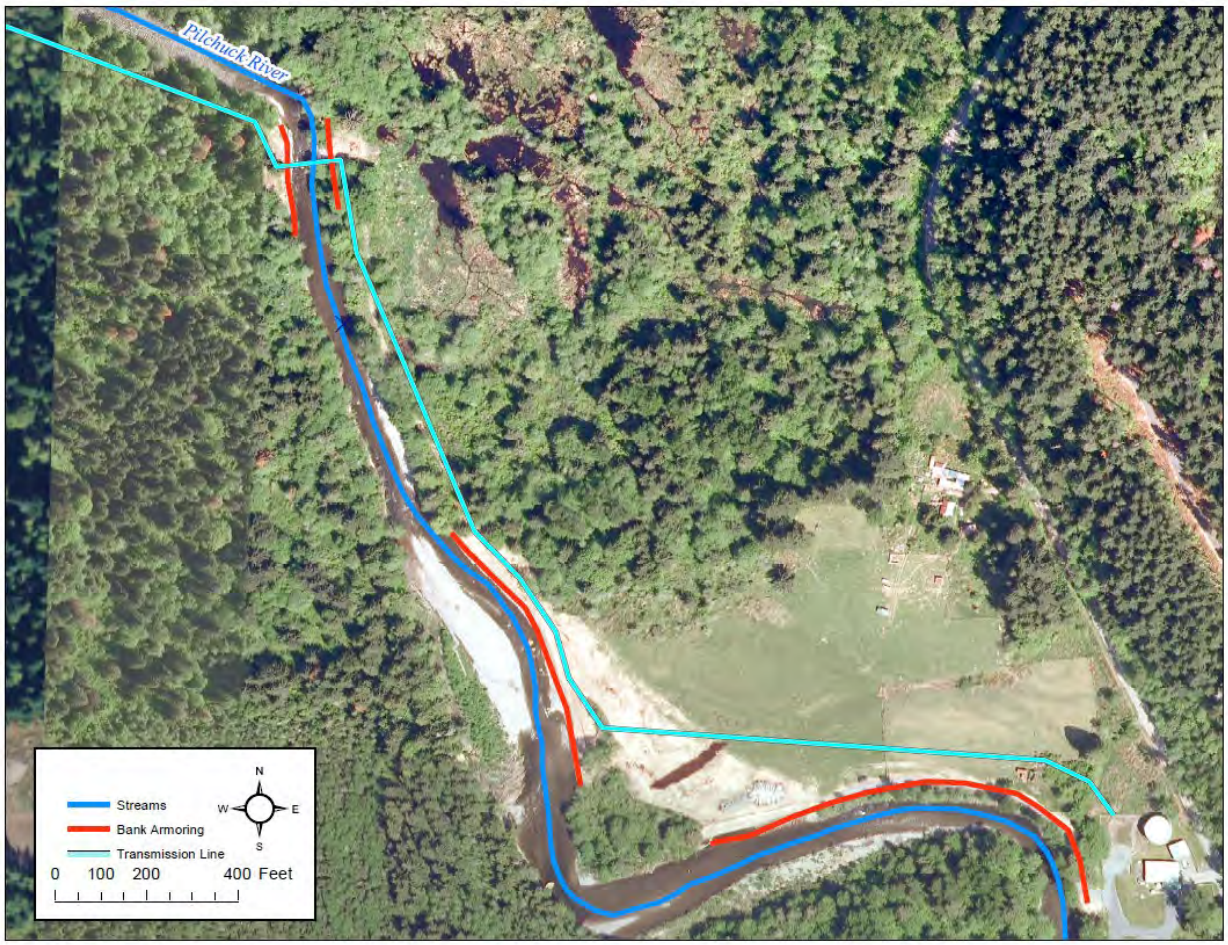


Figure 27. Ortho image for Project Vicinity

WRIA 7 – Project Description
Living with Beavers

Project Name and Number
Living with Beavers (7-P-H8)

WRIA 7 WRE Subbasin
Woods Creek, Pilchuck, Little Pilchuck, Snohomish Estuary/Mainstem subbasins.

Narrative description.
The Snohomish Conservation District (District) coordinates a landowner education and assistance program to encourage landowners to allow beavers and their habitat to remain mostly un-modified on the landscape instead of trapping and removing the beaver and their habitat. This program consists of educating landowners on the importance of beaver ponds through workshops and one-on-one technical assistance site visits and project implementation assistance including design, permitting, and cost-share funding with large tree protection (cages), planting wetland plants, deceiver structures to prevent damming activities, and where appropriate, pond-leveler devices. These devices allow for fish passage but also limit the height of the beaver pond to reduce impacts to human infrastructure. The result of these activities has meant beaver ponds on private property across the county have been maintained or grown in size when they would have otherwise been drained.

A quantitative or qualitative assessment of how the project will function.
An ongoing study in the Skykomish River basin has shown that beaver ponds and the associated below-surface storage have significant potential to increase resilience to hydrologic change (Dittbrenner et al., 2018b – in process). Encouraging landowners to allow beavers to build ponds where they are currently expanding their populations is an extremely cost-effective approach to increasing water storage, recharging groundwater, increasing summer flows, and decreasing surface water temperatures. This project complements the Tulalip Tribes Beaver Reintroduction project, which repopulates beavers to areas in the upper watershed. Where landowners are not willing to allow beavers to remain, relocation efforts can provide benefits in the headwaters.

A map and drawings of the project location.
See Figure 28 below.

Description of the spatial distribution of likely benefits.
Maintaining and promoting beaver on the landscape is anticipated to regulate hydrology (increasing water storage, recharging groundwater, increasing summer flows) decrease surface water temperatures, and buffer the impacts of climate change in the focus subbasins (see Figure 28).

Performance goals and measures.
The program includes proactive outreach to primarily private landowners in the focus subbasins to educate landowners and encourage them to allow beavers to remain on the landscape. Snohomish Conservation District will provide technical assistance, permitting, and installation assistance for beaver control devices that protect culverts (beaver deceivers) and maintain a stable pond level (pond levelers). The District will provide additional incentives to landowners for allowing beavers to remain on the

landscape. These include free native plants that are appropriate for the new hydrologic regime as well as caging materials to protect large existing trees.

- Increased landowner tolerance of beavers and beaver presence in the focus subbasins.
- Install ten beaver control devices.
- Provide technical assistance on at least 30 site visits.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The focus subbasins were selected for their high potential to increase resilience to climate induced hydrologic changes as identified in the Watershed Characterization for WRIA 7 (2015) and the Snohomish Basin Protection Plan (2015). They also represent the nexus of priorities for salmon habitat restoration and water quality improvements (namely water temperature). As all of these priorities are intricately entwined, this focus area became the obvious choice for a comprehensive landscape-scale approach to watershed resilience. Climate change has already resulted in drastic changes to the hydrology of the Snohomish River, trending from a bimodal hydrograph with flood peaks in the fall and spring, to a unimodal hydrograph with intense floods in the middle of winter and low stream and river flows in summer months (Mauger et al., 2015). With the projected loss of snowpack in the upper watershed, it is essential that we take a comprehensive approach to storing and infiltrating water throughout the watershed to mitigate against these projected changes. Lessening water withdrawals in the summer, while providing a direct benefit to summer low flows, is only a piece in the puzzle and does not address the long-term needs for water storage and groundwater recharge in the larger watershed.

Details for each subbasin are as follows:

Pilchuck River: The Pilchuck River supports ESA listed Chinook Salmon and Bull Trout and "restoration of hydrologic and sediment processes for peak and baseflows" is a Tier One priority in the Snohomish River Basin Salmon Conservation Plan. In addition, the Pilchuck River and French Creek basins are the focus for a TMDL for dissolved oxygen and temperature that the Department of Ecology is currently completing. Pressures in the basin include continuing development from the nearby urban centers of Lake Stevens and Snohomish leading to increasing water withdrawal from exempt wells.

French Creek: French Creek is part of the joint TMDL for dissolved oxygen and temperatures with the Pilchuck River. Lower French Creek was once a large scrub shrub wetland in the floodplain of the Snohomish River but has since been diked and drained for farming. Water quality through this lower watershed creates a fish passage barrier and drainage challenges due to upland development and subsiding farmland threaten agricultural viability.

Woods Creek: Woods Creek is home to several species of salmon including ESA listed Chinook and Bull Trout. Restoration of "hydrologic and sediment process for peak and base flow" in Woods Creek is a Tier One priority in the Snohomish River Basin Salmon Conservation Plan. In addition, Woods Creek is part of a TMDL in development for water temperatures in the Lower Skykomish River subbasin. Pressures in the basin include development from the nearby urban center of Monroe and conversion of larger agricultural tracts to a five acre rural residential development.

Lower Skykomish River: This section of the Skykomish River is home to several species of salmon including ESA listed Chinook and Bull Trout. Restoration of "hydrologic and sediment process for peak and base flow" in the Skykomish River is a Tier One priority in the Snohomish River Basin Salmon Conservation Plan. In addition, the lower river is part of a TMDL in development for water temperatures.

Pressures in the basin include development from the nearby urban center of Monroe and conversion of larger agricultural tracts to five acres rural residential development.

Identification of anticipated support for and barriers to completion.

One reason the District has been so successful at achieving habitat restoration and water quality goals is their ability to engage private landowners and build community support for responsible stewardship of our natural resources. The District will capitalize on these strong relationships within the community to implement this project. The District has the staff expertise and partnerships to be able to successfully implement this program in the priority subbasins.

Estimate of capital costs and reoccurring O&M costs.

The project received $100,296 streamflow restoration funding in 2019 to fully fund the program in the four focus subbasins. To continue an ongoing program, additional funding will be needed. Annual program costs are estimated at approximately $22,000 per year to provide landowner outreach, education and on-site technical assistance, permitting assistance, and cost-share project implementation of beaver management devices. Snohomish Conservation District typically provides cost share funding totaling $2,000 each year; this funding is provided by the Snohomish Conservation District Rates and Charges funding, a special assessment charge to some property taxpayers in Snohomish Conservation District's service area that is authorized under RCW 89.08.400. The District's Rates and Charges special assessment charge to property taxpayers is subject to Snohomish County Council approval.

Project durability and resiliency.

Human alterations to the landscape and the climate change have resulted in drastic and accelerated consequences to the health of our watershed. A combination of increased intensity and frequency of winter flood flows, a decrease in snowpack, a decrease in groundwater recharge, and a decrease in summer precipitation have created a new hydrologic regime. While the focus of this project is on restoring summer flow to our rivers, low flows are symptomatic of a much broader hydrologic problem – one that can only be addressed in a comprehensive way by working across the watershed to implement projects that protect or restore natural hydrologic processes and watershed functions to protect against the already realized impacts of climate change. This project aims to restore altered hydrology by promoting beavers on the landscape.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Snohomish Conservation District. Kristin Marshall, kristin@snohomishcd.org. The project sponsor began implementation of the project in 2016 with support of National Estuary Program. A new grant agreement was signed in 2019 with streamflow restoration funding to implement this project.

Documentation of sources, methods, uncertainties, and assumptions.

Dittbrenner et al. 2018a. Modeling intrinsic potential for beaver habitat to inform restoration and climate change adaptation. PLoS ONE 13.

Dittbrenner et al. 2018b (in process). Hydrologic and temperature effects of beaver in headwater streams. Ch.3 of dissertation. School of Environmental and Forest Sciences, UW.

Mauger et al. 2015. State of Knowledge: Climate Change in Puget Sound. Climate Impacts Group, University of Washington.

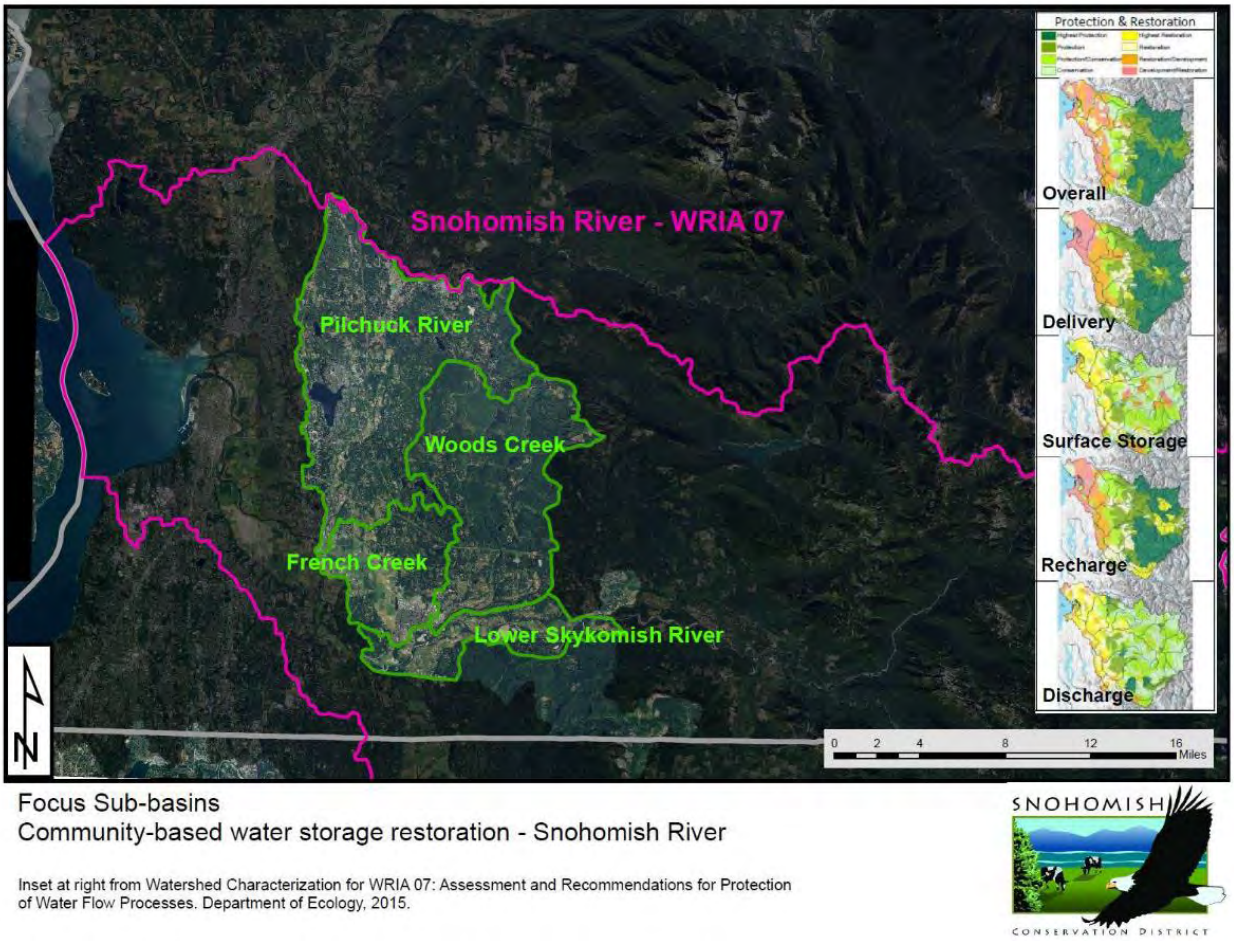


Figure 28. Project focus area for Living with Beavers Project.

Note: Subbasins shown in Figure 28 are different than WRIA 7 subbasins in this watershed plan.

WRIA 7 – Project Description
Wetland Restoration

Project Name and Number
Wetland Restoration (7-P-H10)

WRIA 7 WRE Subbasin
Woods Creek, Pilchuck, Little Pilchuck, Snohomish Estuary/Mainstem, and Skykomish Mainstem

Narrative description.
The Snohomish River watersheds historically supported large populations of Pacific salmonids, including threatened Puget Sound Chinook Salmon and steelhead trout, and the commercially important Coho Salmon. The landscape that supported these fish populations included extensive forests that grew along complex rivers, streams, and estuaries rich with wide floodplains, extensive wetlands, large wood log jams, and beaver ponds. In the mid-1800s, Euro-American settlers began to heavily modify the landscape including extensive alterations for agricultural and forestry purposes. Many of these modifications were located on the river corridor and within the floodplains of the Snohomish and Stillaguamish River systems and continue to impact water quality, salmon production, and hydrologic processes today. Especially as climate change impacts the Snohomish watershed, restoration of wetlands is needed to restore and protect hydrology. A large portion of the converted wetlands are located on private land where restoration of wetlands is completely voluntary, which poses a substantial barrier to wetland restoration.

Snohomish Conservation District (District) will complete eighteen acres of wetland restoration planting on degraded wetlands on privately owned land in the Pilchuck River, French Creek, Woods Creek, and Lower Skykomish River watersheds, with the goal of improving water storage and groundwater recharge. The District will work with private landowners and restoration crews, including Washington Conservation Corps and Veterans Conservation Corps crews, to complete site preparation and maintenance of installed vegetation and to control invasive vegetation. The planting plan for each wetland will be determined based on location, historic condition, soil type, existing hydrologic regime, and invasive vegetation present but will be designed for maximum water storage and/or infiltration.

A quantitative or qualitative assessment of how the project will function.
In addition to storing above and below ground water, wetlands have been shown to significantly contribute to groundwater resources, thus regulating surface water flow throughout watersheds (Carter, 1986; Bradley and Brown, 1997; ven der Kamp and Hayashi, 1998; Mitsch and Gosselink, 2000). Wetlands throughout the Snohomish River watershed have been degraded or completely lost as wetland areas have been converted to make way for human land-uses such as development and agriculture. In the focus subbasins, there are numerous locations where farms have been left fallow due to difficulties draining the land. The District will use aerial imagery, soil maps, and several wetland datasets to identify high potential wetland restoration sites and reach out to landowners to solicit support to complete wetland planting.

A map and drawings of the project location.
See Figure 29 below.

Description of the spatial distribution of likely benefits.

The project will restore degraded wetlands in the focus subbasins to improve surface water storage, increase groundwater recharge, decrease surface water runoff, increase summer stream flows, and ultimately increase hydrologic resilience to climate change in the focus subbasins (See Figure 29 below). Although the first phase of planting includes only 18 acres of planting across a large geographic area, The District is currently in the process of completing a prioritization and site selection exercise to identify wetland restoration opportunities that are expected to provide the greatest potential hydrologic benefits. As additional funding is secured, the District and other project sponsors may use this prioritization to expand implementation across the project area.

Performance goals and measures.

The first phase of the project is anticipated to achieve the following goals:

- Create eighteen acres of restored wetlands through installation of native trees and shrubs.
- Performance measures of 80 percent survival of bare root, 50 percent survival of live stakes, and less than 20 percent invasive species cover by 2024.

Additional planting of prioritized sites will continue beyond 2024 as additional funding is secured.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The focus subbasins were selected for their high potential to increase resilience to climate induced hydrologic changes as identified in the Watershed Characterization for WRIA 7 (2015) and the Snohomish Basin Protection Plan (2015). They also represent the nexus of priorities for salmon habitat restoration and water quality improvements (namely water temperature). As all of these priorities are intricately entwined, this focus area became the obvious choice for a comprehensive landscape-scale approach to watershed resilience. Climate change has already resulted in drastic changes to the hydrology of the Snohomish River, trending from a bimodal hydrograph with flood peaks in the fall and spring, to a unimodal hydrograph with intense floods in the middle of winter and low stream and river flows in summer months (Mauger et al., 2015). With the projected loss of snowpack in the upper watershed, it is essential that we take a comprehensive approach to storing and infiltrating water throughout the watershed to mitigate against these projected changes.

Details for each subbasin are as follows:

Pilchuck River: The Pilchuck River supports ESA-listed Chinook Salmon and Bull Trout and “restoration of hydrologic and sediment processes for peak and baseflows” is a Tier One priority in the Snohomish River Basin Salmon Conservation Plan. In addition, the Pilchuck River and French Creek basins are the focus for a TMDL for dissolved oxygen and temperature that the Department of Ecology is currently completing. Pressures in the basin include continuing development from the nearby urban centers of Lake Stevens and Snohomish leading to increasing water withdrawal from exempt wells.

French Creek: French Creek is part of the joint TMDL for dissolved oxygen and temperatures with the Pilchuck River. Lower French Creek was once a large scrub shrub wetland in the floodplain of the Snohomish River but has since been diked and drained for farming. Water quality through this lower watershed creates a fish passage barrier and drainage challenges due to upland development and subsiding farmland threaten agricultural viability.

Woods Creek: Woods Creek is home to several species of salmon including ESA listed Chinook and Bull Trout. Restoration of “hydrologic and sediment process for peak and base flow” in Woods Creek is a Tier

One priority in the Snohomish River Basin Salmon Conservation Plan. In addition, Woods Creek is part of a TMDL in development for water temperatures in the Lower Skykomish River subbasin. Pressures in the basin include development from the nearby urban center of Monroe and conversion of larger agricultural tracts to five acre rural residential development.

Lower Skykomish River: This section of the Skykomish River is home to several species of salmon including ESA listed Chinook and Bull Trout. Restoration of "hydrologic and sediment process for peak and base flow" in the Skykomish River is a Tier One priority in the Snohomish River Basin Salmon Conservation Plan. In addition, the lower river is part of a TMDL in development for water temperatures. Pressures in the basin include development from the nearby urban center of Monroe and conversion of larger agricultural tracts to five acres rural residential development.

Identification of anticipated support for and barriers to completion.

One reason the District has been so successful at achieving habitat restoration and water quality goals is their ability to engage private landowners and build community support for responsible stewardship of our natural resources. The District will capitalize on these strong relationships within the community to implement this project. The District has the staff expertise and partnerships to be able to successfully implement this program in the focus areas.

Estimate of capital costs and reoccurring O&M costs (order of magnitude costs).

The project received $220,240 streamflow restoration funding in 2019 to implement this project. The District will complete 18 acres of wetland planting and restoration with this funding. Additional funding of approximately $12,500 to $15,000 per acre is needed to complete additional wetland planting to achieve widespread streamflow benefits associated with wetland restoration.

Project durability and resiliency.

Human alterations to the landscape and the climate have resulted in drastic and accelerated consequences to the health of our watershed. A combination of increased intensity and frequency of winter flood flows, a decrease in snowpack, a decrease in groundwater recharge, and a decrease in summer precipitation have created a new hydrologic regime. This project aims to address human alterations to degraded wetlands in the focus areas by restoring them to a more natural and resilient state. Restoration of wetland habitat is expected to contribute to long-standing improvements in overall hydrologic processes and function in the watershed and build resilience in the watershed as climate change continues to alter the hydrologic regime of the Snohomish watershed. Restored wetlands are protected from future degradation or loss by several regulatory programs, including protections from Sections 402 and 404 of the federal Clean Water Act; Washington state regulations including the Water Pollution Control Act, Shoreline Management Act, and State Environmental Policy Act; and Snohomish and King County Critical Areas Ordinances as part of implementation of the Growth Management Act.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Snohomish Conservation District. Kristin Marshall, kristin@snohomishcd.org. The project sponsor began implementation of the project in 2016 with support of NEP funding. A new grant agreement was signed in 2019 with streamflow restoration funding to implement this project and additional funding from the Department of Ecology's Combined Water Quality Program has been secured to provide floodplain wetland and riparian planting funding for three specific sites identified during the first phase of the project.

Snohomish Conservation District has completed a preliminary wetland site prioritization and selection process to identify priority wetland planting opportunities on private land within the project area; final prioritization and site selection for the first 18 acres of wetland restoration will be completed in early 2020.

Documentation of sources, methods, uncertainties, and assumptions.

Carter. 1986. An overview of the hydrologic concerns related to wetlands in the United States. Canadian J. of Botany.

Bradley and Brown. 1997. Modeling of hydrological processes in a floodplain wetland. In Groundwater/Surface Water Ecotones: Biological and Hydrological Interactions and Mgt Options.

Mitsch and Gosselink. 2000. The value of wetlands: importance of scale and landscape setting. Ecological Economics.

Van der Kamp and Hayashi. 1998. The groundwater recharge function of small wetlands in the semi-arid northern prairies. Great Plains Research.

Mauger et al. 2015. State of Knowledge: Climate Change in Puget Sound. Climate Impacts Group, University of Washington.

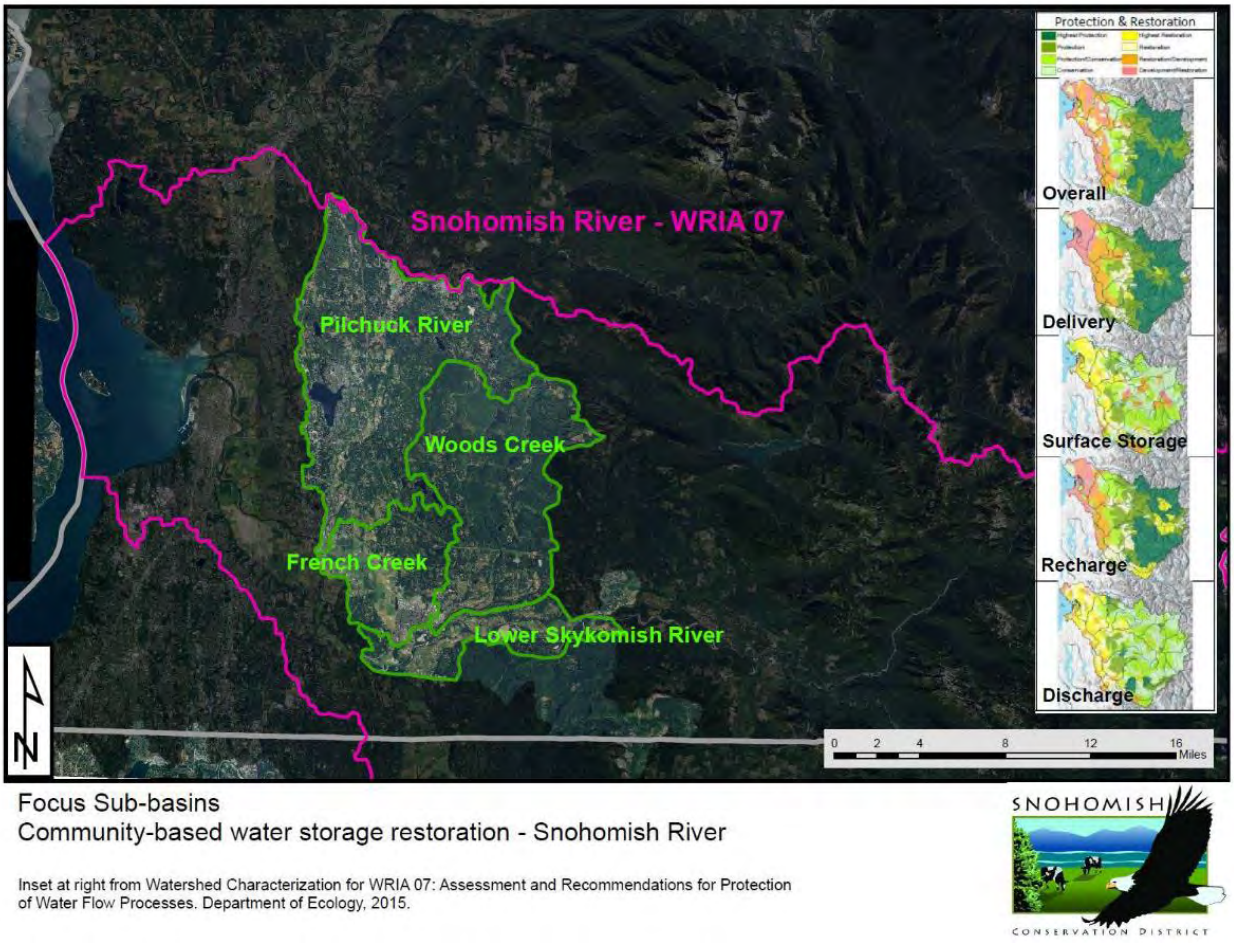


Figure 29. Project Focus Area for Wetland Restoration Project.

Note: Subbasins shown in Figure 29 are different than WRIA 7 subbasins in this watershed plan.

WRIA 7 – Project Description
Woods Creek Riparian Restoration Partnership

Project Name and Number
Woods Creek Riparian Restoration Partnership (7-W-H11[5])

WRIA 7 WRE Subbasin
Woods Creek

Narrative description.
Woods Creek is identified as a high priority watershed in regional salmon planning efforts and water quality improvement plans. For these reasons, several project partners, including the Snohomish Conservation District, Sound Salmon Solutions, Wild Fish Conservancy, and Adopt a Stream Foundation partners have developed several collaborative plans to prioritize and set implementation goals for several of the limiting factors that threaten salmon populations, water quality for wildlife and humans, and streamflow in the watershed. Project partners completed additional analysis and prioritization of the needs of the basin and developed work plans to guide project implementation in the basin including a 2015 fish passage barrier assessment (Wild Fish Conservancy and Snohomish Conservation District) and the *Woods Creek Action Plan* (Snohomish Conservation District 2012); these plans were informed by the *Woods Creek Watershed Habitat Conditions Report* (Snohomish County Surface Water Management 2013), water quality studies, and the salmon recovery plan.

Snohomish Conservation District, Wild Fish Conservancy, Sound Salmon Solutions, and Adopt A Stream Foundation will implement prioritized riparian and wetland plants, log jam installations, and fish passage barrier corrections to restore 45 acres of riparian forest and instream habitat along the mainstem of Woods Creek and correct between three and five fish passage barriers to improve juvenile and adult access to spawning and rearing habitat.

A quantitative or qualitative assessment of how the project will function.
Quantitatively, this project proposes riparian plantings along the mainstem of Woods Creek of up to an additional 45 acres, installation of log jams along the mainstem in conjunction with riparian plantings, and correction of an additional three to five fish passage barriers. Project activities will increase habitat connectivity and provide shade and create pool habitat along the creek to protect water temperatures and directly benefit prey availability of pre-migrant and outmigrating juvenile salmonids.

A map and drawings of the project location.
See Figure 30 below.

Description of the spatial distribution of likely benefits.
The Woods Creek watershed is divided into the Lower, West Fork (named Carpenter Creek at the headwaters), and East Fork Woods Creek subbasins (Figure 30). The two nearly equal sized subbasins of the West and East Forks come together to form Lower Woods Creek at river mile 3.9. On the East Fork, there is a natural waterfall at river mile 4.2 preventing anadromous fish passage. Both the Snohomish County Surface Water habitat conditions analysis and this riparian enhancement action plan focus analysis on the Lower, West Fork and East Fork of Woods Creek to the waterfall. These reaches will be

[5] Other project numbers associated with this project: 07-RPR-022

referred to as the mainstem. The mainstem was further divided into eleven analysis reaches based on both the gradient of the channel and the land-use of the surrounding area (Figure 30).

The project will restore riparian habitat along the mainstem of Woods Creek by planting riparian and wetland habitat to provide shade which will protect water temperatures and outmigration success of juvenile salmonids; installing large wood and log jams to provide refuge habitat and create pools to provide streamflow benefits; and replacing fish passage barriers to improve fish access to spawning and rearing habitat.

Performance goals and measures.

Unknown at this stage of design.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

Woods Creek is home to several species of salmon including ESA listed Chinook and Bull Trout. Restoration of riparian function within Woods Creek will improve water temperatures which is of high value since Woods Creek is part of a TMDL in development for water temperatures in the Lower Skykomish River subbasin. This watershed is the largest Puget Lowland watershed in the Skykomish River basin and supports runs of Chinook (threatened), steelhead (threatened), Bull Trout (threatened), Coho (species of concern), Chum, and Pink Salmon.

Identification of anticipated support for and barriers to completion.

One reason the Snohomish Conservation District, Wild Fish Conservancy, Sound Salmon Solutions, and Adopt A Stream Foundation have been so successful at achieving habitat restoration and water quality goals is their ability to engage private landowners and build community support for responsible stewardship of our natural resources. The project partners will build upon these strong relationships within the community as well as the history of successful project construction in this watershed to garner additional landowner support to implement the next phase of this project. The partners have the staff expertise and partnerships to be able to successfully implement this program in the focus areas.

Estimate of capital costs and reoccurring O&M costs (order of magnitude costs).

Project sponsors have secured several grant funds to implement the first phases of project implementation. The project secured $250,000 of grant funding from Department of Ecology and NOAA to complete initial prioritization, landowner outreach, and 45 acres of riparian restoration. The Salmon Recovery Funding Board (SRFB) and the Washington State Conservation Commission has provided approximately $400,000 to correct four fish passage barriers and complete preliminary design of a fifth barrier correction project, and there was additional funding secured to complete several log jam installations in conjunction with the riparian planting projects.

Additional funding is needed to implement large wood, fish passage barrier, riparian, and wetland restoration actions. At least $950,000 in additional funding is needed for the next phase of planting, large wood installation, and fish passage barrier removal project construction.

Project sponsors have included in the construction cost estimates the costs associated with maintaining planting projects for three to five years, after which time the plantings are expected to achieve a free-to-grow state and maintenance is expected to be minimal. Planting and large wood projects are designed to require limited to no operation and maintenance once initial planting maintenance is completed.

Operation and maintenance costs of fish passage barrier correction projects is the responsibility of the landowner once the project is complete.

Project durability and resiliency.

The project elements that are proposed as part of this cooperative project are designed to work with and contribute to restore natural processes. Maintenance of planting projects is needed for a period of three to five years once the native plants are installed to ensure a high plant survival rate; maintenance includes mechanical, chemical, and manual weed control, watering, plant replacement. The project area is naturally very wet so that watering will likely be quite limited. Monitoring plant survival, native plant/shrub cover and non-native invasive plant cover will be performed for at least the first five years post-implementation; log jams will be monitored for a period of five years as well. Fish passage barrier correction projects are inspected annually by the project sponsor for at least two years, and annually by the landowner after that period.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Snohomish Conservation District, Wild Fish Conservancy, Sound Salmon Solutions, and Adopt A Stream Foundation are collaborating as project sponsors of coordinated, strategic restoration work in the watershed. Primary contact for the partner collaborative for Streamflow Restoration Plan is Snohomish Conservation District. Kristin Marshall, kristin@snohomishcd.org.

Riparian and wetland restoration prioritization has been completed. Fish passage barrier correction prioritization has been completed. Landowner outreach and project design is ongoing. Project sponsors are actively working with several willing landowners who are committed to implementing habitat restoration projects on their land once grant funding is received by sponsors. Project sponsors can immediately proceed with final project design, permitting (if needed), and project implementation once additional grant funding is received.

Documentation of sources, methods, uncertainties, and assumptions.

Carter. 1986. An overview of the hydrologic concerns related to wetlands in the United States. Canadian J. of Botany.

Mitsch and Gosselink. 2000. The value of wetlands: importance of scale and landscape setting. Ecological Economics.

Mauger et al. 2015. State of Knowledge: Climate Change in Puget Sound. Climate Impacts Group, University of Washington.

Snohomish Conservation District. 2012. Woods Creek Action Plan for Riparian Restoration. Lake Stevens, WA.

Snohomish County Public Works Surface Water Management. 2013. Woods Creek Watershed Habitat Conditions Report. Everett, WA.

Wild Fish Conservancy and Snohomish Conservation District. 2015. Unpublished Woods Creek fish passage barrier inventory and prioritization. Duvall, WA.

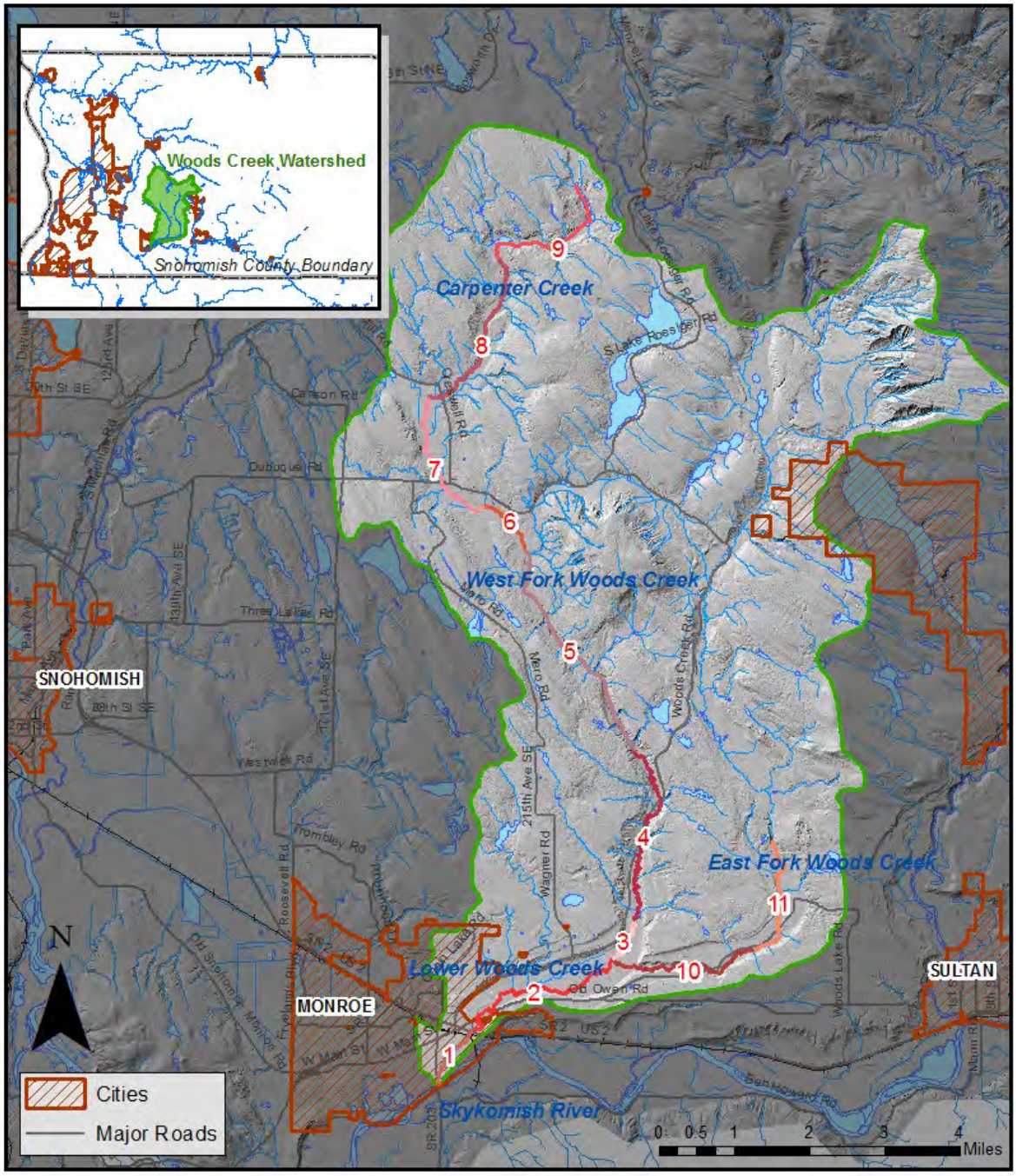


Figure 30. Project focus area for Woods Creek Riparian Restoration Partnership Project.

Note: The Woods Creek watershed (boundary highlighted in green) flows into the Skykomish River at the City of Monroe. The mainstem of Woods Creek (Lower, West Fork, Carpenter, and East Fork) was divided into 11 analysis reaches (shades of red).

WRIA 7 – Project Description
Expansion of Sultan River Side Channel Network (Sultan River Floodplain Activation)

Project Name and Number
Expansion of Sultan River Side Channel Network (Sultan River Floodplain Activation) (7-S-H12)

WRIA 7 WRE Subbasin
Sultan

Narrative description
This project is a salmon habitat restoration project that will use a combination of physical interventions and flow redistribution to re-engage and restore select portions of the Sultan River floodplain. Of the 16 miles of river downstream of Culmback Dam, over 80 percent or approximately 13 miles, lies within a confined canyon. The lowermost 3 miles, just upstream of the confluence with the Skykomish River, is an alluvial floodplain. This area, near the town of Sultan, is populated and includes a combination of residential properties, park lands, and agricultural areas. The proposed project will manipulate and manage the distribution of flow into the floodplain environment within park and agricultural areas and establish a defined path for the return of these flows to the river. The activated, more frequently watered off-channel habitat will provide juvenile salmonid rearing habitat and refugia during high flow conditions. This is an expansion of an existing side channel network that currently provides prime rearing habitat. The project will also provide increased diversity in spawning habitat important for building resiliency in existing and future salmonid populations. The project will also provide increased diversity in spawning habitat important for building resiliency in existing and future salmonid populations.

Quantitative or qualitative assessment of how the project will function
The goal of this project is to expand the lateral migration of the river into off-channel areas to effectively increase the value and utility of these areas for rearing primarily for juvenile Chinook and Coho salmon. The intent and objective of the design is to route flow in a manner that will stimulate geomorphic activity and ensure the persistence of these areas. The degree to which the high flow channel remains seasonally wetted will be informed by detailed hydraulic and hydrologic modelling. A defined outlet and return to the river will ensure that rearing fish are not trapped or stranded when flows recede. Additional benefits will include the “opening up” and more routine wetting of adjacent floodplain areas leading to groundwater recharge and the establishment of a healthy and robust riparian community.

Specific design elements: 1) Increase flow delivery to floodplain by five to eight cfs during low flow, 2) Expand active channel and side channel areas by at least 50,000 square feet, 3) Promote the establishment of a healthy riparian community along activated side channel areas, 4) Place a minimum of at least six new log structures, 4 and 5) Increase substrate diversity over existing conditions. No water offset is assumed for the purposes of this watershed plan.

Map and drawings of the project location
WRIA 7 Snohomish Basin – Sultan Subbasin. The project is in the Lower Sultan River, between river mile (RM) 0.5 and 1.8. The Sultan River is a major tributary to Skykomish River. The project site is shown in relation to surrounding physical features in Figure 31.

Description of the spatial distribution of likely benefits

Expand active channel and side channel by 40,000 square feet.

Performance goals and measures

The goal of this project is to expand the lateral migration of the river into off-channel areas to effectively increase the value and utility of these areas for rearing primarily for juvenile Chinook and Coho Salmon. A secondary goal of this project is to increase the dynamism of the main channel and expand the range of rearing, holding, and spawning habitats available to anadromous fish in the lower river.

Current measures underway include the design and permitting for the project under a Washington State Recreation and Conservation Office grant for $200,000: 1) Design main channel to provide for diverse adult holding and spawning habitat over a range of hydrologic conditions, 2) Design to effectively expand the range of hydrologic conditions over which side channels receive inflow from the main river by manipulating the hydraulic inlet controls, 3) Incorporate the use of LWD structures to increase both adult and juvenile habitat availability in the mainstream and side channels, and 4) Provide design for expansion potential off-channel refuge and rearing habitat in side channels.

Descriptions of the species, life stages and specific ecosystem structure

Chinook Salmon use the entire length of the Sultan River for spawning and rearing. The lower 3 miles, in proximity to the proposed site, is geomorphically distinct from other portions of the river. In contrast to the confined, canyon nature of the upper river, the lowermost reach of the Sultan River is broad, hydraulically diverse, and contains a wide variety of substrate sizes favorable to spawning by a variety of species beyond Chinook Salmon including Pink, Coho, and Chum Salmon as well as winter-run steelhead trout. In years when Pink Salmon are present and abundant, Chinook tend toward using the upper reaches of the Sultan. In even years when Pink Salmon are absent, Chinook are more frequently observed using the lower river. The lower Sultan River also provides important rearing habitat for the aforementioned species.

Identification of anticipated support for and barriers to completion

Landowners at the project site have been notified and are preliminarily supportive of this project to restore natural conditions for the benefit of salmonids. The Aquatic Resource Committee for the Sultan River has been notified and is also supportive of this project and its ability to advance salmon recovery. Identified uncertainties include funding sources and continued landowner willingness to use property for this project.

Estimate of capital costs and reoccurring O&M costs

Estimated total of design, permitting, and construction is approximately $800,000. Ongoing maintenance and monitoring for the first five years is approximately $10,000 per year.

Project durability and resiliency

As a regulated river, Culmback Dam affords the ability to moderate high flow events in the Sultan River and store water for the augmentation of summer flows. This level of flow control coupled with the regulation of temperature during periods of reservoir stratification adds an element of resiliency when facing the hydrologic extremes that are anticipated with climate change.

Project sponsor(s) (if identified) and readiness to proceed/implement

Snohomish County PUD. Keith Binkley, Natural Resources Manager, KMBinkley@snopud.com or Dawn Presler, Sr. Environmental Coordinator, DJPresler@snopud.com. The preliminary design concept for this

project has been identified and discussed with landowners and an Aquatic Resource Committee familiar with the Sultan River.

As mentioned above, the design and permitting phase for this project are currently underway and should be completed by May 2022, allowing for a readiness to proceed with construction implementation shortly thereafter.

Documentation of sources, methods, uncertainties, and assumptions

There is extensive habitat and species data collected in the Sultan River as part of the operations of the Jackson Hydroelectric Project. This information is available for public review at: https://www.snopud.com/PowerSupply/hydro/jhp/jhpfish/fishery.ashx?p=2069

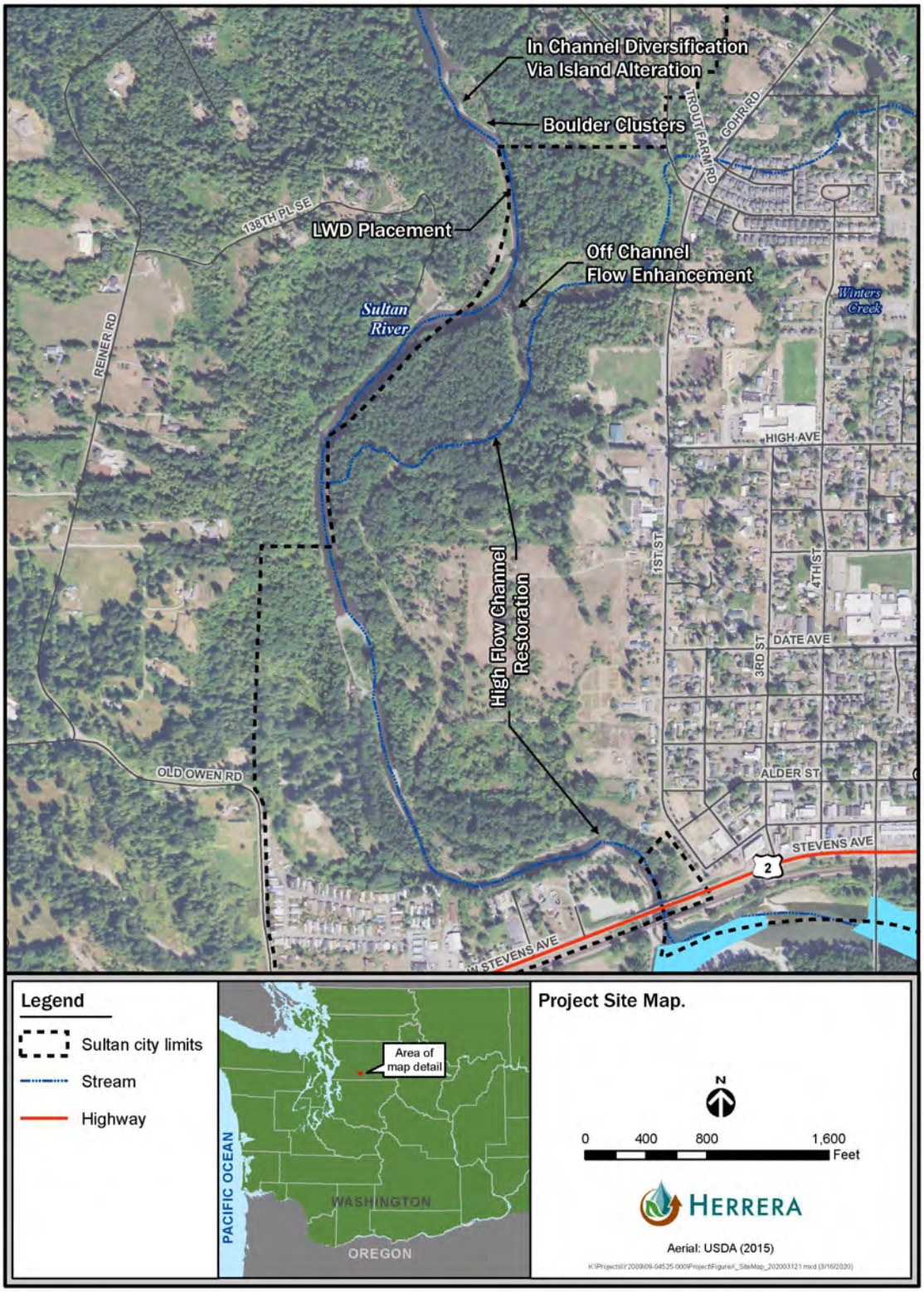


Figure 31. Sultan River Floodplain Activation Project Site Plan

WRIA 7 – Project Description
Haskel Slough Connectivity Habitat Project

Project Name and Number
Haskel Slough Connectivity (7-SM-H13[6])

WRIA 7 WRE Subbasin
Skykomish Mainstem

Narrative Description
Tulalip Tribes will complete designs, outreach and implement restoration on Haskel Slough, an approximately 2.4-mile-long, 71-acre side channel of the Skykomish River near Monroe, Washington. The slough provides critical spawning and rearing habitat for Chinook Salmon and other listed fish species. There is a deteriorating training dike at the upstream end of the slough that prevents surface flow connectivity with the exception of extreme flood events. The goal of the restoration project is to enhance juvenile salmon rearing and flood refugia habitat in Haskel Slough by modifying the inlet dike to promote increased connectivity, water quantity and water quality. Additional project benefits will include floodplain water storage, and prevention of safety and infrastructure damage resulting from catastrophic dike failure.

As part of the planning phase, Tulalip Tribes will conduct a landowner willingness assessment and feasibility analysis including development of potential connectivity alternatives, associated geomorphic analyses, HEC-RAS 2d hydraulic modelling, extensive community outreach, a preferred alternative, and final designs. Restoration will include inlet dike modification, downstream crossing removal/replacement/modification, and riparian planting. The intent is to maximize side channel activation and water quantity at the maximum range of river discharge fluctuation while maintaining or improving flood risks to landowners and infrastructure.

Quantitative or qualitative assessment of how the project will function.
This project will function primarily by modifying the Haskel Slough inlet dike to maximize side channel activation and water quantity at the maximum range of river discharge fluctuation (low and high flows) while maintaining or improving flood risks to landowners and infrastructure. This may require levee setbacks/construction, modifications or replacement to downstream crossings of Haskel Slough, and channel reconfiguration. The intent is to increase juvenile salmon rearing habitat connectivity, quantity and quality in a key area within the Snohomish River Basin.

A map and drawings of the project location.
This project proposes restoration within Haskel Slough, a side channel of the Skykomish River near Monroe, Washington. The project site is shown in relation to surrounding physical features in Figure 32 and Figure 33.

[6] Other numbers associated with this project: 20-11140

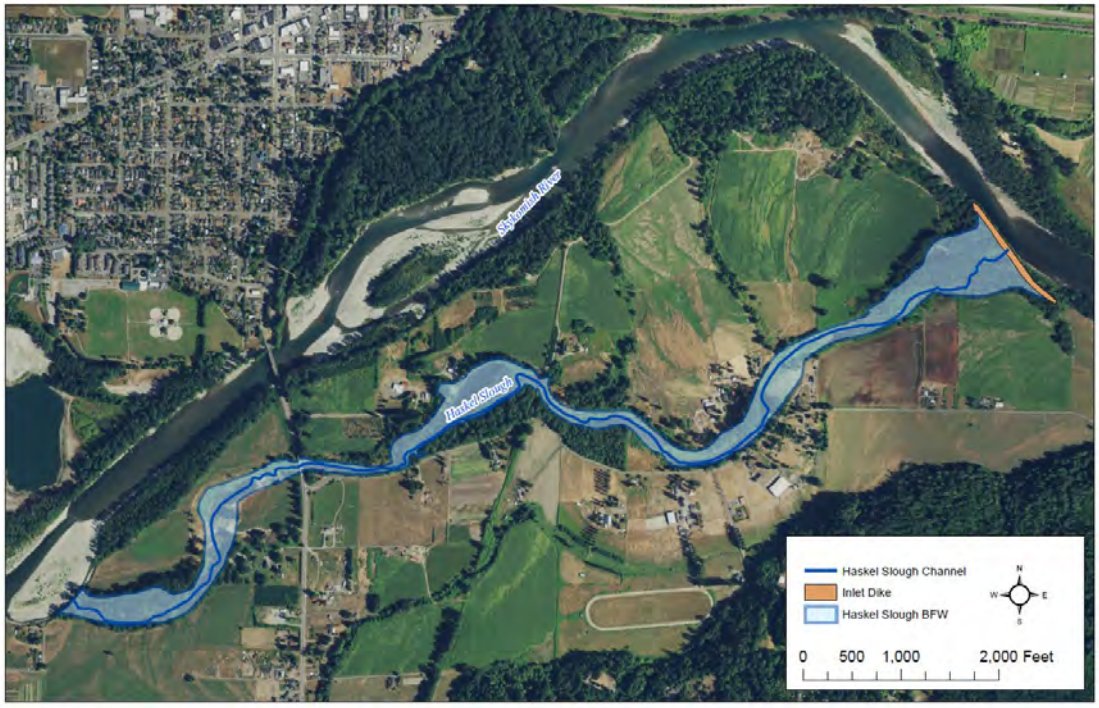


Figure 32. Haskel Slough Site Plan Overview

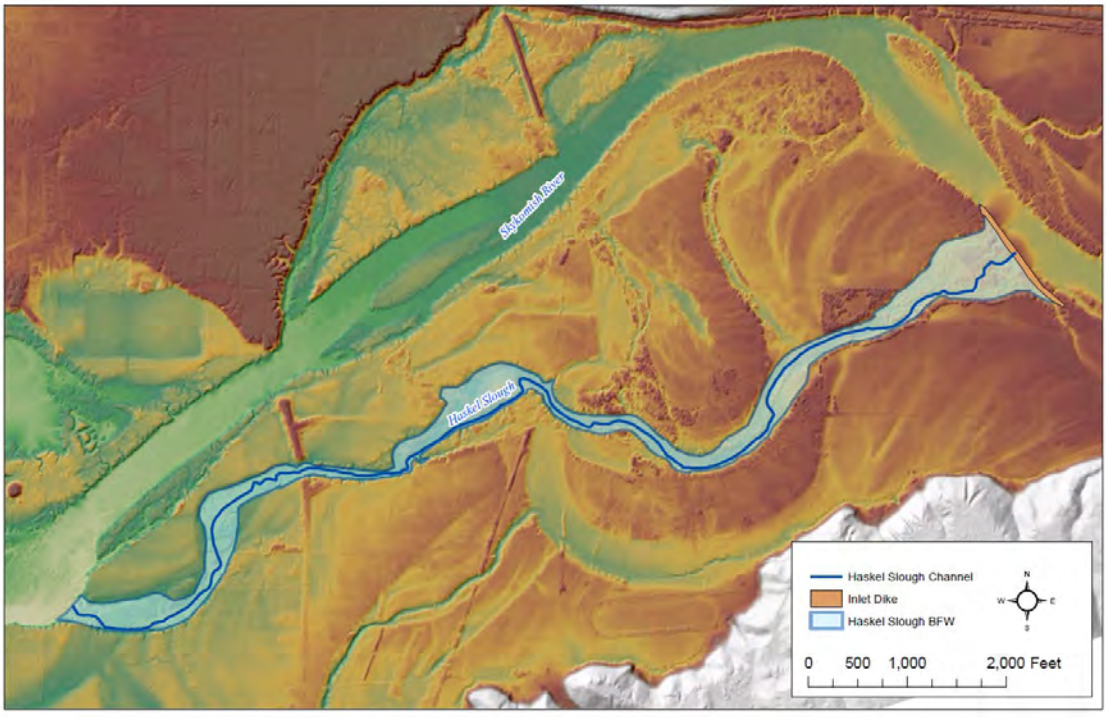


Figure 33. Haskel Slough Site with LIDAR

Description of the anticipated spatial distribution of likely benefits.

Project implementation will benefit fish populations in the Skykomish and larger Snohomish River Watersheds. Flood benefits will occur within the lower Skykomish River reach in the vicinity of the City of Monroe and the Tualco Valley. Increased flow/low flow will be observed within Haskel Slough itself.

Decreased catastrophic flood risk will benefit landowners/infrastructure adjacent to Haskel Slough by preventing unplanned inlet dike failure.

Performance goals and measures.

Increase connectivity of 2.4 miles of priority off-channel habitat.

- Increase connectivity of 71 acres of priority off-channel habitat.
- Increase water quantity and quality of priority off-channel habitat.
- Increase safety resulting from engineered dike modification.
- Increase protection of infrastructure through engineered dike modification.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The proposed project will address myriad limiting factors (floodplain/riparian function, water quality, etc.) for both ESA listed Chinook, steelhead, Bull Trout and other salmonid species at virtually all adult and juvenile freshwater life stages from incubation to rearing and adult holding and spawning. The WRIA 7 Salmonid Limiting Factors Analysis identifies natural floodplain function as impaired within the Skykomish Mainstem due to road, railroad, and dike encroachment that limit natural floodplain processes and block access to and formation of habitat features. There is a training dike on the inlet to Haskel Slough that significantly inhibits connectivity and water quantity. Riparian conditions are relatively intact in Haskel Slough, though there are considerable opportunities for riparian restoration. The Limiting Factors Analysis identifies the restoration of channel migration zone functions and side channel habitat access, along with restoration of riparian function as the primary recommended recovery actions.

Identification of anticipated support and barriers to completion.

This initial phase of the project will include the primary consultation of stakeholders including landowners and the local community. However, this project has been discussed with various stakeholders including Snohomish County, PCC Farmland Trust, Snohomish Conservation District, WDFW, and others. There is significant interest in pursuing project alternatives in Haskel Slough and an acknowledgement that this is an important area to focus restoration and conservation efforts.

The largest constraint for this project will likely be landowner, stakeholder and community agreement on the preferred alternative and project implementation to ensure a multi-benefit outcome. For this reason Tulalip Tribes propose early and consistent engagement through community/stakeholder outreach from the initial phase through project implementation. Other considerations will include stream crossings on Haskel Slough (including the Highway 203 bridge), landowner access, continued agriculture, and reducing flood hazards.

Estimate of capital costs and reoccurring O&M costs.

- Planning Costs (outreach/preliminary-final designs): $400,000
- Implementation Costs: $3,000,000
- O&M Costs: Minimal

Anticipated durability and resiliency.

Climate change and associated impacts will be factored into all current and future project elements. Increased connectivity in Haskel Slough will provide additional resilience through increased habitat accessibility, diversity, quantity, and quality. The intent is to pursue natural process based solutions as

much as possible to reduce maintenance requirements and ensure long term project function and durability.

Project sponsor(s) (if identified) and readiness to proceed/implement.

The Tulalip Tribes are the proposed project sponsor for this work and are ready to begin project planning and eventual implementation. Tulalip restoration project managers have extensive experience implementing restoration projects in this region. These projects have had varying scopes from very large, multimillion-dollar acquisition/restoration projects (Qwuloolt) to smaller fish passage and in-stream projects. Tulalip Tribes are currently collaborating with PCC farmland Trust to acquire a large portion of Haskel Slough and adjacent riparian areas to promote conservation/restoration and agriculture. Tulalip Tribes will draw from this experience and associated lessons learned while conducting these projects. Extensive data has been collected from this site on juvenile fish use, as Tulalip operates a rotary screw trap near Haskel Slough to assess out-migrating salmon smolts. Tulalip Tribes has extensive knowledge of the local landowners, fish use, and geomorphic context.

Documentation of sources, methods, uncertainties, and assumptions.

As this project is in the initial planning and outreach stages, there are several uncertainties regarding the exact method of implementation and landowner willingness for some landowners adjacent to Haskel Slough. However, there is significant momentum for project planning and implementation tasks, and Tulalip Tribes are are confident that the project will result in significant benefits to ESA listed fish species and the surrounding community.

WRIA 7 – Project Description
East Monroe Heritage Site Acquisition

Project Name and Number
East Monroe Heritage Site Acquisition (7-SM-H14)

WRIA 7 WRE Subbasin
Skykomish River Main Stem

Narrative Description
This project includes land acquisition of 43 acres of land located along the main stem of the Skykomish River at the eastern edge of the Monroe city limits. The property consists of a 210-foot feeder bluff, 7-acres of Class II and Class III wetlands, ¾ -mile salmon-bearing oxbow channel, and upland habitat that has been historically farmed. The City of Monroe is seeking to preserve the property as open space and to use the site for flood water storage and displacement. The project will prevent further floodplain development or fill, protect intact riparian and off-channel habitat not currently protected, minimize increases in impervious surface, and prevent urban sprawl. Land acquisition would assist the city in protecting the entire Skykomish River floodplain within Monroe, which includes Al Brolin Park, Sky River Park and the soon to be acquired Cadman site. The four-part open space network provides for a diverse riparian corridor while keeping surface and ground water clean and localized.

Quantitative or qualitative assessment of how the project will function.
Acquiring the East Monroe Heritage site prevents further floodplain development and fill as well as protects off-channel habitats not currently protected. The current property owners purchased the site with the intent of developing the property for commercial use. The property owner is seeking entitlement to change the zoning to proceed with development which proposes the fill of approximately 11-acres of upland habitat to bring the site out of the floodplain. Due to the lack of proximity to the Monroe public water system, a developer would likely need to provide water service to the site through onsite well drilling. Developers of multi-family dwelling units and larger sporting goods stores have shown interest in developing the property as well. Acquisition of the property would sustain critical surface water and groundwater networks from being endangered or depleted.

A map and drawings of the project location.
The project site is shown in relation to surrounding physical features in Figure 34.

Description of the anticipated spatial distribution of likely benefits.
Once land is acquired, future projects would begin to take place. Projects would involve the preservation and enhancement of the site, focusing initially on riparian restoration of the oxbow channel. Enhancement would include restoration to remove large amounts of Himalayan Blackberry and other invasive species present, plant a diversity of native species to enhance habitat, provide added shade benefit to the oxbow channel, and improve the culverts linking the oxbow to the Skykomish River to increase fish passage.

Performance goals and measures.
The performance goals and measures will be based on the improved reconnection of off-channel habitat to the river, the function of the culverts acting as a fish and wildlife passage, the increase in native habitat and canopy present and the decrease of invasive species existing at the site. The City would

include the property in its water quality monitoring program to document the improvement in water quality and its benefit to aquatic habitat.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The six mile reach of the Skykomish River east of Monroe is critical for Chinook spawning and rearing, and has been determined a major transportation corridor for Chinook, Coho and other salmonid species. Chinook Salmon are a priority species and protected under the ESA.

The riparian habitats present provide a vital corridor for wildlife movement and dispersal as well as all the major elements (food, water, and shelter) needed for survival. 85% of Washington's terrestrial vertebrate species use riparian zones for essential life activities with the density of wildlife in riparian areas being comparatively high. Riparian areas provide breeding habitat for birds and amphibian and reptile species are widespread throughout these areas. They also have a greater diversity of mammalian species due the diverse vegetation.

The site's oxbow channel and wetlands provide a movement corridor for species such as marbled murrelets and harlequin ducks to nesting areas outside the project area. They also provide movement corridors for small species such as amphibians and invertebrates to larger species such as bobcats, coyote, and deer. Forested areas also provide needs such as shelter and forest elements provide dens, foraging, and travel ways for many species.

Improvement of the on-site culverts to improve linkage between the oxbow channel and the river will also improve floodwater storage, as well as sediment and organic material transport.

Identification of anticipated support and barriers to completion.

Funding is the primary barrier at this time. Sound Salmon Solutions and the Snohomish Conservation District have eagerly expressed interest in partnering with the City in restoration efforts once the property is purchased.

Estimate of capital costs and reoccurring O&M costs.

Estimated cost to acquire the five parcels of land is $3 million.

Anticipated durability and resiliency.

Once invasive species are removed and native plants are planted, maintenance will be required to ensure plant survival. Invasive species management will also be required. On-going maintenance and monitoring is anticipated to be performed for five years. The city will be responsible for management of the site.

Project Sponsor(s) (if identified) and readiness to proceed/implement.

City of Monroe. Sponsor contact: Megan Darrow, mdarrow@monroewa.gov. The sponsor is ready to proceed with scoping and reconnaissance immediately.

Documentation of sources, methods, uncertainties, and assumptions.

Uncertainties pertain to funding.

Figure 34. Site Plan for East Monroe Heritage Site

WRIA 7 – Project Description
Shinglebolt Slough

Project Name and Number
Shinglebolt Slough Restoration (7-SM-H15[7])

WRIA 7 WRE Subbasin
Skykomish Mainstem

Narrative Description
This project will reconnect the eastern, filled, upstream section of Shinglebolt Slough by excavating approximately 12,500 cubic yards of material along the remnant flood channel alignment. The rip rap and berm along 600-900 feet of Skykomish River east of historical and existing bridge infrastructure would be removed. In total, 1,600 feet of side channel would become fish-accessible during spring out-migration flows. This would also provide some flood relief to the City of Sultan and other Mann Road infrastructure through the removal of floodplain fill and a wider floodplain flood flow inundation connection. Land acquisition is being addressed separately.

The slough channel (2,600 feet) downstream of Mann Road is on Snohomish County property that was acquired with the Conservation Futures program for recreation and habitat restoration. This downstream portion of Shingle Bolt Slough has shrunk in size but remains in contact upstream at flood flows and downstream receives hyporheic flow before re-entering the Skykomish River. Large wood jams will be placed in this channel. In addition to the channel restoration there will be approximately20 acres of riparian vegetation restoration and invasive weed control. Upstream and downstream portions total 5,300 lineal feet of side channel restoration or enhancement.

Quantitative or qualitative assessment of how the project will function.
Project functions include flood water storage, floodplain recharge, floodplain sediment storage, fish rearing and refuge (including cold-water refuge), shading functions and long-term wood recruitment and storage and potential beaver habitat – in short, restoration of formerly functional floodplain and connected channel area. No potential offset volumes have been estimated, though channel restoration with roughness to store channel flow is consistent with GeoEngineers' depiction of conceptual change in stream and groundwater table morphology following in-channel projects (B. August; Jan 28, 2020).

A map and drawings of the project location.
The project site is shown in relation to surrounding physical features on the attached Site Plan included at end of description (Figure 35).

Description of the anticipated spatial distribution of likely benefits.
Removal of the Skykomish River revetment and berm at the upstream end of the project will increase flood storage more frequently across approximately 15 acres of floodplain. The floodplain will store sediment and recharge groundwater as well as passively and actively be re-forested. Separately an existing side channel inlet from the Skykomish River will be connected to 1,600 lineal feet of excavated side channel that will also include wood placement. The side channel and roughness will act to recharge floodplain groundwater for later discharge and flow maintenance. Downstream, the existing Snohomish

[7] Other project numbers associated with this project: 07-MPR-137

County portion of Shinglebolt Slough will be roughened with wood structures to both store more surface water and create scour pools during flooding, and thereby contact hyporheic flow and colder water temperature during low flow.

Performance goals and measures.

The performance goal is to reconnect channels, more frequently at lower flows as well as at higher flows. This will act to infiltrate/surcharge saturation of the floodplain (as per Geoengineers conceptual description). Infiltration is difficult to measure directly; proxy measures include area treated, groundwater levels, and slough outlet discharge. Other goals and measurements include acres planted, wood structures placed, water temperature benefit (relative to mainstem Skykomish).

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The Skykomish River is an important resource for fish and the following salmonid species are known to be present and would be expected to use floodplain side channels and ponded off-channel habitat areas for rearing at various times of the year: Chinook, Coho, Chum, Pink Salmon as well as steelhead trout. Chinook and steelhead are priority species under the ESA. These juvenile salmon species are expected to benefit from increased side channel area, improved habitat structure and cover, increased refuge from flooding depth and velocity, and cold-water refuge in summer.

Identification of anticipated support and barriers to completion.

This project is currently listed in Snohomish County's Floodplains by Design project as well as the Skykomish River Reach Scale Plan. Snohomish County intends to implement the project, when funding is available.

Estimate of capital costs and reoccurring O&M costs.

Shinglebolt design & construction: $3,234,544

Operation & maintenance (first 10 years): $250,000

Anticipated durability and resiliency.

The project is expected to be durable and resilient. The structural integrity of placed wood will be less over 15-20 years, but the site will receive new wood recruitment and grow alder and cottonwood rapidly. Indicators of anticipated durability and resiliency will be greater floodplain forest cover and age, increased floodplain sedimentation, limited channel sedimentation due to flow routing, and points of scour at placed wood that maintains flow alignment, and sustained colder relative water temperature between the mainstem and side channel.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Snohomish County Conservation and Natural Resources, Brett Gaddis, Senior Habitat Specialist, brett.gaddis@co.snohomish.wa.us, is the project sponsor and is ready to proceed pending land acquisition (to be separately funded).

Documentation of sources, methods, uncertainties, and assumptions.

Unknown at this stage of design.

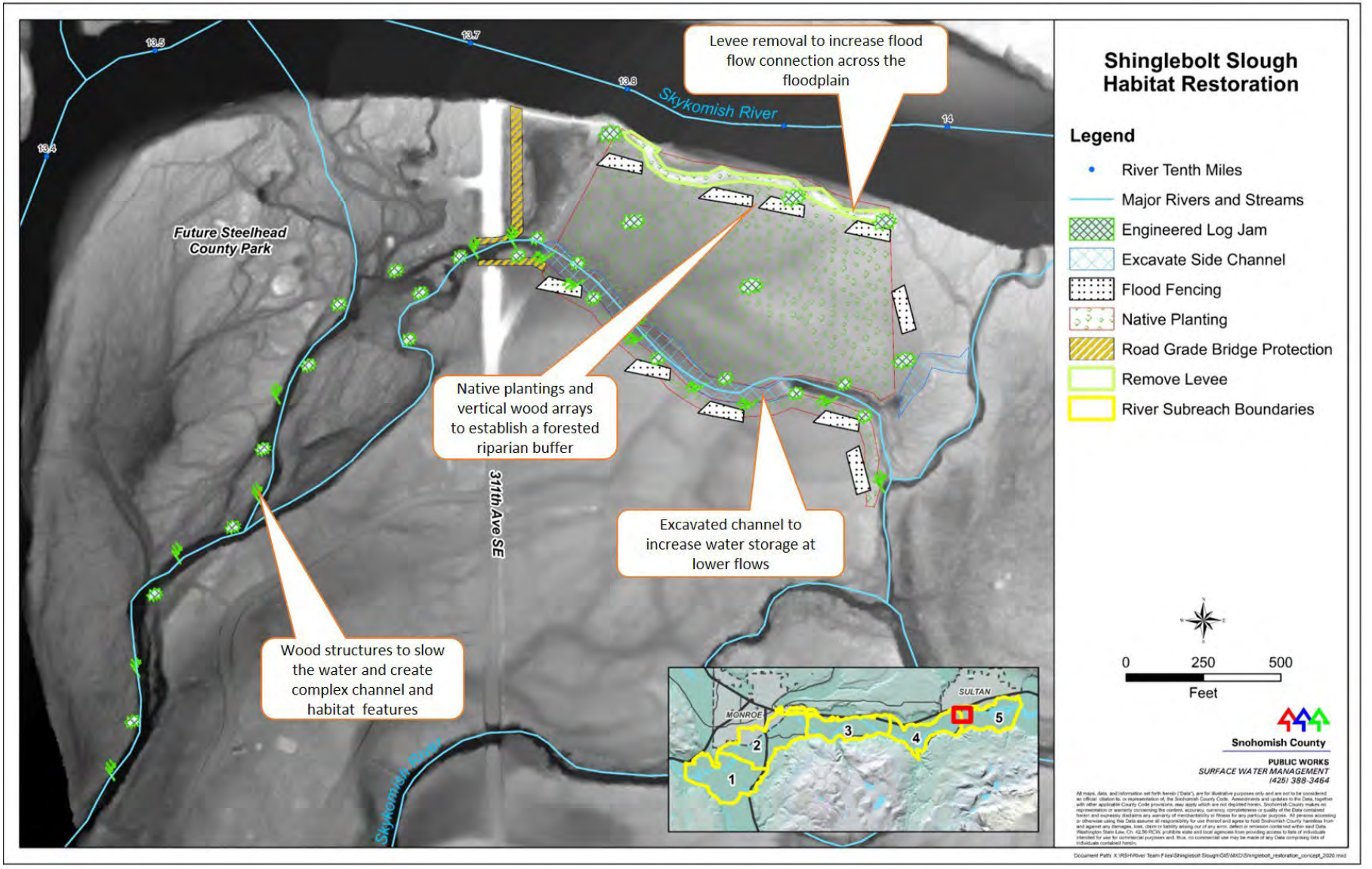


Figure 35. Conceptual Plan View with Benefits labeled

WRIA 7 – Project Description
Snohomish Confluence Project + Left Bank Floodplain Reconnection at RM 1.5

Project Name(s)
Snohomish Confluence Project + Left Bank Floodplain Reconnection at RM 1.5 (7-SM-H16[8])

WRIA 7 WRE Subbasin
Skykomish Mainstem

Narrative Description
Tulalip Tribes and partners propose to restore and enhance floodplain connection, abandoned side channels, and connections to Riley Slough at and just upstream of the junction of the Skykomish and Snoqualmie Rivers that is described as the Snohomish Confluence Project. This proposal requests funds for project planning and property acquisition to complete these floodplain restoration actions. These actions have the potential to measurably increase rearing and spawning habitats for Chinook, steelhead, Coho, Pink and Chum Salmon. Chinook and steelhead are priority species, protected under the ESA.

Bank protection upstream and adjacent to the project area has redirected flows in the Skykomish River, which has contributed to abandonment of side channels, and altering the lower end of Riley Slough leading to dramatic reductions in Coho spawning in Riley Slough tributaries. Project partners include the property owner where the floodplain connection and side channel enhancement would take place, Snohomish County, and Ducks Unlimited. The first two phases, which include acquisition and planning, are already funded through the Salmon Recovery Funding Board/Puget Sound Acquisition and Restoration Fund. Funding is needed for final design and construction.

Quantitative or qualitative assessment of how the project will function.
Qualitatively, this project will restore floodplain connection within the Riley Slough at and just upstream of the junction with the Skykomish and Snoqualmie Rivers. This proposal is for final design, permitting, and construction. Future floodplain restoration actions within this section of river will provide additional rearing and spawning habitats for several species of salmonids.

A map and drawings of the project location.
The project site is shown in relation to surrounding physical features in Figure 36.

Description of the spatial distribution of likely benefits.
This project includes future restoration within the lower 3000 feet of Riley Slough and 2000 feet of side channel of the Skykomish River at the confluence with Riley Slough. This proposal is for final design, permitting and construction.

Performance goals and measures.
Performance goals and measures include:

[8] Other project numbers associated with this project: 2018-0799

- Reestablishing a connection between the Skykomish and Riley Slough, reconnecting the upstream end of a disconnected side channel on the Skykomish River.
- Improving channel and riparian conditions along approximately a mile of river and stream channel.
- Monitoring the physical conditions (e.g. cross-sectional area, aggradation, flow) of the side channel and slough and measuring spawning and juvenile utilization in Riley Slough and the side channel, for at least a five year period, will help determine whether the restoration efforts were effective.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

Floodplain restoration actions within the Riley Slough are designed to measurably increase rearing and spawning habitats for Chinook, steelhead, Coho, Pink and Chum Salmon. Chinook and steelhead are priority species, protected under the ESA.

Identification of anticipated support for and barriers to completion.

Based on previous conversations with agencies and members of the Sustainable Lands Strategy, support for the project is strong. Ultimately what is built will depend on modeling, planned drainage assessments, and views expressed by neighbors, which may result in less than optimum improvements.

Estimate of capital costs and reoccurring O&M costs.

Estimated total cost to design, permit and construct the project is $900,000.

Project durability and resiliency.

If constructed properly and after five years of maintenance it is hoped the project area will naturally adjust to existing conditions and function without requiring additional future maintenance. Additional actions to ensure durability and resiliency include monitoring the physical conditions (e.g. cross-sectional area, aggradation, flow) of the side channel and slough and measuring spawning and juvenile utilization in Riley Slough and the side channel, for at least a five year period. Maintenance of enhanced riparian areas, in the form of weed control and plant replacement are likely and will ensure a riparian planting success.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Tulalip Tribes. Sponsor contact: Daryl Williams, dwilliams@tulaliptribes-nsn.gov and Kurt Nelson, knelson@tulaliptribes-nsn.gov. The sponsor is ready to proceed with design and implementation.

Documentation of sources, methods, uncertainties, and assumptions.

Data collected, modeling and assessments will inform the methods used, uncertainties and address some assumptions.

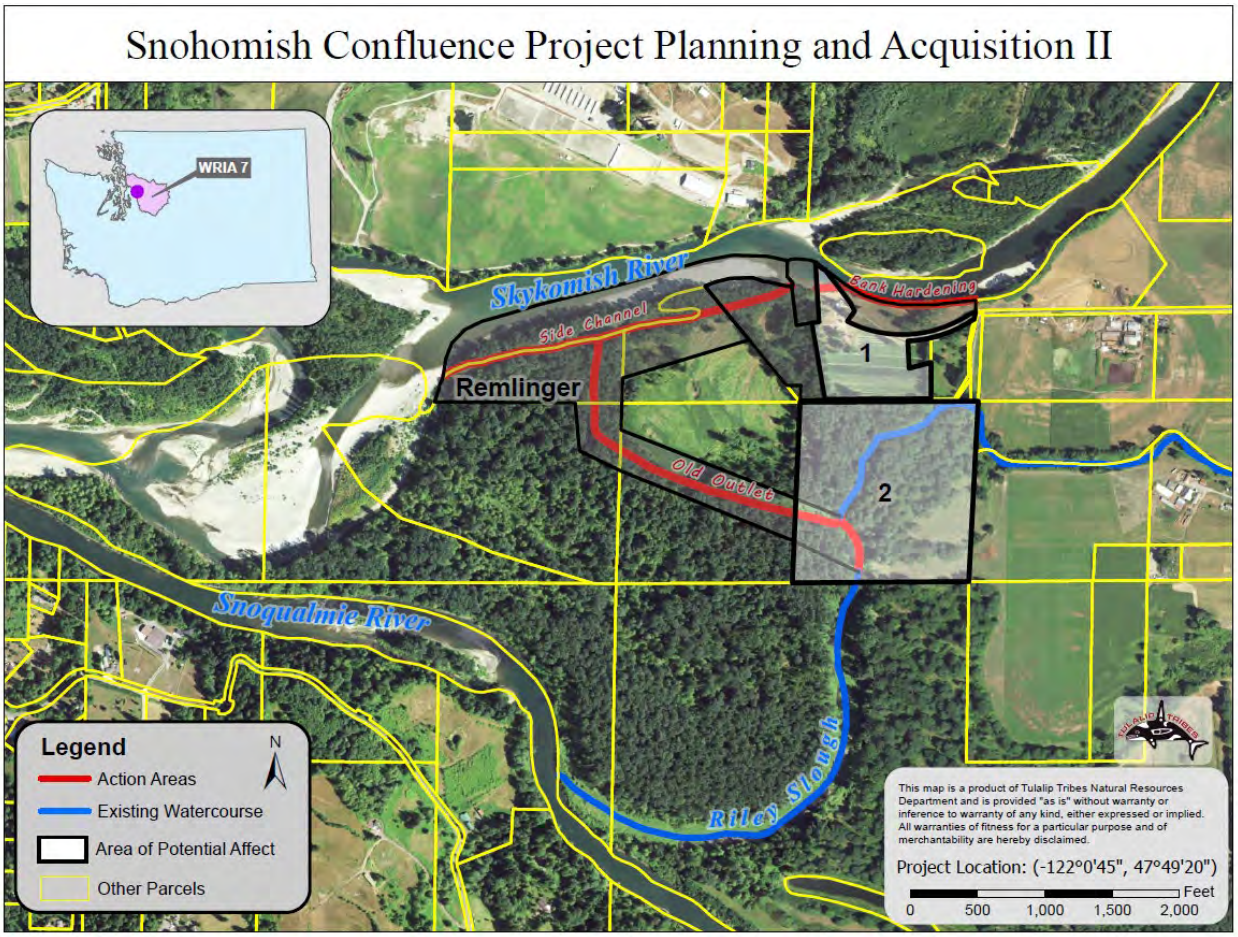


Figure 36. Site Map for Snohomish Confluence Project + Left Bank Floodplain Reconnection at RM 1.5

WRIA 7 – Project Description
Miller River Alluvial Fan Restoration Project

Project Name and Number
Miller River Alluvial Fan Restoration Project (7-USK-H17)

WRIA 7 WRE Subbasin
Upper Skykomish

Narrative Description
The Miller River Alluvial Fan Restoration Project, as conceptualized, is expected to be completed in phases and will include the following elements:

- Removal of existing riprap and compromised road areas, revetments;
- Up to 18.5 acres of restored riparian habitat through floodplain reconnection, reactivation of 2,700 linear feet of side channels, improved ecosystem function, and processes;
- Improved aquatic habitat complexity and quality in up to 250 lineal feet of main channel complex;
- Mitigation of climate change impacts on ESA-listed salmonid species in the lower Miller River and in the South Fork Skykomish River downstream;
- Reduced flood risk and long-term flood hazard management costs; and
- Increased recreational opportunities for local communities.

There are potentially four alternatives and could be phases of this project, each coinciding with a zone in the project footprint. All phases could be constructed simultaneously; however, it is envisioned that this project would be implemented in four phases. King County has acquired the lands required for the project footprint of the first three phases. The description above represents the outcomes of implementing the three phases within three geographical zones of the project footprint. A fourth phase would include revetment removal, along with a setback revetment for flood mitigation, and reactivation of side channels, further increasing the hyporheic input to the lower Miller River.

Quantitative or qualitative assessment of how the project will function.
It is expected that there will be additional annual storage through floodplain reconnection. This project will improve overall watershed hydrology, which will in turn improve downstream water quality, and potentially moderate and augment summer low flows.

A map and drawings of the project location.
The project site is shown in relation to surrounding physical features on the attached Site Plan (Figure 37).

Description of the anticipated spatial distribution of likely benefits.
Approximately 18.5 acres of floodplain restored, and more than 20 acres of area connected to floodplain.

Performance goals and measures.
This proposed floodplain restoration project can help increase floodplain water levels and provide benefits such as increased water storage and resilience to climate change impacts.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The project will provide for the conservation, protection and restoration of natural systems within this area for fish and wildlife habitat. This reach of the lower Miller River serves as a significant habitat area for listed Chinook Salmon, resident Bull Trout, and steelhead, and provides large wildlife corridor ungulates, beaver, bald eagles, songbirds and other native species. The watershed also supports wild runs of Coho, Chinook, Pink, and Chum Salmon and steelhead downstream of the project site. Chinook and steelhead are priority species, protected under the ESA. This proposal addresses several priority ecological actions identified in the Snohomish Plan such as: restoring hydrologic and sediment processes, restoring of wetland functions, enhancing riparian areas, protecting water quality and restoring shoreline conditions (Snohomish Salmon Plan page 11-84 & 11-86, 2005). These restoration actions in the headwaters are critical to a watershed approach to restore habitat forming hydrologic processes for salmon downstream. The project is identified in the Snohomish Basin Salmon Recovery Forum's 4-year Work Plan.

Identification of anticipated support for and barriers to completion.

King County is planning to conduct more in-depth feasibility to refine the project scope in 2020 -21. The County has acquired properties for phases 1 – 3 of the project and engaged in stakeholder discussions with King County Roads which has negotiated terms for their work adjacent to the project site with BNFS Railroad. It is expected that King County's River and Floodplain Management Section and Ecological Restoration and Engineering Services will convene to complete a refined feasibility project, and design and construct this project.

Estimate of capital costs and reoccurring O&M costs.

The total cost for three phases of design and construction is estimated to be approximately $4.6 M. The fourth phase would add approximately $2.6 M in construction costs. Operation and maintenance costs are not known at this time.

Project durability and resiliency.

The benefits of the projects are anticipated to occur both locally and downstream of the project site. The importance of and potential for these benefits are supported by multiple leading publications, including: (1) the Snohomish River Basin (WRIA 7) Salmon Conservation Plan (Salmon Plan), (2) the Snohomish Basin Protection Plan (Protection Plan), and (3) Climate Change Impacts to Salmon Issue Paper (Climate Paper).

Project sponsor(s) (if identified) and readiness to proceed/implement.

This project is sponsored by King County and programmed to begin feasibility and project scope refinement in late 2020.

Documentation of sources, methods, uncertainties, and assumptions.

Restoration Opportunity Report: South Fork Skykomish River Basin Restoration Feasibility Project (Herrera Environmental Consultants, 2013).

Figure 37. Miller River Alluvial Fan Restoration Project Site Plan

WRIA 7 – Project Description
Tulalip Tribes Beaver Reintroduction Program

Project Name and Number
Tulalip Tribes Beaver Reintroduction Program (7-USK-H18)

WRIA 7 WRE Subbasins
Lower Mid-Skykomish, Upper Skykomish, Raging River, and Upper Snoqualmie

Narrative Description
This proposal consists of a restoration project that aims to protect hydrologic processes and function in the Snohomish Watershed through the relocation of beavers from areas of human conflict to headwater tributaries for the improvement of fish rearing habitat and freshwater storage.

Quantitative or qualitative assessment of how the project will function.
By relocating beaver to streams above or within the anadromous zone, we will be protecting hydrologic processes such as stream temperature, impounded surface water area and infiltration (decreasing winter peak flow/increasing summer low flow), the reduction of bank erosion (reducing fine sediment inputs), in-stream, off channel, and low-flow habitat, bank and floodplain connectivity, and ecosystem resilience to regional effects of climate change through adaptively managing sites and populations. Our primary goal is to restore hydrologic processes necessary to long term survival of imperiled fish populations.

A map and drawings of the project location.
See Figure 38.

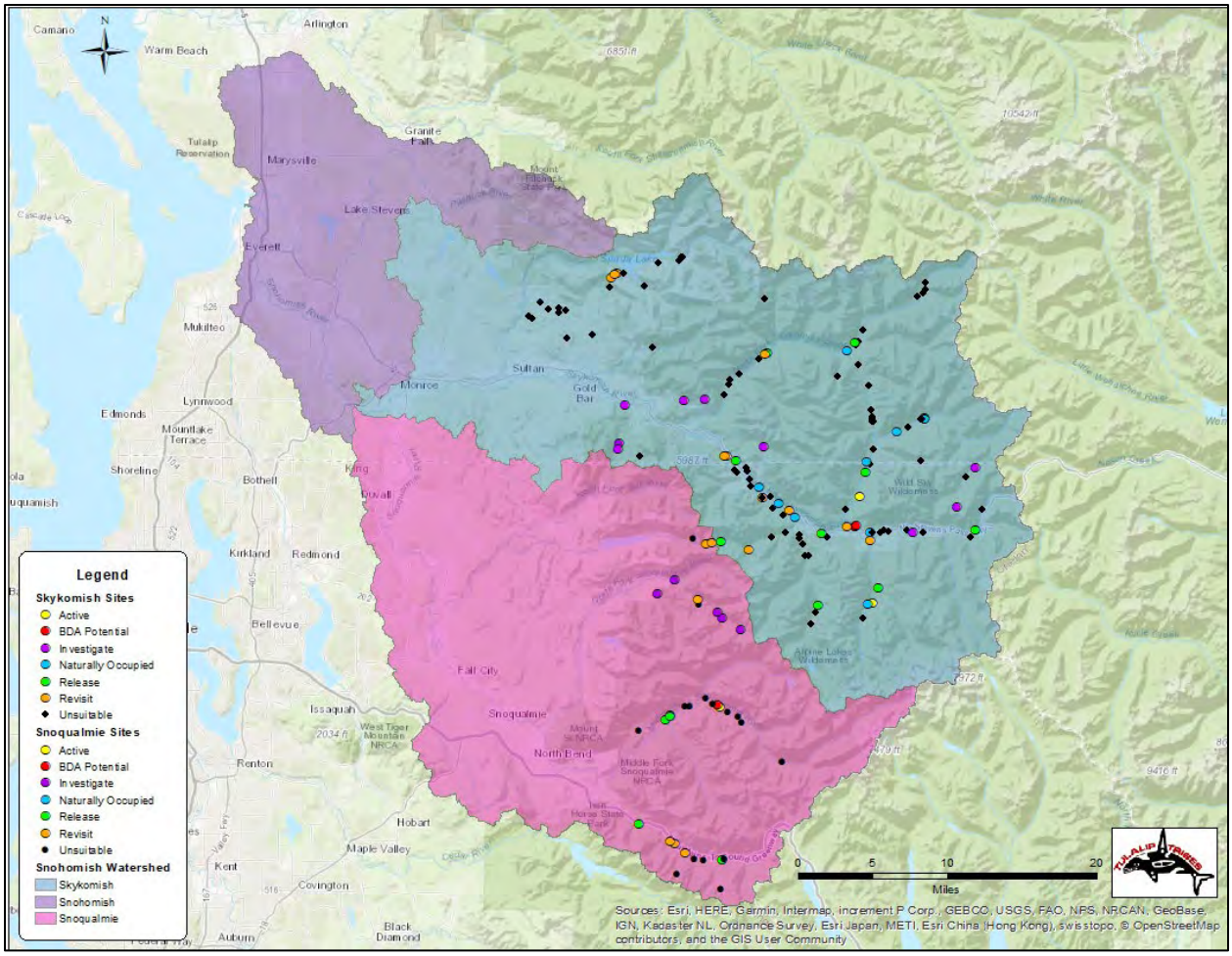


Figure 38. Location of every site that has been identified using the BIP model, visited, and ranked for beaver occupancy and suitability for relocation.

Description of the anticipated spatial distribution of likely benefits.

Beavers will be relocated to carefully selected tributaries to the Skykomish and Snoqualmie rivers on the Mount Baker-Snoqualmie National Forest. The effects of a successful beaver establishment typically encompass an approximate ¼ mile of instream and riparian habitat and water cooling and flow control benefits can extend downstream of the establishment. The hope is that established beavers will reproduce to further expand the recolonization of this portion of their historic range.

Performance goals and measures.

- Restore beaver to strategic locations in the Snohomish Watershed.
- Increase the area of in-stream habitat by increasing the water holding capacity of relocation streams via beaver-built dams, thereby increasing channel complexity.
- Improve public perception of beaver by educating landowners on their ecological benefits to the landscape and encouraging landowners to maintain beaver on their property. Offering field-based opportunities for students and other NR professionals.

- Install BDAs in potential relocation reaches lacking sufficient impounded water for beaver release.
- Success is ensured through monitoring and adaptively managing sites and populations, collaborating with regional beaver management practitioners, and educating the public on the importance of living with beavers.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

See Table 6.

Species	Life History Present (egg, juvenile, adult)	Current Population Trend (decline, stable, rising)	Endangered Species Act Coverage (Y/N)
Chinook	Egg, juvenile, adult	Decline	Y
Bull Trout	Egg, juvenile, adult	Stable	Y
Coho	Egg, juvenile, adult	Decline	Y
Steelhead	Egg, adult	Decline	Y
Chum	Egg, adult	Stable	N
Pink	Egg, adult	Stable	N

Table 6. Species, life stages, and current population trend benefitted by the project

Identification of anticipated support and barriers to completion.

An ongoing obstacle is beaver retention at selected sites. The rigorous site selection process does not always translate to permanent establishment or even dam building. Beavers are highly mobile and although they may abandon our selected stream reach it is possible that they are establishing elsewhere and providing unmonitored benefits. Tulalip Tribes has seen little evidence of post-relocation predation within monitored sites. Tulalip Tribes has also found that sites often take "supplementation" to achieve establishment, with the relocation of multiple families over a couple of years, with newly introduced beavers building off of the progress of the previous. Given Tulalip Tribes' perceived retention limitation, Tulalip staff hope to find a way to track beaver movement post-relocation. Beavers are incredibly difficult to track given their abrasive and sheltered environments and they respond poorly to internal transmitters. Tulalip staff are exploring ways to use eDNA to track individuals in relocation segments. DNA samples are taken from each captured animal so that could be used as a reference for detection post-relocation.

Estimate of capital costs and reoccurring O&M costs.

On average, the Tulalip Beaver Project costs approximately $80,000 to operate on an annual basis. This cost encompasses equipment needs and wages for staff to trap, house, and relocate beavers and identify and monitor trap and relocation sites. Existing funding: RCO: $67,522 (exp. 12/21) - tied to WRIA 7; PIFA: $166,628 (exp. 12/21) – WRIA 7 and WRIA 5.

New: Tribal Forest Protection Act/638 Agreement: $37,800 (exp. 9/23) - tied to South Fork Stillaguamish.

Anticipated durability and resiliency.

The Tulalip Beaver Project has been active since 2014 and is largely reliant on availability of grant funds. Past and current sources that we have leveraged include but are not limited to: EPA, USFWS, Ecology, RCO, King County CWM, TFPA, Ecotrust, etc.

Project sponsor(s) (if identified) and readiness to proceed/implement.

The Tulalip Beaver Project is an ongoing project of the Wildlife Program within the Natural Resources Department of The Tulalip Tribes. The project manager is Molly Alves, malves@tulaliptribes-nsn.gov.

Documentation of sources, methods, uncertainties, and assumptions.

Enhance streamflow

Geomorphic models that relate to sediment transport and hydrology often minimize the role of beaver despite "their widely recognized role in shaping stream ecosystems" (Naiman et al. 1988, Gurnell 1998, Pollock et al. 2004, Pollock et al. 2014, Burchsted et al. 2010).

Beaver dams can cause small to large order streams to move around them as "surface water runoff and groundwater seepage during both high- and low-flow periods" (Westbrook et al., 2006).
When beaver dams breach or complexes become unoccupied, channel sinuosity, sediment accumulation, and hydraulic roughness can persist from the "formation of complex patterns of pools and riffles" (Demmer & Beschta, 2008).

Surface water storage

Beaver dams impound and reduce stream velocity during storm events, retaining flow to reduce storm-water run-off and increasing water retention (Bergstrom, 1985; Grasse & Putnam, 1950; Johnston & Naiman, 1987; Parker, 1986). By creating large differences in velocity, even small and young dams can flood a relatively large surface area (Rosell et al., 2005; Johnston & Naiman 1987). Beaver ponds can dramatically influence the amount of open water area in watersheds (Hood and Bayley 2008; Karran et al., 2017).

Aquifer recharge

Using hydrometric methods, it is determined that larger fluxes of water along looping flow pathways return to riparian areas above dams rather than returning to the stream below the dam, suggesting that "beaver dams generate recharge to the groundwater flow system" (Janzen & Westbrook, 2011). Researchers have proven using small groundwater wells that beaver dams "attenuate the water table decline in the drier summer months" by up to 30 percent due to increased bank infiltrations that decrease hydraulic gradient and transfer upstream of the dams (Westbrook et al., 2006; Lowry and Beschta, 1994; Naiman et al., 1986).

In the Tulalip Beaver Project study area, we have historically done extensive streamflow, surface water and groundwater storage monitoring. Our affiliated researcher Ben Dittbrenner has seen beaver dams increase groundwater storage 2.4 times a unit of surface water storage (Dittbrenner, 2019). These numbers are calculated from gathering stream area and length data, estimated pond volumes, as well as the change in groundwater elevations throughout a site both pre and post beaver reintroduction has occurred.

Water Quality

Regardless of the size of a complex, beaver dams and beaver impoundments have been shown to release cooler water downstream as it returns from sub surface (Dittbrenner, 2019). In addition, beaver ponds can stratify water temperatures by showing recorded temperatures higher in temperature than at the bottom of the pond (Rosell et al., 2005; Margolis et al., 2001; McRae & Edwards, 1994). This unique change to water temperature can improve water quality for macroinvertebrates and fish.

Beaver complexes play a large role in water chemistry and may increase productivity of small freshwater streams. Researchers have found that increased sediment accumulation in beaver ponds results in approximately 1000 times more nitrogen than adjacent riffle areas (Rosell et al., 2005; Naiman & Melilo, 1984). In small order streams, beaver ponds may increase phosphorous and create anaerobic zones that are rich in dissolved nutrients resulting in increased primary production (Rosell et al., 2005; Klotz 1998; Dahm & Sedell, 1986). Margolis et al. (2001a), showed beavers can play an important role in neutralizing inputs of strong acids in regions where atmospheric pollution is high (Rosell et al., 2005; Smith et al., 1991; Cirmo & Driscoll 1993). Beaver complexes retain these biogeochemical and water chemistry benefits on site with only a portion of the chemical elements exiting downstream (Naiman et al., 1994).

Beavers have been noted to increase E. coli and fecal coliform concentrations in grazing systems. Researchers have noted that beaver ponds cause entrapment of organisms and bacteria in the bottom sediment by reducing the velocity of stream flow. However, a large factor remains the age of dams and their ability to trap sediment. The same researchers showed “the highest number of beaver ponds and also had significantly lower fecal coliform and streptococci concentrations” in the water suggesting an ability to act as a filtration system (Skinner et al. 1984).

Sedimentation

“Accumulation rates of sediments [in beaver ponds] far exceed published rates from boreal forest landscapes” and “organic matter content is significantly higher in older ponds”. (Butler & Malanson, 1995).

Snohomish River Basin Salmon Conservation Plan

“Physical processes, such as the movement of water and sediment, and biological processes, such as the growth of vegetation and predator-prey relationships, create and maintain the conditions that salmon need to reproduce, grow and thrive. Recovery actions that address the underlying, natural process problems rather than just the symptoms of habitat loss are most likely to be successful over the long-term.”

Section 4.3 – “Coho use small, low gradient Coastal and tributary streams for spawning and rearing. They need more off-channel habitat, such as oxbows, side-channels, and beaver ponds than Chinook.”
Section 5.2 – “Healthy and harvestable Coho Salmon populations are unlikely over the long-term without significant actions that maintain and restore access, adequate flows, sediment conditions, large woody debris loading, nutrient levels, and temperatures in lowland tributaries where Coho spawn and rear, and in headwater subbasins that contribute to healthy downstream habitat conditions. Coho rearing, which occurs primarily in beaver ponds, backwater pools, and side-channel sloughs, is thought to be a limiting.”

Snohomish Basin Protection Plan

"Beavers are native to the Basin and were once ubiquitous around the region...Beavers are one of the key animals that can affect the quantity and quality of water in an aquatic system. In unpopulated places, their manipulation of the landscape is appropriate and welcomed but in populated and agricultural areas, that manipulation can create challenges. However, the beavers' ability to create water storage helps protect hydrology."

"The Tulalip Tribes are working to improve water storage in the headwaters of the Basin in order to ameliorate the hydrologic shifts caused by climate change. This effort involves trapping beavers and releasing them in appropriate areas on USFS land. Once released, the beavers will create a complex series of dams that will store runoff and/or snow melt in the upper watershed and moderate flows during high-flow and flood events."

Salmon Recovery Funding Board – Salmon Recovery Grants - Manual 18

Specifically recognizes beaver reintroduction as a viable tool for performing in-stream and riparian habitat restoration. "These projects focus on restoring priority wetland or in-stream habitat within specific sub watersheds identified as priorities in local watershed or recovery plans. Site projects where valuable but degraded habitat exists and where beaver reintroduction would benefit salmonid habitat functions and values. Use beaver as a tool for restoring salmon habitat at specific priority locations. Relocate beavers from undesirable locations to areas where they can function to improve salmonid habitat."

References

Snohomish Basin Salmon Recovery Forum [Snohomish County Surface Water Management, King County Snoqualmie Watershed Forum Staff, and Tulalip Tribes Natural Resources Department]. 2015. Snohomish Basin Protection Plan. https://www.govlink.org/watersheds/7/pdf/SBPP/SBPP%20December%202015_reduced%20size.pdf

Snohomish Basin Salmon Recovery Forum. June 2005. "Snohomish River Basin Salmon Conservation Plan." Snohomish County Department of Public Works, Surface Water Management Division. Everett, WA.

Salmon Recovery Grants. January 2021. Manual 18. Grant Manual. Salmon Recovery Funding Board. Washington State Recreation and Conservation Office. Available at: https://rco.wa.gov/wp-content/uploads/2019/05/SAL-Manual18.pdf

WRIA 7 – Project Description
Cherry/Stossel Creek – Climate Resilient Watershed

Project Name and Project Number
Cherry/Stossel Creek - Climate Resilient Watershed (7-CH-H19)

WRIA 7 WRE Subbasin
Cherry/Harris and Snoqualmie South

Narrative Description
The Cherry Creek watershed is 17,640-acres, located north and east of the City of Duvall. The primary land uses are forestry, rural residential, and agricultural. Cherry Creek itself is over 12 miles in length, with the lower two miles located in the King County Agricultural Production District. Annually, flows in Cherry Creek have not changed significantly since the 1940's but an upward trend in peak flows suggest that these peaks may be indicators for the future (ESA, 2020). The watershed experienced two statistically very uncommon flow events in December 2019 and February 2020 that are the highest observed flows in the limited hydrologic record.

Lower Cherry Creek is an alluvial fan characterized by heavy sediment deposition. The stream exits a high-energy environment at the base of steep slopes and enters a low-energy one, losing the ability to adequately transport sediment and forming deposits. The frequent channel migration, avulsion, and relic channels observed in Cherry Valley are associated with alluvial fans (King County, 2020b).

Stossel Creek is a tributary to the Tolt River. Stossel Creek and Cherry Creek are characterized by summer low flows and a projected increase in rural residential growth associated with new domestic permit-exempt wells.

The Project consists of a suite of actions intended to address attenuation of peak flows, seasonal low flow concerns, floodplain reconnection, and agricultural resiliency in the Cherry and Stossel Creek watersheds. While individual project phases and elements may not directly contribute to NEB, the suite of projects proposed are inter-reliant on each other for sequencing and budgeting reasons, and taken together as a whole, they are expected to contribute to NEB.

Lower Cherry Creek Farm, Fish, Flood Projects
There are several projects at varying stages of funding and implementation planned for the lower Cherry Valley area. Project partners include Wild Fish Conservancy, Snoqualmie Indian Tribe, The Tulalip Tribes, Washington Department of Fish and Wildlife (WDFW), Snoqualmie Valley Watershed Improvement District (SVWID), and landowners. These project address floodplain reconnection, fish passage, habitat improvement, and agricultural resiliency.

Cherry Creek Phase II (CP 1)
Wild Fish Conservancy is the project sponsor. Phase II of the Cherry Creek restoration project is located near the confluence with the Snoqualmie River and includes improvement of instream and riparian habitat conditions along approximately 600 feet of the lower mainstem of Cherry Creek, just upstream of Phase I (completed in 2019). The restoration project includes removing bank armoring, installing two large wood habitat structures, three smaller instream structures, and re-contouring the banks to create

planted habitat benches. This work will improve drainage of the adjacent pastures and increase the conveyance and flood storage capacity within the reach. This work enables the Levee Rebuilding, Phase B project, which will use the spoils generated by the channel naturalization to improve the existing, damaged levee which has failed catastrophically several times within the past decade. The project goal is to increase the quantity and quality of juvenile rearing habitat for Coho, Chum, Chinook, Pink, winter steelhead and Coastal Cutthroat. This project was allocated PSAR funding in 2020 for $545,320 with a sponsor match of $134,840.

Levee Rebuilding in Cherry Valley, Phase B (CP 2)

Drainage Improvement District 7 is the project sponsor. This second phase of levee improvement construction (Phase B) will be coordinated with the nearby Cherry Creek Phase II restoration project by Wild Fish Conservancy. The levee project will include final design, permit acquisition, and constructed levee improvements along about 2,000 feet of the left bank of Cherry Cheek. Private property has been damaged when the levee has breached, and the peak flood season corresponds with heavy use of the WDFW wildlife unit by hunters. The result of the project is that floodwater will overtop the levee in a controlled manner during large floods, slowly filling the valley with floodwater and reducing the risk to life and property. The area that will benefit from these improvements covers about 800 acres. This project was awarded in September 2020 for a total of $325,000 from the King County Flood Control District. The rebuilt levee would eventually be moved as part of project 4 below (Cherry Creek Setback Levee, WDFW, and PP1).

North Fork Cherry Creek, Culvert Replacements (CP 3)

Wild Fish Conservancy is the project sponsor. The project is intended to improve fish passage and reduce flooding at 300th Ave NE, a private road crossing the valley at the eastern extent of the project area. Flooding occurs sub-annually in this area, inundating three farms and cutting off access to four businesses and 40 residences. A pasture access road and two associated culverts will be removed and two additional culverts crossing 300th AVE NE will be replaced with large bridges to improve flood conveyance and fish passage. This project was awarded $231,100 from the King County Flood Control District in separate grant rounds for preliminary design (completed) and final design and permits (in progress). This project was also awarded a $99,300 Cooperative Watershed Management Grant for final designs and permits. Construction funds needed to complete the project are estimated at $785,866.

Cherry Creek Setback Levee, WDFW (PP 1)

This project is currently in planning stages and includes ongoing coordination to develop and evaluate options for a future levee-setback project in the WDFW wildlife unit. The project includes reconnection of Cherry Creek with its floodplain would include the watercourse known as Waterwheel Creek within the levee setback and will reduce flood risk and improve conditions for farming by modernizing an agricultural pump drainage system.

Cherry Creek Floodplain Reconnection (CP 4)

SVWID is the project sponsor. SVWID has been working with landowners in lower Cherry Valley to address dangers to human and aquatic life resulting from an avulsion on Cherry Creek prior to its confluence with the North Fork. SVWID is currently completing Phase 1 of emergency actions intended to address the avulsion impacts. Beyond 2020 emergency actions, there is a commitment from landowners and SVWID to implement the proposed Floodplain Reconnection project that will provide Cherry Creek with approximately 8-acres of additional, accessible floodplain habitat area.

SVWID developed a floodplain reconnection plan to 75 percent design in consultation with WDFW, The U.S. Army Corps of Engineers, Snoqualmie Indian Tribe, The Tulalip Tribes, Wild Fish Conservancy, King County Water and Land Resources Division, and landowners. The next step, post 2020 emergency actions, is to permit and fund implementation of the Floodplain Reconnection plan. The emergency actions being conducted in 2020 include minimum actions needed to re-establish fish passage and reduce flood impacts to critical infrastructure. The avulsion on the primary channel of Cherry Creek, upstream of the confluence with the North Fork rerouted flows to the interior of the Drainage District 7 levee. Stream flow was impacting approximately 300-acres of agricultural land and associated infrastructure, including a primary access road to residences, residences, and critical utilities. The 2020 emergency actions include increasing conveyance upstream and downstream of the avulsion site through removal of cobbles and other material, replacement and import of large wood into the excavated channel sections, planting of riparian vegetation throughout the project area at locations that will not be impacted as part of future project actions, and a temporary earthen berm at the avulsion site to be removed as part of implementation of the Floodplain Reconnection Plan. The Floodplain Reconnection Plan is currently at 75 percent design. The project elements include removal of sections of an existing berm downstream of the avulsion site, removal of the temporary earthen berm, excavation of a new side channel at the location of an existing overflow swale, and setback berm.

Water Storage in Upper Cherry Creek/Stossel Creek Watersheds

SVWID has embarked on an assessment of potential small-scale storage projects that could benefit water supply and provide minimal benefit to instream flows within the SVWID service area. One of the ideas identified through this assessment is the potential for enhancing natural storage in the headwaters of key tributaries to the Snoqualmie River. The tributaries that were evaluated as part of the small-scale storage assessment include those that are closed to further appropriation under the instream flow rule (chapter 173-507-030 WAC) including Griffin Creek, Harris Creek, Patterson Creek, and the Raging River; and streams and tributaries with instream flow limitations under the rule including Langlois Creek, Soldberg Creek, and an unnamed tributary to Cherry Creek.

The intent of increasing natural storage in the upper watershed is to enhance groundwater recharge and flow attenuation to improve flows throughout the tributary and mainstem during low-flow periods. Increasing natural storage would also enhance fish and wildlife habitat, including habitat for ESA-listed fish species.

Several potential small-scale storage sites were identified on land in the upper Cherry Valley/Stossel Creek watersheds managed by Department of Natural Resources (DNR) in the Marckworth Forest. SVWID and Anchor QEA staff met with DNR staff I March 2020 to discuss general project concerns on DNR land, and conducted watershed site visits in late May 2020. Several sites were identified with the potential to provide additional water storage. See attached maps.

- Stop #1 - This is a pond and associated wetlands near the upstream end of Stossel Creek. The pond and wetland discharge through a relatively narrow channel at the south end of the area where natural materials could be placed in an effort to enhance the natural storage in the pond. SVWID visited the site and observed the pond, which was much larger than shown in the aerial photograph. An additional pond was observed approximately 1/4 mile upstream of the lower pond. The site is accessible from a DNR road that extends north along Stossel Creek from Northeast Stossel Creek Way.

- Stop #2 – This was a small wetland/pond with a 24-inch culvert that went under the adjacent DNR forest road. A controlled outlet could potentially be constructed to create a foot or two of additional storage, or a Beaver Dam Analog or other type of natural storage could be constructed upstream of the culvert.
- Stop #4 – This is a wetland area where the stream crosses the DNR road close to a turnaround access point. The site is on the tributary to Cherry Creek downstream of a few larger ponds. A controlled outlet could potentially be constructed on the upstream end of the culvert to create a foot or two of additional storage, or a Beaver Dam Analog or other type of natural storage could potentially be constructed upstream of the culvert.

SVWID received Streamflow Restoration funding in 2019 for 57,500 for preliminary design. After conditions from the site visit were reviewed and discussed with SVWID staff, the Stossel Creek site (Stop #1) was selected as a preferred natural storage site to move forward through additional analysis and preliminary design. The site is easy to access and appears to offer topographic and hydrologic conditions that would be well suited for natural storage enhancement. The pond appears to be currently functioning as a natural storage site that would be able to store additional water with placement of natural material at the outlet. The site also offers the potential benefit of recharging the shallow aquifer at the upstream end of Stossel Creek, attenuation of peak flows in the creek, and improved hydrologic conditions that would extend down Stossel Creek to the Tolt River and beyond.

Quantitative or qualitative assessment of how the project will function. Show how offset volume(s) were calculated.

Preliminary estimates show the Water Storage in Upper Cherry Creek/Stossel Creek Watershed element of the project has the capacity to store approximately 53 AFY. Estimates are based on the conceptual configuration of the storage facility and topography at the selected site. The project is still in feasibility stage and the type of storage that will be constructed is unknown at this time. No water offset is assumed for the purposes of this watershed plan.

A Preliminary Design Analyses for the Stossel Creek Site (Stop #1) was completed by Anchor QEA in March 2021. A watershed of approximately 410 acres drains through the site, and raising the pond level at the site 2 feet by placing natural elements at the outlet would provide approximately 15 acre-feet of additional storage volume compared to existing conditions. Soils underlying the site are mostly Seattle muck, which has a low hydraulic conductivity and flat slopes, making conditions suitable for ponding of additional water. The site is surrounded by steep slopes and could be prone to slope instabilities and landslides. However, the current project is not expected to significantly change conditions and could improve landslide conditions by capturing high-energy peak flows and reducing local erosion.

A Western Washington Hydrology model (WWHM) (Clear Creek Solutions 2019) was developed to estimate existing hydrologic conditions and develop conditions for the enhanced site. Peak flow runoff would be reduced because peak flows would be attenuated by the enhanced storage. Infiltration would increase after capture from high runoff events and would likely contribute to baseflow down-gradient along the Stossel Creek channel. The distance and timing to zones of increased baseflow is contingent on the presence and thickness of an unsaturated zone beneath the site. Thinner unsaturated zones would result in more immediate contributions to downstream baseflow, whereas thicker unsaturated zones could potentially result in year-round benefits occurring at distances farther downstream.

SVWID is preparing preliminary design drawings for the proposed natural storage project. It is expected that natural storage will be enhanced by placing BDAs or other natural material near the outlet of the wetland. It will be designed to increase the overall water storage in the wetland complex using natural materials and reverse the effects of down-cutting and erosion. Preliminary drawings will include a cover sheet, overall enhancement plan, and renderings and details for the natural material placements. An opinion of probable cost will also be developed to implement the project, as well as a summary of permitting requirements. Additional site investigations, such as test hole drilling or similar, should also be completed in order to verify the site feasibility.

A map and drawings of the project location.

The project site is shown in relation to surrounding physical features in Figure 39. Water storage areas in Upper Cherry Creek/Stossel Creek Watersheds are shown on Figures 40 and 41.

Description of the spatial distribution of likely benefits.

These projects are targeted within the Cherry Creek and Stossel Creek watersheds. Restoration efforts are proposed near the confluence of Cherry Creek with the Snoqualmie River, which will result in approximately 800 acres of floodplain improvements. One proposed project will reconnect the floodplain of Cherry Creek with Waterwheel Creek to reduce flooding impacts in that area. An additional project focuses on an avulsion site within Cherry Creek which has caused significant flooding triggering the implementation of a floodplain reconnection project that will provide Cherry Creek with approximately eight acres of additional accessible floodplain habitat.

Performance goals and measures.

- A potential list of performance goals and measures includes:
- Protection and conservation of riparian and floodplain habitat
- Protection of residential access, pastures, hunting grounds, businesses, private residences, and critical utilities
- Increase the quantity and quality of juvenile rearing habitat for Coho, Chum, Chinook, Pink, winter steelhead and Coastal Cutthroat

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

Cherry Creek is a large rural tributary to the Snoqualmie River and contains the potential to support moderate levels of Chinook spawning. Cherry Creek is well documented as important habitat for Coho spawning and rearing, and presumed foraging and overwintering habitat for Bull Trout. Existing habitat concerns in the Cherry Creek watershed include fish passage barriers, degraded water quality (Cherry Creek is Category 4A for bacteria, temperature, and dissolved oxygen), lack of riparian vegetation and instream large woody debris, limited floodplain connectivity, and seasonal low flows. For Cherry Creek, habitat restoration for Chinook recovery will be most beneficial in the lower part of the subbasin between the confluence of Cherry Creek and the Snoqualmie River and up to the extent of the 100-year floodplain. Actions above this area will have additional benefit to Coho. Stossel Creek is documented as supporting a high abundance of Coho Salmon. Stossel Creek flows into the Tolt River which is impacted by seasonal low flows.

Identification of anticipated support for and barriers to completion.

The main barrier pertains to funding. Current ongoing collaboration exists between the Wild Fish Conservancy, Snoqualmie Indian Tribe, The Tulalip Tribes, WDFW, SVWID, and landowners. Feasibility and permitting have not yet been completed for the Water Storage in the Upper Cherry and Stossel Creek Watersheds portion of the project, which includes wetland areas.

Estimate of capital costs and reoccurring O&M costs.

Unknown at this time.

Project durability and resiliency.

Climate change and associated impacts will be factored into all current and future project elements. These projects are designed to have flood hazard benefits throughout the valley and in one case, specifically protect 300th Ave NE, a private road crossing the valley. The intent is to pursue natural process-based solutions as much as possible to reduce maintenance requirements and ensure long term project function and durability.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Each sub-project sponsor is listed in the description. SVWID is willing to consider filling the role as the overall project coordinator.

Several projects are ready to proceed with implementation and in some cases have already received grant funding:

- Cherry Creek II allocated PSAR funding in 2020 for $545,320 with a sponsor match of $134,840
- Levee Rebuilding in Cherry Valley, Phase B has been awarded $325,000 from the King County Flood Control District in September 2020.
- North Fork Chery Creek culvert replacement project and Cherry Creek Setback Levee are in the planning stages and in the process of evaluating designs.
- Cherry Creek Floodplain Reconnection Plan is at 75 percent design and is ready to permit and fund implementation
- Water Storage in the Marckworth Forest (Cherry/Stossel Creek) has received Streamflow Restoration funding in 2019 for 57,500 for preliminary design.

Documentation of sources, methods, uncertainties, and assumptions.

Uncertainties pertain to funding. Current design elements are based on best available knowledge. There is significant momentum for continued project planning and implementation as collaboration has been successful with significant engagement with local agencies and the surrounding community. There are also some uncertainties for project design as related to permitting.

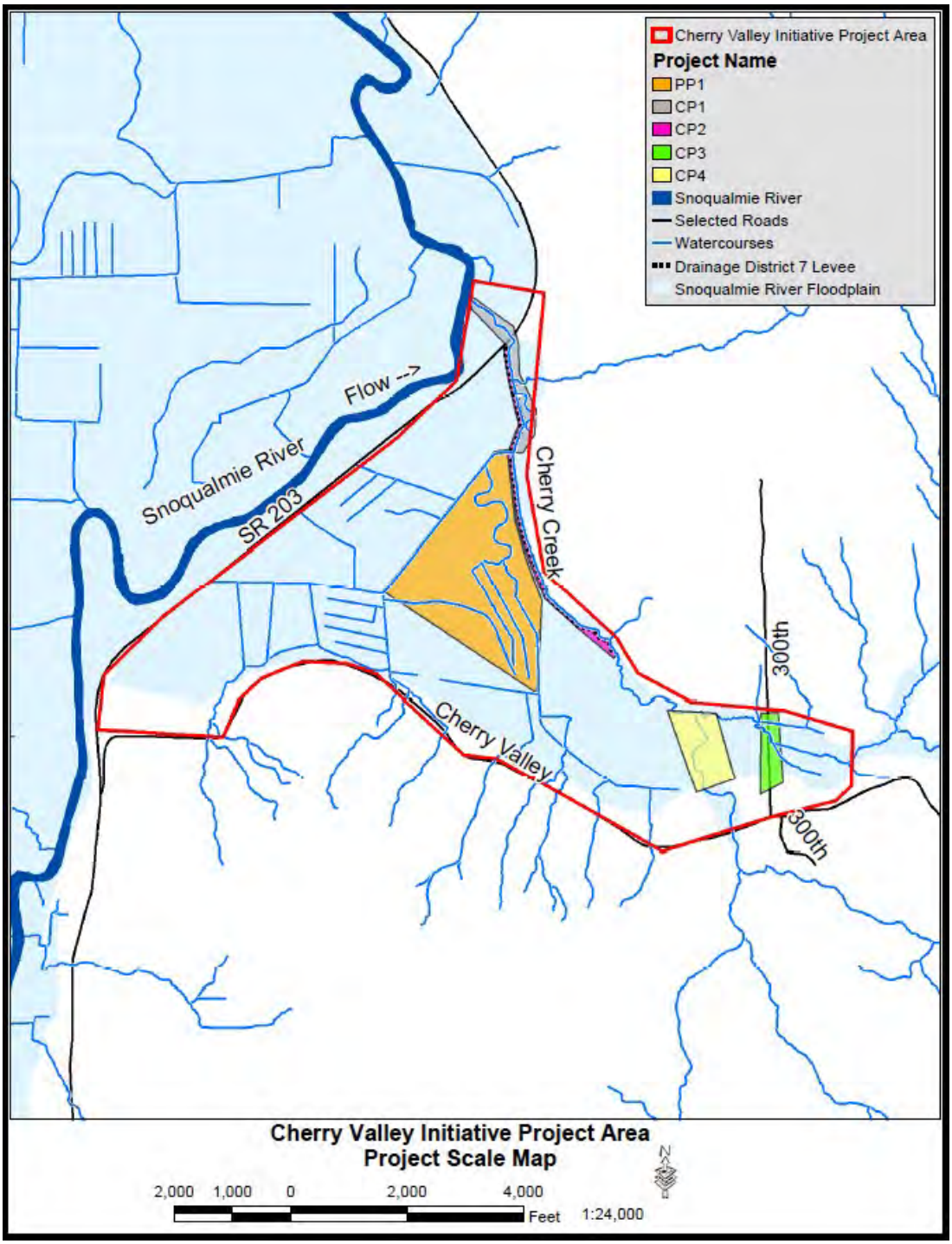


Figure 39. Cherry Valley Initiative Project Area

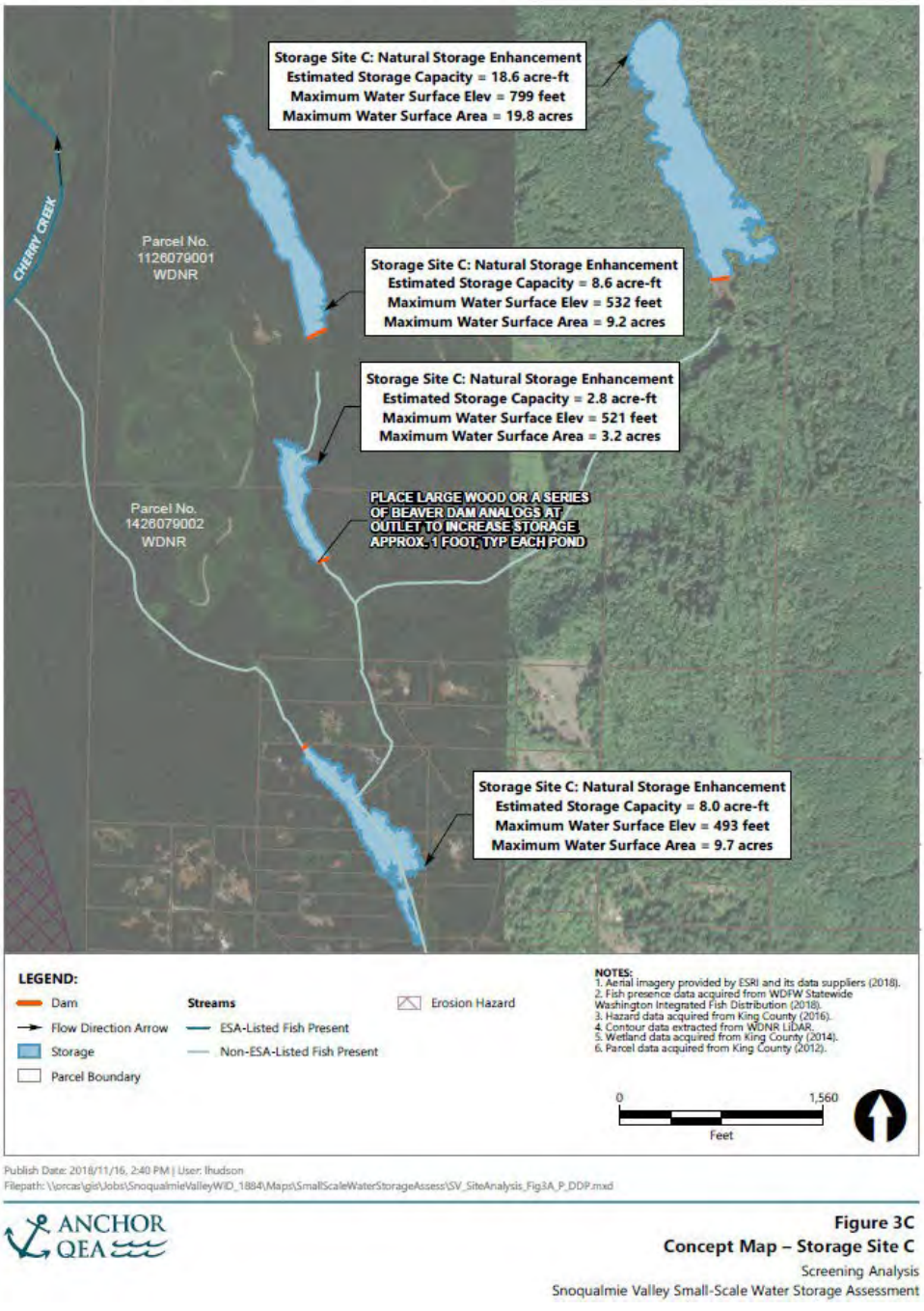


Figure 40. Water Storage in Upper Cherry Creek Watershed

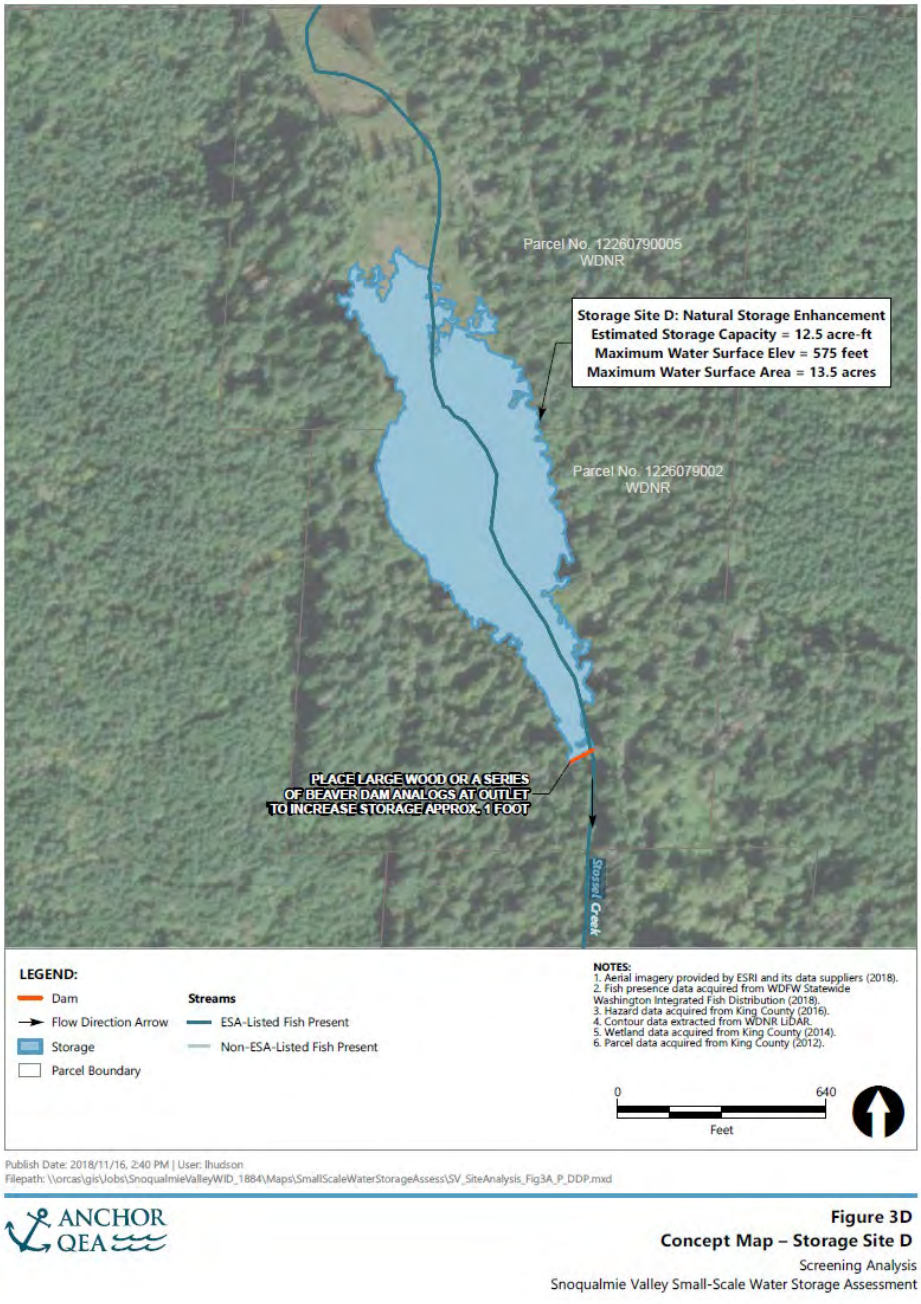


Figure 41. Water Storage in Upper Stossel Creek Watershed

WRIA 7 – Project Description
Camp Gilead Levee Removal Phase 2

Project Name
Camp Gilead Levee Removal Phase 2 (7-SN-H20[9])

WRIA 7 WRE Subbasin
Snoqualmie North

Narrative Description
Phase 1 of this project, completed in 2008, removed approximately 400 feet of revetment and levee. The levee segment had artificially impounded a small creek, creating a ponded area of approximately four acres that had no outlet for fish. Since the first phase, the river has migrated a short distance into the restored bank exposing some additional portions of revetment that was missed in phase 1. As well, it has deposited a large amount of gravel in the river at and downstream of the phase 1 project creating an extension to the creek channel within the river itself, providing some unique rearing habitat. The river channel is not able to migrate in this reach due to revetments and levees on both banks. The phase 2 project would continue the left bank revetment removal downstream of phase 1 on the rest of King County's property for approximately 675 feet. The project may be able to remove an additional 1,000 feet of revetment on private property downstream of King County's property, though negotiations with the landowner have not occurred yet. The 1,675 feet of revetment does not appear to protect any infrastructure and appears ideal for removal. Removal of the additional length of revetment would allow channel migration into the left bank and greatly improve channel edge habitat in general, but much more so in this location than many others due to the presence of the small stream channel that comes out through the phase 1 project area and flows along the revetment.

The projects will improve juvenile rearing and adult spawning habitat for three ESA-listed fish: Chinook Salmon, steelhead, and Bull Trout.

Quantitative or qualitative assessment of how the project will function.
The projects will improve ecosystem function on the Snoqualmie River by reconnecting floodplain habitat, restoring riparian areas and restoring edge habitat for salmon. These projects employ a process based river restoration approach by removing barriers to river channel migration allowing the river to create salmon habitat in a long term sustainable way.

A map and drawings of the project location.
The project site is shown in relation to surrounding physical features on the attached Site Plan (Figure 42).

Description of the anticipated spatial distribution of likely benefits.
These project efforts will restore floodplain habitat within the lower Snoqualmie River. The project is located in one of the core spawning reaches of the Snoqualmie for Chinook and steelhead, so that the benefits to spawners and especially early rearing juveniles is very high. Additionally, of all the core

[9] Other numbers associated with this project: P-7-263

spawning and early rearing reaches of the Snoqualmie, this is the furthest downstream. Therefore, all out-migrating juveniles from the Tolt River core area, Fall City Reach core area, and raging River core area, will benefit from improved rearing in this reach.

Performance goals and measures.

Specific measures unknown at this stage. Projects like this one evolve over several years as river processes are able to act upon the unarmored bank. Typical measures that King County utilizes on similar projects include the length and area of suitable edge habitat conditions for juveniles at various flow levels, as defined by suitably low velocity. Edge habitats include bar edges, undercut banks, backwaters, etc. Data and methods from previously completed projects demonstrate that these measures coincide strongly with fish utilization of the project area.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

Restoration actions are expected to benefit documented Chinook, Coho, Chum, and Pink Salmon as well as Bull, Cutthroat, and steelhead trout. Chinook Salmon and Bull Trout are priority species protected under the ESA.

Identification of anticipated support and barriers to completion.

This project will occur primarily on county-owned land within Tolt-McDonald Park, and will build upon an earlier project. Access for construction is reliant on gaining permission from the downstream landowner, Camp Gilead. King County has had a good relationship with the camp in the past, based on experience during phase 1.

Estimate of capital costs and reoccurring O&M costs.

Estimated total cost to design, permit, construct and monitor the two levee setback projects is $1,500,000.

Anticipated durability and resiliency.

Because the project involves the removal of armoring and no setback facility, the natural asset value of the site will increase over time. The project is unlikely to require any adaptive management actions or adjustments over time. The one minor exception to this will be the downstream terminus of the removal where remaining revetments that protect the privately owned Camp Gilead will need to remain intact.

Project sponsor(s) (if identified) and readiness to proceed/implement.

King County is the sponsor of this project. Lead staff: Andrea Mojzak. King County has capacity to initiate this project within the next 1-4 years, depending on funding availability.

Documentation of sources, methods, uncertainties, and assumptions.

Unknown at this phase of the project.

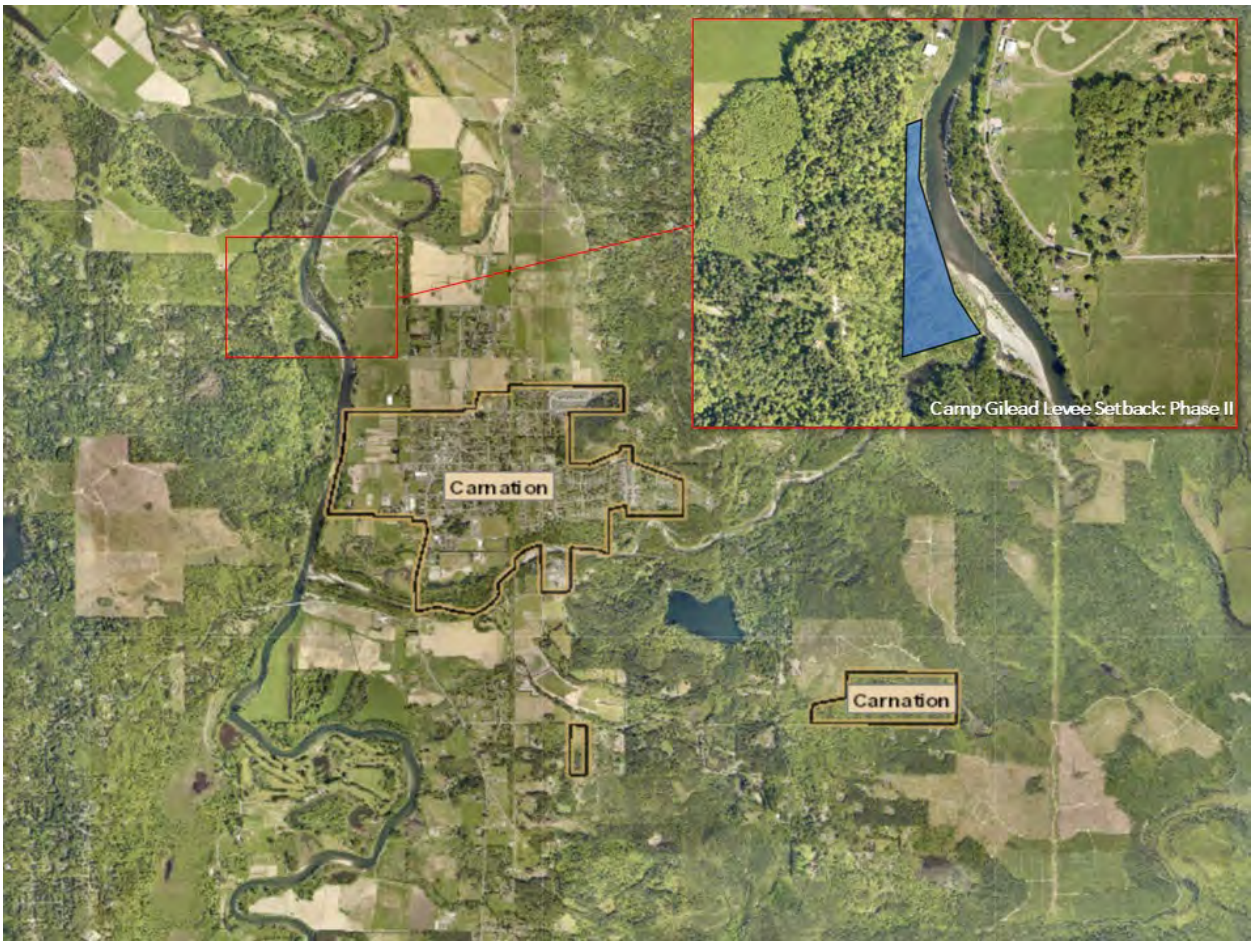


Figure 42. Site Plan for Camp Gilead Levee Setback Phase 2 Project

WRIA 7 – Project Description
McElhoe-Pearson Restoration Project

Project Name and Number
McElhoe-Pearson Restoration Project (7-SN-H21[10])

WRIA 7 WRE Subbasin
Snoqualmie North

Narrative Description
The McElhoe Pearson restoration project site is located north of the City of Carnation. Previous restoration actions at this site occurred in 2012 as part of Phase 1 and included connecting the Snoqualmie River channel to an existing wetland feature to provide 500 feet of off-channel rearing and flood refuge for juvenile salmon.

Potential Restoration Actions for Phase 2 include:

- Removal of 1,500 feet of the McElhoe Pearson levee that was notched in Phase 1 to fully reconnect up to 12 acres of floodplain, a portion of which is currently connected by the Phase 1 project as a backwater/wetland habitat. Some levee setback protection would be necessary as part of this proposal.
- Create a "flow through" channel, essentially notching the levee in a second location further upstream and potentially removing the short cross-levee to improve hydraulic and habitat connectivity while leaving the bulk of the levee in place.

These proposed Phase 2 projects will improve juvenile rearing and adult spawning habitat for three ESA-listed fish: Chinook Salmon, steelhead, and Bull Trout.

Quantitative or qualitative assessment of how the project will function.
Both projects will improve ecosystem function on the Snoqualmie River by reconnecting floodplain habitat, restoring riparian areas and restoring edge habitat for salmon. Proposed levee removal considered as part of Phase 2 could reconnect up to 12 acres of floodplain. A second alternative project action would create a "flow through" channel would also expand floodplain habitat within this project area, but without restoring floodplain processes to the same degree as the first alternative. The project location is located within the "Snoqualmie at Carnation" reach, one of the two most important reaches for restoration as identified in the Snohomish Basin Salmon Conservation Plan (Salmon Plan).

A map and drawings of the project location.
The project site is shown in relation to surrounding physical features in Figure 43 below. The yellow project footprint shown is the maximum extent of proposed project actions.

Description of the anticipated spatial distribution of likely benefits.
These project efforts will restore floodplain habitat within the lower Snoqualmie River. This reach is within a heavily used spawning area for Chinook and steelhead. Where early rearing habitat is

[10] Other project numbers associated with this project: 07-MPR-321

considered the most significant bottleneck for Chinook. The reach is the furthest downstream of the four most important Chinook spawning areas in the Snoqualmie – thus, nearly all out-migrating juveniles will benefit from the increase in habitat quantity and quality resulting from this project.

Performance goals and measures.

Unknown at this stage of design. Will be developed once project activities are determined.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

These restoration actions are expected to benefit documented Chinook, Coho, Chum, and Pink Salmon as well as Bull, Cutthroat, and steelhead. Chinook Salmon and Bull Trout are priority species protected under the ESA. As noted above, this reach is designated as 'Mainstem Primary Restoration" in the Salmon Plan, making it a tier 1 priority for restoration, with a focus on increasing early rearing habitat quantity and quality while also improving spawning habitat quality.

Identification of anticipated support and barriers to completion.

The main barriers pertain to funding and potential acquisition of an adjacent residential parcel. Design feasibility is the next step in order to determine Phase 2 project actions.

Estimate of capital costs and reoccurring O&M costs.

The total cost for a potential "flow through" system to design, permit, construct and monitor is estimated at $918,000. Removal of the levee and setback protection could cost upwards of $6 million. Reoccurring O&M costs are unknown at this time of design.

Anticipated durability and resiliency.

Unknown at this phase of the project. Climate change and associated impacts will be factored into all current and future project elements. The intent is to pursue natural process-based solutions as much as possible to reduce maintenance requirements and ensure long term project function and durability.

Project sponsor(s) (if identified) and readiness to proceed/implement.

King County is the sponsor of this project. Staff Contact: Andrea Mojzak. Project initiation is dependent on successful future acquisition of a privately owned parcel. No timeline is available.

Documentation of sources, methods, uncertainties, and assumptions.

Uncertainties pertain to funding. Since Phase 2 design concepts are still in feasibility, documentation is not readily available at this project stage.

Figure 43. Site Plan for McEhlhoe Pearson Habitat Restoration Phase 2 Project Footprint

WRIA 7 – Project Description
Lower Tolt LB Floodplain Reconnection (SR 203 to Confluence)

Project Name and Number
Lower Tolt LB Floodplain Reconnection (SR 203 to Confluence) (7-SS-H22[11])

WRIA 7 WRE Subbasin
Snoqualmie South

Narrative Description
This project is a feasibility study to determine options for fully or partially removing existing levee/revetment in order to improve floodplain connection within a 20-acre area near Carnation, Washington.

These restoration actions will benefit documented Chinook, Coho, Chum, and Pink Salmon as well as Bull, Cutthroat, and steelhead trout. Chinook Salmon and Bull Trout are priority species protected under the ESA.

Quantitative or qualitative assessment of how the project will function.
This feasibility study is intended to determine options to improve floodplain connection and riverine process within a 20-acre area of disconnected floodplain. These efforts are aimed to provide new off-channel habitat for salmon.

A map and drawings of the project location.
See Figure 44.

Description of the anticipated spatial distribution of likely benefits.
This project proposes to evaluate restoration options to improve floodplain connection with the Tolt River at SR-203 and the confluence with the Snoqualmie River through full or partial removal of the existing levee/revetment within a 20-acre area. These efforts will provide salmon access to off channel waterbodies.

Performance goals and measures.
Deliverables for this feasibility study will include analysis of project costs and benefits, including short and long-term physical and ecological changes produced from partial or complete removal off existing revetment structures. In addition, an analysis of alternatives for anticipated project obstacles, including flood concerns, road and bridge placement, and retention of existing boat launch facilities will be provided.

[11] Other project numbers associated with this project: 07-MPR-259

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

These future restoration actions are expected to benefit documented Chinook, Coho, Chum, and Pink Salmon as well as Bull, Cutthroat, and steelhead trout. Chinook Salmon and Bull Trout are priority species protected under the ESA. The project's proposed restoration of floodplain habitat are designed to provide aquatic habitat for macroinvertebrates and rearing fish.

Identification of anticipated support and barriers to completion.

The future restoration actions will have to address multiple barriers, which will be evaluated in the feasibility study.

The short distance between the existing revetment and NE Tolt Hill Rd raises the potential for project obstacles. The distance from the revetment to NE Tolt Hill Rd ranges from approximately 60 meters to 150 meters throughout the proposed project area. This short distance may limit options for placement of a setback levee. Multiple project alternatives concerning the road, placement of a setback levee, and the existing bridge should be evaluated in the feasibility study.

On the south side of NE Tolt Hill Rd, existing homes and farms lie adjacent to the proposed project site. Concerns from neighbors about flooding and setback placement need to be addressed.

In addition, there is currently a publicly accessible boat launch and parking lot within the proposed project area. Options for moving or replacing this public facility should also be evaluated.

Estimate of capital costs and reoccurring O&M costs.

Estimated total cost for this feasibility level evaluation will be approximately $250,000.

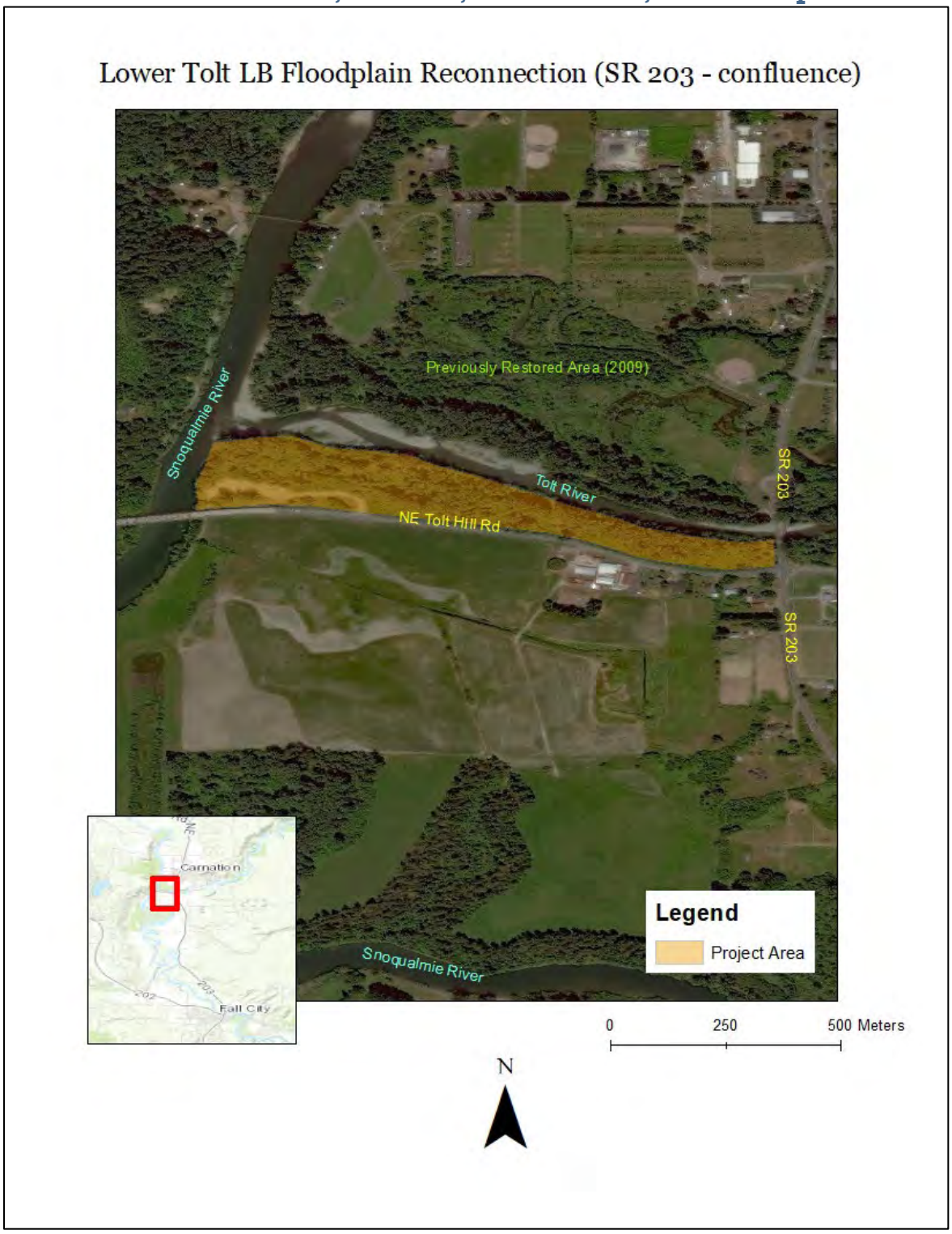
Anticipated durability and resiliency.

Not applicable at this stage of design.

Project sponsor(s) (if identified) and readiness to proceed/implement.

King County, Andrea Mojzak, amojzak@kingcounty.gov. The project is ready to begin feasibility level evaluation.

Documentation of sources, methods, uncertainties, and assumptions.



Unknown at this project stage.

Figure 44. Proposed Project Location

WRIA 7 – Project Description
Fall City Floodplain Reconnection Design and Construction – Left Bank and Right Bank

Project Name and Number
Fall City Floodplain Reconnection Design and Construction – Left Bank and Right Bank (7-SS-H23[12])

WRIA 7 WRE Subbasin
Snoqualmie South

Narrative Description
This project includes two adjacent floodplain reconnection projects located along the lower Snoqualmie River at river mile 34.5. The Barfuse project will remove and set back 2,000 feet of levee on the left bank of the Snoqualmie River, which will reconnect and restore up to 45 acres of floodplain habitat. The Hafner project will remove and set back 1,000 feet of levee on the right bank of the Snoqualmie River, which will reconnect and restore up to 55 acres of floodplain habitat. The river is physically and hydrologically disconnected from its floodplain as a result of channel confinement by levees on both sides of the river. The projects will improve juvenile rearing and adult spawning habitat for three ESA-listed fish: Chinook Salmon, steelhead, and Bull Trout. The existing levees protect adjacent farmland, homes and Neal Road.

Quantitative or qualitative assessment of how the project will function.
The projects will improve ecosystem function on the Snoqualmie River by reconnecting floodplain habitat, restoring riparian areas and restoring edge habitat for salmon. This project will restore 2,600 feet of mainstem river edge habitat and channel migration potential, improve the connection of 145 acres of floodplain, install new setback facilities, and restore native vegetation to 45 acres of floodplain.

A map and drawings of the project location.
The project site is shown in relation to surrounding physical features on the attached Site Plan (Figure 45).

Description of the anticipated spatial distribution of likely benefits.
These project efforts will restore a combination of 100 acres of floodplain habitat within the lower Snoqualmie River.

Performance goals and measures.
Not defined at this stage of project.

[12] Other numbers associated with this project: 2018-0296

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

These restoration actions are expected to benefit documented Chinook, Coho, Chum, and Pink Salmon as well as Bull, Cutthroat, and steelhead trout. Chinook Salmon and Bull Trout are priority species protected under the ESA.

Identification of anticipated support and barriers to completion.

Current ongoing collaboration exists between King County (project sponsor), individual farmers, Fall City Community Association, The Tulalip Tribes, Snoqualmie Indian Tribe, King Conservation District, SVWID, Snoqualmie Valley Preservation Alliance, Sno-Valley Tilth, Snoqualmie Forum, Snoqualmie Watershed Forum, Wild Fish Conservancy, King County Agriculture Commission, City of Duvall, WDFW, Ecology and Washington State Department of Agriculture.

Estimate of capital costs and reoccurring O&M costs.

Estimated total cost to design, permit, construct and monitor the two levee setback projects is $15,250,000. Reoccurring O&M costs will be minimal and limited to plant survival monitoring and invasive species removal.

Anticipated durability and resiliency.

The project is designed to mimic sustainable, pre-settlement conditions and accommodate seasonal hydrologic changes. The project is designed to have flood and erosion hazard benefits to protect Neil Road, the sole access County road.

Once the native plants are installed, maintenance will be required to ensure plant survival. Monitoring of plant survival, native plant replacement, and non-native invasive plant removal will be performed for approximately five years post-construction.

Project sponsor(s) (if identified) and readiness to proceed/implement.

King County is the sponsor of this project. Staff Contact: Andrea Mojzak. This project has secured $17,000,000 in funding and has a timeframe of readiness of three years. The project construction will be funded by Floodplains by Design and for Puget Sound Acquisition and Restoration-Large Capital.

Documentation of sources, methods, uncertainties, and assumptions.

Uncertainties pertain to funding. Current design elements and water offset calculations based on best available knowledge. Additional information on King County's webpage for the project: https://kingcounty.gov/services/environment/animals-and-plants/restoration-projects/projects/fall-city-floodplain-restoration.aspx

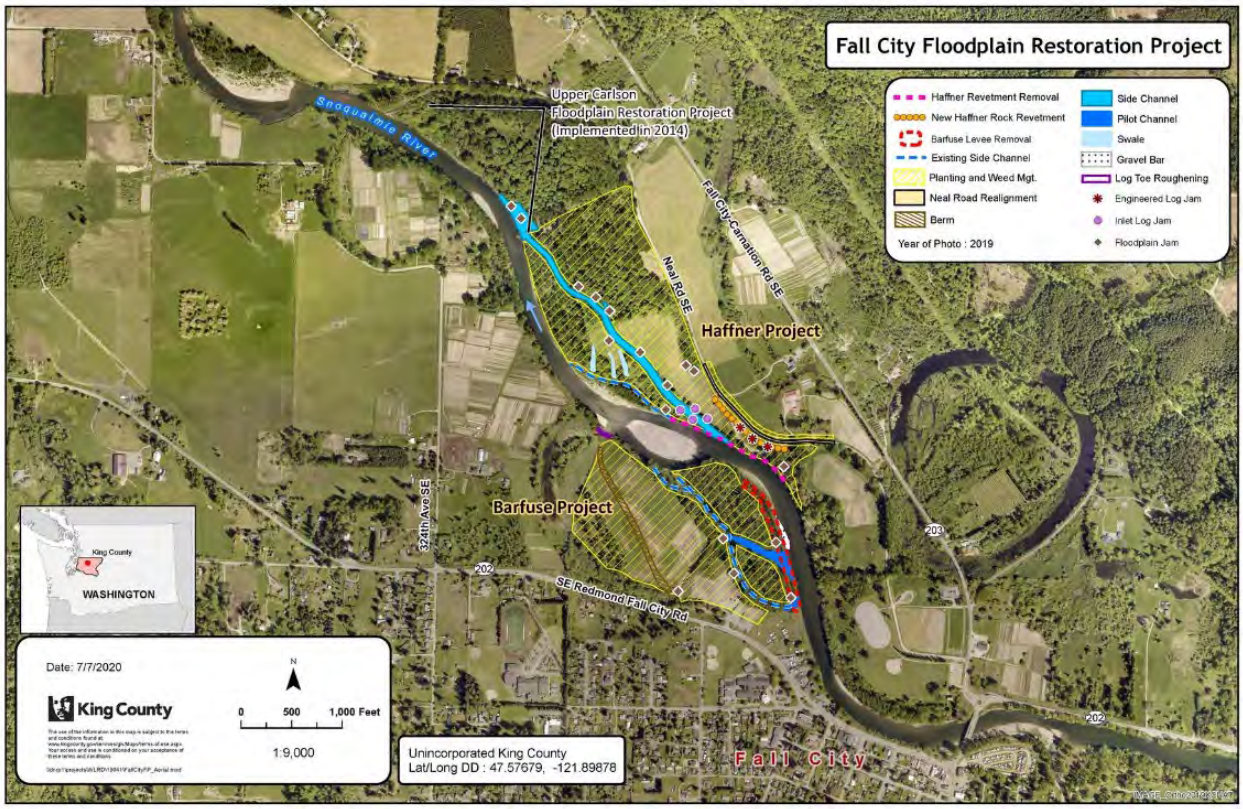


Figure 45. Site Plan for Fall City Floodplain Restoration Project

WRIA 7 – Project Description
Patterson Creek Floodplain Restoration (Sub-Watershed 2C) and Patterson Creek Floodplain Acquisitions

Project Name and Number
Patterson Creek Floodplain Restoration (Sub-Watershed 2C) and Patterson Creek Floodplain Acquisitions (7-PA-H24[13])

WRIA 7 WRE Subbasin
Patterson

Narrative Description
This project includes restoration of the floodplain through riparian restoration and increased channel complexity. This will require acquisition along Patterson Creek. These actions are located outside of the City of Redmond, Washington along Redmond-Fall CityRoad, within the Patterson Creek subbasin. The first phases of this project are already under way. King County has planted a portion of the project area on properties owned by WDOT as well as a homeowner's association open-space tract.

Additional funding is needed to expand the project through acquisition and further restoration project area is dominated by reed canary grass with small inclusions of native pasture grasses. Planting will start in these "islands" of native grasses and expand to revegetate the restof the area. Future phases involve additional acquisition at the upstream end of the project area and additional design and construction.

This project could be particularly beneficial to documented Chinook, Coho, steelhead, Chum, Pink, and resident Cutthroat Trout that utilize this stream as rearing habitat. Chinook and steelhead are priority species, protected under the ESA.

Quantitative or qualitative assessment of how the project will function.
Quantitatively, this project will include restoration of up to 30 acres of floodplain through riparian restoration and increased channel complexity along Patterson Creek.

Native riparian plantings will provide shade along this stream section to protect water temperatures and directly benefit prey availability of pre-migrant and outmigrating juvenile salmonids.

A map and drawings of the project location.
The project site is shown in relation to surrounding physical features in Figure 46.

Description of the spatial distribution of likely benefits.
This project includes restoration of up to 30 acres of floodplain through riparian restoration and increased channel complexity.

[13] Other project numbers associated with this project: 07-RSR-038

Performance goals and measures.

This proposed floodplain restoration project can help increase floodplain water levels and provide benefits such as increased water storage and resilience to climate change impacts.

Given the current vegetation community on the site, dominated by reed canary grass, key measures include the transition from invasive species to a wetland and riparian area dominated by native vegetation. Beavers are active in the area and we expect to realize gains in beaver-associated off-channel habitat in the form of dam complexes and ponds throughout the site.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

These restoration actions will benefit Chinook, Coho, steelhead, Chum, Pink, and resident Cutthroat Trout that utilize this stream. Chinook and steelhead are priority species, protected under the ESA. According to the King County stream report, steelhead and Coho Salmon use the mainstem and several key tributaries of Patterson Creek for both spawning and rearing.

Identification of anticipated support for and barriers to completion.

King County is committed to completing this project. The project is included on internal 10-Year Priority Project Lists and is well aligned with the goals and desired outcomes of the basin-wide Salmon Plan. As per King County's typical approach to floodplain restoration projects, public engagement is anticipated to occur throughout the project life-cycle. King County is already designing a project along the lower half of the project area footprint with no known barriers to implementation. Successful acquisition of upstream areas will be dependent on landowner willingness, but King County has been very successful in acquiring properties along Patterson Creek in the past.

Estimate of capital costs and reoccurring O&M costs.

Estimated total cost to acquire target parcels and perform restoration actions is approximately $1,625,000.

Project durability and resiliency.

Once the native plants are installed, maintenance (weed control, watering, and plant replacement) will be required to ensure a high plant survival rate. The project area is naturally very wet so that watering will likely be quite limited. Monitoring plant survival, native plant/shrub cover and non-native invasive plant cover will be performed for at least the first five years post-implementation. King County will explicitly plan for the likely presence of beavers as they are present in much of the Patterson Creek basin. This may require higher levels of plan replacement over the first few years as well as protective devices such as beaver fencing and plant selection that discourages beaver browse. However, King County has completed other successful revegetation projects with similar conditions along Patterson Creek.

Project sponsor(s) (if identified) and readiness to proceed/implement.

King County Department of Natural Resources and Parks. Sponsor contact: Andrea Mojzak amojzak@kingcounty.gov . The sponsor has completed planting on one section of Patterson Creek. Funding needed for expanding project through acquisition and restoration.

Documentation of sources, methods, uncertainties, and assumptions.

Not applicable at this stage of design.

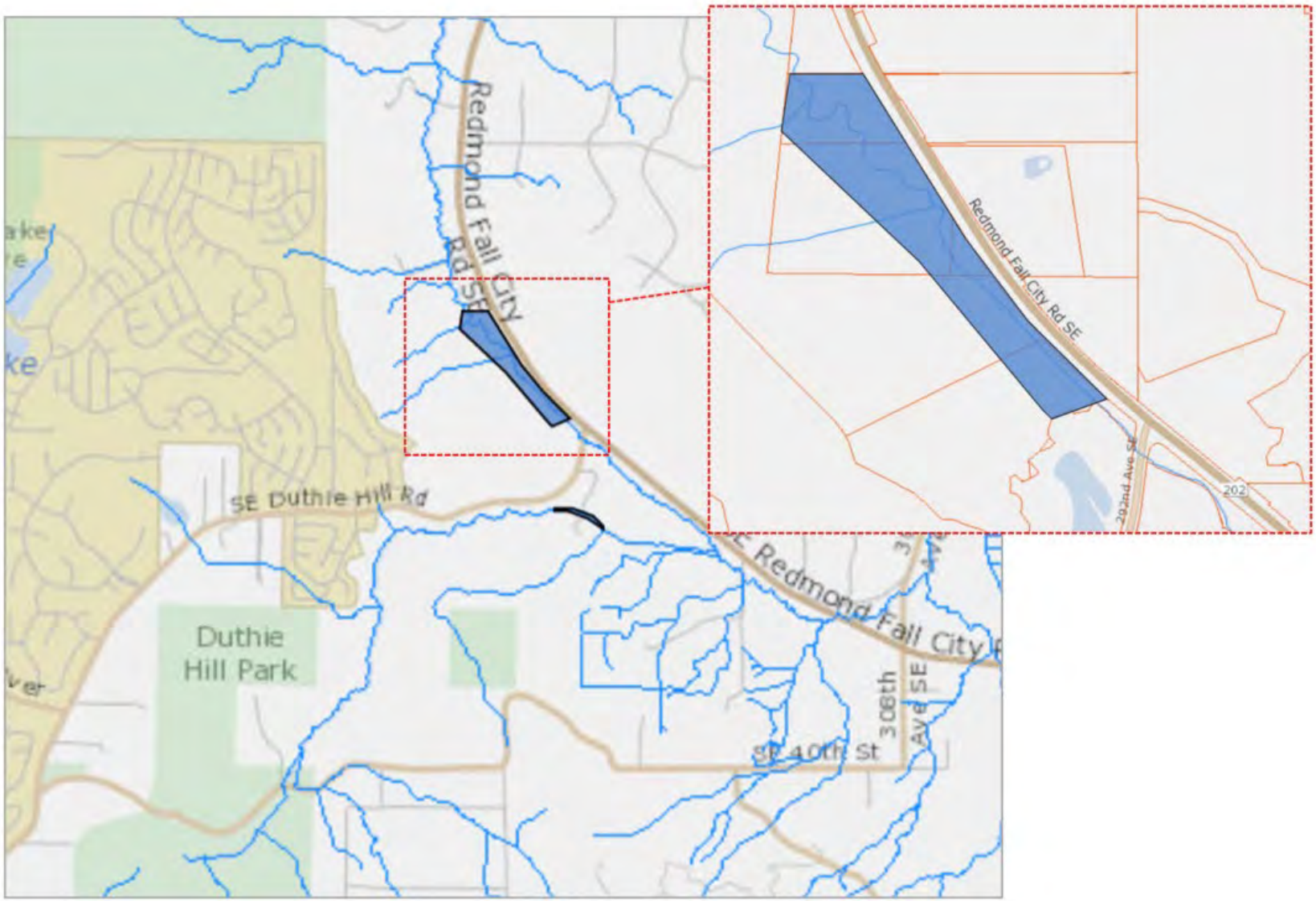


Figure 46. Map of Patterson Creek Floodplain Restoration

WRIA 7 – Project Description
Raging River Left Bank Mouth Levee Setback (Bernard Memorial Park)

Project Name and Number
Raging River Left Bank Mouth Levee Setback (Bernard Memorial Park) (7-RR-H25)

WRIA 7 WRE Subbasin
Raging River

Narrative Description
This project proposes setback of some or all of the existing levee along the left bank of the Raging River at Bernard Memorial Park (King County parcel #1424079050), located at the confluence with the Snoqualmie River, creating important riparian floodplain habitat. This project is located in Fall City, Washington within the WRIA 7 Raging River subbasin. Levee setback will improve floodplain connectivity and expand aquatic habitat as the river traverses an unconstrained floodplain.

These restoration actions will benefit documented Chinook, Coho, steelhead, Chum, Pink, Bull Trout and resident Cutthroat Trout that utilize the Raging River as rearing habitat. Chinook, steelhead, and Bull Trout are priority species, protected under the ESA. The project will further help to prevent the extinction of ESA-listed species that depend on salmon, such as the Southern Resident Killer Whale population.

Quantitative or qualitative assessment of how the project will function.
Quantitatively, this project includes setback a portion or all of the levee to create floodplain habitat for salmon rearing and spawning.

A map and drawings of the project location.
The project site is shown in relation to surrounding physical features in Figure 47 below.

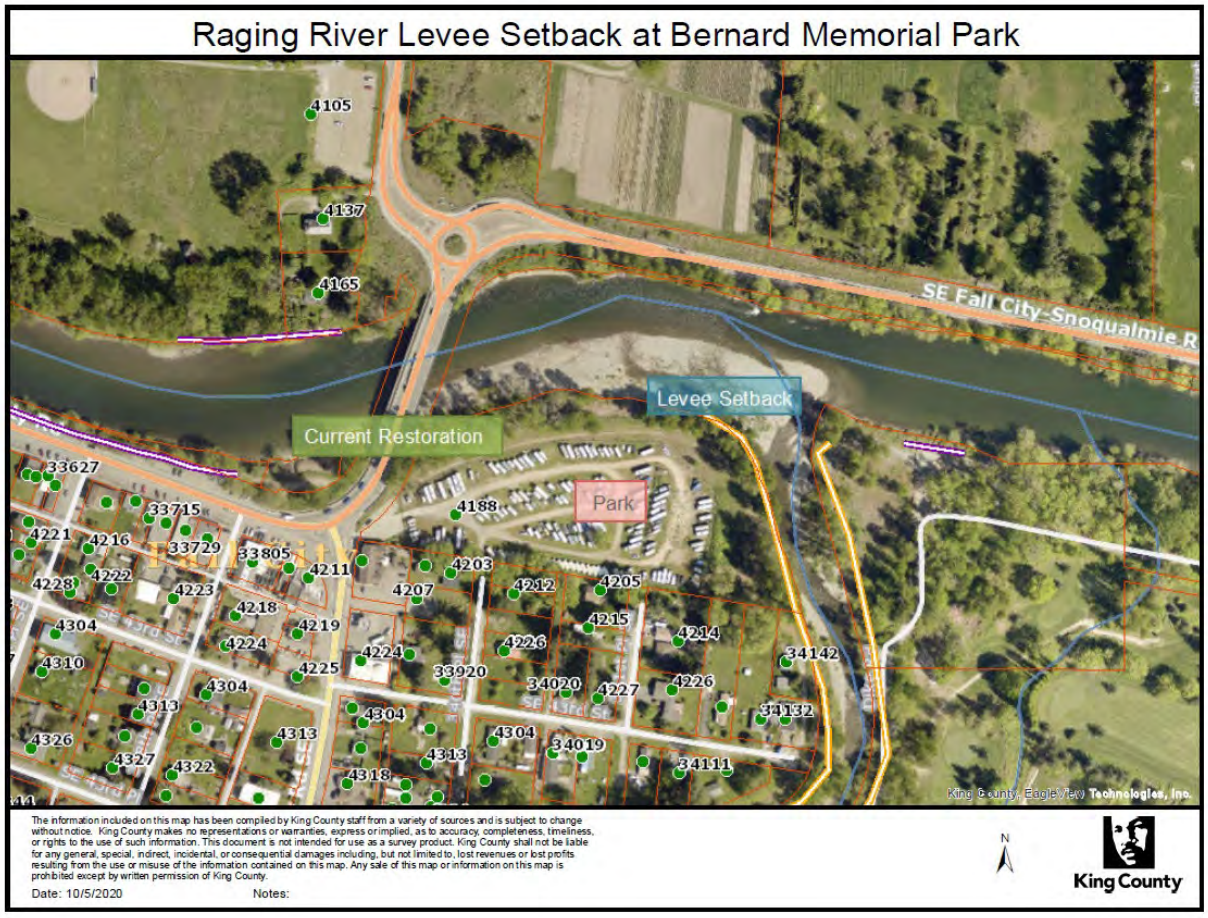


Figure 47. Raging River Left Bank Mouth Levee Setback (Bernard Memorial Park)

Description of the anticipated spatial distribution of likely benefits.

This project involves setting back a portion or all of the levee along the Raging River to create riparian floodplain habitat for salmon rearing and spawning within the Raging River subbasin in Fall City, Washington.

Performance goals and measures.

Specific goals and performance measures for this project have not been scoped at this stage. The overall objective is to support salmon recovery efforts by reconnecting floodplain, in conjunction with the local community. More detailed concepts will be explored in ongoing conversations.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

These restoration actions will benefit documented Chinook, Coho, steelhead, Chum, Pink, Bull Trout and resident Cutthroat Trout that utilize this section of the Raging River. Chinook, steelhead, and Bull Trout are priority species, protected under the ESA. Levee removal will expand existing aquatic habitat for spawning and rearing.

Identification of anticipated support and barriers to completion.

At this stage in the partnership, the landowner is supportive of restoration efforts, and supports conversations around levee setback at Bernard Memorial Park. These conversations are still in the preliminary stage, and specific metrics and performance measures have not been established.

Friends of Fall City Parks/Bernard Memorial Park, LLC have a vision for the Park that includes restored natural areas and a passive use park or open space with recreational and public access in the central area of the parcel (see attached map), along with the current active riparian buffer restoration along the left bank of the Snoqualmie River. The restoration and levee setback is supported by King County and other groups working in the region.

Estimate of capital costs and reoccurring O&M costs.

Estimated total cost to design and permit, remove levee structure, replace levee will be approximately $3 M. Cost estimates are high-level and based on conceptual discussions.

Anticipated durability and resiliency.

Once the project is implemented, long-term ecological monitoring is desired to be performed for at least 10 years.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Mountains to Sound Greenway Trust. Sponsor contact: Mackenzie Dolstad mackenzie.dolstad@mtsgreenway.org. The sponsor is ready to proceed with scoping and reconnaissance and is working with the landowner and community on the long-term plan and vision; the Greenway Trust will pursue future phases (design, implementation) in partnership with the Friends of Fall City Parks. The project is still in the conceptual phase and is not yet ready to proceed toward implementation.

Documentation of sources, methods, uncertainties, and assumptions.

The Mountains to Sound Greenway Trust has recently initiated a small riparian restoration project on the north border of Bernard Memorial Park (along the left bank Snoqualmie River), and is partnering with the landowner, the Bernard Memorial Park LLC and the Friends of Fall City Parks to complete these efforts. This effort is being funded by a small grant from the Snoqualmie Watershed Forum/King County Flood Control District Cooperative Watershed Management grant program.

In early 2017, the Friends of Fall City acquired nearly seven acres of land located at the confluence of the Raging and Snoqualmie Rivers. The Friends' vision for this site, until recently used as an RV storage facility, includes active restoration of the riparian buffer along the Snoqualmie River, complemented by the removal of the RV storage area to create a community park and open space. The Friends contacted the Greenway Trust and other partners in the area (including Snoqualmie Indian Tribe and the Wild Fish Conservancy) to investigate and initiate restoration actions while planning for the future park is underway.

The Greenway Trust sees the initial riparian buffer restoration as an important first step in developing a solid foundation of trust with the Friends of Fall City Parks. Conversations about possible levee setbacks and other larger-scale restoration efforts were mentioned earlier in the process, and the Friends are supportive of the concept overall. However, much work remains in order to scope out a possible future

project that would meet both the landowner and community needs and desires for public and recreation access, and salmon recovery goals. These conversations will continue in partnership with the Friends of Fall City and other interested parties.

WRIA 7 – Project Description
Raging River Bridge to Bridge Acquisitions and Raging River Bridge to Bridge Floodplain Restoration

Project Name and Number
Raging River Bridge to Bridge Acquisitions and Raging River Bridge to Bridge Floodplain Restoration (7-RR-H26[14])

WRIA 7 WRE Subbasin
Raging River

Narrative Description
This project proposes property acquisition of riverfront properties from willing landowners between river mile 0.5 and 328th Way SE at river mile 2 along the Raging River in Fall City, Washington in the WRIA 7 Raging River subbasin. The intent of these acquisitions would be for future floodplain restoration projects. Proposed future floodplain restoration actions include removal and setback of 4,000 feet of levee along the right bank of the Raging River at river mile 1.0 restoring 35 acres of floodplain.

Ultimately, these restoration actions will benefit documented Chinook, Coho, steelhead, Chum, Pink, Bull Trout and resident Cutthroat Trout that utilize the Raging River as rearing habitat. Chinook, steelhead, and Bull Trout are priority species, protected under the ESA.

Quantitative or qualitative assessment of how the project will function.
Quantitatively, this project includes acquisition of properties along the left bank of the Raging River to allow for future restoration to create salmon rearing habitat as the river reestablishes the floodplain within this area. The specific future floodplain restoration actions proposed include removal and setback of 4,000 feet of levee along the right bank of the Raging River at river mile 1.0 which will restore approximately 35 acres of floodplain.

A map and drawings of the project location.
The project site is shown in relation to surrounding physical features on the attached Site Plan in Figure 48.

Description of the anticipated spatial distribution of likely benefits.
This project involves purchasing properties along the left bank of the Raging River within the Raging River subbasin in Fall City, Washington. The total number of properties proposed is still in development.

Performance goals and measures.
Potential performance goals and measures will be based on length of levee removed and area of floodplain reconnected to the river.

[14] Other project numbers associated with this project: 07-MPR-204

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

These restoration actions will benefit documented Chinook, Coho, steelhead, Chum, Pink, Bull Trout and resident Cutthroat Trout that utilize this section of the Raging River. Chinook, steelhead, and Bull Trout are priority species, protected under the ESA. Specifically, salmonids have been documented as using this stream sections for spawning and rearing habitat. Future floodplain restoration actions will expand existing aquatic habitat and provide additional spawning and rearing habitat.

Identification of anticipated support and barriers to completion.

King County is committed to completing this project. The project is included on priority project lists and is well aligned with the goals and desired outcomes of the basin-wide Salmon Plan.

Estimate of capital costs and reoccurring O&M costs.

Estimated total cost to acquire target parcels and conduct floodplain restoration work is approximately $15.5 million.

Anticipated durability and resiliency.

Not applicable

Project sponsor(s) (if identified) and readiness to proceed/implement.

King County Department of Natural Resources and Parks. Sponsor contact: Andrea Mojzak.

Properties have not yet been acquired and feasibility and design have not yet been completed. The sponsor is ready to proceed with scoping and reconnaissance immediately.

Documentation of sources, methods, uncertainties, and assumptions.

Uncertainties pertain to funding and landowner willingness to sell property.

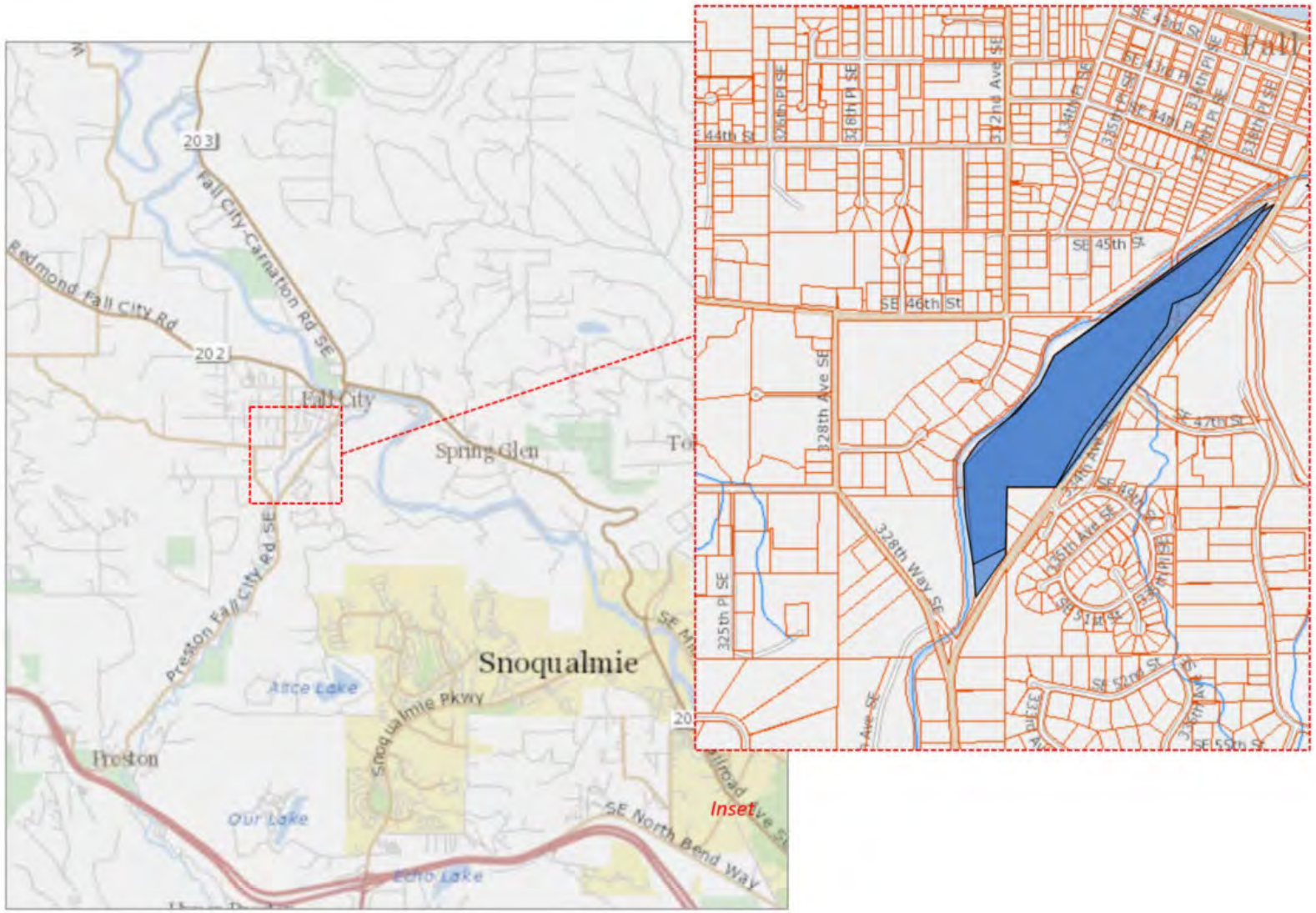


Figure 48. Map of Raging River Bridge to Bridge Floodplain Restoration

WRIA 7 –Project Description
South Fork Snoqualmie River Levee Setback Project

Project Name and Number
South Fork Snoqualmie River Levee Setback Project (Nintendo Project) (7-USN-H27[15])

WRIA 7 WRE Subbasin
Upper Snoqualmie

Narrative Description
The South Fork Snoqualmie River Levee Setback project (SFLS) is a multi-stakeholder approved effort to setback up to 2,500 feet of levee, resulting in:

- 25 acres of reconnected floodplain and increased floodwater storage;
- 12 acres of restored riparian habitat, ecosystem function, and processes;
- Mitigation of climate change impacts on ESA-listed salmonid species downstream;
- Reduced flood risk and long-term flood hazard management costs; and
- Increased recreational opportunities for local communities.

As part of the SFLS project, a new setback levee, approximately 3,000 feet long, 1 to 9 feet high, and meeting current engineering standards, will be constructed. The levee setback alignment would position the new levee within the dedicated right-of-way so no property acquisition is needed for levee construction. This project moves the levee further away from the river, between 400 and 800 feet, therefore reducing impediments to river flow, providing approximately 25 acres of improved habitat and additional connected floodplain for increased floodwater conveyance and storage. At least 12 acres of the newly connected floodplain will undergo riparian and floodplain restoration as part of this project, including areas along the South Fork Snoqualmie River and Ribary Creek.

Quantitative or qualitative assessment of how the project will function.
The project is estimated to provide approximately 2 AFY of additional storage between the levees. The project may consider excavation to mitigate (avoid) downstream impacts if deemed necessary. Lowering the floodplain by a foot would add about 20 acre-feet of compensatory storage – likely at an elevation similar to the downtown areas of North Bend. This project will improve overall watershed hydrology, which will in turn improve downstream water quality, summer low flows, reduce water temperature, and reduce red scour for Chinook Salmon. No water offset is assumed for the purposes of this watershed plan.

A map and drawings of the project location.
The project site is shown in relation to surrounding physical features in Figure 49 and Figure 50.

[15] Other project numbers associated with this project: 07-HRA-004

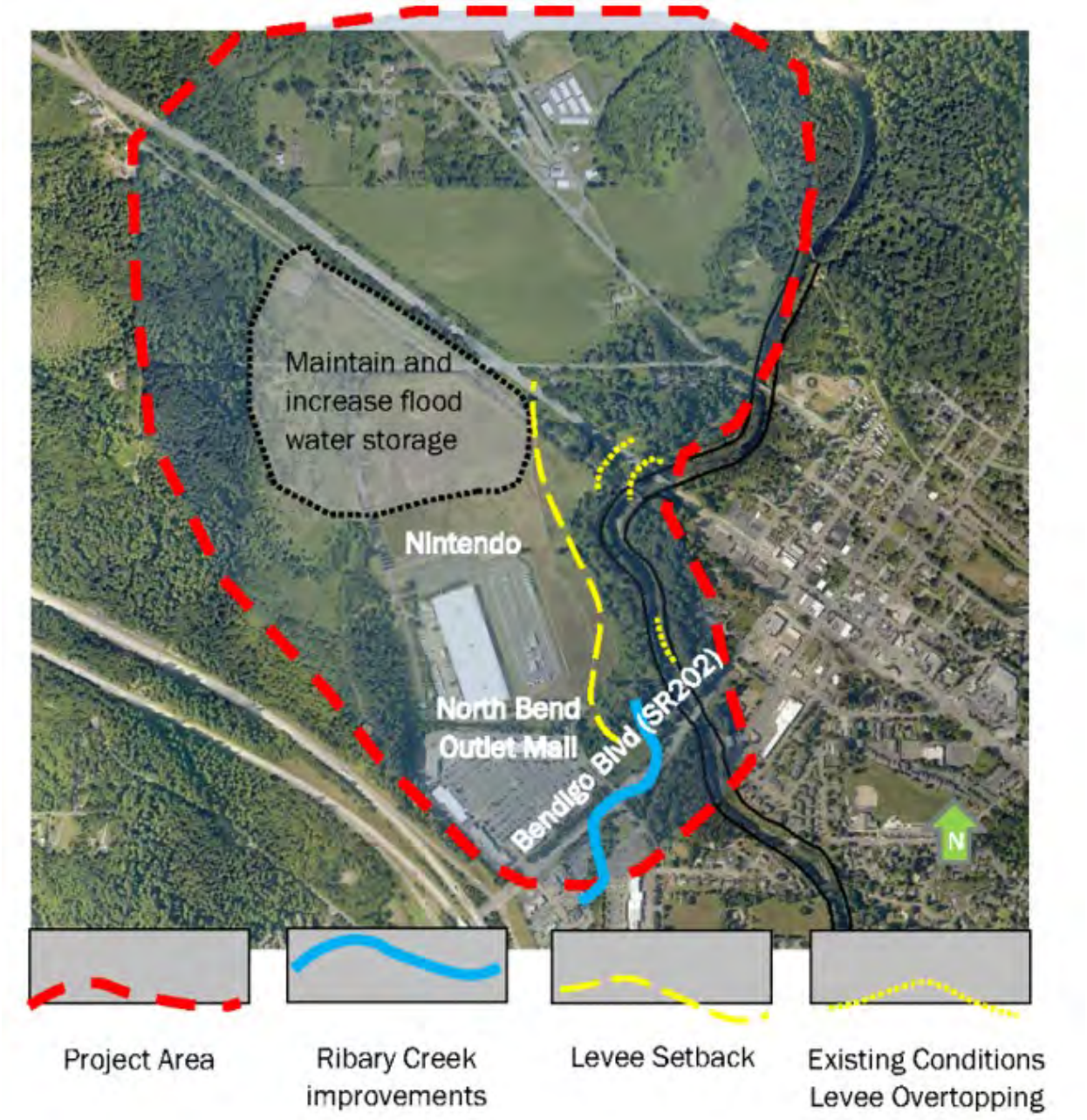


Figure 49. South Fork Snoqualmie River Levee Setback Project Site Plan – Overview

Figure 50. South Fork Snoqualmie River Levee Setback Project Site Plan – Detailed Restoration Actions

Description of the anticipated spatial distribution of likely benefits.

12 acres of floodplain restored. 25 acres of area connected to floodplain. Floodplain inundation is reduced by about 50 acres for the 100-year event.

Performance goals and measures.

The goal of this proposed floodplain restoration project is to help increase floodplain water levels and provide benefits such as increased water storage and resilience to climate change impacts.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The project will provide for the conservation, protection and restoration of natural systems within this area for fish and wildlife habitat. This reach of the Snoqualmie River serves as a significant habitat area for resident Trout species and large wildlife corridor for elk, deer, beaver, wintering bald eagles, pileated woodpecker, songbirds and other native species. The watershed also supports wild runs of Coho, Chinook, Pink, and Chum Salmon and steelhead downstream of the project site and Snoqualmie Falls. Chinook and steelhead are priority species, protected under the ESA. Instream structure enhancement and riparian restoration in the City of North Bend are priorities in the Snohomish River Basin (WRIA 7) Salmon Conservation Plan. This proposal addresses several priority ecological actions identified in the

Snohomish Plan such as: restoring hydrologic and sediment processes, restoring of wetland functions, enhancing riparian areas, protecting water quality and restoring shoreline conditions (Snohomish Salmon Plan page 11-84 & 11-86, 2005). These restoration actions in the headwaters (where listed resident Bull Trout are presumed) are critical to a watershed approach to restore habitat forming hydrologic processes for salmon downstream. The project is identified in the Snohomish Basin Salmon Recovery Forum's 4-year Work Plan as project # 07-HRA-004.

Identification of anticipated support for and barriers to completion.

The City of North Bend is committed to this project. The City has placed this project on the Six-Year Transportation Improvement Program After completion of the setback levee the City may choose to construct and build a road on the landward side of the levee. The project has a letter of support and funding commitment from the King County Flood Control District.

North Bend currently holds a dedicated right-of-way for the levee setback project. The City has been in discussions with the King County Flood Control District regarding ownership of levees, extent of levee removal, new levee design/construction standards and project funding. The City has engaged in stakeholder discussions with Nintendo, BNFS Railroad, and individual property owners.

The City is partnering with King County's River and Floodplain Management Section to design and construct this project. The City also plans to partner with the Mountains to Sound Greenway Trust and/or Snoqualmie Indian Tribe to manage the restoration elements of the stream and floodplain restoration. North Bend and Mountains to Sound Greenway have been working together on riparian restoration in the city for over 10 years and have implemented nine projects to date totaling over $300,000.

Estimate of capital costs and reoccurring O&M costs (order of magnitude costs).

The total project cost is estimated to be approximately $8.6m. The new setback levee will be constructed in a more stable configuration than the existing flood protection facility which should reduce, and may eliminate, flood damages and future post-flood maintenance needs.

Project durability and resiliency.

The benefits of the projects are anticipated to occur both locally and downstream of the project site. The importance of and potential for these benefits are supported by multiple leading publications, including: (1) the Snohomish River Basin (WRIA 7) Salmon Conservation Plan (Salmon Plan), (2) the Snohomish Basin Protection Plan (Protection Plan), and (3) Climate Change Impacts to Salmon Issue Paper (Climate Paper).

Project sponsor(s) (if identified) and readiness to proceed/implement.

This project is already programmed for construction under the King County Flood Control District's 2017 Capital Improvement Strategy for the South Fork Snoqualmie River. The City of North Bend has staff and consultant resources to manage this project.

Documentation of sources, methods, uncertainties, and assumptions.

No specifics provided.

Appendix D – Project Prioritization Guiding Principles Used by the WRIA 7 Committee

The WRIA 7 Committee considered *Snohomish Basin Salmon Recovery Plan* (Salmon Plan) and *Snohomish Basin Protection Plan* (Protection Plan) priority project types when identifying and selecting habitat projects. The WRIA 7 Committee considered priority project types for each subbasin when selecting habitat projects for inclusion in this Plan—focusing on floodplain projects in headwater subbasins that provide downstream benefits.

The Committee prioritized:

- Projects with streamflow benefits (including habitat projects with unquantified streamflow benefits).
- Projects that provide streamflow benefit during the critical flow period.
- Projects expected to have near-term and reliable benefits.

Habitat projects were categorized and prioritized as follows:

- Beaver reintroduction/beaver dam analogs (BDAs) [high priority].
- Floodplain reconnection [high priority].
- Forest or upland protection/management [high priority].
- Riparian enhancement [medium priority].

Fish passage and estuary restoration projects were considered low priority and not included in this plan.

Water right acquisition opportunities were prioritized in the following subbasins with higher projected PE wells, higher projected consumptive use, and greater potential for water right acquisition:

- Pilchuck (focus on lower Pilchuck).
- Patterson.
- Quilceda-Allen.
- Little Pilchuck.
- Raging.

Appendix E – Policy, Implementation, and Adaptive Management Recommendations Proposed by the WRIA 7 Committee

The WRIA 7 Committee spent several months preparing recommendations for policy and regulatory change, as well as plan implementation tracking and adaptive management. While Ecology is not putting forward these recommendations as part of our plan, we want to preserve the work of the committee and present the recommendations for WRIA 7 partners that may choose to move these recommendations forward.

This language is taken directly from the WRIA 7 draft plan (April 15, 2021) with only minor revisions to remove references to appendices.

Policy Recommendations

The Streamflow Restoration law lists optional elements Committees may consider including in the watershed plan to manage water resources for the WRIA or a portion of the WRIA (RCW 90.94.030(3)(f)).

The WRIA 7 Committee included what they have termed "policy and regulatory recommendations" in this watershed plan to show support for programs, policies, and regulatory actions that would contribute to the goal of streamflow restoration. When similar concepts arose from multiple Watershed Restoration and Enhancement Committees, the WRIA 7 Committee coordinated with those other Committees to put forward common language for inclusion in the watershed plans, as appropriate. Coordination also occurred for jurisdictions that cross multiple watersheds. All projects and actions the Committee intended to count toward the required consumptive use offset or Net Ecological Benefit (NEB) are included in Chapter Five: Projects and Actions.[1]

As required by the Final NEB Guidance, the Committee prepared the watershed plan with implementation in mind. However, as articulated in the Streamflow Restoration Policy and Interpretive Statement (POL 2094), "RCW 90.94.020 and 90.94.030 do not create an obligation on any party to ensure that plans, or projects and actions in those plans or associated with rulemaking, are implemented."

The Committee initially identified a list of potential policy and regulatory recommendations. After iterative rounds of discussion, the Committee narrowed the recommendations in this section to those that both supported the goal of streamflow restoration and had full support from the Committee. Committee members identified as the implementing entity for each recommendation are committed to investigating the feasibility of the recommendation. The identification and listing of these policy and regulatory recommendations is directly from the WRIA 7 Committee members and is not endorsed or opposed by Ecology.

The WRIA 7 Committee supports the following recommendations:

1. Well Reporting Upgrades

Proposed implementing entity: Ecology

Recommendation:

Change the Ecology well tracking system in the following ways, in order to efficiently and transparently track the number and location of permit-exempt wells in use:

- Implement a web-based well report form that mimics the current well report forms, and that uploads directly to Ecology's database with Ecology verification;

[1] "New regulations or amendments to existing regulations adopted after January 19, 2018, enacted to contribute to the restoration or enhancement of streamflows may count towards the required consumptive use offset and/or providing NEB." Streamflow Restoration Policy and Interpretive Statement, POL-2094

- Require coordinates (latitude and longitude) of wells on well report forms, and implement an intuitive web tool for well drillers which automatically provides the Public Lands Survey (PLS) location and coordinates for a new well;
- Identify permit-exempt wells on well report forms; and
- Provide Well ID Tag numbers to older wells, and associate well decommissioning, replacement, or other well activities with the Well ID Tag.

Purpose:

Directly and efficiently address identified shortcomings in Ecology's existing well tracking database and reporting protocols. Accurate tracking of the locations and features of PE wells will support the WRIA 7 Committee's desire to engage in monitoring and adaptive management after adoption of the watershed plan.

Funding Sources:

Leverage existing resources and efforts currently underway through the Ecology Well Construction Technical Advisory Group (TAG) and other departmental means. Additional funding from the Washington State Legislature or existing local permitting fees to increase capacity for Ecology to verify well reports may aid in implementing this recommendation in a timely manner.

Additional information or resources: Well Report Location Accuracy Study; Mason County Well Report Location Accuracy Study[2]

2. Encourage Conservation Through Connections to Public Water

Proposed implementing entities: County and city planning departments; public utilities and other water purveyors; Ecology; Department of Health.

Recommendation:

- Adopt and implement consistent and coordinated policies that reduce dependence on water use from PE wells and promote timely and reasonable connections to municipal and regional water supplies.
- Water purveyors and county/city land use planners explore opportunities to extend water distribution systems further into their individual service areas, particularly where rapid rural growth is anticipated.
- Develop cost-benefit analysis and environmental and fiscal implications to (1) fund programs to support connections to public water systems and (2) gain political support.

Purpose:

Reduce uncertainty about future streamflow and aquifer impacts from PE wells. Encourage state/local policies and funding to support streamflow objectives within the watershed plan.

[2] Supplemental resources are available online: https://www.ezview.wa.gov/Portals/_1962/images/WREC/WRIA07/Final%20Plan/Policy%20Supplemental%20Materials.pdf

Demonstrate the WRIA 7 Committee's endorsement of encouraging conservation through promoting connections to public water systems, provided that all provisions of GMA continue to be followed.

Funding Sources:

Existing fees collected through local permitting processes; pass-through fees associated with well maintenance services collected by service providers; state or local rate increases or taxes.

Additional information or resources: Average Water Use Data[3]

On average, public water users consume less per capita than WRIA 7 PE well estimates.

3. Development and Use of Reclaimed Water to Address the Impact of PE Wells

Proposed implementing entities: Washington State Legislature; Ecology.

Recommendation:

Enact and promulgate state laws, rules, and regulations that encourage the development and use of reclaimed water, for the purpose of:

- Offsetting the impact of or providing an alternative to PE wells using reclaimed water;
- Facilitating enhanced reclaimed water treatment to enable its use for streamflow restoration projects;
- Facilitating the development of streamflow restoration projects that use appropriately treated reclaimed water;
- Encouraging developers to integrate rainwater and/or reclaimed water into their projects for the purpose of avoiding or limiting use of a PE well;
- Encouraging partnership with the local water purveyors, where appropriate.

Purpose:

Offset water that would otherwise be diverted from the finite supply in rivers and streams due to PE wells. Reduce the amount of treated wastewater discharged into receiving water bodies. Create water supply options as an alternative to or to offset PE wells, while enhancing resiliency against drought and climate change.

Funding Sources:

If Ecology does not have capacity to support the work to integrate this proposal into the RCW and WAC with existing staffing and resources, the WRIA 7 Committee recommends the Washington State Legislature provide funding for this purpose.

[3] Supplemental resources are available online: https://www.ezview.wa.gov/Portals/_1962/images/WREC/WRIA07/Final%20Plan/Policy%20Supplemental%20Materials.pdf

4. Voluntary Domestic PE Well Metering Program

Proposed implementing entities: Ecology; King County; King and/or Snohomish Conservation Districts.

Recommendation:

Pilot a voluntary five-year program in one or more WRIA 7 subbasins to meter domestic PE wells (indoor and outdoor residential use). Supplement the voluntary metering program with a robust education and community engagement program about water consumption and conservation.

Purpose:

Increase confidence in assumptions regarding the average individual PE well water use to inform the adaptive management process and future water management and planning efforts. Data could inform (1) growth policies and patterns, (2) where to target incentives and education/outreach programs, and (3) where to place resources across subbasins to help improve streamflow, water levels, and temperature.

Funding Sources:

General operation or appropriated funds from (1) the state, (2) counties, and/or (3) conservation districts related to water, habitat restoration (salmon recovery), or housing. Environmental grants.

5. Water Conservation Education & Incentives Program

Proposed implementing entities: Ecology and counties; with support from conservation districts and non-governmental organizations.

Recommendation:

Ecology partners with counties and conservation districts to develop and implement outreach and incentives programs that encourage rural landowners with domestic PE wells to (1) reduce their indoor and outdoor water use through water conservation best practices; and (2) comply with drought and other water use restrictions.

Purpose:

Raise awareness of the impacts domestic PE well water usage has on (1) groundwater levels and (2) the connection to streams and rivers. Supplement water offset and restoration projects, especially in subbasins critical for fish and where water offsets were difficult to find.

Funding Sources:

Potential funding sources could include new funding from Washington State Legislature; grants (e.g., Ecology's Streamflow Restoration Grant Program); allocation of Ecology resources; existing fees associated with new domestic PE wells; contributions from local governments and tribes; and/or part of county or conservation district ongoing education, outreach, and incentive programs.

6. Statewide Mandatory Water Conservation Measures in Unincorporated Areas of the State During Drought

Proposed implementing entities: Washington State Legislature, Ecology.

Recommendation:

Consider implementing mandatory water conservation measures for PE well users in unincorporated areas of the state during drought conditions, as defined by WAC 173-166. Measures would focus on limiting outdoor water use, with exemptions for growing food, watering stock, or for those participating in a Fire Adapted Community program.

The Washington State Legislature could require Ecology or counties to implement water conservation policies. Ecology could write a rule to require water conservation measures. County councils could pass legislation encouraging or requiring water conservation to the extent such mandates are lawful and enforceable or implementable.

Purpose:

Reduce water usage from PE well users during drought. Reduce impacts on streamflows from PE well users and contribute to net ecological benefit. Increase climate change resilience.

Funding Sources:

Potential funding sources could include new funding from Washington State Legislature; allocation of existing Ecology resources; and/or existing fees associated with new domestic PE wells.

Additional Information or Resources:

https://www.nfpa.org/-/media/Files/Public-Education/Resources/Safety-tip-sheets/WildfireRiskReductionSafetyTips.pdf

Implementation and Adaptive Management Recommendations

The Committee supports an adaptive management process for implementing the WRIA 7 watershed plan. Adaptive management is defined in the NEB Guidance as "an interactive and systematic decision-making process that aims to reduce uncertainty over time and help meet project, action, and plan performance goals by learning from the implementation and outcomes of projects and actions," (Ecology 2009). The WRIA 7 Committee believes that adaptive management requires the ability to make adjustments, if needed.

Adaptive management will help address uncertainty and increase assurance of achieving plan objectives by identifying and integrating additional information, data, and research—including related climate change impacts on hydrology—that may assist with future design and implementation of projects. It will also support the improved coordination of water resources. To the extent possible, each of the recommendations put forth by the Committee includes a funding

mechanism. Some of the adaptive management recommendations included in this section are policy recommendations that the WRIA 7 Committee believes will specifically support adaptive management of the watershed plan.

Existing Challenges

The Committee Identified the following challenges:

- Our global climate is changing. While the effects of climate change over the 20-year life of this watershed plan cannot be precisely known, shifts in climatic conditions will influence the hydrologic regime in the watershed and will impact instream flows. Rainfall, snowmelt, and evapotranspiration have been identified as the primary mechanisms driving changes in groundwater storage. These mechanisms will be affected by a changing climate. Air and water temperatures will increase and summer streamflows will be reduced. Groundwater pumping and indirect effects of irrigation and land use changes associated with new PE wells will impact groundwater resources and the availability for future water supply and instream flows. The Committee recognizes that there is no statutory mechanism to ensure that the goals of this plan, to offset PE wells and achieve NEB, will be met under future climatic conditions.
- Projects identified in this plan are expected to increase groundwater storage and augment instream flows as they are implemented and provide aquatic habitat benefits. However, without significant investment in further detailed feasibility studies and identification of project sponsors, many projects remain highly conceptual.
- There is some uncertainty that offset and habitat projects will continue to function as designed, and generate streamflow benefit to offset PE well consumptive use and NEB under a changing climate.
- The adaptive management provisions of this plan should assist with identifying the importance of monitoring and assessing the validity of the estimated offset projections as the plan is implemented to determine whether projects are functioning as designed—and as hydrologic conditions change over time, allow for course corrections where needed. However, current policy does not allow for projects to be added after the plan is finalized and approved, nor is it clear who “owns” the implementation and adaptive management of the plan. It is also unclear who pays for or ensures that projects are implemented if projects are not funded through the competitive funding source allocated by the State.
- The Committee identified uncertainties associated with the PE well projection. One of these uncertainties is that the methods used to generate the PE well projections assumes that in the 2018-2038 period, growth and irrigation practices will mirror past trends and practices. New PE wells and irrigation patterns require monitoring to determine whether the number of new PE wells and associated consumptive use exceeds the volume that was forecast for purposes of this plan.
- The Committee identified lack of (1) clear implementation obligations or responsibilities applicable to plan participants or other state or local authorities, (2) integration of plan

commitments to existing systems governing land and water uses, and (3) adequate funding as additional challenges that may increase uncertainty in plan outcomes.

- This watershed plan is narrow in scope and is not intended to address all water uses or related issues within the watershed. This plan does not address potential impacts to streamflow and habitat as a result of watershed activities beyond new PE wells. For example, this plan does not address potential impacts to streamflow from new permitted withdrawals of surface and groundwater and this plan does not address the needs of all current and future water users in the watershed.
- The Committee has engaged in collective learning about water resources through this planning effort. This collective knowledge could be applied through a broader regional water supply planning effort. If a more comprehensive approach is developed to improve coordination of water resources for both instream and out of stream uses that result in improvements in WRIA 7 watershed health, the Committee will support development of a similarly collaborative and comprehensive planning process. It is expected that the planning process would need to expand to include representatives of all relevant entities in order to address all water resource needs, ensure sustained cooperation, and ultimately improved streamflow.

To address some of the above challenges, the WRIA 7 Committee recommends the following implementation, monitoring, and adaptive management strategies, and proposes an implementing entity, roles and responsibilities, funding mechanisms, and resulting actions for each.

Implementation Recommendations[4]

The WRIA 7 Committee developed the following implementation recommendations to address some of the challenges identified above. The recommendations in this section have the full support of the Committee. Committee members who have been designated as implementing entities have committed to investigating the feasibility of the recommendation. The WRIA 7 Committee supports:

1. Funding for Adaptive Management

The Committee recommends that the Legislature provide funding and a structure to monitor plan implementation (including tracking of new PE wells and project implementation by subbasin) and develop a process to adaptively manage implementation if offsets and NEB are not being met as envisioned by this watershed plan. The legislature should also provide funding to support the participation of entities on the Committee, a needed.

2. Additional Funding for Project Implementation

The Committee recommends that Ecology:

[4] These recommendations are provided by the WRIA 7 Committee for Ecology's consideration in developing an efficient and effective implementation and adaptive management program.

- Track Streamflow Restoration Grant Program funds requested against available capital funding, by WRIA and across the state;
- Revises grant guidance to prioritize projects in approved watershed plans; and/or
- Requests additional funds from the Legislature, if needed, to fully implement the offset and NEB projects identified in each watershed plan or rulemaking process under RCW 90.94.020 and RCW 90.94.030.

3. Adding Projects to the Plan

The Committee recommends that the Legislature allow Ecology to accept, review, and approve the addition of projects to this watershed plan, such as the prospective projects and actions identified in Chapter Five which may be further developed during the 20-year planning horizon. As described above, Ecology should consider the Committee's recommendations to adjust projects and actions.

The Committee supports continued coordination with salmon recovery efforts across the basin as adaptive management is implemented and new projects are added. In keeping with the Committee's commitment to strive for offset projects in all subbasins with consumptive use impacts, the Committee recommends that new projects may be considered for addition to this plan. If habitat projects emerge in the Tulalip subbasin that are appropriate and consistent with the type and nature of projects already on the project list, the Committee recommends these be considered for addition to this watershed plan.

If water offset projects emerge in subbasins that do not currently have water offsets and these projects are appropriate and consistent with the type and nature of projects already on the project list, the Committee recommends these be considered for addition to this watershed plan. If any of the 38 projects identified in this plan are not able to be implemented due to feasibility limitations or other reasons, the Committee intends to adaptively manage the project list to identify replacement projects with similar benefits.

If any of the 38 projects identified in this plan are not able to be implemented due to feasibility limitations or other reasons, the Committee intends to adaptively manage the project list to identify replacement projects with similar benefits.

4. Implement a Process and Program for Tracking PE Wells and Project Implementation

The Committee has identified the need to track streamflow restoration projects and new domestic PE wells in order to:

- Improve the capacity to conduct implementation monitoring of streamflow restoration projects and actions.
- Develop grant funding opportunities and track associated costs.
- Provide a template for adaptively managing emergent streamflow restoration needs.

The Committee recommends piloting the Salmon Recovery Portal (https://srp.rco.wa.gov/about), managed by the Recreation and Conservation Office (RCO), for satisfying these needs. The implementation of project tracking through a pilot program using the Salmon Recovery Portal will be coordinated by the Washington Department of Fish & Wildlife (WDFW) in collaboration with Ecology, and RCO. To improve harmonization of streamflow restoration with ongoing salmon recovery efforts, local salmon recovery Lead Entity (LE) Coordinators shall be consulted prior to initial data uploads. While input and oversight is welcomed, no commitment of additional work is required from LE Coordinators. University of Washington (UW) data stewards will be employed to conduct data entry, quality assurance, and quality control (see supplemental document: project tracking). The Committee recommends that tracking and reporting be completed by Ecology and WDFW biennially.

Additional Information or Resources: WDFW Proposed Project Tracking Supplement[5]

5. Continue Monitoring of Streamflow and Groundwater Levels

This watershed plan is one of many water resource management efforts underway in WRIA 7. Understanding the status and trends of streamflows in the basin will assist with adaptively managing this plan. The Committee understands that neither the impact of individual projects nor new PE wells would be tracked through monitoring streamflow or groundwater levels, but the Committee believes that monitoring assists with an overall understanding of the hydrology in the basin.

As such, the Committee recommends that agencies with current or planned gauging stations and groundwater monitoring programs continue funding and/or seek supplemental funding sources to ensure that monitoring continues and the data is publicly available. This group includes counties, Ecology, USGS, and other relevant entities. The Committee would support the development of a shared clearinghouse so that external reports, data, and links to hydrological and hydrogeological data are easier to find and use. The development of widespread groundwater elevation tracking across the WRIA would help monitor trends.

Additional Information or Resources: Existing Streamflow and Groundwater Monitoring[6]

6. Continue Studies that Improve Understanding of WRIA 7 Hydrology

The Committee supports the continuation or initiation of research, models, and additional datasets that provide regional, basin-wide, and site-specific information to better understand the hydrology of WRIA 7 and inform the adaptive management of this plan. Examples could include the recent Snoqualmie Indian Tribe's forest gap study, UW Climate Impacts Group Research, Snoqualmie Indian Tribe/EPA VELMA modeling, National Marine Fisheries Service/National

[5] Supplemental resources are available online: https://www.ezview.wa.gov/Portals/_1962/images/WREC/WRIA07/Final%20Plan/Policy%20Supplemental%20Materials.pdf

[6] Supplemental resources are available online: https://www.ezview.wa.gov/Portals/_1962/images/WREC/WRIA07/Final%20Plan/Policy%20Supplemental%20Materials.pdf

Oceanic and Atmospheric Administration monitoring and hydrology-fish life cycle modeling, King County water quality monitoring, and others).

7. Monitor Projects for Effectiveness

The Committee recommends that Ecology require effectiveness monitoring for projects funded by the Streamflow Restoration Grant Program to ensure that projects continue to function as designed and generate streamflow benefit to offset PE well consumptive use under a changing climate. The Committee also supports project sponsors using best available science to monitor project effectiveness and incorporating monitoring into the cost and implementation of offset projects.

Through development of the project list, the Committee discussed streamflow benefits from habitat projects, such as levee setbacks and floodplain reconnection projects. Due to uncertainty, the Committee did not count the water offset from these projects, although the Committee believes these projects can provide streamflow benefit. The Committee supports monitoring habitat projects to better understand their streamflow benefits. Monitoring pre- and post-project groundwater levels, streamflow, conducting aquifer testing (transmissivity, hydraulic conductivity, and storage properties), groundwater/surface water modeling, and completing performance monitoring can help improve understanding of streamflow benefits from habitat projects.

Table 1.1: Recommended Implementation Actions

Action	**Responsible Entity/Frequency**	**Funding Considerations**
Track building permits issued with PE wells, implemented projects and a summary of each by subbasin	Counties/annually WDFW, Ecology /biennially	The number of building permits and associated fees are transmitted to Ecology annually. No additional funding is needed. County costs funded by existing fees for new PE wells[7] ECY and WDFW may need additional funding to maintain the Salmon Recovery Portal and report to Committee
Monitor streamflow and groundwater levels	Various (USGS, Ecology, Counties, etc.)	External entities fund and implement these programs. Committee support may be helpful in communicating the importance and ensuring continuation of these efforts.

[7] RCW 90.94.030 (4)(a)(A) requires that, "an applicant shall pay a fee of five hundred dollars to the permitting authority," and RCW 90.94.030(4)(a)(iv) requires that local jurisdictions "Annually transmit to the department three hundred fifty dollars of each fee collected under this subsection."

Action	Responsible Entity/Frequency	Funding Considerations
Continue studies that improve understanding of WRIA 7 hydrology	Various (University of Washington, Counties, Tribes, NGOs, etc.)	These studies will require additional and new funding outside the Streamflow Grant process. Committee support may be helpful in securing outside funds.
Monitor projects to determine effectiveness of streamflow benefits	Project sponsors	Most projects in Chapter Five do not include effectiveness monitoring details or associated costs. As projects are proposed, sponsors should build effectiveness monitoring into the design and budget requests of projects – particularly for certain offset projects, such as MAR or new reservoir creation that have not been implemented in WRIA 7 for streamflow benefits in the past.

Adaptive Management Recommendations[8]

1. Reconvening the WRIA 7 Committee

The WRIA 7 Committee recommends that Ecology reconvene the Committee under the following circumstances:

- April 2026, 2032, and 2038;
- If after 2026, at the time of developing the biennial report (see watershed plan implementation reports below), Ecology identifies that the adopted goals of the watershed plan are not on track to be met in the plan's 20-year timeframe;
- If after 2026, a Committee member identifies, after reviewing the watershed plan implementation report described below, that the adopted goals of this watershed plan are not on track to be met in this plan's 20-year timeframe.

Ecology should invite all members of the WRIA 7 Committee, including ex-officio members, to reconvene. The WRIA 7 Committee as a whole will reconvene if at least one entity representing each of the following groups agrees to participate:

- Snoqualmie Indian Tribe
- Tulalip Tribes of Washington
- Each county within the WRIA

[8] These recommendations are provided by the WRIA 7 Committee for Ecology's consideration in developing an efficient and effective implementation and adaptive management program.

- A city government within the WRIA
- Washington State Department of Fish and Wildlife
- Washington State Department of Ecology
- The largest publicly owned water purveyor that is not a municipality
- An organization representing agricultural interests
- An organization representing environmental interests
- An organization representing the residential construction industry
- The largest irrigation district within the WRIA

If no representative is available from the same government or organization that participated in the WRIA 7 Committee at the time of plan approval, the Committee member may propose an alternate entity to represent the same interest on the Committee. At the time that Ecology reconvenes the Committee, the Committee may choose to reconvene a workgroup to report back recommendations to the full Committee. A subgroup of Committee members may convene, but representation from all of the following groups is needed to represent the entire Committee.

1. Watershed Plan Implementation Reports

The WRIA 7 Committee recommends that Ecology consider the following process for reporting on the status of the watershed plan.

The Committee recommends Ecology issue watershed plan implementation reports biennially (every two years) detailing the successes, challenges, and gaps related to implementation of the watershed plan. Each report should cover the two-year period occurring immediately prior to the year of issuance, as well as cumulative reporting from any previous reporting periods. The first report should be issued two years after the plan is adopted by Ecology and include:

- Information on whether the watershed plan is on track to achieve the expected NEB and water offsets.
- Streamflow conditions, including identifying subbasins with known impacts that have not yet implemented water offset or habitat projects.
- Number and location (by subbasin) of new PE wells and projects.
- Information on any discretionary programs that were implemented. For example, water conservation education and outreach, incentives for public water service connections, voluntary PE well metering, and legislative updates.

If a project sponsor identifies that proposed water offset from the project are not able to be met after studying feasibility of the project, the Committee recommends that they report this to Ecology. The report should be sent to all members of the WRIA 7 Committee, King and Snohomish County Councils, all local jurisdictions within the watershed, and any additional stakeholders identified at the time of reporting. All Committee members should have 45 days to review the report and submit comments to Ecology. Following the 45-day Committee comment

period, Ecology should issue its responses and findings to the Committee. Ecology should attempt to address comments received from the WRIA 7 Committee.

During any comment period after 2026, any member of the WRIA 7 Committee may request that Ecology reconvene the Committee to review recommendations to adjust the projects and actions. Following the issuance of Ecology's responses to Committee comments, the Committee should have an additional 14 days to offer additional comments to Ecology. At the end of the full 60-day Committee comment period, if any adjustments or amendments to the plan are recommended, they shall be at the sole discretion of Ecology. Ecology should issue its final findings within 30 days from the close of the full 60 day Committee comment period. Ecology will have sole discretion to make the amendments.

If Ecology reconvenes the Committee during the comment period for the watershed plan implementation report, amendments to the plan may be delayed to allow for additional Committee discussion. At the time of reconvening, the WRIA 7 Committee may develop recommendations to Ecology to adjust the projects and actions. Ecology should review and consider recommendations developed by the Committee. Ecology should develop and send a report to all members of the Committee with Ecology's response to the Committee's recommendations following the review and comment process described in watershed plan implementation reports above.

The WRIA 7 Committee also anticipates discussing:

- Status of policy recommendations;
- Status of requests to the legislature;
- Cumulative number of PE wells in relation to the status of projects implemented in WRIA 7 (the Committee understands that this plan must offset consumptive use and meet NEB at the WRIA-scale; the purpose of evaluating at a subbasin scale is to identify whether the Committee recommends the addition of projects in any given subbasin);
- Expanding or focusing conservation and outreach programs in subbasins where no water offset projects have been identified or implemented;
- Contacting project sponsors to encourage project development and implementation in subbasins with the most need;
- Seeking outside funding for project implementation;
- Drafting letters of support for Streamflow Grant proposals;
- Identifying additional offset projects for Streamflow grant program;
- Suggesting revisions to Stream Restoration Grant Guidance.

3. Reporting on Streamflow Restoration Grant Program

The Committee recommends that Ecology develop a report of projects that applied for streamflow restoration funding, noting which projects are included in this watershed plan, within

two weeks of the close of each grant application period and distribute the report to the WRIA 7 Committee. The Committee also recommends that Ecology develops a report of projects that did and did not receive funding within two weeks of contacting applicants with funding offers. The report should be cumulative, including summary information from previous streamflow restoration grant rounds.

Committee members can request additional information from Ecology, if the report does not provide sufficient detail to enable the Committee to understand implementation progress as it is occurring.

Table 1.2: Recommended Adaptive Management Process

Action	**Entity or Entities Responsible**	**Committee Role**	**Funding Considerations**
Develop and distribute watershed plan implementation report, including any recommended adjustments to projects and actions.	Ecology	Review report	Ecology may need additional funding to support development of the report.
Support reconvening of the WRIA 7 Committee in 2026, 2032, 2038, and as requested by Committee at other dates, if needed.	Ecology	Committee reviews report, status of PE wells, status of projects; presentations on projects, effectiveness monitoring, new science, and research in basin; develop recommendations for projects in response.	Ecology staff time will be required. Ecology may need additional support from RCO, WDFW and project sponsors to develop summary report and distribute or convene a meeting if the Committee deems it necessary. Ecology may need additional funding to support reconvening.